

## Early Bats Flew First, Developed "Sonar" Later

Brian Handwerk  
for [National Geographic News](#)

February 13, 2008

Bats learned to fly before they developed their internal "sonar" to navigate and catch insects, the most primitive bat fossil ever found shows.

"This new bat [fossil] is clearly a flying animal, but it lacks the features in the skull that we'd expect to see in an echolocating bat," said Nancy Simmons, chair of Vertebrate Zoology at the American Museum of Natural History in New York and co-author of a new study on the fossil.

Echolocation is the radar-like ability of some animals to emit high-pitched sounds, then detect obstacles or prey by listening to the sounds bounce back.

### Bat Evolution

Bats are thought to have evolved from terrestrial [mammals](#), and scientists have long pondered whether they took to the air before or after they could echolocate.

Previously the most primitive bats known were from the early Eocene, about 50 million years ago, and were fully capable of flapping flight.

They also had physical adaptations for echolocation, and a few fossils even have preserved stomach contents that reveal meals of flying insects.

"So we know they were flying animals and [were] probably echolocating and catching flying insects," Simmons said.

But the new species found in [Wyoming](#)'s fossil-rich Green River formation, *Onychonycteris finneyi*, is some 52.5 million years old.

*Onychonycteris* had fully developed, flight-capable wings, but its ear structure shows that it would not have been able to employ modern bats' famous sonar.

(Related news: ["Scientists Fill Blanks on Bat Family Tree"](#) [January 27, 2005].)

### Which Came First?

The new study, which appears tomorrow in the journal *Nature*, may put to rest the idea that echolocation evolved first.

That theory suggests that small tree-dwelling mammals developed echolocation to snatch their insect prey in midair.

This hunting method could have gradually led to evolutionary selection for longer arms and digits that enabled the animals to leap—and later glide—after their prey, until they eventually developed full-flapping flight.

"We don't know for sure, but what makes the most sense in terms of the evolution of flight is that bats evolved from a gliding ancestor, something similar to a gliding squirrel," Simmons said.

Gliding has evolved several times in tree-dwelling mammals as they gradually acquired membranes to enable gliding through canopies.

"The hypothesis for bat flight is that it evolved as a means to expand their range and maneuverability to find food and escape predators," Simmons added.

*Onychonycteris* also has morphological features that suggest it was an expert climber. Its limb proportions and claw-tipped fingers resemble characteristics of both modern bats and non-flying animals, such as sloths, that hang under branches.

"Probably what it was doing was flying to get from place to place, landing in some vegetation, and then climbing around looking for food," Simmons explained.

"As a bat that can't echolocate, it probably wasn't chasing food in the air but listening for prey-generated sounds [like a beetle hitting a leaf].

"That's the way that some living bats hunt, even using echolocation for navigation."

(See a [picture of a bizarre new bat](#).)

### **Flying Blind?**

While *Onychonycteris* makes it clear that ancient bats could fly without the ability to sense prey, scientists are still wondering if the mammals flew in the dark.

John Speakman, the chair of zoology at the University of Aberdeen in the United Kingdom who wrote a commentary on the study, has a theory.

"The possibility is there that bats were originally [awake during the day] and were forced into the nocturnal niche by the appearance of avian predator species some 50 to 60 million years ago," Speakman said.

Both birds and mammals increased dramatically during this time period, which followed the extinction of the dinosaurs at the end of the [Cretaceous](#), 65 million years ago.

New nocturnal lifestyles might have led some bats to develop echolocation, while others may have relied on increased night vision to get around.

Unfortunately existing *Onychonycteris* fossils will shed no light on this question.

"The eye sockets were crushed, so it can't be determined if they were enlarged as in other nocturnal, non-echolocating animals," Speakman explained.

Despite this setback, however, the fossils represent a breakthrough in the understanding of bat evolution.

"This kind of puts the icing on the cake," Speakman said.

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## In Crocodile Evolution, the Bite Came Before the Body

**John Roach**  
for National Geographic News

August 25, 2004

Today the crush of a crocodile's mighty jaws signals lights-out for many a fish or other water-loving animal. But according to a new study, the croc's characteristic jaws evolved on dry land—and long before its swim-tuned body.

The finding stems from the discovery of a well-preserved fossil of an ancestor of crocodylians in northwestern China. A crocodylian is any member of an order of reptiles that includes crocodiles, alligators, caimans, gavials, and related extinct forms.

The discovery will be reported in tomorrow's issue of the journal *Nature*.

The creature, named *Junggarsuchus sloani*, was a three-foot-long [one-meter-long] sphenosuchian—one of a class of small, slender, land-dwelling crocodylians that lived from about 230 million to 150 million years ago.

*Junggarsuchus*'s skull shares many characteristics with skulls of modern crocodylians. But its body is much more similar to those of sphenosuchians, according to James Clark, an associate professor of biology at the George Washington University in Washington, D.C.

In fact, the forelimbs of *Junggarsuchus* are more adapted to walking on land than those of its sphenosuchian contemporaries, according to the study led by Clark. Co-authors include Xu Xing and Yuan Wang, from the Chinese Academy of Sciences in Beijing, and Catherine Forster, from Stony Brook University in New York State.

Based on their analysis of the new fossil, the team concludes in *Nature* that the skull of modern crocodiles evolved while the legs and body were evolving toward greater walking ability, rather than toward greater swimming ability.

Specializations for land walking are mainly found in the forelimbs, including a ball-and-socket joint in the shoulder, like that of mammals. "These specializations indicated the forelimbs were held underneath the body, not out to the side as in living crocodylians," Clark said.

The finding does not surprise Hans-Dieter Sues, the associate director for research and collections at the Smithsonian Institution's National Museum of Natural History in Washington, D.C.

"The fact that today's semiaquatic crocodylians—crocodiles, alligators, and their relatives—are descended from land-dwelling ancestors was already established in the 1920s by German and South African researchers," he said.

"This new find," he added, "is noteworthy for its good preservation and particular combination of features."

Sues is a member of the National Geographic Society's Committee for Research and Exploration.

### **Crocodylians and Sphenosuchians**

Modern crocodylians have sprawling limbs and broad bodies, giving them a distinctive side-to-side swagger when walking on land.

The sphenosuchians, in contrast, had an erect stance, like dinosaurs and mammals.

In water, crocodylians tuck their limbs into their bodies and swish their powerful tails back and forth to swim. Nostrils located on the top of their snouts allow them to breathe while keeping their bodies submerged.

Opportunistic feeders, crocodilians lie in wait for prey to cross their paths and then lunge with lightninglike speed to capture it between their powerful jaws. Once they impale it with their sharp teeth, crocodilians swallow prey whole.

According to Sues, nobody knows what factors led modern crocodilians to adapt a semiaquatic lifestyle, but, he said, "The ability to crush prey with their jaws was already well established in far more remote ancestors of crocodilians [than *Junggarsuchus*]."

### **Fossil Find**

Found in Xinjiang, China, the *Junggarsuchus* fossil comprises the front half of the skeleton and is the most complete known skeleton of a nonmarine crocodilian ancestor.

The fossil dates to the Middle Jurassic period, about 175 million years ago. "This part of Asia, which is the land area most removed from any seacoast in the world, was beginning its long history of seasonal aridity then," Clark said.

Conifer and palmlike cycad trees and ferns dominated the landscape. There were no flowering plants.

Several rivers flowed from the mountains, and floods spreading out from stream channels trapped many of the fossils that researchers find today, Clark said.

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# SFU biologists to study snakehead fish

Invasive species caught in Burnaby, B.C., pond earlier in June

[CBC News](#)

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Biologists at British Columbia's Simon Fraser University are studying the invasive predator known as the snakehead fish [caught in a Burnaby pond](#) earlier in June.

The fish was caught by biologists last week after they partially drained a pond in Burnaby's Central Park following previous unsuccessful attempts. The fish was killed shortly after being captured.

Biologists will now dissect the fish and send tissue samples to the University of British Columbia and the province's Ministry of Environment to determine its sex, what it had been eating and how long it had been in the pond.

SFU grad student Michael Beakes says concerns about the alien predator are well founded.

"They can reproduce multiple times per year and each female can produce up to 15,000 to 50,000 eggs per spawning event," he said. "They can double their population size within 15 months."

Snakeheads are native to freshwater in Russia and China and have few predators when fully grown. They are considered highly invasive, can grow up to a metre in length and have small but sharp teeth.

They are reported to have wiped out native fish stocks in parts of the U.S., and are said to eat frogs, birds and even small pets.

They are also capable of breathing oxygen and squirming short distances over land.

The search for the snakehead began after a Burnaby resident posted [video of the fish](#) on YouTube.

SFU grad student Corey Phillis says it's a good thing the resident raised the alarm.

"It's good to have someone out there that knew what they were looking at and knew of the dangers of having that fish potentially becoming established in our local waterway."

Beakes said the snakehead's carcass will be preserved.

"We plan to send it to the Royal Museum of British Columbia, where it will be stored in its collections."

## "Extinct" Pygmy Elephants Found Living on Borneo

John Roach  
for [National Geographic News](#)

April 23, 2008

A gift exchange between Asian rulers several centuries ago may have inadvertently saved a population of elephants from extinction, according to a new study.

Today a small population of unusually placid and genetically distinct elephants lives in the northeast corner of Borneo, a Southeast Asian island shared by Indonesia, Malaysia, and Brunei ([see map](#)).

Scientists have long wondered why the elephants' range is so restricted and why they are less aggressive than other wild elephants in Asia.

The new research suggests the elephants may have descended from a population of elephants that originally lived on the island of Java in what is now [Indonesia](#) (see [Indonesia map](#)).

The finding is based on an analysis of archaeological and historical records. It supports a long-held local belief that the elephants arrived there from the island of Sulu, which is now part of the [Philippines](#).

The sultan of Java is thought to have sent the Javan elephants as a gift to the sultan of Sulu. For unknown reasons, descendants of the elephants were subsequently shipped to Borneo and abandoned.

Back on Java, the original population went extinct by the end of the 18th century, after the arrival of Europeans in Southeast Asia.

The gift to the sultan of Sulu may therefore have inadvertently kept the lineage alive.

"There's a lot of literature on these exchanges between the different courts," said Michael Stuewe, an elephant biologist for WWF, an international conservation organization.

"These elephants may be the oldest example of a wild [mammal] population that is saved without intention to do so by royalty and through a captive detour," Stuewe said.

### DNA and Archaeology

Stuewe was not an author of the new study, but he was part of the research team that showed the Bornean elephants to be a genetically distinct population of [Asian elephants](#).

He began studying them in 1999 as part of a project to determine how to protect wildlife from the rapid conversion of Southeast Asian forest habitat into palm oil plantations.

He noticed then that the elephants were unusual—shorter and rounder than other Asian elephants and with longer tails.

"They were like little cartoon figures of an elephant," he said.

(See [photos of pygmy elephants and the threats facing them](#).)

His colleagues at Columbia University in New York conducted DNA analysis in 2003 and found the Bornean population to be genetically distinct.

The team concluded the elephants were likely isolated on the island when the last land bridges connecting Borneo to the mainland disappeared some 18,000 years ago.

WWF's Junaidi Payne was a co-author of the genetics study and the new paper.

He and co-authors Earl of Cranbrook and Charles M.U. Leh were unable to find archaeological or historical evidence confirming the existence of so-called pygmy elephants on Borneo beyond a few centuries.

They concluded that the most plausible explanation is the Bornean elephant population "consists of remnant survivors of the extinct Javan population."

The study, the authors add, raises the importance of the Bornean population and suggests other large mammals could be saved from extinction by removal from threatened habitat to safer locations.

(Related: [Borneo Elephants: From Pest to Priority](#) [September 4, 2003])

The research was published last week in the *Sarawak Museum Journal*.

### **Palm Oil Threat**

Simon Hedges is the Asian elephant coordinator for the New York-based Wildlife Conservation Society.

He said the new study makes a "plausible case" that the Bornean population is descended from the Javan elephants but that more research is needed before firm conclusions can be drawn.

If the authors of the new study are correct, he added, the remnant Javan population on Borneo will be important for genetic reasons, since it would contain material thought lost from the gene pool.

However, the population will likely be given less of a conservation priority, since it is outside its original wild range.

"[Such] factors are generally seen as downgrading the importance of such populations versus the truly wild animals," he said.

WWF's Stuewe noted that if the finding is confirmed, it will mark another instance in which royalty had inadvertently saved a mammal from extinction.

A similar fate met the alpine ibex, a mountain goat whose remaining population was protected by an Italian king in the 1850s, captive-bred by the Swiss, and reintroduced throughout the Alps in the 1900s.

European royalty imported [Przewalski horses](#) from Mongolia in the early 20th century for their stables. The wild horses went extinct in the 1960s. European captives were reintroduced to Mongolia in 1992.

"The ability of these large charismatic mammals to recover from what seem to be extreme [population] bottlenecks apparently is there," Stuewe said.

"There is a chance for these guys if you take care of them."

### **Palm Oil Threat**

Today, Stuewe added, the elephants face new challenges from the rapidly developing palm oil industry in northeastern Borneo, where the remnant population is located.

Driven by surging demand from the biofuels industry, Stuewe said the forest is being converted to palm oil plantations at increasing rates.

"And unfortunately," he said, "oil palm plantations are to elephants what a candy store is to little kids—they just love them."

The love, however, is not shared by plantation managers who view the elephants as a nuisance and kill them. Biologists estimate about a thousand elephants remain on Borneo.

The only hope for these elephants now is protection of the lowland forest as nature reserves or sustainably managed logging concessions, Stuewe said.

Hedges, of the Wildlife Conservation Society, noted the palm oil expansion threatens a host of species on Borneo.

Alaska halibut fishing **HALIBUT BIOLOGY** and life-history of the Alaskan North Pacific Halibut is as follows:

## HALIBUT BIOLOGY

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### **Hippoglossus stenolepis - Halibut Biology from Egg to Maturity.**

North Pacific Halibut, a member of the Flounder Family of fish, are unique because they have a biological characteristic that only the Flounder Family has. When they are first hatched from the egg they swim upright and have one eye on each side of their head like all other species of fish. At about five weeks of age and one inch in length, one eye "migrates" over the top of the head so that both eyes are on the same side of the head. At this time the juvenile Halibut "lays over" on its' side with both eyes on the upward or top side. As the fish grows the under side becomes white, the top side becomes a mottled darker variation of colors resembling the sea bottom, and their body flattens into an oval shape: thus the nickname "Flatfish". The Pacific Halibut, upon becoming a mature spawning adult average about 25 to 30 pounds in weight. They spawn during the winter months in about 1,200 feet of water. The males range upward to about 60 pounds and the females range upward to about 600 pounds in weight. Huge Pacific Halibut, known as a "Barn Door", can attain a length of over 8 feet and a width of over 5 feet. They have a button-sized calcified deposit in their head called an Otolith or "Ear Bone" that forms an annual growth ring. The age of an individual fish can be determined by counting the number of growth rings as you would age a tree. They can attain a lifespan of over 30 years. Halibut are predatory feeders that eat almost everything that swims in the sea. Their snow-white flesh makes excellent table-fare. This makes them a very popular game-fish species with deep-sea fishermen. The Official State Record Halibut is 459 pounds-0 ounces.

### **Life Cycle**

Halibut spawn at depths of 600 to 1,500 feet from November through March. Female halibut release anywhere from a few thousand to 4 million eggs, depending on the size of the fish. About 15 days later, the eggs hatch and the larvae drift with deep ocean currents. In the Gulf of Alaska, the eggs and larvae drift in a counter clockwise direction along the coast.

As the larvae mature, they move higher in the water column and ride the surface currents to shallower, more nourishing coastal waters.

Although age at maturity varies over time, about half of male halibut are sexually mature by 8 years of age, while half of the females are mature by age 11.

#### **Eye Migration**

The larvae start life in an upright position like other fish, with an eye on each side of the head. When the larvae are about one inch long, the left eye moves over the snout to the right side of the head. At the same time, the coloration on the left side of the body fades. The halibut end up with both eyes on the pigmented (olive to dark brown) upper side of their body, while their underside is white. By the time they are six months old young halibut settle to the bottom in shallow, nearshore areas.

#### **Diet**

Halibut feed on plankton during their first year of life. Young halibut (1-3 years old) feed on euphausiids (small shrimp-like organisms) and small fish. As halibut grow, fish make up a larger part of their diet. Besides pollock, sablefish, cod, and rockfish, large halibut also eat octopus, herring, crabs, clams, and smaller halibut.

#### **Size and Age**

Halibut are the largest of all the flatfishes. Some halibut exceed 400 pounds, including the 459 pound state record fish caught during 1996 in Unalaska Bay.

Female halibut grow faster and are typically larger than males of the same age. Most halibut taken in the sport fishery are 5-15 years old. Males rarely reach 100 pounds.

Halibut age is estimated by counting growth rings laid down in the fishes' "otolith," a bony structure in the inner ear.

### **Where to Find Them**

Halibut can be found throughout most of the marine waters of Alaska - as far north as Nome, along the Aleutian Chain, and throughout the waters of the southeastern Alaska panhandle. Halibut can also be found along the continental shelf as far south as southern California, as well as along the coasts of Japan and Russia.

Halibut are usually on or near the bottom over mud, sand, or gravel banks. Most are caught at depths of 90 to 900 feet, but halibut have been recorded at depths up to 3,600 feet. As halibut mature, they migrate in a clockwise direction in the Gulf of Alaska, countering the drift of eggs and larvae. Halibut tagged in the Bering Sea have been caught as far south as the coast of Oregon, a migration of over 2,000 miles.

Halibut also move seasonally between shallow waters and deep waters. Mature fish move to deeper offshore areas in the fall to spawn, and return to nearshore feeding areas in early summer. It's not yet clear if fish return to the same areas to spawn or feed year after year.

## **Management of the Halibut Fisheries**

Since 1923, both the sport and the commercial halibut fisheries have been managed under a treaty between Canada and the United States.

### **The Role of the International Pacific Halibut Commission**

The treaty established the International Pacific Halibut Commission (IPHC), which is charged with the conservation of halibut. The IPHC conducts research and sets the allowable catches for each of ten regulatory areas from Oregon to Alaska.

### **The Role of the North Pacific Fishery Management Council**

Sampling HalibutThe NPFMC is one of eight regional councils established by Congress in 1976 to oversee management of the nation's fisheries. The Council has eleven voting members, six from Alaska, three from Washington, one from Oregon, and a federal representative, the Alaska Regional Director of NMFS. The Council's office is in Anchorage, Alaska.

Once the IPHC has set the allowable halibut catches for each area, it is up to the Council to portion out the harvest between sport, commercial and subsistence users who fish U.S. waters. The Council can also set daily bag and possession limits for halibut in U.S. waters.

### **ADF&G's Role**

ADF&G collects sport fishery data and provides it to the IPHC and the NPFMC to help them in making management and allocation decisions.

### **Your Role**

You can ensure that management agencies are using the best possible information by responding to surveys, providing accurate information if interviewed by fishery technicians, and by allowing your fish to be measured.

## **Sport Fishing for Halibut**



## Ancient cave discovery unlocks secrets of superbugs

SHERYL UBELACKER

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Deep inside a cave in New Mexico, researchers have made a startling discovery – bacteria that are resistant to antibiotics, yet have been pristinely isolated from human contact for more than four million years.

Bacterial resistance to antibiotics – the infection-killing wonder drugs that began with mass-produced penicillin in the early 1940s – was long thought to have arisen because of wholesale and indiscriminate use of the medications to treat disease in both people and animals.

Over time, more and more disease-causing bacteria, including the superbug MRSA, are becoming immune to most antibiotics now in use. And the growing number of bugs mutating to dodge the killing effects of the drugs has researchers and pharmaceutical companies scrambling to find new agents.

But the discovery of species of naturally resistant bacteria in the Lechuguilla Cave, in Carlsbad Caverns National Park, represents a major leap in the understanding of resistance threatening the treatment of infectious diseases around the world.

The conclusion: it isn't just man-made.

“Our study shows that antibiotic resistance is hard-wired into bacteria. It could be billions of years old, but we have only been trying to understand it for the last 70 years,” said co-principal investigator Gerry Wright, scientific director of the Institute for Infectious Disease Research at McMaster University in Hamilton.

“This has important clinical implications,” Dr. Wright said. “It suggests that there are far more antibiotics in the environment that could be found and used to treat currently untreatable infections.”

That’s because a particular bacterium creates its own antibiotic as a means of fighting off other bacteria, said co-author Hazel Barton, a cave microbiologist at the University of Akron who helped recover the micro-organisms within the New Mexico cave.

One way to think of it is the bacterial version of *The Hunger Games* – kill or be killed.

“They’re carrying out germ warfare, so it’s like an arms race,” said Dr. Barton, explaining that the bacteria are competing for scarce food resources in their environment, whether in backyard soil or deep within a cavern.

“These chemical weapons that they make are antibiotics,” she said.

“So these organisms have adapted by developing resistance to those chemical weapons. So even though somebody comes along and spits this weapon at them, they can defend themselves and that’s where resistance comes from.”

While most of us think of antibiotics as pills from a bottle, most in fact originated in nature, like the mould identified by Scottish biologist Alexander Fleming in 1928 that gave rise to penicillin.

“If you look at it in the soil, you’ve got one bacterium next to another bacterium,” she said. “That bacterium is squirting out the same drug that you have in that pill.”

In never-before-visited recesses far inside the Lechuguilla Cave, researchers collected strains of bacteria, scraping them off the surfaces of rock. An analysis showed none are capable of causing human disease and almost all were resistant to at least one antibiotic, with some able to fend off up to 14 of the drugs.

In all, resistance was found to virtually every antibiotic that doctors currently use to treat patients, according to the study published in the journal PLoS ONE.

The good news is that where there is resistance among bacteria in the environment, there must also be natural antibiotics other micro-organisms have created.

“What it means is that there’s also a broad range of antibiotics we’ve yet to discover,” said Dr. Barton, noting that the researchers have already isolated one and are working with a pharmaceutical company to develop it into a drug.

“So we’re just hunting them down now.”

## *Homo floresiensis*: the Hobbit



*Homo floresiensis* is a species of dwarf human discovered at the Liang Bua cave on the Indonesian island of Flores in 2003 (Brown et al. 2004, Morwood et al. 2004, Lahr and Foley 2004). *H. floresiensis* was only about 1 meter in height and fully bipedal, with a very small brain size of 417cc. The skull has human-like teeth with a receding forehead and no chin. *floresiensis* fossils have been discovered from 38,000 to 18,000 years ago, though archeological evidence suggests it lived at Liang Bua between at least 95,000 and 13,000 years ago. It used stone tools and fire, and hunted pygmy elephants (mostly juvenile ones), Komodo dragons, and the giant rats found on Flores. Its discoverers believe that *floresiensis* is a dwarf form of *Homo erectus* - it is

not uncommon for dwarf forms of large mammals to evolve on islands.

The most complete *floresiensis* fossil, LB1, consists of an almost complete skull and a partial skeleton consisting of leg bones, parts of the pelvis, hands and feet, and some other fragments. LB1 was an adult of about 30, probably female judging by the pelvis. Males could have been larger, though the other fossils found so far indicate only individuals about the same size as LB1. Because of the damp condition and young age, the bones of LB1 have not fossilized (i.e. had not turned to stone), and reportedly had the consistency of mashed potatoes.

The brain size of the *floresiensis* skull is extraordinarily small, at 380cc. This is as small as any australopithecine ever discovered, and fairly typical for a chimpanzee. (Chimps range from about 300 to 500cc, averaging about 400cc, but are physically bigger than *floresiensis*.) This is smaller than would be expected even for a dwarf form of *Homo erectus*, and suggests there was active selection for a small brain size for some reason. (Human pygmies, incidentally, are nothing like *H. floresiensis*; their brains are almost as large as those of normal-sized humans)

There has been some speculation that the stone tools found with it were actually made by *Homo sapiens*, mainly because it is hard to believe a creature with such a small brain could make such sophisticated stone tools. There is no other evidence in support of this, however, and if it were not for the small brain size, there would be no hesitation about assuming *floresiensis* made the tools because of the close association between the tools and the fossils. The same tools are found through the entire deposit (from 90,000 to 13,000 years ago) and, interestingly, they are not like any stone tools made by *Homo erectus*.

Because evolving from *erectus* to *floresiensis* is such a drastic reduction in body size, there has been some speculation that *floresiensis* might actually have evolved from something smaller, such as the [Dmanisi hominids](#) found in Georgia, some of which have brain sizes between 600 and 700 cc, smaller than the 800-900cc typical of early *erectus*.

Flores was also in the news in 1998, when Mike Morwood (who is also involved with this new find) announced the discovery of stone tools at another site on Flores dated at 840,000 years. It was assumed at the time that this was evidence of *Homo erectus*, since *erectus* was the only pre-*sapiens*

hominid known to have existed in Indonesia. Because Flores is thought to have always been separated from Java by a deep sea passage, this indicated a hitherto-unsuspected ability of *H. erectus* to cross sea barriers. The possibility now exists that the hominid responsible for this early archaeological evidence might not have been *Homo erectus*, but something else such as a Dmanisi hominid or a partly evolved form of *floresiensis*.

Modern humans arrived on Flores between 55,000 and 35,000 years ago, and presumably interacted with *floresiensis*, though there is no evidence of this at Liang Bua.

However Indonesian folklore tells of creatures called Ebu

Gogo which were small, inarticulate, and walked with an odd gait. This sounds remarkably suggestive of *floresiensis*, but it could easily be coincidence - if *floresiensis* had been found in Ireland, we'd possibly be wondering if they were leprechauns.

There is a possibility that DNA, particularly [mitochondrial DNA](#) (mtDNA), might be able to be retrieved from the bones. Their relatively recent age and the fact that the bones have not been fossilized increases the likelihood that this can be done, but the tropical climate of Indonesia reduces the chance of success. High temperatures degrade DNA, and the Neandertal fossils from which mtDNA have been extracted all came from much colder climates than Indonesia. We will have to wait and see whether mtDNA can be successfully extracted from LB1. If so, it should prove very enlightening. (Some creationists are predicting that it will show *floresiensis* to be modern humans, but if, as Brown et al. believe, they descended from *Homo erectus*, the mtDNA of *floresiensis* should be even more different from modern humans than the Neandertals were.)

The discovery of *H. floresiensis* does not change the broad picture of human evolution, including our lineage - it was certainly not ancestral to us. But since it is the most extreme example of human adaptation ever found, it suggests that humans are more subject to evolutionary forces than we tend to think. And the fact that *floresiensis* lived so recently and yet has been unknown until now suggests that there could be other surprises waiting in the human family tree.

## Other interpretations?

Anatomist [Maciej Henneberg has claimed](#) that the skull is extremely similar to that of a microcephalic specimen from Crete, microcephaly being a disease that causes small brain sizes. However, Peter Brown and his team have considered and rejected this explanation:

It's more difficult to rule out, I suppose, the analogy with abnormal modern humans, like pituitary dwarfs or microcephalic dwarfs, because there you can have small-bodied people who have small brain sizes as well. Very few of these people actually reach adulthood and they have a range of distinctive features, depending upon which particular syndrome they have, throughout the cranial vault and rest of the skeleton. None of these features are found in Liang Bua. It has a suite of clearly archaic traits which are replicated in a variety of early hominids and these archaic traits are not found in any abnormal humans which have ever been recorded. We now have the remains of 5 or 6 other individuals from the site, so it's not just one. There's a population of these things now and they all share the same features. (Peter Brown, in [an interview with Scientific American](#))



Skull of LB1 compared with a modern human

## Mussels Evolve Quickly To Defend Against Invasive Crabs

ScienceDaily (Aug. 11, 2006) — Scientists at the University of New Hampshire (UNH) have found that invasive crab species may precipitate evolutionary change in blue mussels in as little as 15 years. The study, by UNH graduate student Aaren Freeman with associate professor of zoology James Byers and published in the Aug. 11 issue of the journal *Science*, indicates that such a response can evolve in an evolutionary nanosecond compared to the thousands of years previously assumed. The paper is called "Divergent induced responses to an invasive predator in marine mussel populations."

"It's the blending of ecological and evolutionary time," says Freeman, a Ph.D. candidate in the department of zoology. "It's an important development in the arms race between these crabs and these mollusks." Crabs prey on blue mussels by crushing their shells.

Freeman looked at the inducible defense -- shell thickening -- of blue mussels (*Mytilus edulis*) in the presence of two invasive crab species in New England, the Asian shore crab *Hemigrapsus sanguineus* and the green crab *Carcinus maenas*. While *Carcinus* was introduced to New England from Europe between 150 and 200 years ago, *Hemigrapsus* is a relative newcomer, arriving from Asia to New Jersey in 1988. While previous research had established that mussels recognize *Carcinus*, it had not been determined if they recognize *Hemigrapsus*. And, crucial to the design of Freeman's study, *Hemigrapsus* is not present north of mid-coast Maine.

"This set up a chance to look at populations that had been exposed to the predators for varying lengths of time," says Freeman. "We wanted to know, how is it that these mollusks can recognize a crab that is historically not present in North America?"

Freeman exposed mussels native to the northern -- above mid-coast Maine -- and southern New England to both *Carcinus* and the *Hemigrapsus*. Both populations thickened their shells when exposed to waterborne cues of *Carcinus*, but only the southern mussels -- Freeman describes them as "more worldly" -- expressed inducible shell thickening in the presence of *Hemigrapsus*.

"The mussel's inducible response to *H. sanguineus* reflects natural selection favoring the recognition of this novel predator through rapid evolution of cue specificity or thresholds," Freeman and Byers write.

Findings were consistent in two experiments over two years, one in a laboratory setting in Nahant, Mass., and



*Scientists Aaren Freeman and James Byers at the University of New Hampshire (UNH) have found that invasive crab species Hemigrapsus sanguineus (left) and Carcinus maenas (right) may precipitate evolutionary change in blue mussels in as little as 15 years. (Credit: Aaren Freeman)*

one in the field at Woods Hole, Mass. "The consistency over two years and two sites really suggests an underlying robust mechanism," says Byers, who is Freeman's dissertation advisor.

While this sort of rapid evolutionary response to predators has been exhibited in some other species, all have been vertebrates. The blue mussel, which Freeman describes as the lab rat of marine biologists, is an invertebrate "that people assume is not very bright," he says. Yet his findings indicate that within the brief span of 15 years, it has evolved an inducible response to a new predator.

How do mussels evolve so quickly? In southern New England, the scientists say, mussels are prey to many crabs as well as other marine species. "When *Hemigrapsus* came along the mussels' wheels were well-greased to respond," says Byers. "That's our best guess."

Byers helps put the impact of the research in context. Because extensive data does not exist on invasive ecology, "there's a tendency to extrapolate any data you get on an invasive species. But here we show that the response from the prey differs over just a couple hundred kilometers."

And while its "real world" impact is not immediately obvious, Byers suggests that perhaps northern Maine and Canadian shellfishers might consider "beefing up the worldliness of their naïve mussel populations before the *Hemigrapsus* arrives," he says, suggesting that this could be done by mixing some of the responsive southern mussels into the naïve northern stocks. "Although 15 years is fast to evolve better defenses to your predator, it can be painfully long if you're a shellfisherman," Byers adds.

This paper is one chapter of Freeman's doctoral dissertation, which also explores how mussels respond to sea stars and to multiple predators. He anticipates completing his doctoral work by October 2006, when he will begin a post-doctoral position with UNH research associate professor Fred Short.

Freeman notes that there's one predator mussels will not need to defend themselves against: him. "I used to like them, before I started working with them for my dissertation," he says. "Not anymore."

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