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■ Reproductive Behavior

Mating Strategies in Marine Isopods

Paracerceis sculpta is a sea-dwelling isopod crustacean. Their terrestrial isopod relatives, pill bugs or “roly-polies,” are familiar to most gardeners and turners of stones. Pill bugs thrive in dark, protected places, and are named for their ability to roll themselves into a tight ball. *Paracerceis* isopods also perform this trick, and like pill bugs, they thrive in dark, protected

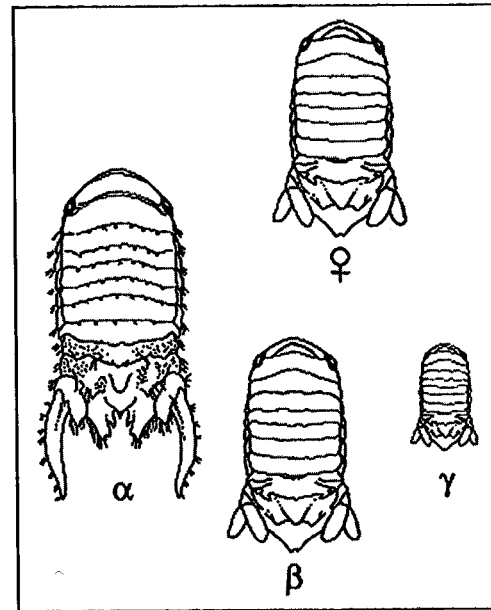
places. For *P. sculpta*, such places are spongocoels, cavities within sponges inhabiting the Sea of Cortez. At the tip of this finger of ocean separating Baja, California, from Mexico's mainland, isopods use spongocoels as breeding sites. Here, alternative mating strategies have evolved.

Alternative mating strategies represent *polymorphisms*, distinct forms of reproductive behavior, life history or body type that persist within a single population. Such polymorphisms exist in most species in which competition for mates occurs. In *P. sculpta*, females are similar in appearance. Males, however, exhibit three distinct "morphs" that each display different repertoires of mating behavior. Alpha males are largest, although they are less than a centimeter long. Like tiny sultans, α -males (alpha males) attempt to sequester harems of females within spongocoels, using their robust bodies and horn-like posterior limbs to defend or usurp these sites. Many fail to mate at all. Smaller β -males (beta males) are about half as long as α -males. They invade harems by looking and acting like females. Tiny γ -males (gamma males) are less than 3 mm (.35 in) long. They invade harems by moving fast and hiding within spongocoels.

All immature isopods in this species feed and grow on algae before making their way to sponges. Alpha males establish spongocoel territories and wait for females to arrive, whereas β - and γ -males wait for harems to become established before beginning their mating attempts. Females spend their preadult lives storing fat and developing eggs. They swim to sponges to find mates. Courtship is brief because females discriminate neither α -male nor spongocoel characteristics. Instead, females prefer spongocoels containing harems, perhaps because the existence of these established sites predicts their relative safety. Once inside, females molt, become receptive for one day, then shed their mouthparts and enter a 3-week pregnancy. Juvenile isopods leave their spent mothers and settle on algae. Spent mothers leave spongocoels and die.

What conditions allow the three male morphs to co-exist? Alpha males grow slowly but may live 6 months. Beta males have intermediate growth and survival rates. Gamma males mature fast but die young. Because male reproductive tenure varies inversely with maturation time, life history differences that could influence the relative contributions of each morph to population numbers appear to cancel. Alpha males devote about 20% of their bodies to sperm production. In β -males, this amount exceeds 50%, and as much as 80% or more of γ -male bodies consist of sperm! Yet within spongocoels, the relative fertilization success of each male morph varies, with the density of receptive females, and with the frequency of other male morphs. In terms of total offspring numbers, the average fitnesses of the three male morphs are equivalent.

Such conditions are considered sufficient to maintain a genetic polymorphism, and indeed, the three male morphs are distinct at a single gene. The number of females that enter spongocoels varies throughout the year and is



The four adult morphs in Paracerceis sculpta; females are monomorphic; α -males are largest, possess elongated uropods, and comprise 81% of aggregate male population samples; β -males are smaller than α -males, resemble females in their behavior and external morphology (although β -males are slightly smaller than females), invade spongocoels by mimicking female behavior, and comprise 4% of aggregate male population samples; γ -males are smallest, comprise 15% of aggregate male population, and use their small size and rapid movements to invade spongocoels.

Courtesy of Stephen M. Shuster.

unpredictable at any given time, causing the success of each male morph to oscillate. Thus, like the prows of three shrimp boats moored together in the nearby harbor, the relative frequencies of α -, β - and γ -males, rise and fall, always in motion, but remaining constant over time.

Further Resources

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