Breaking ranks to get along

It is not always for economy that birds fly in a particular formation

S ANANTHANARAYANAN


Snow geese in flight

The iconic "V" formation of geese in flight has been found to be aerodynamically the exact way to minimise drag and optimise effort during long flights. A detailed study of birds in flight, by James R Usherwood, Marinos Stavrou, John C Lowel, Kyle Roskilly and Alan M Wilson at the Royal Veterinary College, London, published in the journal, *Nature*, showed that flying in groups is often costlier, in terms of effort, than flying alone, and the reason that birds choose to fly in groups may be other gains of community living.

The classic geese

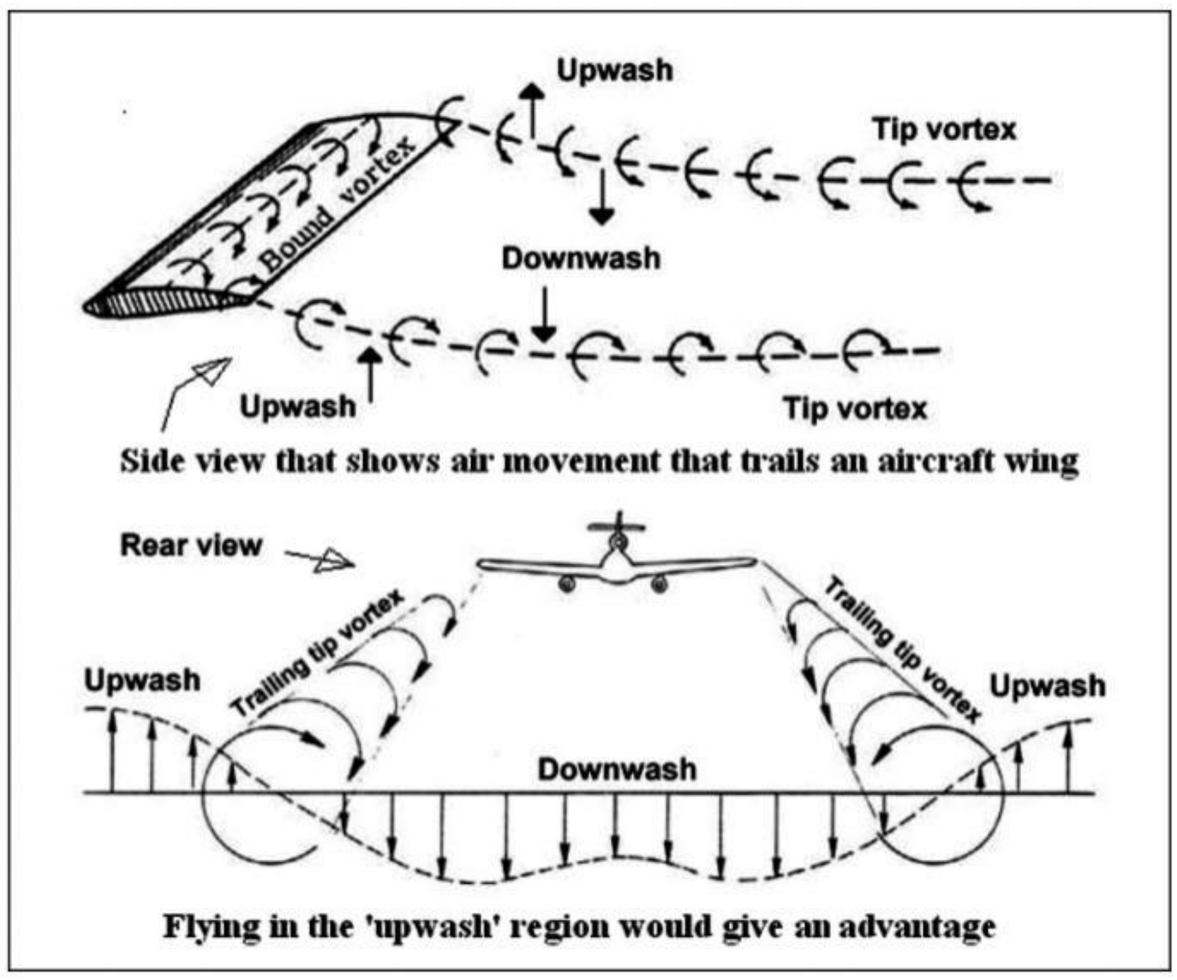
Just like pushing through a crowd in single file is easier than going three abreast, there is an advantage in flying behind another flying object. Any flying object is able to stay airborne because its forward motion generates "lift" that is equal to its weight, and thus keeps it from falling to the ground.

The angle of the object to generate this lift, however, doesn't come free but it causes "drag". This is the force which the object must overcome by effort, like burning fuel in the engine, in the case of an aircraft or flapping of wings, in case of a bird. But if one is flying behind a leader, the drag is partially overcome by the leader's effort.

There is also some advantage in getting lift from the vortices, or the upward movement of air caused by the leader. The followers can thus fly at a shallower angle and there is an overall economy of effort. The best saving, in fact, is not directly behind the leader but slightly to the side, which gives rise to the "V" formation of geese in flight.

There was an early study which monitored the heartbeat of pelicans in flight and showed that the heart rate was much slower when flying in the "V" formation. When many birds are involved, the group can position itself to further tweak the mutual benefit and it has been shown that the effort saving can be as much as 70 per cent.

As the leader birds would naturally tire faster than the followers, geese and other birds that fly long distances in formation have evolved to rotate the leader position, so that the group as a whole is able to cover the largest distance before needing to rest.



Flying in a cluster

The group at the Royal Veterinary College noted that the "V" formation, however, was limited to large birds on long, migratory flights, the more common flight mode being in groups of birds flying close together. Did such flight also yield aerodynamic advantage? The London group used state-of-the-art monitoring devices to study the internals of a flock of pigeons in flight and found it was the contrary that was true!

The study was of 18 pigeons during seven bouts of voluntary, straight and circling flight, around their home loft, over a period of more than nine pigeon-hours of flight, 400 pigeon-kilometres, and over 243,000 flaps. Back-mounted global positioning system, or GPS devices enabled pinpointing the position of each bird at every instant of flight and gyroscopic sensors recorded the acceleration and centrifugal forces the birds experienced. Wingbeat motions were monitored with a 300 Hertz sensor and the study took into account local wind conditions with the help of an anemometer mounted on a nearby rooftop. The arrangement yielded data in sufficient quantity and with the quality to allow for detailed, mathematical and statistical analysis of how the effort expended, as measured by the flap frequency and body motions, was related to airspeed, induced, climbing and accelerating power, and proximity to other pigeons. The data was sufficient to separately examine the effect of each factor, to be assessed for its cost, in terms of effort, and the economy, if any, of different modes of flight.

The result of the study showed that in the case of pigeons flying locally around their roosting spot, there are a number of effects that do not arise in solitary flight. For instance, turning to the left or right, while flying in a group, calls for tilted or "banked" turns, like an aircraft, which increases the effective body weight, which then needs more lift to maintain flight.

The observed higher flap frequency, which is mechanically less efficient, is needed to provide greater control, essential for flying in close proximity, and particularly directly behind other birds in flight. This is a substantial additional cost of flying in a close cluster.

The reasons of economy, which are celebrated in the case of geese and pelicans, are obviously not the motivators of group behaviour in the case of smaller birds which stay together over short distances.

Other benefits

At the same time, it is seen that even the classic long-distance geese do not always stick to the mathematically ideal flying formation, for economy of effort alone. The "V" formation itself is not only for energy efficiency, it also provides the possibility of each bird being able to see the largest number of other birds, so that the group stays together.

In the case of smaller birds on shorter flights, the benefit of energy conservation is also not a major factor. Even if energy saving is a goal, it may not be paramount, unlike on long flights, across stretches of water for instance, where it is important that the group be capable of reaching the next place for resting and possibly feeding. The priorities may include mutual observation, collective guidance and navigation, enhanced security as a result of greater numbers of individuals or of eyes, fitness display, and assessment of group numbers. The coordinated bursts of flying in groups, by pigeons, may be for testing and maintaining fitness and their ability to move fast and accurately, which is important for security. It is evident that there is more than one reason for the way behaviour and flight, in birds, has evolved in the animal kingdom.

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THIEF OF THE TREE

Mistletoe -- famous for stolen holiday kisses -- is a parasite that steals water and nutrients from other plants

DAVID HILLOCK

A parasitic plant with potentially poisonous berries might not sound like something that would boost your Christmas decorations to the next level. But, botanically speaking, that's what mistletoe is.

There are some 1,300 species of this evergreen plant worldwide. They're all parasitic or semi-parasitic, meaning they can survive only on a host plant. Rather than being rooted in the ground, they live on the branches of other trees and shrubs.

Just two types are native to North America. Twelve species of the American mistletoe can be found distributed largely across the southern half of the United States, mostly affecting deciduous trees in the East as well as some evergreens in the West. Sixteen species of the leafless dwarf mistletoe infect only trees in the pine family and are mostly found along the West Coast.

The American mistletoe, the one used at Christmas in the U S, is in the genus *Phoradendron*, which means "thief of the tree" in Greek. It has green leaves and is capable of photosynthesis and so produces much of its own food. But American mistletoe also sucks water and other nutrients out of its host plant by sending root-like structures called haustoria into the vascular tissue just under the bark of branches and twigs. These invading structures can live for many years inside a tree even if the mistletoe plant itself is removed.

Mistletoes are what botanists call dioecious, meaning these plants have separate male and female versions. The females produce the fruits, called berries, which are generally white, but can be pink or reddish depending on the species. Birds widely distribute the seeds after eating the berries. Seeds of some species can also be shot out of the fruit like a cannonball at up to 100 kilometres an hour to a distance as far as 50 feet. A sticky substance on the seeds helps them attach to any tree they land on until they germinate and begin to grow.

In general, mistletoe won't kill a tree unless it is heavily infested. Even then the tree doesn't usually die from the mistletoe; most often death is an indirect effect of attacks from diseases or insects that take advantage of the stressed tree. Mistletoe's parasitic ways can cause significant economic damage to forests, industrially harvested for lumber.

For a homeowner, though, it's usually not necessary to control mistletoe -- which is good, since getting rid of it can be difficult and takes patience and persistence. You can prune it out, being sure to get all those spreading haustoria under the host's bark or try chemical controls like the plant growth regulator ethephon.

Maybe you'll want to trim a sprig to decorate with during Christmastime. One of the most common traditions associated with mistletoe, dating back at least to the 1700s, is that anyone lingering beneath it would welcome a holiday kiss.

In my home state of Oklahoma, mistletoe is our state floral emblem, apparently because it was the only greenery available to put on graves during the particularly hard winter of 1889. In other parts of the world, mistletoe is considered to bestow life and fertility, serve as a peace offering and protect against poison.

About poison: Mistletoe has a reputation as a poisonous plant. While the European species *Viscum album* is reportedly toxic, American mistletoe is not deadly. Better to keep it away from little kids and pets, though, and if you are concerned, stick with artificial mistletoe for decorative purposes.

Mistletoe is an important part of the ecosystem in the places where it grows in North America. Lots of birds rely on mistletoe berries as a food source, as do elk, deer, squirrels, chipmunks and even porcupines, which will also eat the leaves when other fresh foliage is scarce. Tangled clumps of mistletoe, traditionally referred to as witches' brooms, provide nesting sites for birds, including spotted owls and Cooper's hawks, and other animals. Three kinds of butterflies in the U S are entirely dependent on mistletoes. And it's also an important nectar and pollen plant for honeybees and other native bees.

So, this parasitic plant plays a valuable role in both ecosystems and human traditions. If it grows near you, enjoy it because you probably wouldn't be able to completely get rid of it anyway. And at Christmastime, it just may come in handy.

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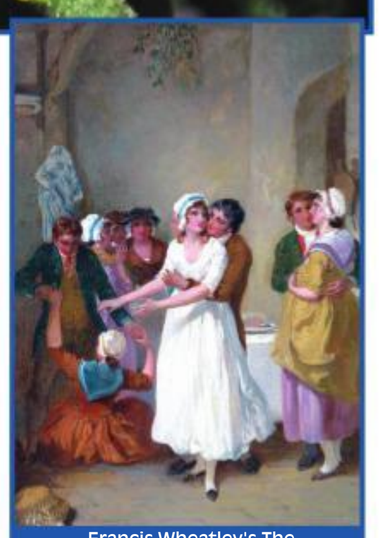
Francis Wheatley's The Mistletoe Bough

PLUS POINTS

Legs galore

Scientists have discovered the first-ever "true millipede" with more than 1,000 legs in a minefield in Australia, making it the creature with the greatest number of legs ever known to humans. While the name "millipede" derives from the Latin words "mille" (thousand) and "pes" (foot), until now no millipede had been found with more than 750 legs, the scientists said.

The creature was found six metres underground in a drill hole created for mineral exploration in the mining area of the Eastern Goldfields Province of Australia, the scientists noted in a study published in the journal *Scientific Reports* last week. They found that the millipede belongs to a new species named *Eumillipes Persephone* and has a total of 1,306 legs -- more than any other known animal.

Scientists measured four members of the new species and found that they are eyeless, have short legs, and cone-shaped heads with antennae and a beak. They have long, thread-like bodies with up to 330 segments and are up to 0.9 millimetres wide and 95.7mm long. "Here we report the discovery of *E. persephone*, the first super-elongated millipede known from Australia, and the new world record holder of the animal with greatest number of legs," the scientists wrote in the study, "Discovered six metres below ground in a drill hole created for mineral exploration, *E. persephone* possesses troglomorphic features; it lacks eyes and pigmentation, and it has a greatly elongated body -- features that stand in stark contrast to its closest surface-dwelling relatives in Australia and all other members of its order."

The researchers also found that the new species is distantly related to the previous record-holder for the greatest number of legs, the Californian millipede *Illacme plenipes*. They speculate that the large number of segments and legs seen in this millipede species may enable it to generate pushing forces to move through narrow openings in the soil habitats they live in.

Millipedes are among the earliest animals on the planet to breathe atmospheric oxygen, and have lived on Earth for more than 400 million years. Although there are about 12,000 known millipede species, with some extinct ones that grew to two metres in length, researchers say there are still nearly 80,000 species that are yet to be described.

Scientists believe such invertebrate creatures living below the Earth's surface comprise a cryptic and diverse fauna that remain vastly understudied, despite their ecological importance in the filtration of groundwater and the screening of environmental toxins. They called for efforts to conserve this underground habitat to minimise the impact of mining in this region.

"Discovered in the resource-rich Goldfields-Esperance region and threatened by encroaching surface mining, documentation of this species and conservation of its habitat are of critical importance," they wrote.

The independent

Singapore bacteria

An unexpected discovery by a team of doctors analysing skin and wound samples has led to a new species of bacteria being identified and named after Singapore.

Staphylococcus singaporensis sp. nov (*S. singaporensis*) is part of the Staphylococcus aureus (*S. aureus*) complex, which commonly causes conditions from mild skin and wound infections to surgical and more serious bloodstream infections that may be fatal. The discovery was published in the *International Journal of Systematic and Evolutionary Microbiology* on 26 October this year.

This complex is a group of four different species, including *S. singaporensis* that have a similar genetic make-up. Associate professor Raymond Lin, director of the National Public Health Laboratory at the National Centre for Infectious Diseases, said last week that everyone will likely be infected by *S. aureus* at some point in their lives.

The straits times/ann