Rhithropanopues harrisii

A mud crab

Phylum: Arthropoda, Crustacea
Class: Malacostraca
Order: Decapoda
Section: Brachyura
Family: Panopeidae

Taxonomy: The large and taxonomically problematic family, Xanthidae was divided into eight smaller families by Guinot (1978). This included Panopeidae, to which *R. harrisii* belongs, and Pilumnidae (*Pilumnus*) placing emphasis on more discrete characters (e.g. pleopod morphology) than previously used (e.g. carapace and chelae morphology) (Martin and Abele 1986; Schubart et al. 2000). *Rhithropanopeus* was separated from *Panopeus* based on unique pleopod morphology (Martin and Abele 1986). Thus, known synonyms previously used for *R. harrisii* include *Panopeus wurdemannii* and *Pilumnus harrisii* (Wicksten 2012).

Description

Size: Male carapace generally 16 mm in length and female carapaces are usually 12 mm in length (Wicksten 2012). Type specimen was 19 mm (Rathbun 1930), and among Coos Bay specimens 36% (both sexes) measured at least 6 mm in width (Pisciotto 1977) and males were larger than females (Ryan 1956). Weight rarely over four grams (San Francisco Bay, Smith 1967).
Color: Dull green to brown dorsally, pale white ventrally. Dactyls whitish (Rathbun 1930; see Fig. in Wicksten 2012).
General Morphology: The body of decapod crustaceans can be divided into the **cephalothorax** (fused head and thorax) and **abdomen**. They have a large plate-like carapace dorsally, beneath which are five pairs of thoracic appendages (see **chelipeds** and **pereopods**) and three pairs of maxillipeds (see **mouthparts**). The abdomen and associated appendages are reduced and folded ventrally (Decapoda, Kuris et al. 2007).
Cephalothorax:

Eyes: Frontal and fill orbits.

Antennae:

Mouthparts: The mouth of decapod crustaceans comprises six pairs of appendages including one pair of mandibles (on either side of the mouth), two pairs of maxillae and three pairs of maxillipeds. The maxillae and maxillipeds attach posterior to the mouth and extend to cover the mandibles (Ruppert et al. 2004).

Carapace: Sub-quadrate, almost trapezoidal and wider than long. Carapace sides converge slightly. Front truncate and posterior broad with greatest width at fourth lateral tooth (Ryan 1956). Prominent horizontal dorsal ridges (Rathbun 1930) (Fig. 1) (Ryan 1956).

Frontal Area: Front truncate and less than a third as wide as carapace. Frontal margin straight, double-edged, channeled and thick with a triangular median notch (Figs. 1, 2).

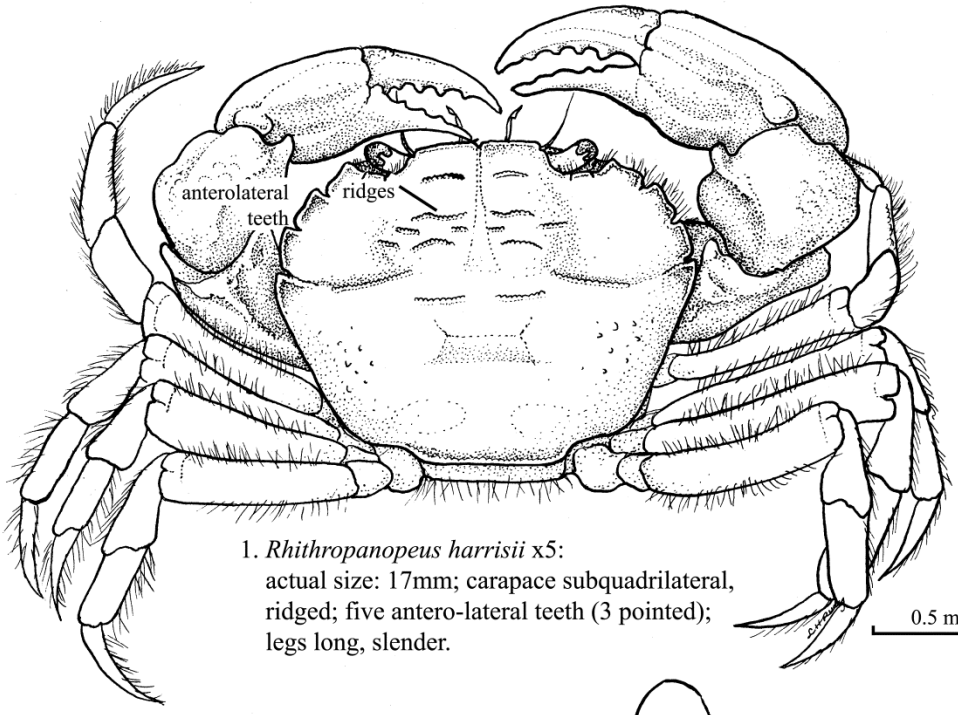
Teeth: Five carapace teeth. The first, antero-lateral tooth fused with the postorbital angle and followed by 2–3 anterolateral teeth. Last three teeth are dentate, pointing forward with the last tooth smallest (Fig. 2) (Wicksten 2012).

Pereopods: Long, slender compressed and covered with fine hairs (Fig. 1).

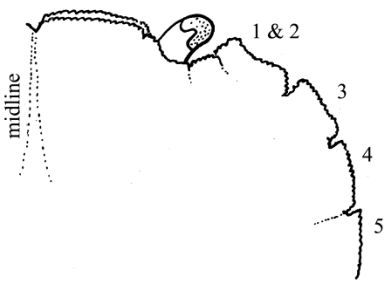
Chelipeds: Unequal, heavy, with short fixed finger and curved dactyl. Minor chelae with longer fixed finger and dactyl. Carpus with internal tooth (Wicksten 2012). Chelae smooth (older individuals), or with lines and granules (young individuals) (Fig. 4).
Abdomen (Pleon): Male abdomen narrow (see **Sexual Dimorphism**) with five segments with third segment not contiguous with coxa of the last pair of legs (Fig. 3). Terminal segment rounded (Fig. 3) (Rathbun 1930).
Telson & Uropods:
Sexual Dimorphism: Male and female brachyuran crabs are generally easy to differentiate. The most conspicuous feature, the abdomen, is narrow and triangular in males while it is wide and flap-like in females (Brachyura, Kuris et al. 2007).

Hiebert, T.C. 2015. *Rhithropanopues harrisii. In:* Oregon Estuarine Invertebrates: Rudys' Illustrated Guide to Common Species, 3rd ed. T.C. Hiebert, B.A. Butler and A.L. Shanks (eds.). University of Oregon Libraries and Oregon Institute of Marine Biology, Charleston, OR.

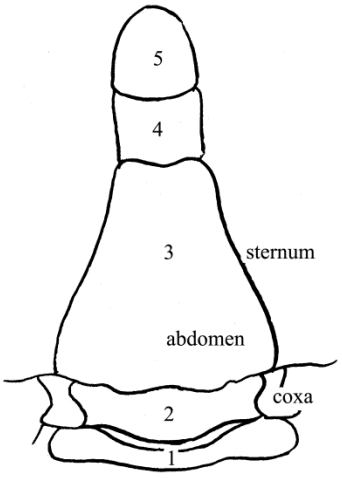
Rhithropanopeus harrisii



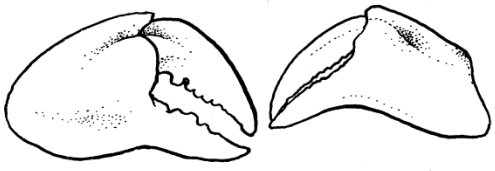
1. *Rhithropanopeus harrisii* x5:
actual size: 17mm; carapace subquadrilateral, ridged; five antero-lateral teeth (3 pointed); legs long, slender.



2. Carapace (right frontal):
frontal edge straight, double-edged; triangular median notch; eyes fills orbit; teeth 1,2 coalesced; 3,4,5 dentate.



3. Abdomen (Male):
narrow; segment three not contiguous with coxae of legs.



4. Chelae (Male):
heavy, unequal; white, smooth
(after Benedict, Rathbun).

Possible Misidentifications

Two panopeid genera occur locally; *Rhithropanopeus* and *Lophopanopeus* (Kuris et al. 2007). *Rhithropanopeus,* currently monotypic, is characterized by unique pleopod morphology, particularly the lack of a lateral tooth. Additional characters include a median process that is rounded and with one long central spine and 3–4 long spines laterally (Martin and Abele 1986). Furthermore, *R. harrisii* has white dactyls (or fingers) while local members of *Lophopanopeus* have black dactyls and are not found in brackish water (Kuris et al. 2007). Additional characters of the genus *Lophopanopeus* include tri-lobed pleopods with accessory processes extending acutely from the main shaft, a medial lobe that is deeply furrowed and a simple lateral tooth (Martin and Abele 1986). The two local species can be differentiated by the distal segments of ambulatory legs that are hairy in *L. bellus* and smooth in *L. leucomanus* (Kuris et al. 2007).

Rhithropanopeus can also be mistaken for the shore crab, *Hemigrapsus oregonensis*, but *Rhithropanopeus* has strong dorsal ridges, three side spurs (Ricketts and Calvin 1971) (last three pointed antero-lateral teeth), slightly convergent sides and long, slender legs. *Rhithropanopeus harrisii* sometimes competes for food with *H. oregonensis* in the lower parts of bays where they can co-occur.

Ecological Information

Range: Type locality is the Cambridge Marshes and the Charles River, Massachusetts (Wicksten 2012). Native to the Gulf of St. Lawrence, Canada to Veracruz, Mexico and introduced to northern Europe (e.g. Holland) and the west coast of North America (San Francisco and Coos Bay) in 1940 (Garth and Abbott 1980; Puls 2001; Wicksten 2012).

Local Distribution: Probably introduced to San Francisco, California with eastern oyster spat (*Crassostrea virginica*) in 1940 and expanded northward to Coos Bay, Oregon (Ricketts and Calvin 1971). Oregon distribution includes Haynes Inlet, Coos River (Pisciotto 1977), Netarts Bay (Stout 1976) and Yaquina Bay (Pisciotto 1977).

Habitat: Sloughs, under rocks and in mud banks of estuaries, where it burrows (Puls 2001; Kuris et al. 2007). Tolerates a diversity of conditions (see **Salinity** and **Temperature**), but prefers some kind of shelter (e.g. oyster beds, Chesapeake Bay, Ryan 1956).

Salinity: Euryhaline and tolerant of a wide range in salinity, usually brackish to freshwater (Rathbun 1930; Garth and Abbott 1980; Pisciotto 1977; Forward 2009). This species osmoregulates very effectively, increasing excretion of urine in dilute waters and adjusting the permeability of the body wall (Garth and Abbott 1980). Adult salinity tolerance is generally between 0–18, but can range to salinities of up to 40 (Forward 2009). Larvae develop normally (in lab) at salinities of 5–35, while no larvae survive at salinities less than 1 (Costlow et al. 1966). Additionally, zoeae were found in salinities of 4–23.5 (greatest number at 15, Bousfield 1955). It is thought that tolerance of lower salinities is the result of reproductive refuge from the rhizocephalan parasite, *Loxothylaxus panopaei*, that settles onto *R. harrisii* larvae at salinities above 10 (Forward 2009). This parasite is currently only present in Chesapeake Bay on the east coast, and the Gulf of Mexico, where infection rates are affected by salinity and spatial separation between host populations (Grosholz and Ruiz 1995).

Temperature: Adults and larvae tolerant of a wide temperature range, from 7°to 35° C (Costlow et al. 1966; Vernberg and Vernberg 1972; Forward 2009). Temperature range unknown for planktonic larvae (Costlow et al. 1966), but their retention in the estuary (rather than moving offshore) suggests a wide tolerance (Forward 2009). Found in Coos Bay at temperatures ranging from 9–16° (October to December, Pisciotto 1977).

Tidal Level: High intertidal to depths of approximately 37 m (Wicksten 2012).

Associates: Parasitic rhizocephalan, *Loxothylaxus panopaei,* infests *R. harrisii* in regions where salinity is higher than 10. The *L. panopaei* cyprids settle on *R. harrisii* megalopae (Forward 2009).

Abundance: Can be the dominant species and is found in nearly every arm of Chesapeake Bay, but only occurs in widely

scattered patches (where it is abundant) in Oregon estuaries (Ryan 1956; Kuris et al. 2007).

Life-History Information

Reproduction: Reproductive timing varies with latitude. Individuals in northern latitudes are reproductive from July–August, those in mid-latitude from April–September and southern individuals from April–November (Forward 2009). In Chesapeake Bay, females are ovigerous in summer and early fall (Ryan 1956). Females do not migrate to more saline waters to release larvae (Costlow et al. 1966). In regions with a diurnal tidal cycle, larvae are released two hours following high tide, presumably to reduce larval exposure to the low salinity environment of adults, as the tide is not to enable larvae to move offshore as is seen in other brachyurans (Forward 2009).

Larva: The larvae and larval biology of *R. harrisii* are well described (Connolly 1925; Costlow and Bookhout 1971; Forward 2009; Marco-Herrero et al. 2014). Larval development in *R. harrisii* proceeds via a prezoea, several zoea (four total) and a final megalopae stage, each marked by a molt (Jaffe et al. 1987; Puls 2001; Forward 2009). The zoea are planktotrophic and have large compound eyes and four spines: one each dorsal and rostral and two lateral (see Fig. 54.5, Martin 2014). The rostrum is longer than the dorsal spine (Connolly 1925; Puls 2001) and lateral spines on the distal ends of the fifth abdominal segments are very long (Connolly 1925). Larval size at each of four stages is outlined in Connolly (1925). Megalopae are 1.1 x 1.0 mm (Connolly 1925; Puls 2001; see Fig. 54.9, Martin 2014), have a carapace with uneven surface and rostrum with median triangular tooth, as seen in adults (see **Frontal Area**) (Connolly 1925). Wild-caught megalopae identified using DNA sequence data were described by Marco-Herrero et al. in 2014. The megalopae of *R. harrisii* are unique among panopeids in lacking horns at the rostrum base. Other differentiating characters include the number of segments of the antennular flagellum (six in *R. harrisii*) and the absence of a recurved spine on the cheliped ischium (for typical panopeid spine see Fig. 54.7, Martin 2014). Unique to *R. harrisii*, larvae do not move offshore and, instead, are retained near the adult population within the estuary by vertically migrating within the water column (ascend during flood and descend during ebb tides) (Forward 2009). Larva settlement is accelerated by chemical cues from conspecifics, biofilms, estuarine water, humic acids and prey odor. Metamorphosis times are reduced with reducing salinity (Fitzgerald et al. 1998). Conversely, settlement is reduced by predator chemical cues, hypoxia and increasing ammonia/ammonium concentrations (Forward 2009).

Juvenile: Can be recognized by their granulated chelae.

Longevity: Less than two years (Grosholz and Ruiz 1995).

Growth Rate: Growth occurs in conjunction with molting. In pre-molting periods the epidermis separates from the old cuticle and a dramatic increase in epidermal cell growth occurs. Post-molt individuals will have soft shells until a thin membranous layer is deposited and the cuticle gradually hardens. During a molt decapods have the ability to regenerate limbs that were previously autotomized (Kuris et al. 2007). Experiments in R. harrisii showed that eyestalk removal increased growth rate up to two times and that growth resulted from cell proliferation, not enlargement (Freeman et al. 1983). Sexual maturity in R. harrisii is probably reached during the second summer and the total number of juvenile in-stars (molts) is not known (Ryan 1956).

Food: Algae and small crabs (sometimes including juvenile conspecifics). *Rhithropanopeus harrisii* is a nocturnal feeder.

Predators:

Behavior: Xanthid and panopeid crabs are generally slow-moving, inactive crabs, sometimes playing dead when disturbed (Kuris et al. 2007). *Rhithropanopeus harrisii* hides under rocks and is less active than *Hemigrapsus oregonensis,* with which it co-occurs.

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