MEETING SOCIETY FOR INTEGRATIVE AND COMPARATIVE BIOLOGY

Meeting Spotlights Creatures Great and Small

DENVER—Biologists gathering here earlier this month for the annual meeting of the Society for Integrative and Comparative Biology could not help but marvel at the unusual adaptations and peculiar lifestyles described.

Legless Amphibians Nurse Their Young

The tropical amphibians called caecilians have no shortage of peculiarities. The creatures are legless, looking so much like oversized earthworms that they are often called "rubber eels" in pet stores. The 150 or so species of caecilians also have a reproductive strategy that sets them off from other amphibians. Instead of simply laying their eggs and then leaving, caecilians guard their eggs and some even brood their young internally, nourishing them with secretions into the reproductive tract. Now, caecilians have gotten even stranger.

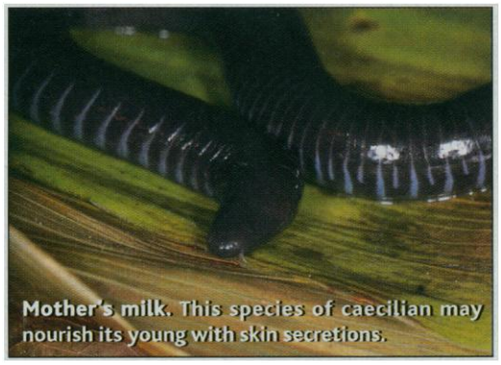
A team of biologists has discovered that a few caecilians bear live, helpless young that apparently depend on extended care from the mother to survive. But it's how the young feed that has drawn the most attention. James O'Reilly, now a herpetologist at the University of Massachusetts, Amherst, reported at the meeting that they seem to feed on their mother's skin or on the secretions it produces—a behavior eerily similar to suckling in mammals.

"I don't think there's ever been any indication of feeding of young in this manner in amphibians," says Sunny Boyd, a neuroendocrinologist at the University of Notre Dame in Indiana. Adds Marvalee Wake, an evolutionary biologist at the University of California, Berkeley, "This is terrifically new and interesting."

Boyd says the finding should be appreciated not just by caecilian enthusiasts such as herself but by anyone interested in preserving biodiversity. In certain parts of the tropics, "these animals can represent a tremendous amount of biomass," she notes. Yet caecilian numbers, like those of frogs and salamanders, seem to be declining. "It's very important that we understand their reproduction and behavior," she says, because it could help explain the decline or provide ways to breed the animals in captivity.

O'Reilly stumbled on the unusual caecilian breeding behavior in 1996 while doing feeding experiments on a West African species called *Geotrypetes seraphini*. One morning, he was dismayed to find that one animal was surrounded in its burrow by what appeared to be earthworms. He thought they had been mistakenly provided as food by a co-worker, but when O'Reilly looked closer, he found that the "worms"—which soon died—were really young, helpless caecilians.

O'Reilly's collaborators, herpetologists Mark Wilkinson of the Museum of Natural History in London and Ronald Nussbaum of the University of Michigan, Ann Arbor, realized immediately that this discovery fit in well with some other puzzling observations. For example, they and Carlos Jared of the Instituto Butantan in São Paulo, Brazil, had found other unusual immature young as well as hatchlings of several caecilian species that have buck teeth similar to those that help the fetuses that develop inside the mother get nourishment from the lining of the oviduct. Wilkinson suggested the hatchlings might use the teeth to feed off the mother's skin. In 1997, when O'Reilly—with the help of Danté Fenolio at the Amphibia Research Group in Saratoga, California—raised a new clutch of *G. seraphini* young and tracked their development, they began to see evidence for that type of feeding.



Mother's milk. This species of caecilian may nourish its young with skin secretions.

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O'Reilly's newborn animals were 4 centimeters long and quite helpless. They stayed close to their mothers, on whose skin they apparently feed, and underwent a fivefold increase in weight over the next few weeks. The young displayed mouth structures that could help them obtain food. These included their own set of buck teeth. "This is a new use of that equipment after they are born," says Wake. Wilkinson had also found that the mouths of young *G. seraphini* have jaw muscles that virtually disappear by adulthood. These may help them get a better grip on the mother's skin.

Another clue that skin is a source of nourishment came from Jared and Wilkinson, who had observed that females in some species undergo changes that may prepare them for nourishing their clutch. When the young are born, the female's skin fades from dark blue to gray and becomes crinkled and full of ridges. The researchers also found that the underlying dermal layer of the skin is thicker in mothers than in nonbrooding females and contains glands that may secrete a nourishing fluid or a compound useful for communication. "The young are squeezing something from the skin," O'Reilly reported.

Colleagues note that more work needs to be done to prove that these caecilians do in fact feed their young, say, by witnessing the transfer of secretions, and to understand what causes the mother's skin to change. But it seems that *G. seraphini* is not the only caecilian that provides extended care to its young. Wilkinson, Nussbaum, and Jared have evidence that hatchlings of some egg-laying species of the genus *Siphonops* may also get nourishment from their mothers. If so, "that would be another independent evolution [of extended care]," says Wake.

Snakes Take Slow Passage to Prey

The sprint of the cheetah, the high-speed dive of a falcon, the sting of a sea anemone—all are features that help predators capture their prey. Now add to the list a less picturesque adaptation: the chronic constipation seen in certain snakes. Harvey Lillywhite, a physiological ecologist from the University of Florida, Gainesville, proposed at the meeting that retaining feces may give these snakes an edge over large quarry by adding bulk to their bodies. "It probably has to do with the fact that these animals feed on large and potentially dangerous prey," he explained. "Large [body] mass probably has a mechanical advantage."

Like others who have raised snakes, Lillywhite had noticed that different species vary dramatically in their passage times—how long it takes ingested food to exit the body as fecal material. To find out how these differences might be related to behavior, he and two University of Florida undergraduates, Brice Noonan and Pierre de Delva, tracked the passage times in a dozen snake species. Half were heavy-bodied, sit-and-wait predators that tend to move rela-

tively little except to ambush nearby prey; the other half were tree snakes, which depend on being svelte and swift so that they can slither up to their prey without breaking the slender twigs and leaves that support them. The scientific literature provided passage times for six more snake species.

The researchers found that passage times in the larger, ground-dwelling snakes were much longer than those of the arboreal snakes. One Gaboon viper, *Bitis gabonica*, had the longest time, eating multiple times over the course of a year but defecating only once, after 420 days. In contrast, its arboreal cousin, the sedge viper (*Atheris nitschei*), tended to produce a stool about once a week. A 145-day difference existed between the ground-dwelling and arboreal representatives of the family that includes boas and pythons. And the very slender arboreal *Uromacer oxyrhyncus* was the fastest, getting rid of waste in less than 2 days.

The "constipated" snakes retained the feces in the hindguts, thus putting 3% to 22% of added weight far to the rear. By anchoring the snakes' rear ends, the weight could be a boon for snakes that ambush relatively large animals, such as small antelope, says David Cundall, a functional morphologist at Lehigh University in Bethlehem, Pennsylvania. His own work shows, he says, that the sit-and-wait snakes do best when they are heavier: They can strike more quickly and get a better hold on prey. Indeed, he notes, the snakes that the Lillywhite group found to retain their feces longest are some of "the most effective and most rapid strikers."

Retaining feces would be a far more efficient way of gaining ballast than, say, simply having a broader posterior, says Victor Hutchison, a physiological ecologist at the University of Oklahoma, Norman. "They don't have to maintain [any tissue], they just have to drag [the feces] around," he points out.

Hutchison and Cundall caution that there could be other possible explanations for the Lillywhite team's finding. Longer retention times in the gut may simply enable the body to absorb more water or nutrients from the feces. "The effect on ambush ability could be accidental," Cundall adds. Lillywhite himself has considered these possibilities, but says that holding onto feces for more than a few extra days, or even weeks, is a bit extreme unless it provides some adaptive advantage.

Over the next years, Lillywhite hopes to study more snakes to see whether the correlation between passage time and predation strategy holds up and whether the amount of feces does indeed affect prey capture. But, for the time being, his colleagues find the idea that constipation makes some snakes better hunters appealing, even though it is a little peculiar. Says Hutchison: "It makes pretty good sense."

Death struggle. This drawing from the 1800s illustrates why some snakes may need extra weight.

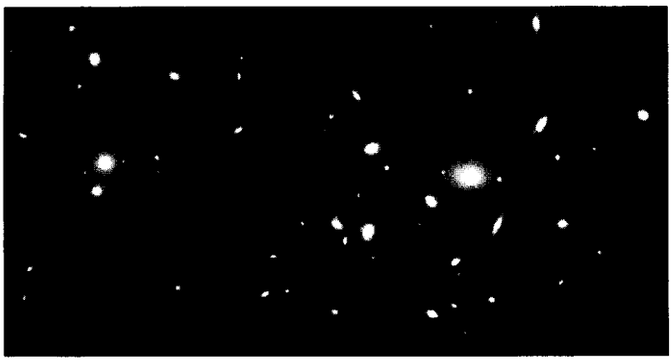
—ELIZABETH PENNISI

ASTRONOMY

The Mystery of the Migrating Galaxy Clusters

Conflicting results have astronomers puzzled over whether there is a bulk motion of galaxies across a vast swath of sky

A mass migration of galaxies may be taking place, but astronomers can't agree on which way they are going. First reported 4 years ago by Marc Postman of the Space Telescope Science Institute in Baltimore and Tod Lauer of the National Optical Astronomy Observatories, the migration seemed to be taking place on a scale so huge—a swath of sky hundreds of millions of light-years across—that astronomers withheld judgment about whether it was real and what could be causing it until confirmation came in. Now three other groups have gone looking for the mass movement and have come back with results that only deepen the mystery.



Follow the crowd. Do nearby Abell clusters like this all move one way?

Two of the teams, one led by Michael Hudson of Canada's University of Victoria and the other by Jeffrey Willick of Stanford University in California, found "bulk motions" of galaxy clusters with very similar speeds, but at roughly 90 degrees to the earlier result. A third team, led by Riccardo Giovanelli of Cornell University in Ithaca, New York, found no bulk motion at all. "The field is pretty confused right now," says Michael Strauss of Princeton University, with astronomers wondering which, if any, of the varied techniques used can be trusted.

Astronomers have known since 1929 that, because of the expansion triggered by the big bang, all galaxies in the universe move away from us with a speed proportional to their distance. This velocity, detectable as a "redshift" in the galaxy's spectrum, is generally used as a yardstick for their distance. But galaxies have other "peculiar velocities," over and above the general cosmic expansion, which astronomers generally attribute to the gravitational pull of large concentrations of galaxies nearby. Using NASA's COBE spacecraft in 1993, astronomers got a fix on our own galaxy's peculiar velocity: We are moving at 600 kilometers per second (km/s) with respect to the uniform background glow left by the big bang, in a slightly different direction from that found by the Hudson and Willick teams.

To map cluster motions, astronomers have to work out how much their velocity—easy to determine from redshift—departs from the velocity that the overall cosmic expansion would give to an object at that dis-

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