Feature article / En vedette

By Emma Despland

Locust plagues then and now

The desert locust (*Schistocerca gregaria*, Orthoptera: Acrididae) is the world's most notorious insect pest. As these quotes indicate, the desert locust has plagued Western civilization since the dawn of recorded history. Still today, it constitutes a severe threat to both subsistence and commercial agriculture across Africa, the Middle East and Eastern Asia — as testified by the swarms currently ravaging Northern and Western Africa.

In the summer of 2003, the right amount of rain in the right places at the right times led to excellent locust breeding conditions in the Western Sahel and along the Red Sea Coast, two notorious locust breeding zones that have given rise to many outbreaks in the past (Popov 1997) — indeed, Moses' east wind brought locusts from the Red Sea coastal plains. Locust populations grew and gregarised, and raised alarm that outbreaks might be developing. In the winter 2003-2004, the Red Sea locusts were unable to find suitable breeding conditions, and, instead of migrating into Darfur as was feared, they died out, dispersed and disappeared. However, in Western Africa, the swarms formed in the Sahel migrated north to the Mediterranean coast, where vegetation flourishes following the winter rains. Their progeny returned to the Sahel in the summer of 2004 where breeding conditions were once again excellent, and the population exploded. Swarms containing thousands of locusts per square metre and covering tens of square kilometres have been observed last fall leaving the Sahel, moving North towards fruit orchards on the Mediterranean coast and south towards tropical farmland. Each swarm can easily contain billions of individuals and eat more in a day than the entire human population of New York does in a week. This past winter, numerous swarms criss-crossed Morocco and Algeria and raised fears about the onset of a new major plague(Enserink 2004; FAO 2005).

Locust outbreaks are based on a individual-level change from a solitarious to a gregarious form (Simpson et al.1999). So different are these two forms, that they were long considered to be two separate species until Sir Boris Uvarov, in the 1920s, showed that an individual locust could

> *So Moses stretched forth his rod over the land of Egypt, and the Lord brought an east wind upon the land all that day and all that night; and when it was morning the east wind had brought the locusts. And the locusts came up over all the land of Egypt, and settled on the whole country of Egypt, such a dense swarm of locusts as had never been before, nor ever shall be again. For they covered the face of the whole land, so that the land was darkened, and they ate all the plants in the land and all the fruit of the trees which the hail had left; not a green thing remained, neither tree nor plant of the field, through all the land of Egypt. Then Pharaoh called Moses and Aaron in haste, and said, "I have sinned against the Lord your God, and against you. Now therefore, forgive my sin, I pray you, only this once, and entreat the Lord your God only to remove this death from me." So he went out from Pharaoh, and entreated the Lord. And the Lord turned a very strong west wind, which lifted the locusts and drove them into the Red Sea; not a single locust was left in all the country of Egypt.*
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> Exodus 10: 12-19

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change from one to the other (Uvarov 1977). At low population density, locusts are in the solitarious form: they are green and timid, don't move much, avoid one another and are barely noticed by humans. However, when population density is high, locusts switch to the gregarious form: the most dramatic change is their adoption of bright black-and-yellow stripes. However, more importantly, gregarious locusts are much more active and are attracted to one another. This change in behaviour leads them to aggregate and form large groups that migrate together, destroying all vegetation in their path. The switch between forms is triggered by contact with other locusts (Simpson et al. 2001). So when density is high, contact between individuals increases, locusts start behaving gregariously and aggregate, further increasing contact between individuals. This feedback loop creates a snowball effect that can spiral further and further, generating plague conditions where hundreds of swarms migrate across continents, following weather conditions suitable for breeding (Despland 2004).

Once a locust population has gregarised, it can seed an outbreak if it remains concentrated and multiplies. However, if vegetation in the locust's desert breeding grounds is too sparse and if topography and winds break up developing swarms, the locusts can be decimated and dispersed, and swarms can simply disappear. Both the gregarisation of solitarious populations and the further expansion of these gregarious populations into swarms depend on a multitude of environmental factors at different spatial scales, making locust swarms very difficult to predict (Despland et al. 2004).

The locusts lay their eggs and die in like manner after laying them. Their eggs are subject to destruction by the autumn rains, when the rains are unusually heavy; but in seasons of drought the locusts are exceedingly numerous, from the absence of any destructive cause, since their destruction seems then to be a matter of accident and to depend on luck.

Aristotle (350 B.C.E.) History of Animals, Book V, part 28

Control efforts are currently underway across Northern and Western Africa to halt the progression of swarms: ground and aerial spraying of insecticides, mainly organophosphates, were used to treat 2.2 million ha in November 2004, and an additional 880 000 ha in December (FAO 2005). More environmentally-friendly control agents, including the entomopathogenic fungus *Metarhizium* and insect growth regulators, are being developed, but have not reached the stage where they are used operationally. Widespread spraying against locusts raises concerns not only about risks to non-target organisms including livestock and people, but also about its efficacy. Locust swarms are very mobile and travel in very remote areas, and, during outbreak conditions, it is impossible to find, let alone treat, all swarms. Locust swarms can cover hundreds of kilometers per day with the right winds, and often cross international borders. Control operations therefore require precise up-to-date information on the positions of swarms, good infrastructure from which control efforts can be mounted wherever they are needed, and international cooperation. The history of locust control efforts shows the extent of these logistical challenges.

The last big locust plague occurred in 1986-1989. Gregarious populations appeared in the notorious breeding areas along the Red Sea coast. Pest management was neglected during the Ethiopian-Eritrean war, and locust populations grew unchecked in breeding areas strewn with landmines. Swarms soon spread to 23 countries. Massive control efforts were deployed and 25 million ha were sprayed with insecticide at a cost of US$ 310 million (Showler 2002). Hindsight now makes it clear that, although insecticide spraying saved valuable crops, the plague was brought to an end, not by control efforts, but by natural conditions. Like in the book of Exodus, swarms were blown out to sea and drowned; others were lost on barren desert sands and poor rainfall impeded further breeding.

Past experience thus suggests that it is next to impossible to bring severe plagues under control before they run themselves out naturally. Reactive interventions against large swarms are very costly, both financially and environmentally, and are not effective at halting plagues, although they can be critical in protecting valuable crops. Alternative proactive control strategies involve regular monitoring of populations in high risk areas, and spraying gregarious populations when they begin to pose a threat but before they spiral out of control (Showler 2002). These strategies can be effective at halting upsurges before they reach plague level, but require considerable investment on a continuous basis, even in years where locusts are not a threat. Few affected countries can afford to spare these resources on insects that are not causing an immediate problem, when so many other problems (including other pest insects) demand attention.

Some experts therefore advocate abandoning the hope of controlling outbreaks and focussing on protecting high value crops, leaving the locusts free rein with other vegetation (Enserink 2004). Indeed, although locust plagues can be catastrophic locally, the damage they cause is relatively small compared to other agricultural threats such as droughts and endemic pests, and does not have long lasting ecological consequences. A landscape can appear totally desolate after the passage of locusts, but desert vegetation is by nature transient and resilient, and grows back rapidly to its original state if rainfall is suitable. However, under this minimalist reactive approach, crops and pasturelands of low financial value are left to the locusts, and these resources are essential to economically vulnerable subsistence farmers and herders, who then need to be compensated for their losses. In many cases, food aid may be required. In 2004, Mauritania bore the brunt of most locust activity, and the crops that remain are expected to meet only 21% of cereal requirements (FAO 2004). Another 20% have been secured via commercial imports and food aid pledges, but food shortages are occurring in some areas.

The true costs of locust outbreaks are therefore not only financial but also social, political and humanitarian. This makes it particularly difficult to assess the importance of locust damage and to evaluate the relative value of different control strategies. Moreover, the practicality, desirability and effectiveness of locust control strategies remain controversial. Although we are no longer quite as powerless before locusts as were ancient peoples, Aristotle's observation still holds true, that, during a major plague, "their destruction seems then to be a matter of accident and to depend on luck".

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