

Social ties in bat colonies

Bats Band Together



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Bats form the planet's largest colonies of vertebrates. The complex mechanisms governing their giant colonies' creation and continuation are just as intriguing as their size

There are over 1,100 species of bats in the world. The vast majority lead nocturnal, secretive lives, and use echolocation to orient themselves. Bats feed on invertebrates (chiefly insects), other vertebrates (lizards, birds) or their blood, as well as nectar and fruit. Their myriad physiological, behavioral and food-chain adaptations make bats an excellent subject for studying the evolution of social behavior, including the formation and maintenance of social bonds. They are regarded as very sociable animals, forming

some communities that number as many as several million individuals. However, most colonies are smaller, with between several dozen to several hundred individuals. Scientists are investigating whether colonies are loose groupings of animals that simply use the same shelter, or perhaps colony-members share closer, lasting ties. Is colony-formation the result of calculation, yielding benefits for the individuals involved?

Fleeting liaisons

Although we think of bats as social animals, surprisingly males and females only come together during breeding periods. In temperate climates this usually takes place in late summer, fall or early spring, depending on the species. Males choose locations suitable for mating, for example hollows of trees near lakes and roads, bird or bat boxes, cave inlets, or even tall buildings. They alert others to their presence by uttering specific calls and performing mating flights. Passing females evaluate the males' quality, and once a male is selected, the female may

Bats use pre-existing shelters provided by the environment. Individuals that live in forests during the breeding season make use of several tree hollows, moving every few days



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The Mammal Research Institute of the Polish Academy of Science in Białowieża has carried out research on bats' strategy of finding new hideouts. Finding a tree hollow using just echolocation is difficult. Once a hollow has been identified, other bats can be informed of its existence

choose to remain in his hideout for some time. The most attractive males may assemble several females to create a harem. The bonds between males and females do not last. The males are unable to supervise their females, which results in the females meeting other males. By attracting more females, the males attempt to increase their chance to reproduce, whereas by changing partners the females improve their chances to find the best male to father their few offspring (usually one or two young). The fleetingness of bonds between males and females may stem from the fact that the males take no part in the upbringing of the young. In addition insemination and fertilization do not occur at the same time. The females can carry sperm in their birth canal for as long as the entire winter, and fertilization may occur as late as several months after insemination. By then the partners have long forgotten their encounter...

Familiar voices

In temperate climates, bats form breeding colonies in the spring. They consist of females only, and of course the pups after they are born. In contrast to the relationships between males and females during the mating period, the bonds between bats in breeding colonies are permanent. Females frequently return to the colonies where they

were born, and eagerly settle in the same shelters and meet the same females. Some bats that form colonies are related – they are mothers, daughters, sisters. Does that indicate actual bonds between individuals, or rather just an attachment to the location? The latter explanation was widely accepted for a long time, especially in hot climates, where breeding locations (for example caves) are limited. However, experiments have shown that bats from the same colony can distinguish individuals from other colonies and exhibit aggression towards outsiders. Bats are able to identify one another by smell as well as social calls. Females recognize their offspring by their calls, and, similarly, the young recognize their mothers by voice. Research indicates that that calls of twins are more similar than to the calls of other pups, and that social calls vary between colonies. As a result, social calls carry information about colony membership, facilitating the formation and maintenance of the colony's distinct identity. There are also reports confirming that bats are able to recognize one another not only by their social calls, but also by their echolocation sounds. It was previously thought that echolocation serves purely as a means of orientation in space, and that echolocation sounds in themselves do not carry information identifying individuals. However, the

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There are over
1,100 species
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Only some extend their
activity into day time

latest observations indicate the existence of a precise identification mechanism in these sounds as well.

Warmer together

For many years, one of the main advantages for bats keeping together during breeding periods was thought to be the conservation of energy. Research shows that after availability of food, temperature of surroundings is the next most important factor affecting the pups' growth - the warmer it is, the faster their development (although there are exceptions, of course). Cool hideouts are not favorable for the pups' development. Residing in a group allows bats to regulate and maintain a body temperature optimal for the fastest growth. Bats can cluster together or disperse within the shelter, altering its microclimate, although this does not explain the distinctness of the colony. It seems that if this were the only or main mechanism favoring the formation of colonies, it would not matter which colony the individuals belong to. At the very least there would be no need for such a subtle mechanism of recognition of individuals. One concept invoked to explain the phenomenon of colony formation and the maintenance

of bonds between individuals focuses on the benefits resulting from the exchange of information about vital resources.

Information exchange

For bats, such information regarding the availability of food and shelter is of crucial importance. The availability of insects is extremely variable in space and time, therefore knowing which sector of the environment contains plentiful food resources is extremely important. Radiotelemetry carried out by researchers from the Max Planck Institute in Germany indicates that hunting individuals of the *Noctilio albiventris* species remain within a distance from each other that allows them to eavesdrop on their neighbor. When approaching their prey, they utter calls specific to feeding, which can easily be heard by other individuals. Therefore if a bat comes across a place where food is plentiful, other bats can quickly take advantage of this knowledge to maximize their hunting success. A similar mechanism, conducive to reciprocating and maintaining bonds, is used in finding and changing shelter.

By and large, bats are unable to independently build nests, instead relying on suitable pre-existing shelters. It might

seem that there should be nothing simpler than finding suitable tree hollows, especially as bats inhabiting forests during the breeding season make use of many tree hollows, moving regularly every few days. However, aviary experiments carried out at the Mammal Research Institute of the Polish Academy of Sciences in Białowieża have shown that bats do not have an easy time finding a small opening of a tree hollow using only echolocation.

Neighborly help

It seems that the irregular surface of a tree trunk results in a masking of the echo, making an opening hard for bats to notice. Finding such an opening is particularly difficult for species that hunt in the open. Species that hunt among dense treetops, on the other hand, are able to find tree hollows in flight, albeit only from a close proximity. Once a hollow has been identified, other bats are informed of its existence. Bat echolocation sounds reproduced from within a hollow have been shown to significantly shorten the time other bats take to find the opening, therefore bats are able to improve the efficacy of their search through simple eavesdropping. The significant energy expenditure associated with searching for shelter is then spread out among more individuals. Observations carried out on Bechstein's bat, *Myotis bechsteinii*, confirm that information about shelter quality is transmitted to other individuals within the colony, and even suggest that a colony may use scout bats that search out, evaluate the quality of a shelter, and influence the colony's decision regarding its choice. The intriguing mechanism of information transfer within the colony is the subject of ongoing research.

Male solidarity

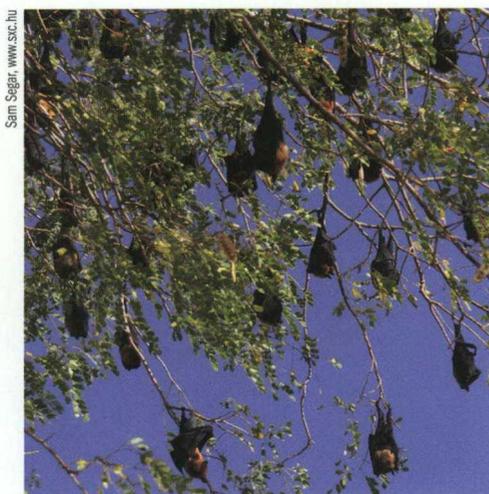
While females bring up their young, the vast majority of males lead solitary lives. At best they are indifferent to each other, although there are exceptions. For example, males of the parti-colored (*Vespertilio murinus*) and barbastelle (*Barbastella barbastellus*) bat species form communities of several dozen or even several hundred individuals in early spring. The males exhibit an attachment to regular shelters, and so far it is not known if they are also

attached to each other. We can guess at one additional reason why they stick together, at least: comparative analysis has shown that colonies of males are formed by species that feed on insects whose appearance is short-lived, difficult to predict, and spread across a large area. As a result bats hunting together, such as *Noctilio albiventris*, receive invaluable benefits. Every year, once they attain adequate condition, the males leave their colonies to compete among themselves for females. It seems, therefore, that colony-formation yields specific benefits – the males cooperate while doing so pays off, but then become rivals once advantages stemming from colony life come to an end.

Grouping into colonies not only results in optimal energy expenditure, but also maintains social contact; this is certainly true for females, and possibly also for males. Colonies act as information centers that most likely help to improve hunting success and allow bats to exchange valuable information about shelters. ■

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Bats form large colonies and maintain bonds with each other. This is probably because of the benefits brought by the exchange of information regarding vital resources