A Study of Habits of Cave Animals

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Ⅰ. Introduction

A study of cave life involves not only the plants and animals themselves, but their environment and the ways in which it affects them. The most obvious characteristic of caves is the prevailing utter darkness beyond the twilight zone that extends a little way in from the entrance.

A similar degree of darkness indeed surrounds parasites that live inside their hosts and the billions of animals that live deep below the surface of the sea. Such darkness, however, is entirely beyond the experience of those organisms that live on the surface of the Earth. Outside a cave, even on the darkest night, a person can see dim outlines after his eyes become accustomed to the dark, but well inside a cave he literally cannot see his hand before his face.

An experiment with photographic film gives striking proof of this complete absence of light: A film developed after being exposed for a week in the depths of a cave was completely blank.

An additional factor important to cave animal life is the nearly constant

high relative humidity. In most caves water continually drips from the ceiling and the walls, and the drip water either accumulates in pools or nows away in streams.

Cave walls are sometimes so moist that aquatic organisms can readily crawl over them. Small crustaceans and flatworms, which outside of caves normally live only in pools or streams, are found even on the ceilings of humid caves.

Other caves, however are so dry and dusty that a person finds it hard to breathe in them when the dust has been disturbed. These dry caves are exceptional. Life is rare in such caves, and they are of interest chiefly to archeologists and paleontologists, who look in them for evidence of earlier habitation by people or extinct species of animals.

Biologists are interested chiefly in caves with a moist atmosphere, for these are the only ones that now contain large numbers of living organisms.

Organisms that pass their entire lives in the inner part of a typical cave, then, must be adapted to continuous utter darkness, combined with high humidity and moderate temperature, both virtually constant throughout the year.

The animals most thoroughly adapted to such conditions may also possess other special characteristics, such as extra-long feelers for finding their way about.

There are degrees of adaptation to cave life. Adaption is relatively slight in animals that live in caves only during the winter or for even shorter periods.

One convenient way to classify cave animals a according to how much of their time they spend in caves.

Ⅱ. Degree of Adaption to Caves

Caves, especially their entrance zones, are often inhabited temporarily by animals that usually live above ground but occasionally move into a cave for protection. Bears use caves for their long winter sleeps.

Bats may remain in caves continuously throughout the winter, when they are hibernating, but in the summer they rest in them only during the daylight hours. Skunks, raccoons, moths, mosquitoes, and even people use caves as wintering places or take refuge in them to avoid extreme heat, cold, or storms. Animals that do this are called *trogloxenes*, from the Greek words *troglos*(cave) and *xenos*(guest). Trogloxenes never complete their whole life cycle in a cave.

Other species of animals regularly live in the dark zones of caves, although they can and do survive outside caves, provided the environment is moist and dark. Earthworms are a good example, and some of the salamanders, beetles, and crustaceans found in caves are included in this category.

They are known as *troglophiles*, from *troglos*(cave) and *phileo* (love). Some individual troglophiles may complete their entire life cycle in a cave,

but other individuals of the same species live outside.

Last, there are forms that live permanently in the dark zone and are found exclusively in caves. They commonly have very reduced pigment and have either very small eyes or none at all. These forms are known as *troglobites*, from *troglos*(cave) and *bios*(life). They include the blind cave fishes *Amblyopsis spelaea* and *Typhlichrhys subterraneus*, such isopods as *Asellus propinqus*, and such salamanders as *Haideotriton wallacei* and *Typhlomolges rathbuni*.

Troglabitic insects frequently have longer appendages and thinner shells than do related forms. All existing troglobites have evolved from troglophiles.

Another group of organisms that can live in caves, but that are not technically regarded as cave forms, are parasites, such as the ticks and lice that infest cave-dwelling animals. A few parasitic species, however, are classed as troglobitics, because they are never found outside a cave.

Bats in particular carry so many ticks and lice that, in caves where large numbers of bats assemble, these parasites may rain continually from the ceiling. Parasites are also found in the gills of cave crustaceans and on the skins of cave fish and salamanders.

Ⅲ. Troglobites

We assume that with additional study the bacteria now known only from

caves will someday be found in such other environments as the surface soil. Therefore, such bacteria are excluded from the trogrobite group. The simplest of the troglobites are some of the one-celled protozoans.

Next in ascending order of complexity are the cave-dwelling flatworms known as planarians, which are rarely more than 2 centimeters in length. Flatworms are aquatic and feed by extending a tube from the center of the body. The cave forms are white and eyeless.

Flatworms can, in addition, float through the water; they are found in large numbers feeding an the bodies of bats and other organisms that fall into the water. They have the remarkable ability to regenerate a new head or tall, and will form two complete organisms if cut in half. Little is known of the life cycle of cave planarians.

Snails and slugs are attracted to the moist environment of a cave. Several dozen species of snails are troglobites. They slither along walls and floors, feeding on tiny fragments of organic matter. Slugs have been seen invading the burrows of beetles, and possibly they feed on dead cave animals, but no troglobitic slugs are now known.

Cave crayfish are not all colorless, and many are closely related to species that do not live in caves. *Orconectes pellucidus*, a form abundant in many caves of the southeastern United States, is about 15 centimeters long, or as large as the crayfish in surface streams. The cave crayfish, however, utilize their food much more slowly, and can live twice as long as surface forms in water with a given content of dissolved oxygen.

The cave crayfish's slow life processes facilitate its survival during times of diminished food supply.

Cave crayfish and other cave dwelling crustaceans occasionally make their way into the watercourses that flaw into springs or wells.

Millipedes form another large group of organisms that require a moist environment and are common in caves. They burrow into cave silt and feed on humus and fungi.

The troglobitic forms have less body pigment, thinner shells, longer legs and antennae, fewer eye facets, and longer sensory bristles than surface forms in some of the cave forms, the shell is so thin that it will wrinkle in dry air. Millipedes, provided there is sufficient moisture, can live anywhere in a cave. Since they feed on anything organic, from bat guano to paper discarded by cave explorers, millipedes are widely distributed. Centipedes also frequent caves, but only a few supposedly troglobitic species are found in North Amenca.

Earthworms burrow in the mud of many caves. They ingest the mud, extract nutrient material from it, and then pass the remainder through their digestive tracts. Their castings contain sufficient nutrients to provide food for other organisms that live in the mud. No truly troglobitic species of earthworms are known; those found in caves are also found in surface soils.

These are the springtails or collembolans. Springtails live in most caves, although they frequently escape notice because of their small size. They feed on decaying organic material.

Many species of winged insects live in caves. These include various species of files, gnats, and crane files. Mosquitoes use caves for overwintering, and speleologists are occasionally surprised to find themselves bitten by mosquitoes because they have disturbed a swarm inside a cave None of the winged insects are troglobites, but many are trapped in the webs of cave spiders and thus become important items in the cave food supply.

Hundreds of thousands of glowworms live on the walls and ceilings of Waitomo Cave and illuminate a with a diffused glow. The largest aggregation of them a associated with the cave stream, but small groups are scattered throughout the cave. They can also live on the surface. These insects can control the intensity of the light they produce, and they are capable of glowing 24 hours a day.

In the cave most of them find shelter in holes in or near the ceiling. A glowworm feeds by producing what appears to be a long thread of silk, which bears a series of mucous droplets at regular intervals, giving the appearance of a string of beads These "fishing lines" vary in length from 2 centimeters to nearly a meter. In darkness, midges and small flies are attracted upward by the glowworm's light and become ensnared in the sticky droplets of mucus.

The glowworm then draws up the fishing line and eats the prey After eating, the glowworm always removes the remains of the meal from its hole and keeps the fishing lines clean and in good repair to be used repeatedly

for catching further prey.

Some moths spend the winter in caves. One species, *Scoliopteryx libntrix*, found in the twilight zone shows a distinct orientation to light-it keeps the axis of its body parallel to the light rays, with its head farthest from the light source. These moths appear to sparkle when the light of a lamp is turned on them, the light being reflected from beads of water that condense on their bodies.

Wasps and ichneumon flies also use the twilight zone for shelter during the winter. Some wasps apparently spend their whole life cycle near a cave entrance, keeping inside except when they emerge to feed.

There is a larger number of species of cave beetles than of any other cave-dwelling animal group in the United States. There are 200 known troglobitic species and subspecies. Even though sheltered by the cave, many beetles remain under stones and near walls and are therefore frequently overlooked by people traveling through caves.

The features of the troglobitic beetles in one cave population are often distinct from those of their relatives dwelling in a cave only a few kilometers away. T. C. Barr has found that the many species of cave beetles in the United States differ widely in form and structure. In the Ohio River basin and the southeastern states, beetles are common in most of the large caves, each of which may have its own species or subspecies that is commonly absent in practically all the other caves.

Cave beetles generally are colored, their colors ranging from reddish brown

to black depending on the species. They not only are blind but also commonly have no optic nerves, their appendages are longer than those of comparable surface forms. Many species of cave beetle have powerful jaws, and these species have been seen to feed on millipedes, of her beetles, insect larvae, and cave cricket eggs.

Beetles abound in caves that contain large numbers of bats; they consume the carcasses of bats that later the floor, and they feed on bat guano. Beetles are preyed on in turn by cave crikets and spiders. Notwithstanding the great abundance af American cave beetles, little ıs known of their mating habits egg depositing, or larval development.

Cave crickets are the most conspicuous inhabtants of large caves, where swarms of them live on ceilings and horizontal surfacer. The bodies of the adults are about 5 centimeters long but their average length overall, when measured from the tip of the antennae to the end of the hind legs is about 15 centimeters. A New Zealand species attains a length of 45 centimeters.

Most cave crickets are not troglobites; they migrate to the entrance and feed outside when environmental conditions approach those of a cave-damp, dark, and neither too warm nor too cold. Only one genus of cricket m the United States, Ceuthophilus, is thought to contain some species that are troglobitic. These live in caves in the Rocky Mountain states, and the best studied one is Ceuthophilus longipes, found in Carlsbad Caverns and other caves nearby.

The eastern cave cricket Hodenoecus subterraneus roosts near cave

entrances and forages outside, mainly as a scavenger. When mature, the crickets migrate deeper into the cave to sandy areas where they mate. The female lays her eggs by plunging her ovipositer into the ground and depositing the eggs beneath the surface. The embryonic development takes about two months. Many of these eggs are eaten by predators such as the cave beetle Neaphaenops. Upon hatching, the immature crickets, or nymphs, move to ceilings to complete their development, thus avoiding predation by the beetles. The nymphs are usually located apart from the adults.

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