



also in the Line Islands. They have some of the greatest densities of fish in the world because the waters around them are unusually full of nutrients brought by upwelling currents. There, with the reefs already protected, the main beneficiaries are expected to be declining populations of tuna as well as the sharks, birds, turtles, and dolphins that are accidentally caught by longline fishing.

The most significant opposition to making the monuments bigger came from the Pentagon. Nelson says several senior officials there expressed concern to him “that the designation of a monument over a big area could lead to future restrictions on their ability to operate

effectively.” He said the officials cited lawsuits stemming from Bush’s designation of the Northwestern Hawaiian Islands monument that restricted the use of sonar in war games.

Eight groups of recreational fishers also expressed their displeasure in a letter to Connaughton, as did some politicians in the Commonwealth of the Northern Marianas. The Marianas Hotel Association and the Chamber of Commerce, on the other hand, enthusiastically endorsed the proposal as a way to “boost the local economy in promoting ecotourism.”

Although scientists and conservationists are delighted with the new sanctuaries, they say bigger no-take areas are needed to counter

increased fishing pressure in the Pacific. As a board member of Environmental Defense, marine biologist Jane Lubchenco of Oregon State University in Corvallis lobbied hard for Bush to protect the entire Exclusive Economic Zone around each island, which would have quadrupled the area protected. If confirmed as President-elect Barack Obama’s choice to head NOAA, Lubchenco, also a past president of AAAS, which publishes *Science*, will oversee how all these monuments are managed. “We will continue to work with the next Administration to see if they can extend the area,” says Nelson.

—CHRISTOPHER PALA

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CLIMATE CHANGE

Higher Temperatures Seen Reducing Global Harvests

Thousands of people died from the heat that baked western Europe in the summer of 2003. The heat wave also devastated the region’s agricultural sector: In France, where temperatures were 3.6°C above normal, the country’s corn and fruit harvests fell more than 25%. Thirty-one years earlier, another very hot summer shrank harvests in southwest Russia and Ukraine and led to a tripling in world grain prices.

By the end of the century, two researchers predict, those summers may seem like cool ones, and the impact on agriculture will be even greater.

In a paper appearing on page 240, atmospheric scientist David Battisti of the University of Washington, Seattle, and economist Rosamond Naylor of Stanford University in Palo Alto, California, apply 23 global climate models used by the Intergovernmental Panel on Climate Change to estimate end-of-century temperatures. Their conclusions with regard to agriculture are sobering. “In the past, heat waves, drought, and food shortages have hit particular regions,” says Battisti. But the future will be different: “Yields are going to be down every place.” Heat will be the main culprit. “If you look at extreme high temperatures so far observed—basically since agriculture started—the worst summers on record have been mostly because of heat,” not drought, he says.

The models predict that by 2090, the average summer temperature in France will be



Brownout. These wilting sunflowers in southwestern France show the effects of the exceptionally hot summer of 2003 that devastated agriculture.

3.7°C above the 20th century average. Elevated temperatures not only cause excess evaporation but also speed up plant growth with consequent reductions in crop yields, the authors note. Although rising temperatures may initially boost food production in temperate latitudes by prolonging the growing season, Battisti and Naylor say crops will eventu-

ally suffer unless growers develop heat-resistant versions that don’t need a lot of water. “You have to go back at least several million years before you find ... temperatures” comparable to those being predicted, Battisti says.

Just as France offered a glimpse of the future in temperate regions, says Naylor, the Sahel in Africa shows what life could be like in the tropics and subtropics, home to half the world’s population. A generation-long drought in the region lifted in the early 1990s, but higher temperatures have remained, depressing crop and livestock production. The authors predict future production reductions of 20% to 40%, while the population in tropical regions is expected to double to 6 billion.

The conclusions of the paper seem “reasonable,” says plant and soil scientist Peter Smith of the University of Aberdeen in the United Kingdom, who also does greenhouse gas modeling. Smith adds that future pressures on food supplies come not only from steadily growing populations but also from changes in food preferences, in particular, more people eating meat. “Demand for livestock products in developing countries will greatly increase over the next few decades,” says Smith. That trend, he says, represents “a switch to less efficient ways of feeding ourselves.”

So developing heat-tolerant crops won’t be enough to solve the problem of rising temperatures, he says. “We humans also need to change our behavior.”

—CONSTANCE HOLDEN



Higher Temperatures Seen Reducing Global Harvests
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Editor's Summary

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