Harvard Forest LTER, a trailblazing project in historical ecology (see sidebar on p. 626).

Indeed, not every site leader shares the communal spirit. David Tilman of the University of Minnesota, Twin Cities, admits he shuns most network meetings and leaves collaborative studies to others at his Cedar Creek site. "I personally believe that creativity in science is more of an individual than a group effort," says Tilman, who points out that the LTERs were conceived to operate independently. Adds William Schlesinger of Duke University, a soil biogeochemist at the Jornada Basin site in New Mexico, "I'm a little old-fashioned. I came up in the ranks [of people who] did everything individually." But Schlesinger says he applauds efforts by younger scientists at the sites to join forces.

And some scientists argue that the payoff of studies performed across several sites is overblown. "I'm cautious. I just don't think that's where the science is," says John Hobbie of the Marine Biological Laboratory in Woods Hole, Massachusetts. He thinks the LTER network's greater value is to bring together scientists "with common interests" to solve problems and generate new ideas for their own sites.

A more nagging problem, perhaps, is the perception among the broader ecology community that the LTER sites get more than their fair share of attention and funding from NSF. The reality, claims Jim Gosz of the University of New Mexico, Albuquerque, chair of the LTER coordinating committee, is stagnant budgets spread thinly over many sites that scientists must supplement with other grants. Nor do all sites have the right stuff. Reviews led three sites—Okefenokee in Georgia, North Inlet in South Carolina, and Illinois Rivers—to be shut down several years ago. "The sites are being asked to do far too much," says Washington's Franklin, with requirements ranging from intense data management to precollege education programs. He's hoping that a 20-year review, headed by biologists Kris Krishtalka and Frank Harris and due out by December, will recommend a boost to site budgets.

Still, the LTERs have developed a cachet that may skew some decisions in their favor. "There's a sense that every new idea that comes along is best done at one of the LTERs"—such as integrating social and ecological science—"when there may actually be a better place," says Stanford ecologist Pamela Matson, who's not affiliated with any of the sites. She hears concerns that when new funding comes along, "doors are too easily opened" to the LTERs compared to other long-established ecological research stations such as Stanford's own Jasper Ridge. While not questioning the validity of awards won by LTERs, Matson says it's "more of a worry about how things will go in the future."

Hands across the water

Despite its limitations, the LTER system has inspired similar projects—and new collaborations—in 21-and-counting countries. One of the first efforts at global outreach began several years ago, when U.S. and Hungarian researchers joined forces on a study of grassland biodiversity. The pooled data revealed a correlation between aridity and fewer plant species, firming up models predicting deleterious effects of global warming on arid plant communities.

Although one aim is to collect the same basic data, not all these international LTERs are carbon copies of U.S. sites; some, such as those in the United Kingdom and Canada, are focused more on monitoring than on research. Others, including China's and Taiwan's, study problems tailored to national priorities. China secured a $25 million World Bank loan in 1993 to build its 29 LTERs, which focus on helping farmers reduce erosion and boost crop yields. Western Europe has lagged behind, although French ecologists expect 10 sites to join the international network by fall.

The LTER concept may have taken off elsewhere in the world, but it has fallen short on its home turf in one big way. The Risser report urged other U.S. agencies that run ecology sites to emulate the model. Twenty-four LTERs "are not sufficient to explain continental science," explains Gosz, who thinks that about 50 sites could make greater inroads into questions such as how ecological processes change with scale, or across several types of lakes. But the advice came with no funding, and an über-network never arose.

Long-time LTER boosters say such shortcomings should not dim the program's luster. "It was an extraordinarily innovative program when NSF began it, and it has accomplished a tremendous amount of innovative science," Franklin says. "It's been a good investment scientifically. It hasn't achieved everything people expect. But holy smokes, you can't do it all." —JOCELYN KAISER

NEWS

The Partitioning of the Red Sea

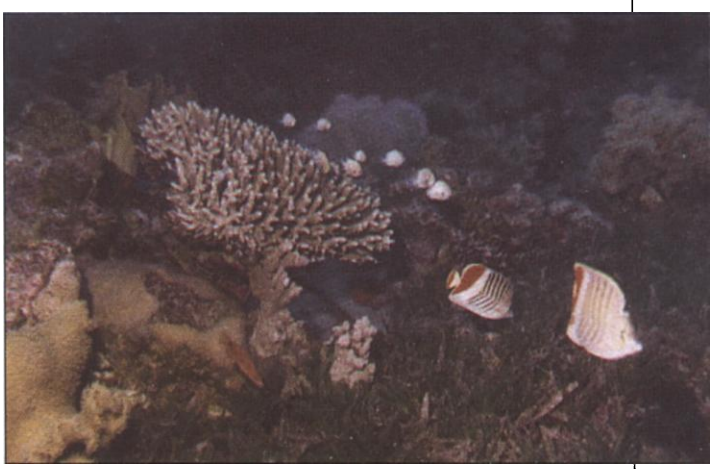
Israeli and Jordanian researchers have embarked on a novel experiment in marine ecology—and in scientific cooperation

For the past 2 years, marine scientists have been engaged in a remarkable new experiment in the Red Sea. While tensions in the Middle East have escalated in the wake of renewed clashes between Israelis and Palestinians, researchers from Israel and Jordan have embarked on a long-term collaborative effort to monitor coral reefs that straddle the border between their two countries.

The Red Sea Marine Peace Park aims to protect a unique but imperiled ecosystem at the northern tip of the Gulf of Aqaba. Home to 140 species of stony corals and nearly 1000 species of fish, the gulf's magnificent coral reefs are a marine biologist's delight. Particularly intriguing is why they exist at all: Nowhere else in the Indian or Pacific oceans do reef-building corals grow so far north of the equator.

Like the Long Term Ecological Research (LTER) sites (see p. 624), the young marine reserve is probing fundamental processes—such as the ebb and flow of nutrients and changes in coral cover—over many years. "There's a slew of basic science questions that this project will hopefully begin to provide some data on," says Michael Crosby, a science adviser at the Agency for International Development and the National Oceanic and Atmospheric Administration, two U.S. agencies that are helping fund and organize the park's research.

But the most remarkable aspect of the research effort is the fact that it exists at all. Although separated by only a few kilometers, the Israeli and Jordanian marine scientists had never been in contact until recently. "I remember many days sitting on the beach and



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Under siege. Early data show that a fifth of the Red Sea reserve's corals have died off in the past 2 years.

dreaming one day we will go to Aqaba and talk to our colleagues," says Jonathan Erez of the Interuniversity Institute for Marine Science in Eilat, Israel, referring to his Jordanian counterparts at the Aqaba Marine Science Center. "That dream has become reality."

Mending a gulf

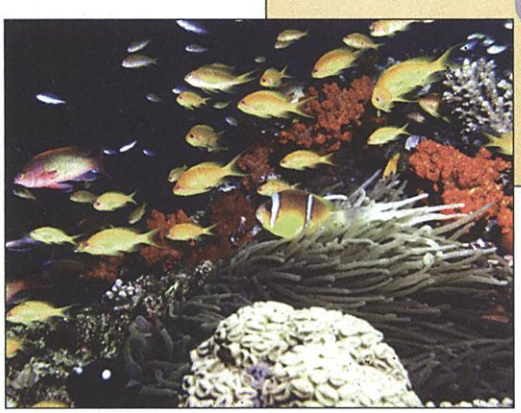
The reserve traces its origins to the peace treaty that Jordan and Israel signed in 1994. Not only did the pact call for a formal end to hostilities, but it also included agreements on measures to help establish a permanent peace. These included opening border crossings, establishing free-trade zones, and cobbling together the marine park from the Eilat Coral Nature Reserve, which runs along 2 kilometers of Israeli coastline, and the Aqaba Marine Park, a 7-kilometer-long strip on the Jordanian side.

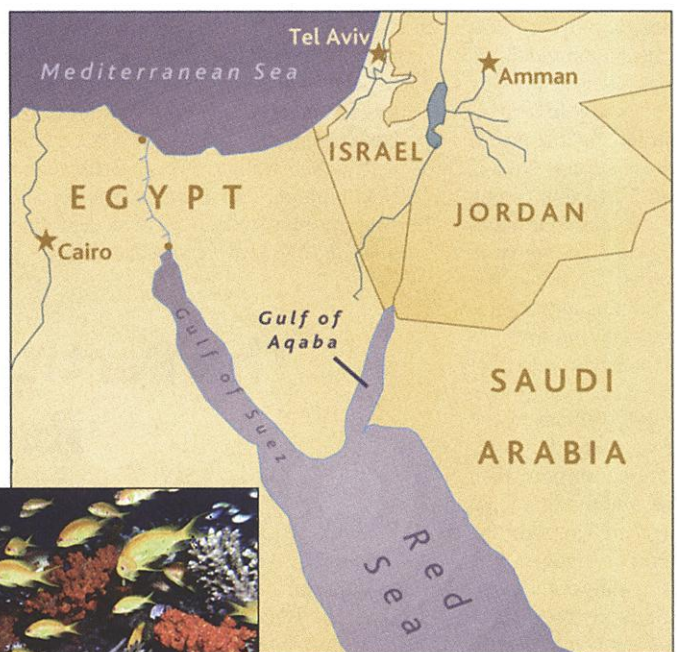
The reefs are in danger. Because the Gulf of Aqaba is isolated from the rest of the Red Sea by the narrow Straits of Tiran, its water circulation is sluggish. That leaves the gulf exquisitely vulnerable to agricultural runoff and sewage, and to silt dumped offshore by dredging and landfill operations on both sides of the border. The reefs are also under direct assault from a thriving coral trade and from hulls and keels that graze the reefs.

Fortunately for this fragile ecosystem, the Peace Park has proved more than a half-hearted confidence-building measure between the two former enemies. Soon after the park's creation, scientists and officials from Jordan, Israel, and the United States began hashing out how research could improve reef management. This dialogue led to a $2 million, 3-year effort, launched in 1999, that's now amassing a trove of data on the reefs.

Under the U.S.-funded initiative, Israeli and Jordanian researchers are building a high-resolution map of the entire reef ecosystem in the Peace Park, as well as surveying and tracking the corals, algae, and reef animal populations. At the same time, the scientists are measuring the currents, temperature, and chemistry of the gulf to create detailed circulation models that could help explain how deep-water currents supply the shallow-water reefs with nutrients. The information is being pooled into a single LTER-style database that enables results from different teams to be combined seamlessly for ecosystem-wide analysis and modeling.

The data are also finding a real-world application: gauging the punishment that humans are inflicting on the reefs. Fish farms, which keep millions of gilthead seabream in offshore cages, have started up on the Israeli side of the gulf over the past 2 years. The farms have released vast quantities of nitrogen, phosphates, and other nutrients into the gulf, claims Erez, whose team has reconstructed nutrient flow from their monitoring in the gulf. "It's like a city of 40,000 people sitting under the water, excreting," he says. Initially, the nutrients sink into deep waters, but during cold winters, the water near the surface cools enough to allow mixing in the water column. This in turn delivers the fish-farm pollution to the reefs, Erez says. The nutrient influx triggers algal blooms that block sunlight from reaching the corals, slowing growth or killing them.





Ecopolitical hot spot. The marine reserve is bringing together researchers from former enemies Israel and Jordan.

Erez believes the fish farms are largely to blame for the fact that a fifth of the park's corals have died off in the past 2 years. "Coral reefs and fish farming are not going together," he says. "We were lucky to monitor all these changes as they occurred." A committee appointed by the Israeli government recommended this month that the fish farms slash their release of nitrogen into the gulf by raising their juvenile fish on land and reducing the feed for their marine farms, and that the pollution in the gulf be studied more closely. Officials at Ardag, the company that runs the offshore fish farms, claim that the damage to the reefs has come mainly from other sources of pollution. "The fish farms in the gulf have no bad effect on the environment outside the limited area of the farms itself," says Ardag's Elisha Turniansky.

Riven, but together

Although relationships between project scientists have remained good, according to both sides, the region's turmoil has placed some constraints on the way research is conducted. For now, researchers must settle for a form of synchronized science. Last summer, for example, Israeli and Jordanian researchers on the gulf measured such parameters as water temperature and salinity. But rather than piling into a single boat, each team met at the border offshore to calibrate equipment before plying its own waters separately. Only later were the data pooled.

Despite the cumbersome procedures dictated by politics, the project has done "extremely well," says Geoffrey O'Sullivan of the Marine Institute in Dublin, who helped review the park's research for the U.S. government. Under the circumstances, he says, "it is a credit to all involved that they have made progress at all." Adds Crosby: "We're clearly moving in a positive direction. But we're not there quite yet."

Also encouraging is the fact that political support for the project is holding strong in both countries—with a commitment, it would appear, to continue the research after the U.S. money runs out in 2003. "I see it as a long-term relationship," says Bilal Bashir, commissioner for environment, regulation, and enforcement with the Aqaba Special Economic Zone Authority in Jordan.

If it does live up to its promise, the Peace Park may even serve as a model for other parts of the world, where coastal ecosystems are shared by countries that want to move from conflict to cooperation—from the river deltas between Pakistan and India to the Adriatic coastline of the former Yugoslavia. "There are so many areas that are potentially ripe," says Crosby, for both political and ecological healing. **–CARL ZIMMER**

Carl Zimmer is the author of *Parasite Rex* and *At the Water's Edge*.

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