WILDLIFE

CAN ANIMALS SURVIVE ALMOST 9,000 METRES ABOVE SEA LEVEL? YES, THEY CAN. AND NOT JUST SURVIVE: THEY TRAVEL ABOUT 1,000-KILOMETRES IN ONE DAY ...

RAISING THE BAR

BY LILY WHITEMAN

PHOTO: QINGHAI LAKE NATIONAL NATURE RESERVE

Each spring, flocks of bar-headed geese fly to Qinghai Lake in China to build nests and raise their chicks. Then, breeding finished, they head south over the highest mountains in the world at altitudes where even the hardiest mammals die very quickly. Welcome to the world of the toughest flying bird on Earth.

On Mount Everest, kerosene cannot burn; there is not enough oxygen. Helicopters cannot fly there; the air is not thick enough. If you were transported instantly from sea level to Everest's summit, a height of almost 9 kilometres, you would probably lose consciousness within minutes – assuming you didn't freeze first.

But if you *do* get to stand on top of Everest, late in spring or autumn, you might be lucky enough to hear a honking noise and witness the utterly astounding sight of a flock of geese flying over your head. At elevations that offer only about 30 percent of the oxygen available at sea level, these bar-headed geese (*Anser indicus*) are some of the world's highest-altitude migrants, if not the highest. From their winter-feeding grounds in the lowlands of India and Nepal, they fly across the Himalayas on their way to summer-breeding grounds in Kyrgyzstan, Mongolia and China. Then every autumn, they retrace their route back south. They cover much of their route with little or no opportunity to acclimatise, depending on the direction in which they are flying. Even more unbelievably, with a little help from tailwinds, they may be able to cover the one-way trip – often in excess of 1,600 kilometres – in days.

Dr S. Marsh Tenney, recognised goose expert and professor of physiology at Dartmouth Medical School in the US state of New Hampshire described them as super birds. "They do everything better than other birds," he said.

The geese's efficient respiratory systems certainly play a big part in achieving their awe-inspiring feats.

Honking bar-headed geese take a pre-migration cold dip in the snow at Terkhiin Tsagaan Lake in west-central Mongolia.

PHOTO: GETTY IMAGES

HEAVY BREATHERS

Bar-headed geese can breathe particularly deeply. This means that for each breath, they draw in more air (and therefore more oxygen) than other birds, which are already better breathers than most mammals. When bar-headed geese breathe, even at very fast rates, it is believed that they don't get dizzy as the blood vessels in their brains do not constrict. So even when physically taxed, they keep their wits about them. Definitely not bird-brained.

The bird's blood then aggressively grabs the inhaled oxygen. The bar-headed goose's haemoglobin (in its red blood cells) has a particular affinity for oxygen because of a special amino acid in its structure. This, along with several other adaptations, allows the birds to make the most of the meagre resources at close to 9 kilometres above sea level.

Once the oxygen is in the bird's blood, it needs to go where it is of most use when the bird is flying: into the flight muscles. Several adaptations assist this process, says Dr Graham Scott, a postdoctoral research fellow at the University of St Andrews in Scotland. Scott, who became an expert on bar-headed geese as a doctorate student at the University of British Columbia in Canada, adds: "[For example], the bar-headed goose's flight muscles are penetrated by dense networks of small blood vessels, called capillaries, that receive blood from larger vessels." These capillaries dump their oxygen loads into microscopic energy-producing factories known as mitochondria, which are found in most cells.

The muscle cells of the bar-headed geese are full of power-producing mitochondria, many of which are strategically positioned near cell membranes and thus able to very quickly grab oxygen from adjacent capillaries. And provide a mighty big flap.

PHOTO: MONGOLIAN WILDLIFE SCIENCE & CONSERVATION CENTER

INCREDIBLE JOURNEY

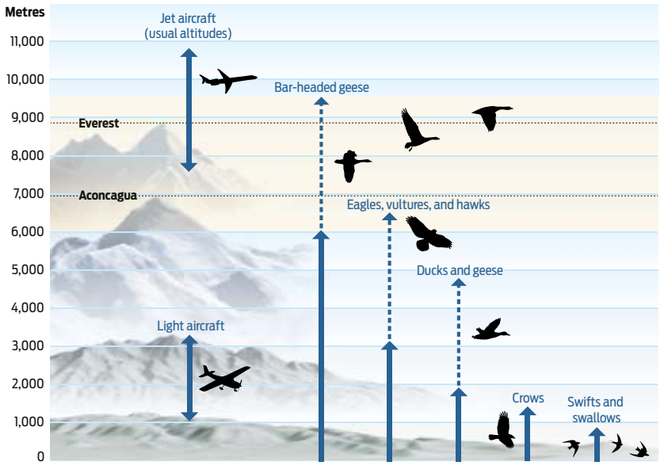
It's well known that bar-headed geese fly higher than other birds, but the distances they cover are equally impressive. One goose, tagged in Darkhad Valley, Khövsgöl, in Mongolia, was later identified by its tag in Somnathpur, Mysore, in India. That is an incredible 4,700-plus kilometres away, even if the bird flew in a straight line. If, as likely, it didn't, that could easily be a 5,000-kilometre trip. Admittedly, the second sighting was several months later but that's not bad for a 4-kilogram animal that gets its power from a diet of rice, grass, wheat and barley.

GOOSE BUMPS

The bar-headed goose has a robust grey body, a long neck and a short, tapered beak that forms an S-shaped silhouette. The distance from the front of a bar-headed goose's bill to its tail feathers ranges from 70 to 80 centimetres. Adults weigh between 2 and 3 kilograms and stand around 0.6 to 0.7 metres high. Two horizontal black stripes on the back of the bird's white head give the species its name.

Bar-headed geese choose their mates during winter or spring and may stay with each other for life.

There are about 60,000 wild bar-headed geese in the world, but their numbers may be declining because of hunting. Other potential threats are posed by habitat loss and climate change.



OTHER HIGH-FLYERS

The highest-flying bird ever recorded was a Ruppell's griffon vulture (*Gyps rueppellii*) which, on November 29, 1973, was sucked into a jet engine 11,300 metres above the Ivory Coast. Another record-setting aerial encounter, this time in North America, is held by a mallard (*Anas platyrhynchos*) that collided with a plane on July 9, 1962, at 6,400 metres, between Battle Mountain and Elko in the US state of Nevada. Luckily, not all high flyers come to sticky endings. In 1953, a yellow-billed chough (*Pyrrhocorax graculus*) was spotted on Everest pecking at climbers' food scraps at 8,200 metres.

Researchers from the US Geological Survey attach satellite transmitter tags to a sampling of bar-headed geese at Chilika Lake Reserve in Orissa, India. This is the largest waterbird congregation site in the Indian subcontinent.

PHOTOS: GETTY IMAGES; SHANE HEATH; JOHN TAKEKAWA

HIGH SOCIETY

The flapping rate (225 flaps per minute) of bar-headed geese is about the same as similar-sized birds, but unusual as the geese have longer wings (1.5 metres). This allows them to generate more lift in the thin air at their normal altitudes. "These birds are powerful flappers, not soarers that just glide with the wind," says Dr M. Roger Fedde, professor of anatomy and physiology at Kansas State University's College of Veterinary Medicine in the United States.

The other thing the bar-headed goose brings to its high-altitude party is clever manipulation of weather conditions. By using tailwinds, the geese capitalise on winds to speed up their journeys. According to Fedde, they can fly over 80 kilometres per hour on their own power. They also boast a streamlined shape that reduces wind resistance. "Add tailwinds of perhaps 160 kilometres per hour if they are lucky, and these birds can *really* move," adds Fedde.

All the exertion and super-efficient energy transfer that helps them fly so high and so far also generates body heat. This heat is retained by an inner layer of highly insulative down feathers, which helps to stop the birds from freezing to death. An outer layer of tightly woven feathers waterproofs the geese, preventing a build-up of body ice that would weigh them down and plunge them to their doom.

The logic behind its incredibly tough migratory route, however, continues to baffle everyone. A possible explanation is that the species originally established its routes long before tectonic plates collided under the Himalayas and pushed them up to their current heights.

It is plausible that the mountains rose slowly enough that the geese could continue to fly their usual routes while adapting to the altitude. Each new generation probably learned the route by travelling in flocks during its first year and then taught it to its own offspring. The species might have thus perpetuated its routes down the centuries, and become a "behavioural fossil" from early, pre-Himalayan Asia.

Other explanations suggest that extreme, high-altitude jet-stream heavy migration paths save the goose both time and energy, compared with longer routes that circumvent the mountains.

GOOSE TRACKS

Although no one knows for sure how migrating birds navigate, some scientists suspect that they follow a combination of cues: tall peaks and geographic features like rivers; the position of the sun and the stars; geomagnetic signals; and changes in barometric pressure. The honking of bar-headed geese during flight may convey messages that help flocks stay together and also create orienting echoes, although this is still just a theory and the birds have not yet been studied while flying.

Despite many, many theories, questions remain about the birds' strength, stamina and migratory routes. Some answers could be provided by an international research team that is currently studying the in-flight physiology of the geese. This involves outfitting migrating geese with monitors that measure their heart rates and high-tech GPS units that record their travels.

But they will always be a marvel because, says Scott, "they can accomplish what would make most people and most other animals comatose". ■