



## EPIDEMIOLOGY

## Iraqi Death Estimates Called Too High; Methods Faulted

A new estimate of the number of Iraqis who have died as a consequence of the U.S.-led invasion in March 2003 has ignited a firestorm of its own. At 400,000 to 800,000 deaths, the new number is at least 10 times higher than estimates cited by the Iraqi government and U.S.-led coalition. U.S. President George W. Bush immediately dismissed the study, characterizing its methodology as “pretty well discredited.” Other Administration officials charged that the study, released with significant publicity 4 weeks before U.S. midterm elections, was politically motivated. Researchers who spoke with *Science* disagree that the authors’ motives are suspect but raise several questions about the methodology of the study, which was published 11 October in *The Lancet*.

Experts on both sides of the debate concede that it is notoriously difficult to get an accurate count of casualties in Iraq. The Iraqi Ministry of Health has estimated up to 40,000 violent deaths so far, based on death certificates reported by hospitals and morgues. That figure falls within the range published by Iraqi Body Count, an independent London-based group opposed to the war that compiles casualty numbers from media reports. There is little doubt that the real number of deaths is higher than this, because only a fraction of deaths are officially recorded or reported by journalists. But just how small is that fraction?

The *Lancet* study, designed by researchers at Johns Hopkins University in Baltimore, Maryland, is based on a survey conducted between May and July by a team of 10 Iraqi health workers. (The Johns Hopkins researchers met with the Iraqi team twice across the border in Jordan to advise on the survey techniques.) The team visited



**Counting the dead.** Researchers attribute most of the estimated 400,000 to 800,000 Iraqi deaths to violent causes, including gunshots, air strikes, and car bombings, such as this one in Baghdad.

47 neighborhoods in 18 different regions across the country, going door-to-door and asking families about recent deaths. They collected data from a total of 1849 households containing 12,801 residents. For the 14 months before the invasion, the Iraqi families reported 82 deaths, an annual death rate of 5.5 per 1000 people. Within the same households, 547 people died between the start of the invasion and July of this year—an annual increase of 7.8 deaths per 1000. By applying this rate to the entire population of 27 million, the researchers conclude that 655,000 more Iraqis have died than would have if the invasion had never happened. About 8% of these extra deaths are attributed to deteriorating public health, but an estimated 601,000 are violent—56% from gunshots and about 13% each from air strikes, car bombs, and other explosions. The researchers calculate a 95% probability that

the true number of violent deaths lies between 426,369 and 793,663.

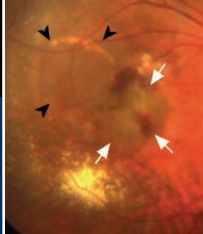
Many academics spoke up in defense of the study. “I too find the survey’s estimates shockingly high, ... [but] the choice of method is anything but controversial,” wrote Francesco Checchi, an epidemiologist at the London School of Hygiene and Tropical Medicine on 12 October on a humanitarian Web site. The statistical technique used, called cluster surveying, divides the population into different regions, neighborhoods, and households, in contrast to a random sampling of people on the streets.

The method may be sound, but several critics question the way it was carried out in this study. Madelyn Hicks, a psychiatrist and public health researcher at King’s College London in the U.K., says she “simply cannot believe” the paper’s claim that 40 consecutive houses were surveyed in a single day. “There is simply not enough time in the day,” she says, “so I have to conclude that something else is going on for at least some of these interviews.” Households may have been “prepared by someone, made ready for rapid reporting,” she says, which “raises the issue of bias being introduced.”

Lead author Gilbert Burnham, an epidemiologist at Johns Hopkins, counters that “40 adjacent households is entirely achievable in a day’s work if well organized.” Les Roberts, also at Hopkins, adds that 80% of the 547 deaths were corroborated with death certificates. The fact that hundreds of thousands of death certificates seem to have gone unregistered by the Ministry of Health is no surprise, says Roberts, because “those have always been grossly underreported.”

Neil Johnson and Sean Gourley, physicists at Oxford University in the U.K. who have been analyzing Iraqi casualty data for a separate study, also question whether the sample is representative. The paper indicates that the survey team avoided small back alleys for safety reasons. But this could bias the data because deaths from car bombs, street-market explosions, and shootings from vehicles should be more likely on larger streets, says Johnson. Burnham counters that such streets were included and that the methods section of the published paper is oversimplified. He also told *Science* that he does not know exactly how the Iraqi team conducted its survey; the details about ▶

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neighborhoods surveyed were destroyed “in case they fell into the wrong hands and could increase the risks to residents.” These explanations have infuriated the study’s critics. Michael Spagat, an economist at Royal Holloway, University of London, who specializes in civil conflicts, says the scientific community should call for an in-depth investigation into the researchers’ procedures. “It is almost a crime to let it go unchallenged,” adds Johnson.

Co-author Roberts is no stranger to such

controversy. He led a smaller study of Iraqi casualties, published in *The Lancet* in 2004, that estimated 100,000 deaths. That work was criticized for relying on too few samples. This time, he says, “we took enough samples, and if anyone wants to verify our results, it’s easy.” The study suggests that close to four times the number of deaths occurred in the first half of 2006 than in the first half of 2002, he says, “and anyone could simply pick four to six spots in Iraq and go to the local graveyards. The increase ... should be obvious.”

For now, Spagat says he is sticking with casualty numbers published by the United Nations Development Programme (UNDP). A UNDP survey of 21,668 Iraqi households put the number of postinvasion violent deaths between 18,000 and 29,000 up to mid-2004. “When a survey suggests so much higher numbers than all other sources of information,” he says, “the purveyors of this outlier must make a good-faith effort to explain why all the other information is so badly wrong.”

—JOHN BOHANNON

## ECOLOGY

# Report Warns of Looming Pollination Crisis in North America

California almonds are a huge food crop in the United States, and land devoted to almond trees is expected to increase another 50% by 2012. But that growth depends in large part on availability of the almonds’ pollinator, the honeybee.

And honeybees are in trouble, according to a report on North American pollinators\* unveiled this week by the National Research Council (NRC) of the National Academies.

Although there is “no strong evidence for a current pollination crisis,” there may be one looming, reports an NRC committee led by entomologist May Berenbaum of the University of Illinois, Urbana-Champaign.

The committee calls for better long-term monitoring of all pollinators, noting that few records exist for species other than honeybees.

A study earlier this year documented decreasing pollinator diversity

in Europe, and there are similar fears about what’s happening in North America (*Science*, 21 July, p. 286). Last year, for the first time since 1922, California almond growers imported bees from Australia to service their trees because U.S. bee colonies are being decimated by a

\* *Status of Pollinators in North America*, [www.nap.edu/catalog/11761.html](http://www.nap.edu/catalog/11761.html)

mite, *Varroa destructor*, which sucks the life out of larvae. According to the report, the mite, which first showed up in 1987, is even overshadowing the Africanized honeybee, which—adaptable, angry, pushy, and proliferative—has been steadily encroaching in the southern United States and muscling aside the gentler European honeybee population.

Roughly one-third of the North American diet comes from food—fruits, vegetables,

The NRC report notes that just as modern agriculture relies too much on monocultures, there is too much reliance on honeybees, which beekeepers truck around from one crop to another, like migrant workers. Almonds are particularly vulnerable, says Kevin Hackett of the Agricultural Research Service, because their trees flower early in the year when honeybee colonies are weakened from winter mite infestations. He says mites have caused the price of bee rental for almond growers to go from about \$30 to as much as \$150 per hive.

NRC calls for more research on the mite problem, noting that *Varroa* have become resistant to antibiotics and pesticides. It’s been difficult to breed mite resistance into the bees, in part because of the queens’ loose mating habits. Hence the need, says the committee, to develop “non-*Apis*” pollinators such as the alfalfa leaf-cutter bee, which doesn’t have a mite problem.

The committee also advises that the U.S. government establish discovery surveys for wild pollinators of U.S. crops and of rare or endangered plants. The NRC report adds that beyond increased research and data-gathering, simple steps, such as growing wildflowers in golf-course roughs, can help keep a diverse array of pollinators in business.

Adding to the buzz surrounding the report, the 3-year-old North American Pollination Protection Campaign ([www.pollinator.org](http://www.pollinator.org)) sponsored a symposium this week at USDA to discuss better management of pollinator resources worldwide.

—CONSTANCE HOLDEN



**Stamps of approval.** Next spring, the U.S. Post Office will issue these and other stamps depicting pollinators.

seeds, and nuts—that rely on animal pollinators, which include beetles, butterflies, flies, bats, hummingbirds, and bumblebees. But the king of pollinators is *Apis mellifera*, the European honeybee. Much preferred over its African cousin, it’s a “generalist” that pollinates a huge variety of crops. It is also highly social and thus easy to muster.