Alger says, researchers can use cannabinoid-receptor blockers or mice lacking cannabinoid receptors to see whether cannabinoid-mediated DSI occurs in these brain areas and to pin down its roles in brain function.

The studies also shed light on how marijuana affects brain functions such as memory, says Alger. "For years people thought that cannabinoids disrupt the development of LTP," he says, but now it appears that endogenous cannabinoid release may instead enhance it, by triggering DSI. But whereas the normal effects of DSI and DSE are limited to just the neurons in the vicinity of those releasing the cannabinoid and last only tens of seconds, marijuana use exposes the entire brain to high levels of marijuana's active ingredient, tetrahydrocannabinol (THC), for much longer. That would "swamp the whole system," says Irvine's Piomelli.

And that may explain findings such as those reported last December in the *Journal of Neuroscience* by Sam Deadwyler's team at Wake Forest University School of Medicine in Winston-Salem, North Carolina, showing that THC-treated rats behave on some memory tests as if they had no hippocampus. THC flooding the brain would eliminate the local activity patterns set up by DSE and DSI, just as spilling a bottle of ink across a page obliterates any words written there.

–MARCIA BARINAGA

MARINE MAMMALOGY

River Dolphins Add Branches to Family Tree

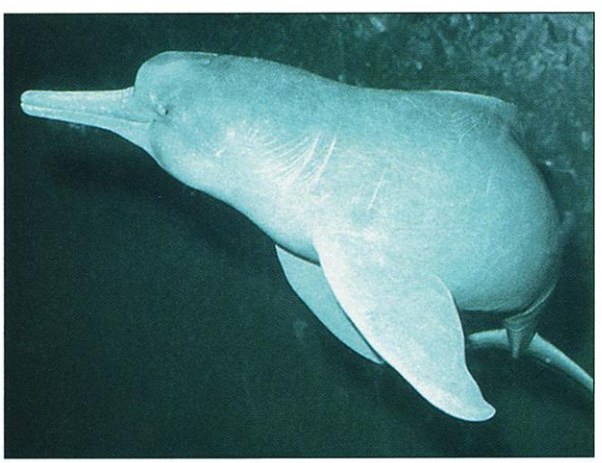
YOKOHAMA—Scientists who study marine mammals have long puzzled over where to place four species of river dolphins on the family tree. Similar in appearance, the Ganges, Yangtze, Amazon, and La Plata dolphins were thought to be more closely related to each other than to their whale cousins. But new data from a genetic analysis suggest that the species diverged at different times. One of the species may have diverged before beaked whales, whereas most dolphins did not appear until much later.

Norihiro Okada, a molecular biologist at the Tokyo Institute of Technology, and colleagues presented results here* based on a technique that uses unique repetitive bits of DNA, called short interspersed elements (SINEs), that are inserted randomly throughout the genome. Okada says the probability of identical but independent insertions at the same location in unrelated species is vanishingly small, as is the possibility of an insertion being precisely deleted later in evolutionary time. "It's the golden method" for molecular studies of evolution, says Hans Thewissen, a paleontologist at Northeastern Ohio Universities College of Medicine in Rootstown.

Okada and his colleagues gathered DNA samples from 14 cetacean species and identified 25 new SINEs, from which they constructed a relative timeline of whale, dolphin, and porpoise divergence. One significant conclusion was that the molecular analysis shows a clear separation between toothed whales, or Odontoceti, and baleen whales, or Mysticeti. Although this is the traditional morphological division, previous molecular analyses had been divided on the issue.

Based on his analysis, Okada believes that toothed marine animals diverged in the following order: sperm whales, Ganges river dolphin, and beaked whales, followed by the remaining freshwater and marine dolphins. No SINEs were found that could be used to resolve the relationships between those remaining freshwater and marine dolphins, although some SINEs indicate a sister relationship between the two South American river dolphins (Amazon and La Plata), and other SINEs clearly group together the remaining marine dolphins. Despite these gaps, Okada says that "the analysis still clearly shows that river dolphins are paraphyletic."

The new analysis supports a growing number of morphological studies, says Christian de Muizon, a paleontologist at the National Museum of Natural History in Paris, "so I was quite happy to see these results." And Ulfur Arnason, a molecular phylogeneticist at Lund University, Sweden, adds that Okada's results are also consistent with a growing number of molecular studies. Both agree that the results strengthen the case for



CREDIT: (DOLPHIN) VARIN–VISAGE/JACANA/PHOTO RESEARCHERS

Intruder. The Ganges river dolphin may fit between sperm and beaked whales on the evolutionary tree.

* Evolution and Adaptation of Marine Mammals, 12 March, Tokyo Institute of Technology, Nagatsuta campus.

ScienceScope

Courting a Consortium A former pharmaceutical executive is trying to shake up the proteomics world. Alan Williamson, a retired Merck & Co. official, is pushing an ambitious plan to have companies solve the structures and functions of 200 human proteins a year—then give away what they learn.

It might sound implausible. But the project has already won a pledge of support from The Wellcome Trust, a British charity. Williamson also claims that "nine or 10" firms are thinking of contributing $3 million each to the consortium, which he hopes will begin work this year. He hopes to seal these commitments with a business plan in the next few weeks.

Williamson has pulled off a similar coup in the past. He was instrumental in launching the SNP Consortium, which has made public more than 850,000 single-nucleotide polymorphisms (SNPs), the genetic variations that may be used to study diseases (*Science*, 16 April 1999, p. 406). The new proteomics group, he argues, could play a similar role in jump-starting drug development by sharing basic knowledge.

You've Got Mail President George W. Bush and Secretary of Health and Human Services Tommy Thompson received yet another letter this week urging them to allow the federal government to fund research on embryonic stem cells (*Science*, 1 September 2000, p. 1442). Antiabortion groups and some lawmakers are opposing the plan, because it involves extracting cells from embryos. But 112 university presidents have now joined 95 members of Congress and 80 Nobel laureates in urging the Administration not to backtrack.

Meanwhile, eight groups—including the American Society of Cell Biology, the Juvenile Diabetes Research Foundation International, and Harvard University—have hired some lobbying muscle to fight for stem cells. Vicki Hart, a consultant and aide to former Senator Bob Dole, will help the new Coalition for the Advancement of Medical Research make its case.

Contributors: David Malakoff, Robert Koenig, Dennis Normile, Eliot Marshall, Gretchen Vogel

revising where river dolphins fit among toothed whales.

But Okada's conclusion that Ganges river dolphins diverged between sperm and beaked whales—both of which live in the open ocean, are deep divers, and feed on squid—is more controversial. Thewissen says that Okada's conclusion "would clear up some problems" with the prevailing view that sperm and beaked whales are closely related. Although they share morphological and behavioral characteristics, "the [traditional] relationships are not all that well supported [in the fossil record]," Thewissen says. Okada's analysis suggests that beaked and sperm whales evolved at different times as shallow water animals and at some later date independently developed their common characteristics.

De Muizon has serious doubts about that interpretation, however. Although the fossil record suggests some morphological traits that link beaked whales more closely to Ganges river dolphins than to sperm whales, he says, most of the evidence points to beaked and sperm whales' proximity on the family tree. Still, Okada's results are sufficiently intriguing to send de Muizon back home "to rerun the studies." Arnason, whose own studies have not conclusively resolved such relationships, is heartened that morphologists, who have often dismissed molecular analyses, are taking the study seriously. "The two approaches should really complement each other," he says. **–DENNIS NORMILE**

CLIMATE CHANGE

Early Birds May Miss the Worms

A long-term study has provided new insight into potential short-term consequences of global climate change. Since the 1970s, Jacques Blondel, an evolutionary ecologist at the Center of Functional and Evolutionary Ecology in Montpellier, France, has spent each spring studying blue tits in the woods near his institute and in Corsica, an island 125 kilometers away. His decades-long project has created "an incredible opportunity to test the idea that short-term climate variations can affect the metabolism and breeding of small birds," comments Kenneth Nagy, a physiological ecologist at the University of California, Los Angeles.

On page 2598 of this issue, Blondel and his colleagues describe the energetic costs to birds that fail to breed where and when their food is in peak abundance. When food is scarce, parents must work harder to feed their young, and the parents' overall survival suffers as a result, the researchers report. "This is one of the few studies that have empirically demonstrated a link between energy expenditure in parental effort and fitness," says Tony Williams, a physiological ecologist at Simon Fraser University in Burnaby, Canada. The work suggests that animals could be caught in a race against time as they evolve to adjust to shifts in the seasonal availability food sources brought about by climate change. Although birds do seem to be breeding earlier in areas undergoing warming, the worry exists that some won't adapt fast enough. This new work demonstrates the detrimental consequences that could result.

Blondel embarked on this study when Donald Thomas, a physiological ecologist at the University of Sherbrooke in Quebec, Canada, joined the French group for a sabbatical 4 years ago. Thomas and Blondel quickly realized that the blue tit populations presented an unusual opportunity to examine how animals cope with reproducing when food is not abundant.

Blondel had decades' worth of data on birds from both Montpellier and Corsica, including good statistics on when they started to breed, how many young they produced, and how well parents and offspring did. These data could provide a historical context for any single-season study.

In addition, although birds in the two locales typically settle in different habitats—evergreen oak trees in Corsica and deciduous trees in Montpellier—some of the continental birds nest in evergreen oak forests just like the blue tits in Corsica. Blondel's data had shown that these atypical populations were less likely to return to breed a second year as usual, suggesting that living in this evergreen habitat impaired the birds' overall survival. But Blondel's team didn't know why.

That's where Thomas came in. More interested in short-term energetics of the birds' breeding activity than in long-term evolutionary change, he added a new test to the repertoire of daily observations: one to monitor the energetics involved in the birds' daily activities. When the researchers caught birds to determine their breeding status and to measure growth of the nestlings over the course of a season, they injected them with minute amounts of hydrogen and oxygen isotopes and then took a small blood sample. Twenty-four hours later, they recaught the same birds and took a second blood sample. Working with John Speakman from the University of Aberdeen in Scotland, they used the ratio of the isotopes from the two samples to calculate the amount of carbon dioxide produced, and from that they determined energy expenditure. They gathered the same data for the evergreen dwellers in Corsica and the atypical birds that inhabited the evergreen oak habitats near Montpellier.

The results were startling, says Thomas. The Montpellier birds were using almost twice as much energy as the birds in Corsica to rear their young. Typically, breeding birds hop about at three to four times their resting metabolism, but these blue tits were running at seven times, a rate that can't be sustained for long.

"At first, the data didn't make any sense," notes Thomas. But once they compared the timing of the emergence of caterpillars—the birds' favorite food—with the timing of egg hatching in the two locales, the story became clear. In Corsica, the birds breed in June, when new oak leaves stimulate a population explosion in caterpillars. But on the continent, the birds breed 3 weeks earlier, coinciding with the greening of the deciduous oaks and, again, an abundance of caterpillars. That puts the atypical population nesting in evergreen oaks near Montpellier at a disadvantage: Those trees are not budding and caterpillars have not yet emerged in May. Out of sync with their food source, "those birds ended up having to work relatively hard for relatively less payoff," Nagy comments. That hard work may burn fat reserves, leaving the birds more vulnerable to starvation during the winter, Thomas suggests.

Climate casualties. Changing climates may cause blue tits to breed out of sync with their food source.

CREDIT: GEORGE MCCARTHY/CORBIS

The new work "confirms what many people thought but were never able to show: that breeding too early has a fitness cost," says Marcel Visser of the Netherlands Institute of Ecology in Heteren. Uncertainties remain, adds Visser, because it is difficult to compare two populations of birds, one of which has evolved to be well adapted to the evergreen oaks while the other has not. Nevertheless, the work hints that as climate changes and the timing of the seasons shifts, says Blondel, "more and more populations of birds will become maladapted to breeding."

–ELIZABETH PENNISI