A *Rossia pacifica* individual drifting, “being” an ink blob. Not actively swimming, it is, instead, drifting diagonally from left to right and from front to back in picture, and slowly rolling clockwise (from the observer’s point of view) around its long axis. The shadows of its arms show it is almost on the substrate. See page 3 for an article on the Stubby Squid.

Escapes Of The Bobtails
Text & photos by Ronald L. Shimek, Ph. D.

Sepiolids are small squid-like animals related to cuttlefish found in shallow seas from the polar regions to the tropics. One of my favorite animals is the sepiolid *Rossia pacifica*, found in shallow waters around the northern Pacific from California to the Kamchatka peninsula. Undoubtedly the cutest marine invertebrate found in the region, I believe everyone should get to know something about these delightful small junior-grade squids.

In the halcyon days of yore, I did some minor research about them and thought some folks might find it interesting. However, I think it is first incumbent upon me to set the conditions of the times, as both what constitutes diving research and, indeed, the whole concept of "manipulative" marine environmental science were unknown when these observations were initiated.

The Wherefores

Back in ancient times, from about 1970 until 1995, I spent a not inconsiderable amount of time underwater investigating odd predator-prey behavioral interactions occurring in what is now fashionably called "The Salish Sea". As an aside, copies of the research articles resulting from some aspects of my research, supported in part by PNWSC, were (still are?) available in the PNWSC library.

Today, it is somewhat hard for people to realize that back in the early 1970s, diving science was "a new thing." While the aqualung had been invented during World War II, the ancillary equipment allowing long term diving in cold waters only became available much later. For example, the first foam neoprene wet suits that made possible diving research in local waters were a product of the mid-1960s, and other necessary equipment appeared much later.

Water conducts heat from the body's core about 55x as fast as air making it quite possible to die of hypothermia even in tropical coral reef water. Although such an unpleasant way to punch one's ticket may take several hours, a delay which may allow rescue, hypothermia in tropical waters remains a major contributing factor to shipwreck fatalities where the survivors have no life rafts or boats. In the Pacific NW, water temperatures are low enough that without some way to prevent heat loss, a fully submerged individual losing heat from the head as well as the torso rapidly becomes disoriented, with debilitation including convulsive shivering, lack of coordination, and the failure of coherent mental processes occurring in only a few minutes.

When I started diving in 1970 on the Pacific coast of North America, there were fewer than a half dozen scientists using scuba to actually study or examine subtidal environments, while there were also somewhat more "dilettantes" who simply collected study organisms from such habitats. At that time, a world-wide conference of all true marine ecologists, those who actually worked in the subtidal habitats they studied, could be held in a very small room.

Indeed, at that time, it was by no means certain that such research could – or should – be carried out at the University of Washington. I had discussions with several UW faculty members, some of whom would eventually be on my graduate committee, as to whether or not the research I was proposing was even technologically feasible, let alone possible to complete in a reasonable length of time. At that time, Alan Kohn had calculated the average time to complete a Ph. D. in the Zoology Department from start to finish to be between 7 and 8 years, significantly longer than the stay of a junior faculty member in the same department. Consequently, worries about doing research projects that might increase the time involved were quite real.

Additionally, the absolute number of data obtained per dollar expended in subtidal marine ecological research was, and remains, considerably less than in comparable terrestrial ecological projects. It was due in no small amount to the foresight of the National Science Foundation that I (and the UW) could afford to support the work that I and a few other grad students were attempting. What was more of a problem was the uncertainty of simply being able to collect sufficient information to statistically process it properly. Finally, such activities were inherently dangerous; the year before I started intensively doing my research diving, two diving-related fatalities occurred at the Friday Harbor Laboratories, resulting in serious questions being raised about whether or not the university should allow such work.

On the other hand, by electing to study some of the interactions commonly found in these hitherto unknown habitats, those of us who did the work all had numerous opportunities to observe, in detail, events which no other human had ever observed or documented. Such unique moments are more than simply thrilling and tremendously rewarding, they may seriously be life changing. The desire to not only get to know the unknown, but also to get glimpses of the absolutely unimagined, is an exceptional motivator. In short, our activities at the time were not just "pushing the edge of the envelope", they were more akin to inventing a whole new category of envelopes.

The Whys

As we all know, estuarine regions of the Pacific Northwest are dominated by cool to cold, dim, dark, and often semi-opaque waters, and most benthic habitats are characterized by sandy, silty, and muddy substrates. Fifty years on, such habitats, unfortunately, still largely remain unexplored and undocumented. This is a self-perpetuating condition, as people who don't understand a given habitat tend to ignore it, a default behavior for both scientists and non-scientists alike.

To this olde invertebrate zoologist/ecologist, such a narrowness of focus, particularly by professional diving scientists, implied by such behavior was, and remains, puzzling. It is also very troublesome, particularly as there is a wee tiny, itsy-bitsy, additional problem with the present degree of profound ignorance about these particular habitats.

Such shallow-water unconsolidated sediment benthic habitats and their constituent organisms are the only reasonable proxies for the similar unconsolidated-sediment ecosystems comprising the majority of our misnamed Planet's solid surface: the world's sea bottoms. Our resident orb, "Earth", should really be called "Water" or "Ocean" as the vast majority of the planet's surface is covered by a salty aqueous layer, is very cold, totally dark, and under pressures that are almost unimaginable.

Such habitats are effectively not only unknowable and unknown to the majority of humanity but are likely to remain that way for some time to come. It is technologically considerably easier to send humans to the moon and back than it is to get humans to the deeper oceanic regions and back to the surface. Put another way, the shallow water "unattractive, uninteresting" regions such as those discussed in this article are the closest most humans will ever get to being able to directly examine, manipulate, and understand habitats comparable to the deep-sea benthos. Given such deep-sea habitats comprise the world's largest ecologically defined regions and given how our world's terrestrial and oceanic shallow-water biological habitats are currently on the fast track to becoming totally unraveled, the fact we know essentially diddly squat about deep-sea environments would seem to be a considerable problem. Oh, and if the reader thinks the last sentence was hyperbole, it is incumbent upon said reader to do some investigation of the terms such as "Insect Apocalypse" and "Earth's Sixth Major Mass Extinction Event"; if you doubt my statements, Mr. Google awaits...

Initially, It Is All About Observation

The majority of the observations and data in this article were obtained over a few hundred scuba excursions totaling, I'd guess, somewhere between 200 to 300 hours of actual observation time, spread over approximately 25 years. In other words, it was a consistent, but not intensive, project. Additionally, I was able to maintain and observe several of these small critters in "mesocosm aquaria" emulating the normal *Rossia pacifica* natural habitat, over several years.

In the early 1970s, essentially every aspect of *Rossia pacifica* behavior or natural history was simply unknown. There was no documentation of *Rossia pacifica* ever having been observed in their natural habitat, and precious few had been kept alive in aquaria for more than scant minutes. Coincidentally, about the same time I started making observations, two other scientists, the late Roland Anderson, of the Seattle Aquarium, and William Summers, of Western Washington University, started work on the same species. Over the subsequent couple of decades, we became correspondents or collaborators to a greater or lesser degree.

Dramatis Personae

Most of the images in this article were taken in Friday Harbor Bay, directly in front of the FHL facility where I had a 100m x 100m research site. This area had enough *R. pacifica* that I would encounter them relatively frequently during my research which was more focused on predator-prey interactions of what were, at the time, termed "turrid" gastropods. The following two sequential images of a juvenile *R. pacifica* individual, about 2.5 cm (1 inch) long, were taken as rapidly as my strobes would recycle. The color change occurring in response to the strobe's flash illuminating the first image appeared "instantaneous" and was completed well before my strobes had recycled.

Fig. 1

Fig. 2

This individual is shown, in **Fig. 1**, in a vigilant but "unalarmed" posture and color (aka "before") and in **Fig. 2**, in a "frightened" ("after") color. The color change precipitated by my strobes firing occurred in a fraction of a second. While capable of dramatic color changes, sepiolids don't have the repertoire of colors and patterns available to our local octopuses, and like them, it is probably color blind. At the depths that these images were obtained (ca 18 m, 60 ft), the reddish color appears to be very dark red, effectively black, while the lighter color tends to match the gray of the substrate. Although looking quite obvious to a human, the light individual would be almost invisible to a predator, such as a fish, that might observe it over a monochromatic color range.

During the day, *Rossia* individuals are typically buried with only the eyes and a depression for the hypostome (aka siphon) visible. I noticed the individual in the image below when it slowly came out from under its sedimentary covering and began to watch me approaching. Of course, lacking a head, it couldn't watch me without pivoting its body, which it did. I approached much more slowly than a dogfish (*Squalus acanthias*) would swim, trying not to frighten it. In these areas I think the dogs were probably their major predators.

This *Rossia* (**Fig. 3**) seemed interested in my approach but was not quite ready to flee. It slowly moved a bit, but not too much as I approached; presumably a predator, such as a dogfish would try to catch a swimming squid, but might ignore, or not even see, an immobile individual on the bottom. Consequently, for the squid, it would be safer to remain on the substrate being, at least, semi-buried. Nevertheless, the "relaxed" coloration pattern is typically all dark; white or grey colors generally seemed to indicate the animal is "concerned". When I got about a meter away, in the artificiality of my lights, it turned "white". In the ambient light at that depth, it actually changed color to closely match the pale grey bottom color. The relatively bright pinkish color of the animal's viscera as well as the yellow-orange of the sea pen to the right, are photographic artifacts, and without the strobe's illumination were neither as intense nor colored as they appear in the image.

Fig. 3

Predators And Escapes

Several sepiolids have stereotyped escape responses similar to the one I will describe for *Rossia pacifica*. In the *R. pacifica* I observed, this response was generated by slow-hunting, patrolling, predators. In my study areas these were predominantly individuals of the spiny dogfish, *Squalus acanthias*. When hunting, these truly graceful and really beautiful small sharks are poetry in motion as they swim slowly in a zig-zag or sine-wave pattern, parallel to the substrate about 50 cm to 1 m (one and a half to three feet) above it.

By copying a dogfish's velocity, distance above the substrate, and characteristic "hunting" motions, over time I was able to induce the escape response described in the following paragraphs in well over a hundred separate instances.

Typically, *Rossia* individuals would launch themselves from the bottom and swim, apparently purposefully, up directly in front of the dog, where the shark couldn't help but see them. It looked to me as if they were trying to attract the predator's attention. Then the sepiolid changed direction to swim more-or-less in a straight line, leading the dog on. After seeing this, probably innate, behavior several times, I concluded the sepiolid was actively, and instinctively, inducing the predator to fixate upon it. I think for the entire escape behavioral process described below to succeed, the predator truly must be intensively "focused" on an individual squid. As will be seen, the escape behavior is elaborate, and very effective – provided, I think, the shark is really intensively focused on the squid.

Once the shark is intently pursuing the squid, the *Rossia* individuals went through a series of repetitions of a cycle:

First, they would turn darker and darker as its red chromatophores are expanded, making the creature appear in ambient light to change color from a light gray to solid black.

Then, they would discharge a blob of black ink,

Simultaneously, and apparently instantly, they become colorless (as mentioned, a pale gray which matches the substrate below them), effectively vanishing from mid-water a few feet (typically no more than 2 m) in front of the shark, leaving a blob of ink floating where it had been swimming.

The "cryptic" sepiolid would continue swimming on the same course.

Subsequently, within a few seconds:

The squid would again start to darken, and

Become fully visible again, moving on its same course, about a meter or two (a few feet) from the ink blob.

Then in less than a minute, this entire sequence of events would be repeated. Typically, each individual *Rossia* would go through three or four cycles of inking, bleaching, darkening, and then inking again. They would cover a few meters during each cycle, swimming in a straight line a meter or two (3 to 6 feet) in front of the shark, about 30 to 60 cm (a foot or two) above the bottom.

The final time it releases an ink blob… It vanishes completely, and…

A superb magician's trick had just been executed underwater, right in front of the shark's eyes. The magician made itself vanish. And as with any good magic trick, misdirection is the key to success.

A *Rossia pacifica* individual in the "drifting" posture. This is the posture occurring as the animal is dropping to the bottom prior to covering itself with sediment.

The larger gray blob, left of center, in the lousy image (**Left**) is an ink blob made by a swimming "escaping" *Rossia*. The black "smear" to the left is the preceding blob, broken-up and dispersed the turbulence caused by my left-most strobe housing (out of sight further to the left). Remember, this was all taking place over a soft, muddy-sand substrate. Unfortunately, I sometimes disturbed the sediment while chasing the actors in the drama occurring in front of me. Often such disturbed sediments were entrained in the turbulence surrounding me and when I had to stop and focus, the sediment cloud overtook me and resulted in an image such as the one above. Consequently, the sediment in the water obscures this particular blob somewhat, but the blobs typically floated along, slowly sinking without dispersing in the water and maintaining a more-or-less blobby shape. A drifting sepiolid quite closely mimics a drifting ink blot in both apparent color and shape.

The key is the cyclic behavior pattern. The sequence of the pale, almost invisible, prey item turning dark followed by suddenly inking, disappearing, and then subsequently reappearing and getting dark repeats three or four times in quick, but regular, succession. Generally, the dogfish often seemed somewhat distracted by the first ink blob, but generally seemed to get less and less interested in the blobs with each successive inking, and slowly increased its speed to close in on its prey. Concurrently, the squids also increased speed and started to "bob and weave" a bit, keeping in front of the shark. Then the squids would ink for their final time and vanish… leaving each dogfish to chase a ghost.

When it should have inked the last time, the squid actually did not do so. Instead, it stopped actively swimming, simultaneously becoming completely dark, while splaying its arms into a "tangled" posture, and …

Presto, instead of a small squid in front of the dog, there is what appears to be an ink blob, drifting slightly off to the side, even slowly 'tumbling" or rolling in the water, appearing to drift while gradually descending toward the substrate. In every instance I watched, the sharks would swim past such "ink blobs". Upon touching the substrate, the "blob" bleaches, instantly matching the substrate's color and effectively disappearing, all the while rapidly covering itself with sediments.

In addition to observing this behavior numerous times where dogs were actually pursuing the little squids. I emulated the predators by playing the part of the shark – and even when I knew what was occurring it was hard for me to realize when the final "ink blob" was actually a squid. The response worked every time I watched; after the final and "fake" inking, the dogfish swam on as if they were still chasing a bleached sepiolid which would surely reappear shortly. But, of course, the final time, their prey never reappeared and by the time the sharks started to look around for the missing squid, they were generally at least a few meters beyond where the squids had been visible, and their prey were buried out sight. Of course, my trailing presence undoubtedly affected these dogs' behavioral responses. I am sure I distracted them, but those distractions were never sufficient to stop them from pursuing the sepiolid, in the first place, and I think, in most cases, they would not have found the squid were I not present.

Other Information

Rossia pacifica are mid-water nocturnal predators that live for one and a half to two years in the Salish Sea and feed on small fish or planktonic shrimp. Larger, presumably female, individuals reach about 4 to 6 cm (about 2 to 3 inches) in length. They spawn only once, and as is typical in cephalopods, both individuals subsequently die. The males die shortly after mating while the females die a short time later, after depositing their eggs, one each, in tough white capsules fastened to a hard substrate. After six to eight months, these capsules each open to release the single small juvenile. The two images, at left, show a couple of eggs clutches, each probably from one female. Pictured *R. pacifica* egg

Fig. 4

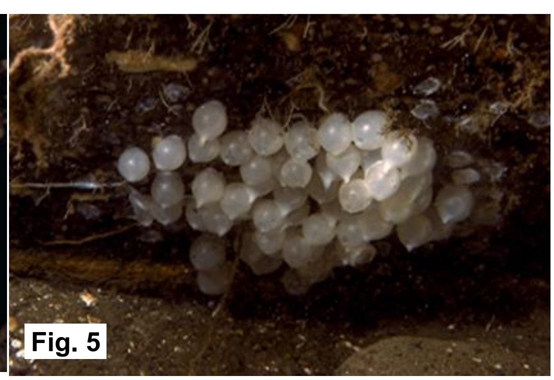

Fig. 5

capsules are on an old, discarded coffee mug, (**Fig. 4**) and on a vertical rock face, in lower Puget Sound (**Fig. 5**). Each capsule is about a centimeter (0.4 in) in height.

Fig. 6

Fig. 7

The next two images (**Fig. 6,7**), taken about 45 seconds apart, were taken in Discovery Bay and are of a newly hatched, itsy-bitsy, baby *Rossia*. Less than 1 cm long, this *Rossia* was probably only a few days post hatching. The right photo (**Fig. 7**) shows it swimming just above the substrate. When this color pattern occurs as the animal is swimming without strobe illumination, the animal closely matches the substrate behind it and effectively "disappears."

This last image is of a *Rossia* watching me as I took its picture. (**Fig. 8**) Who could resist those eyes? It was about 2.5 centimeters (1 inch) long.

Fig. 8

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