

WHAT THE GROUNDHOG UNDERGOES TO MAKE A 'HOLIDAY'

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FEBRUARY 2 is Candlemas Day and Groundhog Day. According to tradition the weather on this day is very important because it is an omen of good or bad luck for planting and sowing. The groundhog, also known as woodchuck or marmot, is the medium through which the meaning of the hidden knowledge is revealed. On this fateful day, the woodchuck breaks its winter sleep and leaves its den. If the day is clear and the animal sees its shadow on the ground, it hurries back to the burrow for six weeks more of hibernation. This means that spring will be late and the crops poor. If the day is cloudy and no shadow is cast, an early spring with a good harvest is foretold, and the groundhog stays abroad. This brings up the subject of how the woodchuck prepares itself to enact the role of an oracle.

Throughout the summer, the groundhog fattens itself in anticipation of winter's scarcity. When ready for hibernation, it selects a suitable den. This may be a burrow in the woods, the hollow base of a stump, or a hole along a hedgerow. Usually, the entrance to the den has a southern exposure and the nesting chamber, unless it is a well-insulated haystack, is deep enough to be below the frost line. Accommodated in its nest, the woodchuck goes into a state of deep hibernation, or torpor, by steps lasting several days, even weeks.

HOW IT ACHIEVES NIRVANA

First, a sluggishness engulfs the animal. This is followed by drowsiness that may lapse into a light sleep or revert to sluggish wakefulness. The woodchuck seesaws between these preliminary stages for several days and may even return to a very brief period of activity. Finally, it curls up into a ball and passes from the dormancy of a warm-blooded animal to a condition of torpor analogous to that of a nearly frozen reptile or amphibian. The temperature of the woodchuck drops from a typically normal mammalian 98° or 99° Fahrenheit, to 60°, 50°, or even a low of 36°, the exact temperature depending on that of the surroundings. The drop in body temperature is protracted over the course of days, sometimes weeks, and is broken by a series of small rises. It adjusts itself finally to within a degree or

two of the environmental temperature.

At the same time the heart rate drops from a minimum of 80 beats per minute to as few as 4 or 5. The respiratory rate also falls from an active 140 per minute and a quiescent non-hibernating 25 to 30 to an almost unbelievable low of less than one complete respiratory cycle in five minutes. One per minute is, however, the average rate of respiration in hibernation. All other vital functions follow suit and the animal becomes stiff, cold to the touch, and

great, within an hour or two. The heart-beat increases in speed to more than 200 per minute and the rate of respiration to above normal basal level. All these processes take place concurrently with a rise in heat production that is almost explosive. Fat is the source of the energy expended in waking and leaving the nest.

Such interruptions of deep hibernation during the five or six months of the cold season are frequent and of short duration. After the first of such awakenings the wood-

chuck regains the torpid condition within a few hours, certainly within a day, and with little or none of the fluctuations in temperature and rate of vital activities characteristic of the initial process. As days grow longer and warmer and green shoots begin to appear, the groundhog wakes more frequently and spends more time in outdoor wanderings. When in one of these forays it meets its mate, hibernation for the season is over.

The existence of specified external factors that certainly oblige the woodchuck to enter hibernation has not been conclusively demonstrated. Low temperature, scarcity of food, and dryness have been suggested but none of these hold. It is no colder in September and October when the groundhog goes into hibernation than it is in March and April when it comes out. Similarly, food is far more abundant in late summer and early fall

than in late winter and early spring. Normally, humidity is as high, if not higher, in fall than it is in summer. Laboratory experiments confirm that these external factors as well as others, such as light, darkness, confined air, etc., have no direct effect in inducing torpor.

Undoubtedly, the woodchuck enters hibernation in compliance with an inner urge to fulfill a necessary part of its annual life cycle at a certain time. During the late summer and early fall the body of the woodchuck fills to capacity with energy in the form of fat. Its reproductive organs however, stay latent until spring. Nevertheless, the device of hibernation provides the means for carrying over to the next season with a minimum of loss the accumulated energy needed for the breeding season.

THERE'S AESTIVATION, TOO

The concept of hibernation, defined as the act by an organism of passing a period



Cartoon by Margaret G. Bradbury

HIS DAY (FEBRUARY 2)

seems to be dead. Nevertheless, the groundhog continues to give off perspiration and heat, though in such minuscule quantities that their production can be detected only with special instruments. This is in marked contrast with the condition of bloodless and coldblooded organisms, whose vital functions are completely suspended during hibernation.

The woodchuck in torpor is not really so unconscious as it seems. It can easily be induced to waken by handling, by warming its chamber, or by other mechanical means. Certain internal stimuli, such as a weak sensation of hunger or the urge to mate, may cause the woodchuck to return to a state of normal wakefulness and may even impel it outdoors for a brief excursion that could possibly coincide with Candlemas Day. The process of waking is rapid and violent. The temperature rises from the hibernation level to approximately 98° in a matter of minutes or, if the difference is

of time in a state of torpor, can include stages in the life cycle of a shrub, an amoeba, and a hookworm, as well as a frog, a woodchuck, and a host of other plants and animals. Contrary to the implications of the term, hibernation is not restricted to the calendar winter. Many plants and animals start hibernating before the end of summer and continue in a state of torpor through part of spring. In the tropics and even in high latitudes, a long dry summer is characterized by a multitude of hibernating or, as it would be called in this case, aestivating plants and animals. Thus, the crucial part of hibernation is neither the time nor the place but the kind of suspended animation assumed by the organism.

In birds and mammals, complete suspension of vital activities means death. The definition of hibernation in the case of warm-blooded animals must be modified, therefore, to indicate a state of torpor acquired through a profound decrease of heat production accompanied by a lowering of body temperature to within a few degrees of environmental temperature. This physiological condition of hibernation, which must be reversible, rarely obtains in birds, the one authentic example being the poor-will, and is found in few species of mammals, none larger than the woodchuck. True mammal hibernators include some species of temperate-zone bats, the hedgehog and African tenrec, the ground squirrel, chipmunk, prairie dog, jumping mouse, pocket mouse, jerboa,

hamster, and dormouse. The spiny anteater of the Australian region is a true hibernator but whether or not its relative, the platypus or duckbill, of Australia and Tasmania can be so classified is not certainly known.

A number of carnivores, notably the bear, skunk, badger, and raccoon, are said to hibernate. These animals can pass through the preliminary hibernation stages of sluggishness, drowsiness, and dormancy as described for the woodchuck, but no farther. They can become completely passive but they never descend to true torpidity. With them there is no appreciable lowering of body temperature and they continue to produce enough heat to remain warm to the touch. All breed before or during the hibernation period and the female bear even produces and suckles her young during the winter. It seems then that compared with the woodchuck and other true hibernators, the bear, badger, skunk, and raccoon pass the winter in a state of relaxed, rather than partially suspended, animation.

Whether or not the woodchuck makes the traditional meteorological test on the second day of February, the devotees of Groundhog Day will not allow the fete to pass by unobserved. We suspect that while weather conditions at one end of the county may let the groundhog cast its shadow, the overcast at the other extreme might make for a different story, but still a story that has become a cherished part of American folklore.

BIRDS OF BALINSASAYO LAKES IN THE PHILIPPINES

By AUSTIN L. RAND
CURATOR OF BIRDS

THE COASTAL RANGE of eastern Negros is volcanic. On its jagged crest is a ragged, cup-shaped depression, little more than a couple of miles across, in which, side by side, lie the two Lakes Balinsasayo at an altitude of about 3,000 feet. Here Silliman University has a biology station, a lakeside house where I spent a week. From the crest I could look out to the islands of Cebu and Siquijor, the Straits of Cebu, and the Visayan Sea, and, dimly visible only on good days, Zamboanga far to the south. Inland the view was over rough, wooded slopes and peaks (that reach 4,500 feet) with some of the most magnificent forest trees I've seen anywhere.

The fading of daylight in the deep little mountain valley where the station stands comes suddenly and early. Our house was in evening shadow by 3 P.M., and it deepened to twilight while the sun was still shining on the slope opposite. I watched the evening happenings. First hornbills crossed high up, from valley wall to valley wall, on their way to some sleeping place; then spine-tailed swifts paid an evening visit and passed on. By 5:45 the first of the small bats appeared. Not until 6 P.M. when dusk had deepened did medium-sized fruit-bats come

to feed in their favorite tree near camp. Strangely they did not stop and feed but seemed to hover only a moment, snatching a bite here and there, on the wing. Later, about 7:30 of a moonlight night, I returned to see if they had settled down. But no, the medium-sized bats were still feeding in the same way. However, two big fruit-bats, real "flying foxes," had come into the trees and were feeding as I expected them to—resting in the trees, snarling, and sending down showers of fruit and seeds.

EXCLUSIVE TREE CAFETERIAS

Fruiting trees of many sorts bearing various-sized fruit are common here. They provide food for a great many birds as well as the bats. We found seven species of fruit-eating pigeons, a hornbill, and two flowerpeckers that depend on fruit, as well as many others that do so occasionally, but strangely there are no favorite trees to which great numbers of species and individuals come. Perhaps it's the very abundance of such trees here that makes the concentration about one tree, so striking a feature of the lowlands, unnecessary in these mountains. Another point is that certain fruit trees are used by only one or two species. For example, the fruit trees fed in by fruit-bats at night were not frequented by any birds

in the daytime. Another, a small-fruited tree, was frequented only by bulbuls while I watched. Does the abundance of fruiting trees allow each species to choose its own kind of tree, too?

There was only one flower-feeder, a sunbird, at this camp. This reflects a general condition of the Philippines, compared with New Guinea, for example. In the Philippines fruit-eaters are common, but flower-feeders few; while in New Guinea flower-feeders (including a species-rich family of honey-eaters, many brush-tongued lorries, and a couple of sunbirds) are as plentiful as fruit-eaters. Is there a difference in Philippine flowers that has discouraged flower-feeding specialization, or is it a zoogeographical accident?

In my experience, tropical flowerpeckers (tiny, short-billed, mostly brilliantly colored birds) have little to do with flowers, despite their name, and are mostly fruit-eaters. I spent some time watching an orange-breasted species. It was always a stolid, inactive bird, even when feeding in a fruit tree. Then, one day I got a surprise when I saw one of these birds moving actively about the twigs and leaves of a tall forest tree, as sprightly as any leaf warbler.

This brought to mind the two very different aspects of the diet of these birds and of corresponding modification of the digestive system. They eat fruit and also insects and spiders. The spiders pass down the gullet, into the stomach, and then into the intestine, as is normal for birds. With fruit it is otherwise. Berries are swallowed whole. These pass down the gullet, bypass the small stomach entirely, and go directly into the intestine. Apparently no stomach action is necessary for the intestines to extract the nourishment from the fruit, and the stomach has been modified accordingly. I wonder if the two types of activity, the lethargic and the sprightly, are also correlated?

PROTECTIVE FACTORS

Time after time as I've looked up into the forest trees my eyes have been captivated by the yellow belly of the elegant titmouse, the orange-yellow underparts of a flowerpecker, and the rich yellow venter of the canary flycatcher. They're certainly advertising colors. Hugh Cott, British biologist, showed that, in general, bright-colored birds are poorer in flavor than those whose colors are concealing in effect, and it is reasoned that this is a protection against predators that otherwise might be attracted by the bright colors. Cott worked mostly with north-temperate forms. I wonder if the same is true of birds of the tropical forests? Or, as is perhaps also true of coral reef fishes, is it that the protection of their habitat, the dense masses of foliage (as of coral) with many hiding places, have allowed

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