had been tried before on corals, Harvard marine biologists Steven Vollmer and Stephen Palumbi have shown that appearances can be deceptive: Three "species" are really two.

The work is as noteworthy for its techniques as for its findings. Harilaos Lessios, an evolutionary biologist at the Smithsonian Tropical Research Institute in Panama, describes the study as "a first-rate application of molecular markers to solve an evolutionary problem that morphology and conventional crosses between gametes were unable to solve." Although not everyone agrees, Lessios thinks the results will clarify when a particular coral is a separate species.

Coral experts had suspected that many coral species were promiscuous. In a maritime orgy, dozens of corals release their gametes on the same few nights once a year. Occasionally, sperm of one species pair with eggs of another and hybrids result—at least that's what lab tests indicate. But whether hybrids survive, or, more important, whether they can reproduce sexually, has been a matter of debate. If they can reproduce sexually with other hybrids, they have the potential to split off as new species, thereby contributing to the evolution of these organisms.

Vollmer and Palumbi evaluated DNA from three *Acropora* "species": staghorn, elkhorn, and *Acropora prolifera*, sometimes called fused staghorn. They focused on some noncoding sequences, or introns, from two genes and also some mitochondrial DNA. As expected in species, the mitochondrial DNA and the introns in both copies of each gene in the elkhorn were readily distinguishable from the staghorn's. But *A. prolifera* had one copy of each gene from each of the two species, indicating that *A. prolifera* is a first-generation descendent of elkhorn and staghorn corals.

The relatively recent origin of the hybrid was unexpected and suggests, at least to Vollmer and Palumbi, that *A. prolifera* doesn't warrant designation as a separate species. Had hybridization occurred long ago and the hybrid reproduced sexually, as some researchers suspected, then *A. prolifera* might have had time to evolve into its own species. Alternatively, others expected that the elkhorn and staghorn corals interbreed so much—with each other and with the hybrids—that their genomes would be too similar for biologists to call them separate species.

But neither hypothesis is quite correct, say Vollmer and Palumbi. Because this hybrid only very rarely reproduces sexually, it seems to be an evolutionary dead end even though it can live a long time and propagate asexually. Vollmer calls it an "immortal mule."

But not everyone is convinced about this interpretation. "How common [these first-generation hybrids] are going to turn out to be is hard to know," cautions Nancy Knowlton of the Scripps Institution of Oceanography in La Jolla, California. Bette Willis, a coral expert at James Cook University in Townsville, Australia, points out that the new data indicate that some interbreeding occurs between the hybrid and its parents, so the results actually support the idea that corals tend to be too intermingled to qualify as separate species. Contrary to what Vollmer and Palumbi say, "the paper adds to a growing body of evidence that [interbreeding] has played a role in the evolutionary history of the coral genus [with the most species], *Acropora*," she suggests.

Figuring out what makes a coral a distinct species is not just academic, Vollmer, Palumbi, and others say. As Richard Aronson, a marine biologist and paleoecologist at the Dauphin Island Sea Lab in Alabama, points out, clarifying what is a species that can reproduce sexually can help conservationists decide which corals to protect.

–ELIZABETH PENNISI

ARCHAEOLOGY

Millions Pledged for Afghan Restoration

Afghan leaders are gathering this week in Kabul to map out the country's political future. Two weeks earlier, international donors met in the capital city to confront another daunting challenge—restoring Afghanistan's cultural and archaeological heritage after 23 years of strife. The meeting, blessed by the interim government and the United Nations Educational, Scientific, and Cultural Organization (UNESCO), produced millions of dollars in pledges to rebuild and restore structures and provide the human resources needed to maintain them. But participants agreed that an even more important ingredient is political stability.

Gutted. Kabul Museum is in ruins, but researchers saved a few statues like this one from Fondukistan.

The proposed restorations do not include rebuilding the famed Bamiyan Buddhas that the Taliban destroyed (*Science*, 9 March 2001, p. 1873). After much discussion, the participants agreed to leave that decision to the new government. But the plan would stabilize the fractured cliffs that sheltered them, build a new Kabul Museum to replace the one destroyed by war, and rejuvenate the country's archaeological institutes and its scattered community of researchers. Most Afghan researchers are "dead, wounded, or gone," notes Robert Knox, Oriental antiquities chief at London's British Museum, who attended the meeting.

Afghan art and culture are a unique blend of civilizations—Greek, Persian, Indian, and Chinese—that have influenced the region. That rich amalgam has attracted support from European as well as Asian governments, institutes, and foundations. "We received lots of pledges; everyone is strongly motivated," says Christian Manhart, UNESCO's Asian cultural heritage division chief. The notable exceptions are the British and U.S. governments, which instead are focusing on military and humanitarian aid.

A Japanese foundation has pledged $700,000 to begin a project this summer to shore up the Bamiyan cliffs, weakened by the explosives the Taliban used. After surveying the structure, engineers will insert steel cables and concrete. "There is great danger that the niches [surrounding the site] will collapse," says Paul Bucherer-Dietschi, a Swiss architect who has visited Bamiyan and championed the rebuilding of the statues. There are also tentative plans for a museum and a sound-and-light show at the site.

There were a few happy surprises for the scholars visiting Kabul, including invaluable painted terra cotta statues from Fondukistan that were saved by Afghan archaeologists. But the Kabul Museum, now an empty shell, lost 80% to 90% of its collections. Greece has promised $750,000 to reconstruct the current building, which is 8 kilometers from the city center. Others argue for a more central location, but the decision will be up to the new government.

Rebuilding a research community will require more than money and political will. The German Archaeological Institute of Berlin has offered $350,000 to jump-start Kabul's own archaeological institute, part of the country's academy of sciences, and the University of Kabul also has an archaeology department. "Both are completely wrecked" from the prolonged fighting, says Knox. "But the real problem is, who do you train?" A half-dozen

CREDITS: (LEFT TO RIGHT) MARCO DI LAURO/AP; WILLIAM ALLEN/ARKANSAS STATE UNIVERSITY

Afghan archaeologists attended the Kabul meeting, but the rigors of life in modern-day Kabul might discourage prospective students and returning scholars.

The German foreign ministry has promised $350,000 to conserve a number of archaeological sites. One of the most fragile is the Minaret of Jam, the second highest in the world. Built in the 12th century, the structure is leaning because its foundation is weakening. Italy will provide $800,000 for repairs and an additional $500,000 for other conservation projects.

Most of the pledges will be held in trust by UNESCO. But the largest gift—$5 million from the Aga Khan Trust for Culture, a Geneva-based organization—will go directly to the municipal government to recreate the Bagh-e-Babur gardens, planted by the famed first Moghul emperor and the site of his 16th century tomb. The funds also will help rebuild traditional Kabul residences and improve public sanitation.

Interim President Hamid Karzai spoke at length to participants about the importance of rescuing and rebuilding the country's cultural heritage. But any long-term restoration requires an end to chaos and war, leaving scientists at the mercy of the political winds. "No one really knows what will happen," says Bucherer-Dietschi.

–ANDREW LAWLER

EXOPLANETS

'New Jupiter' Turns Up In Strange Company

Planet hunters are expected to announce this week that they have discovered 13 new planets that orbit sunlike stars in our corner of the Milky Way. This new harvest, which brings the total number of known extrasolar planets close to 90, includes an exoplanet that orbits farther from its star than Jupiter orbits the sun—the greatest known star-planet distance of any exoplanet. "This [far-out planet] is the first good evidence that planets actually form where our basic theories say they ought to," says Charles Beichman, a planetary expert at the Jet Propulsion Laboratory in Pasadena, California.

The new planets were discovered by Geoffrey Marcy and Debra Fischer of the University of California, Berkeley; Paul Butler of the Carnegie Institution of Washington in Washington, D.C.; and Steven Vogt of the UC Observatories/Lick Observatory near San Jose, California. The astronomers used telescopes in California, Hawaii, and Australia to measure Doppler shifts in the spectra of light from the planets' stars. The Doppler shifts arise as the orbiting planets tug the stars in different directions.

Like most other extrasolar planetary systems discovered so far, the newcomers include several enormous objects orbiting extremely close to their host stars. It's not surprising that star-hugging super-Jupiters unlike anything in our own solar system were the first to be discovered by the Doppler method, Marcy says. Not only do they exert the greatest gravitational pull on their stars, but their short orbital periods make their effects on starlight show up relatively quickly in astronomers' observations. But that doesn't mean that massive, close-in planets are the rule, Marcy says.

EXOPLANETS WITH LARGEST ORBITAL RADII

Planet	Distance (AU)	Period (Earth years)	Mass (Jupiters)
HD145675	2.9	4.9	≥4.05
EpsEri	3.4	6.9	≥0.88
HD39091	3.5	6.2	≥9.94
HD74156	3.5	6.2	≥7.46
47Uma c	3.8	7.2	≥0.76
Jupiter	5.2	11.9	1.00
55 Cancri c	5.8	14.8	≥4.05

The new far-out planet brings mixed evidence that solar system–like star systems are indeed out there. With a mass at least 4.05 times that of Jupiter (that is, 1290 Earth masses), the planet orbits the star 55 Cancri every 14.8 years at an average distance of 5.8 astronomical units (AU), slightly greater than Jupiter's distance of 5.2 AU. (An astronomical unit is the average distance of Earth's orbit from the sun, about 150 million kilometers.) So far, so familiar. The catch is that 55 Cancri also hosts two large, close-in planets, one just 0.12 AU from the star, the other 0.24 AU.

Planets such as 55 Cancri's inner companions vex astrophysicists with two big questions: How did they get there? And what do they say about the likelihood that planets with Earth-like masses and orbits exist in the same system? Current theories imply that Jupiter-like "fluid giants" must form at least 3 to 4 AU from the star. To explain how they might move closer, Douglas Lin of the University of California, Santa Cruz, and others have proposed that newly formed giant planets follow a shrinking disk of preplanetary material that swirls into the star, drawing the planet inward by tidal interactions. Fred Rasio of Northwestern University in Evanston, Illinois, and others support a planetary pinball game scenario in which a close encounter between two massive planets shoots one into a much tighter orbit and the other into a somewhat larger orbit around the star. If the migration model is correct, Earth-like planets could potentially form after a giant planet had spiraled inward, if additional matter remained in a disk around the star. In the planetary-pinball model, however, the interactions between a close-in and a far-out giant would sweep up or kick out any Earth-like planets orbiting in between them.

The next few years should bring a flood of new data to help resolve these possibilities, says Marcy's longtime collaborator Butler. With 1200 stars now under study and more to come, another half-dozen years of observations should bag several more Jupiter-like planets in Jupiter-like orbits, Butler says—objects that might help determine how hospitable, or hostile, the universe is to planets like our own.

–DONALD GOLDSMITH

Donald Goldsmith, the author of *Connecting With the Cosmos: Nine Ways to Experience the Wonder of the Universe*, is a science writer in Berkeley, California.

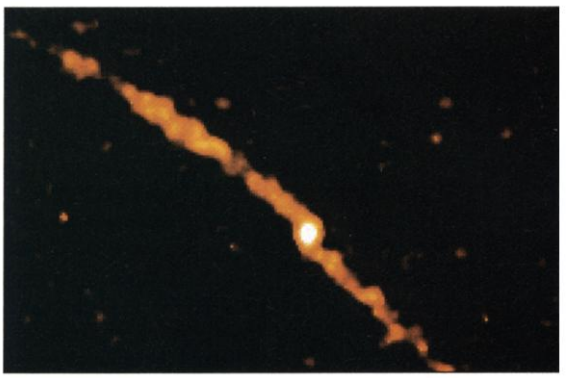
ASTRONOMY

Lucky Catch Identifies Disintegrating Cluster

ALBUQUERQUE, NEW MEXICO—The Milky Way galaxy is tearing apart its oldest inhabitants, and for the first time astronomers are witnessing the slaughter. A striking image presented here 3 June at a meeting of the American Astronomical Society* shows a globular cluster known as Palomar 5 being torn asunder by tidal forces of our home galaxy. Researchers say the observation and others like it could shed new light on the distribution of dark matter in the halo of the Milky Way. "This is a very exciting and beautiful result," says theorist David Spergel of Princeton University.

Globular clusters are large, spherical aggregations of old stars. They probably formed along with the galaxy, some 12 billion to 14 billion years ago. About 150 globulars are known to loop in wide orbits around the Milky Way's center. Some of them contain

* 200th meeting, 2–6 June.



Tails of woe. Streamers of stars from Palomar 5 reveal a globular cluster being torn to shreds.

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