Part 20
Isopods

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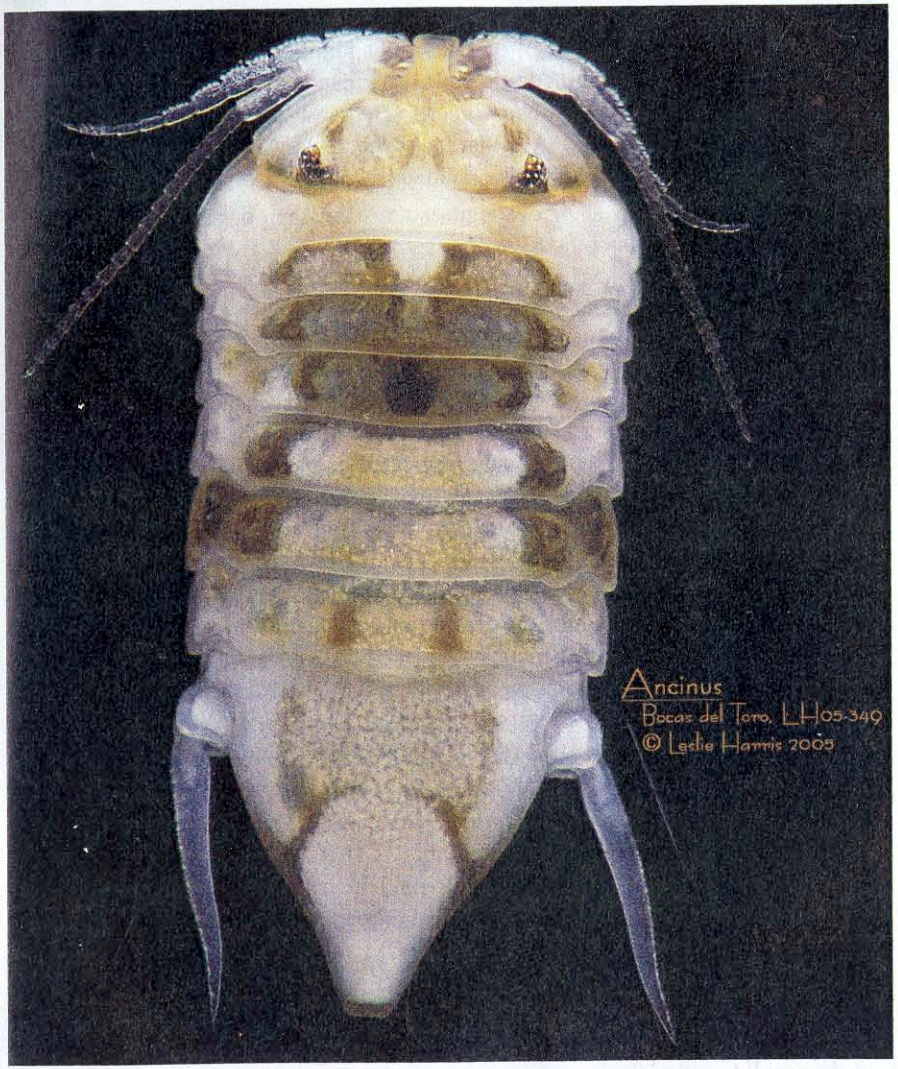

Ancinus brasiliensis, a species reported from the Caribbean coast of Costa Rica (Photo: Leslie Harris)

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Abstract The order Isopoda is diverse (~10,300 described species worldwide) and common in almost all environments – marine, terrestrial, and freshwater. A total of 78 marine species have been reported from Costa Rica (46 species from the Caribbean coast and 34 from the Pacific), comprising 6 suborders and 24 families. Two species occur on both coasts: *Excirolana braziliensis* and *Cirolana parva*. Numerous additional species are expected to occur in Costa Rican waters, probably three times this number, but due to the paucity of research on this taxon in this region only these 78 can be included in our species lists. Only two broad surveys have been accomplished for Costa Rican isopods: Brusca & Iverson's (1985) survey of the Pacific coast, and an unpublished survey of the isopods of Cahuita (Brusca & White, in preparation). Representatives of at least eight families (Anthuridae, Ancinidae, Sphaeromatidae, Cirolanidae, Corallanidae, Aegidae, Gnathiidae, Hognathidae) occur on both the Pacific and Caribbean coasts. The most specious families of isopods on Costa Rican shores are: Asellota (16 species), Anthuridae (14 species), Sphaeromatidae (13 species), and Cirolanidae (seven species).

Introduction

The order Isopoda is one of the nine orders in the crustacean superorder Peracarida. Peracarids are the "marsupial crustaceans," distinguished from the three other eumalacostracan superorders (Hoplocarida, Syncarida, Eucarida) by the presence of a ventral marsupium constructed by specialized thoracic coxal endites called oöstegites, in which the developing embryos are housed (except in Thermosbaenacea, which carry broods beneath the carapace). All peracarids undergo direct development with brooding, hence true larval forms do not occur in this superorder. Isopods can be distinguished from other peracarids (and crustaceans in general) by their dorsoventrally flattened body (except in Anthuridea and Phreatoicidea); compact head with unstalked compound eyes; seven free thoracomeres (five in Gnathiidea); one pair of maxillipeds; appendages never chelate; six pairs of biramous pleonal appendages, including five pairs of platelike respiratory/natatory pleopods and a single pair of fanlike or sticklike uropods; and biphasic molting (i.e., posterior half of body molts before anterior half).

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All isopods possess one of the two fundamental morphologies, being "short-tailed" or "long-tailed" (Brusca & Wilson 1991). In the more primitive, short-tailed isopods the telsonic region is small, positioning the anus and uropods terminally or subterminally on the pleotelson (Phreatoicidea, Asellota, Microcerberidea, Oniscidea, Calabozoidea). The more derived, long-tailed isopods have the telsonic region greatly elongated, thus shifting the anus and uropods to a subterminal position on the pleotelson (Flabellifera, Anthuridea, Gnathiidea, Epicaridea, Valvifera).

In the sea, isopods compare in ecological importance to the related Amphipoda and Tanaidacea, notably as abundant intermediate links in food chains. They typically predominate, along with tanaids, bivalves, and polychaetes, in soft bottom sediment samples from continental shelves. On many coasts, isopods may constitute the majority of prey items consumed by nearshore fishes (Wallerstein & Brusca 1982). In the Arctic region, they are one of the primary food items of gray whales (R.C. Brusca, personal observation). Intertidal isopods are predominantly benthic and cryptic, living under rocks, in crevices, empty shells and worm tubes, and among sessile and sedentary organisms, such as algae, sponges, hydroids, ectoprocts, mussels, urchins, barnacles, and ascidians. Some burrow in natural substrates including mud, sand, soft rocks, and driftwood, and some burrowers, such as the *Limnoria* (the gribbles) and *Sphaeroma*, can do extensive damage to pilings and wooden boats. In the tropics, some species of *Sphaeroma* burrow into mangroves, weakening the prop roots and causing them to break more easily, which typically stimulates the growth of multiple new rootlets, leading to the classic stairstep structure of red mangrove prop roots (Perry & Brusca 1989). Several species are important scavengers on shore wrack or dead animals (e.g., *Ligia*, *Tylos*). Cirolanids, corallanids, and tridentellids are voracious carnivores, functioning both as predators and scavengers. Epicarideans are all parasites on other crustaceans, cymothoids are all parasites on fishes, and aegids and gnathids are "temporary parasites" on fishes. Some invertebrate parasites, notably acanthocephalans, use isopods as intermediate hosts.

Of 10,300 described isopod species, about 4,500 are terrestrial/freshwater and 5,800 marine. Isopods occur in nearly every environment on Earth – from the littoral zone to the greatest depths of the sea (10,000 m or more), in lakes, streams, rivers, springs, cave systems, and water entrapments in bromeliads (see www.nmnh.si.edu/iz/isopod/; Brusca & Brusca 2003). Terrestrial species are found nearly everywhere, even in the driest deserts. Many aquatic species are parasites. The body of isopods (Fig. 20.1) is usually dorsoventrally flattened and composed of three regions (see Brusca & Iverson 1985; Brusca & Brusca 2003): (1) the cephalon or cephalothorax (head), bearing compound eyes (some species have greatly reduced eyes), two pairs of antennae, mandibles, two pairs of maxillae, and the maxillipeds; (2) the pereon, composed of those thoracic segments not fused with the head, its segments (pereonites) bearing paired uniramous legs, or pereopods (with few exceptions, isopods have seven pairs of pereopods); and (3) pleon (abdomen) with its free or variously fused segments, or pleonites. All isopods have the sixth pleonite fused with the telson, thus forming a pleotelson. The pleonal appendages are ventral swimming and gas-exchange structures called pleopods.

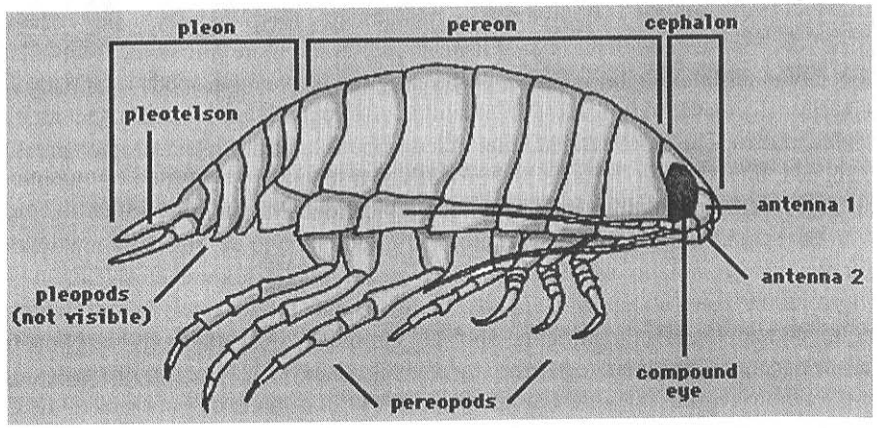

Fig. 20.1 Schematic isopod with morphological characteristics (from http://tolweb.org/tree)

Most isopods are dioecious, and generally males and females can be distinguished by the form of the second (or the first and second) pleopods (which bear gonopods, or appendices masculinae, in males), presence of a pair of penes on the ventrum of the last pereonite in males, and presence of oostegites in mature females.

Limited information on the marine isopods of Costa Rica is available. Brusca & Iverson (1985) produced a guide to the isopods of the Pacific coast of Costa Rica, including a total of 37 species of 14 families; these numbers include actual recorded species as well as those which are expected to occur along the Pacific coast of Costa Rica. Guzmán *et al.* (1988) studied the diel and seasonal occurrence, density, size, and sex ratio of *Excorallana tricornis occidentalis* from Isla del Caño. Several studies have addressed the effects of root-boring isopods of the genus *Sphaeroma* on mangroves along the Pacific coast of Costa Rica (Villalobos *et al.* 1985; Perry 1988; Perry & Brusca 1989). Dexter (1974) examined the macroscopic infauna of sandy beaches along both the Pacific and the Atlantic coasts of Costa Rica; the isopods *Excirolana braziliensis* (as *Cirolana salvadorensis*) and *Exosphaeroma* sp. (as *E. diminutum*) were the most abundant species, occurring on both coasts. Jiménez & Vargas (1990) reported on the parasitic bopyrid isopod *Probopyrus pandalicola* infesting the caridean shrimp *Palaemonetes schmitti* (reported as *P. hiltonii*) on the Pacific coast (also see Campos & Campos 1989). Markham (1992) summarized known distributions for the bopyrid isopods of the tropical eastern Pacific. Regarding the Caribbean coast of Costa Rica, Breedy & Murillo (1995) collected seven isopods on artificial habitats, but the validity of their identifications has not been established. More recently, Wetzer & Bruce (1999) described a new genus and species of sphaeromatid isopods from Caribbean Costa Rica. Brusca & White (in preparation) conducted an 18-month study of isopod diversity on the Cahuita Reef, and data from that work are included in this part (incorporated into Species List 20.1 which is included on the CD-Rom).

Isopod Diversity in Costa Rica

A total of 78 isopod species have been reported from both coasts of Costa Rica (Species Lists 20.1 and 20.2 are included on the CD-Rom); two species (*E. braziliensis* and *C. parva*) have been collected from both coasts. At least 16 additional species are expected to occur in shallow waters along the Pacific coast of Costa Rica, but have not yet been collected there (Brusca & Iverson 1985); they are not included in this part. The isopod fauna of Costa Rica's offshore benthic habitats has yet to be studied in any detail. Overall, it is reasonable to assume that species diversity of the Isopoda of both Pacific and Caribbean coasts of Costa Rica is considerably higher than reflected by the reports so far published, probably three times the reported diversity to date.

Costa Rican isopods are represented by 6 suborders and 24 families. Representatives of eight families (Anthuridae, Ancinidae, Sphaeromatidae, Cirolanidae, Corallanidae, Aegidae, Gnathiidae, Holognathidae) occur on both coasts. The most specious families of isopods in Costa Rican waters are: Asellota (16 species), Anthuridae (14 species), Sphaeromatidae (13 species), and Cirolanidae (seven species).

The only place on the Caribbean coast of Costa Rica that has been examined for its isopod fauna is Cahuita National Park, which is well-known for its nearshore fringing reef. Unlike offshore barrier reefs, which are characterized by extensive coral growth, complex zonation, and large deep inner lagoons, fringing reefs are small in size, shallow, and under the influence of terrestrial/coastal runoff and sedimentation. In the case of Cahuita, coastal runoff from nearshore and upland disturbance (deforestation and soil erosion, agriculture, etc.) has powerfully impacted the reef for many years. Most of the Cahuita reef suffers from high sediment load and eutrophication. Sedimentation decreases water clarity, which disrupts endosymbiotic photosynthesis reducing coral growth. Coral recruitment is reduced because of the coverage by sediments and increased growth of non-coral organisms, which further reduces the settlement of coral planula larvae (Cortés & Risk 1985; Cortés 1994). Agricultural pollution adds excessive nutrients to the system and further drives eutrophication. It is well-known that moderate levels of nutrients lead to changes in community structure where scleractinian corals are outcompeted for space by algae and benthic filter feeders such as sponges, bryozoans, and tunicates (Pastorok & Bilyard 1985; Tomascik & Sander 1987; Wittenberg & Hunte 1992; Naim 1993; Chabanet *et al.* 1995). This change in community structure may result in increased bioerosion of the reef framework reducing habitat complexity which, in turn, affects other organisms (Sano *et al.* 1987). At higher nutrient inputs, coral growth may be reduced due to inorganic phosphate, which prevents calcification (Kinsey & Davies 1979).

Cahuita National Park (9°18′ N, 82°7′ W) was established in 1970 and includes a small 240 ha barrier reef and a 1,100 ha coastal lowland wet forest (Cortés & Risk 1985). Cahuita has coral growth relatively close to the shore and scattered patch reefs within the lagoon. On the reef crest, spur and groove formations reach 10 m

in depth (Risk *et al.* 1980). Shoreward from the reef crest, the lagoon varies in width from 400 to 1,100 m and has a depth of less than 10 m. The lagoon has scattered boulders and rocky outcrops, coral heads, scattered small patch reefs, large rubble areas, sand/mud flats, and sea grass beds. The reef crest itself is approximately 4 km long with well-developed buttresses (spur and groove formations), but live coral coverage and diversity are low within the lagoon and outer reef zones.

Despite the anthropogenic impacts and destruction of corals, the isopod fauna of the Cahuita reef area is quite diverse (45 species), more diverse than some studied "pristine" reefs such as Carrie Bow Cay, Belize (Brusca, Kensley & White, unpublished data, 2007). However, species composition differs markedly between Cahuita and "pristine" offshore reefs, in that the Cahuita community is strongly dominated by herbivores and detritivores as opposed to a predominance of carnivores on offshore reefs. At Cahuita, species richness is positively associated with habitat type, and most species occur in algal-covered coral rubble habitats. There is no change in species richness at Cahuita between the wet and the dry season. Of the 45 isopod species known from the Cahuita reef, one, *Paracerceis caudata* (an herbivore), is the dominant species in all samples taken, except dry-season algal-covered rubble samples.

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Collections

The Museo de Zoología of the Universidad de Costa Rica houses a small collection of Costa Rican isopods. The largest collections are those of the Los Angeles County Museum of Natural History and the US National Museum of Natural History (Smithsonian Institution).

Recommendations

The isopod fauna of Costa Rica has been studied mainly by non-Costa Rican investigators. There is currently no isopod specialist working in Costa Rica. As a consequence, material deposited in public collections (in Costa Rica) is scarce. Joint projects as well as regional workshops with specialists on this group of crustaceans would help increase the interest of students and scientists in Costa Rica.

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