Locusts in Africa: A Plague Is Possible

Control efforts helped stave off crop destruction but better weather, armed conflict favor the insects

A REBEL GROUP waging a guerrilla war in Western Sahara against the government of Morocco acknowledged that it was responsible for the 8 December downing of a plane engaged in U.S.–backed antilocust operations and for damaging a companion plane. The loss of the plane and its crew of five demonstrates the hazards of locust control efforts and the degree to which military and political conflicts in the region obstruct them.

The planes had just completed pesticide spraying operations against desert locust swarms in Senegal and Mauritania as part of the major effort across the breadth of Africa to control the most serious onslaught of desert locusts in a generation.

The 1988 campaign in Africa is ending with decidedly mixed results. Serious crop losses were averted with the help of more effective locust control efforts which got an assist from timely remote sensing data. But continued favorable conditions for the voracious migratory insects prompted the assessment in a recent U.S. Agency for International Development (AID) update that "this infestation may well achieve plague status by early next year."

Desert locust swarms have been reported in Iraq and Iran. A surge into Pakistan and India is anticipated, so that desert locusts could be present in force across their full ecological range in 1989.

How goes the battle? According to Shannon Wilson, an entomologist working with the AID locust task force, "From the standpoint of geography, we're losing this one. But that's a long way from the total picture." Very little crop land was lost, says Wilson. "Morocco fought the locusts to a standstill," and much the same was true in the Sahelian countries south of the Sahara.

Antilocust campaigners can not claim full credit for the success. One must grant "equal billing to the weather," says Wilson. Desert locusts prefer a diet of natural vegetation—grasses and trees—and attack crops when enough of the former is not available. Because of above-average rains, "This year there was so much green out there that the locusts did not have to turn to the crops," says Wilson.

Armed conflict, however, continues to impede control operations in several key areas besides northwestern Africa. Iraq and Iran have reported control operations against desert locust swarms, but, although there is currently an armistice in the Iran-Iraq war, no outside assessment of the seriousness of the infestation has been possible. Combat zones in Ethiopia and Sudan, which are important locust-breeding sites and migration routes, have been inaccessible for several years, and Chad in the Sahel region has only recently seen fighting ebb.

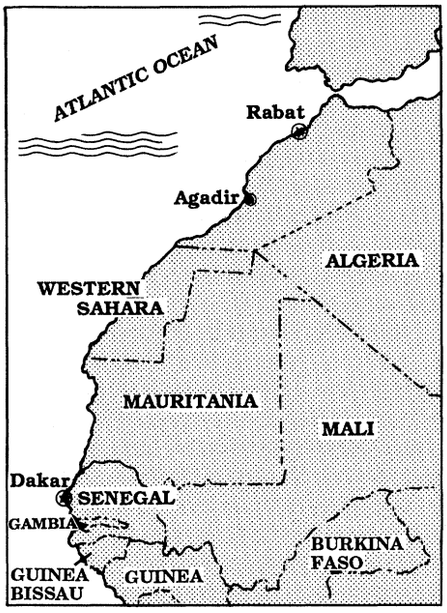
The plane shot down over the Sahara was a DC-7 on contract to AID enroute from Dakar, Senegal, to Agadir, Morocco. It crashed after being struck by a ground-to-air missile near the border between Mauritania and Morocco in an area where Bedouin rebels of the Polisario Front organization have been attempting to establish an independent state. A second DC-7 sustained missile damage but was able to land at an airfield inside Morocco.

Western Sahara, the desolate former Spanish colony which is the prize for which the Polisario rebels have been fighting, is a pivotal area for antilocust efforts. Desert locusts found unusually hospitable conditions there last year and used it as stopover before traveling north to Morocco. Because the same areas in Western Sahara and Mauritania again received higher than normal rains, it is important that they be checked for locusts by ground reconnaissance. Extreme caution is required because, as an American familiar with the territory says, "There are land mines all over the place."

The current locust plague can be traced to early 1987 when swarms were spotted in breeding areas on the Red Sea coast (*Science*, 4 March, p. 1088). The success of the swarms in moving westward across the continent and establishing themselves in western Africa is attributed mainly to two consecutive years of above-average rains that brought better harvests to the drought-prone Sahel, but created conditions favorable for locust breeding.

In recent weeks, major control efforts, in which the two DC-7's participated, were mounted to combat late-season locust invasions in Mauritania and Senegal in West Africa. These locust swarms are expected to head northward to interior areas of Western Sahara and Mauritania and then into Morocco. Attention has now shifted to breeding areas in or near the Atlas Mountains where the locusts overwinter. Countermeasures in coming months there and along the Red Sea coast are regarded as crucial to containing the threat for next year.

"If the Moroccans keep the pressure on," says Wilson, "it will reduce the movement into the Sahel next year. Cold weather now affects the Atlas area so that the locusts slow down and can move only short distances if they move at all and are, therefore, easier to attack. "But in cold wet weather, the chemicals become much less effective," says Wilson.



Because regional locust control organizations, which were built up after World War II, crumbled after the locust threat subsided in the 1960s, the burden of the battle for the past 2 years had to be borne by undermanned national crop protection services in the region, with foreign donor organizations providing funds and technical assistance. For a developing country, Morocco has put heavy resources into the fight already; to expect it to continue to do so under adverse conditions for strategic purposes rather than for crop protection is asking a great deal.

It is perhaps not surprising, therefore, that King Hassan II of Morocco has called for formation of an international locust strike force empowered to operate across borders. Locusts do not observe national boundaries but locust fighters in Africa and the Middle East are constrained from hot pursuit. Hassan's idea was endorsed in a

United Nations resolution last month, and that may well appeal to donor countries which want to see the locust threat ended as quickly and economically as possible. Nevertheless, it is far from clear how such a force would be formed and would operate.

The task of locust surveillance and international coordination of the campaign is performed by the United Nations Food and Agriculture Organization (FAO) in Rome. U.N. agencies carry heavy political impedimenta but FAO's emergency center for locust operations continues to get good marks for its performance. The center is making use of information provided by FAO's Remote Sensing Center from its new Artemis system that has been operational since August. The system provides rainfall estimates for regions where desert locusts are active by automated analysis of data indicating raincloud cover from the European meteorological satellite Meteosat. Soil moisture is an essential factor in the hatching of locust eggs and determines population development.

Vegetation in so-called locust recession areas provides food and shelter for immature locusts until they grow wings. The system also uses data from the U.S. National Oceanic and Atmospheric Administration's weather satellites processed by National Aeronautics and Space Administration scientists into a vegetation index for the relevant areas to help identify danger spots.

Actually stopping the locust remains a formidable task. If warfare and the weakness of national antilocust forces are the main negative factors, another is summed up as "dieldrin." The organochloride pesticide is effective against locusts but is persistent and residues have turned up in alarming concentrations in humans and animals in Africa. Its use has been effectively banned by donors, while African governments, sensitized by recent horror stories about dumping of toxic wastes in Africa, are taking a tougher line than ever against environmental hazards.

The current gap in the armamentarium against locusts is written up by many to neglect of research on the insect between outbreaks. "The biggest shortcoming is in research," says Wilson. "In off years, nobody funds research, they're not interested." When there is a plague, then money becomes available, but even then it's "infinitesimal," he says.

"Environmentally acceptable controls are needed." Many areas of research, notably biological controls, hold great potential, says Wilson, "but we're not doing it at a level that offers a promise of real progress." Except for remote sensing and better electronic guidance systems in the field, "we're operating with 20-year-old technology."

■ JOHN WALSH

Test Ban Talks Reach Impasse

U.S. and Soviet negotiators have failed to reach agreement on a method for ensuring compliance with a 1974 treaty that limits underground nuclear explosions to a maximum of 150 kilotons. Talks between the two countries ended on 15 December at an impasse over a U.S. demand that an intrusive on-site technique known as CORRTEX be used to measure blasts above 50 kilotons.

The Reagan Administration has long argued that seismometers cannot measure the size of explosions accurately enough to guard against Soviet cheating, and it has repeatedly charged that some past Soviet tests constitute "a likely violation" of the 1974 treaty, formally known as the Threshold Test Ban Treaty. The treaty has never been ratified by the United States, and the Administration has insisted that a protocol permitting CORRTEX monitoring be added before the Senate approves the measure. It has also said that it would not consider any further testing restrictions until the threshold treaty is ratified. In the meantime, however, both sides have pledged to keep their testing programs within the 150-kiloton limit.

The Soviet government has argued that seismic methods are adequate to monitor compliance with the treaty, and until recently it has resisted the notion of using CORRTEX, which involves placing an electronic cable in a borehole very close to the shaft containing the nuclear explosive.

Last year, however, both sides agreed to undertake a remarkable experiment in which the two techniques would be compared. Blasts were set off at the U.S. test site in Nevada in August and at the Soviet test site in Kazakhstan in September, and both Soviet and U.S. scientists conducted on-site measurements with CORRTEX for each explosion. It was the first time that officials from either country had witnessed a blast on the other's home turf. In addition, both sides exchanged data on the geology of their test sites and the yields of ten previous tests.

The results of the experiment are classified, but they apparently did not demonstrate the superiority of the CORRTEX method, as the Administration had hoped. According to a report in the *Washington Post,* which has been confirmed by Administration officials, the CORRTEX method put the blast at the U.S. test site above the 150-kiloton threshold, while seismic methods measured it at close to the predicted yield of 145 kilotons. Both methods were well within the 30% margin of error claimed for CORRTEX.

The experiment evidently changed neither side's mind. In negotiations in Geneva, U.S. representatives continued to argue for the right to monitor any blast above 50 kilotons with the CORRTEX method. The Soviets, according to an Administration official, insisted that CORRTEX be used only for a limited number of shots in order to calibrate each test site.

Because of differences in the geology of the two test sites, explosions of the same magnitude at each site will give different seismic signals at remote locations. The Soviets apparently argued that by setting off a few blasts measured both by CORRTEX and seismic techniques, the so-called "bias factor" resulting from the different geology could be calculated. After that, seismic techniques should be used for all tests, the Soviets said.

Both sides were sticking to their positions when the talks ended last week. They are not scheduled to resume until after the Reagan Administration leaves office.

Many U.S. seismologists have argued that seismic techniques are adequate for treaty verification. Last year, an influential study by the Office of Technology Assessment (OTA) concluded that, with adequate calibration of the test sites, seismic monitoring would be just as accurate as CORRTEX. Moreover, some weapons scientists have expressed nervousness at the prospect of having Soviet officials in almost constant residence at the Nevada Test Site. Milo Nordyke of the Lawrence Livermore National Laboratory testified in October before the House Committee on Foreign Affairs that sensitive information on U.S. weapons tests could be revealed if the Soviets monitored U.S. tests with CORRTEX.

As for the charge that some Soviet tests constitute a likely violation of the threshold treaty, the OTA study concluded that the evidence does not support it. A team of experts at the Livermore laboratory and many independent seismologists have reached a similar conclusion. The Administration, however, repeated the charge in a report earlier this month.

■ COLIN NORMAN