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The importance of armed conflict to Desert Locust control, 1986-2002

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Abstract

In Africa and Asia in recent years (1986 to 2002), repeated outbreaks and plagues of the desert locust, *Schistocerca gregaria* (Forskål), have prompted the international community, through early intervention, to focus on preventing plague status from being reached. The relative lack of applied research breakthroughs on desert locust monitoring and control, means that for preventive or proactive control, direct access to the breeding areas is essential for both operations so that conventional, short-residual pesticides can be applied to gregarizing or fully gregarious populations. There are a number of challenges to desert locust survey and control as it is currently practiced: these include lack of funding and training, weak regional organizations, and remote and rugged terrain in breeding areas. The most intractable challenge to overcome, and arguably the chief cause for desert locust outbreaks to develop without suppressive interventions to plague status, is armed conflict, especially in countries with key breeding areas. Salient areas of armed conflict in countries where key desert locust breeding areas exist, and the impacts of those conflicts on desert locust survey and control, are described. Possible solutions of the problems presented by armed conflict for desert locust operations are discussed.

Key words

armed conflict, desert locust, locust control, *Schistocerca gregaria*

Introduction

Repeated outbreaks and plagues of the desert locust, *Schistocerca gregaria* (Forskål), in Africa and Asia (Showler & Potter 1991, Showler 1993, 1995b, 2001) in recent years (1986 to 2002), have prompted the international community to focus on prevention through early intervention (Showler 1997, 2002, FAO/EMPRES 1999). The general aim is to develop and implement practical, cost-effective, and environmentally benign strategies for plague prevention that incorporate improved survey and control tactics, and human and material resources at national and regional scales.

Research has focused on monitoring and forecasting desert locust activity, including global information systems (FAO/EMPRES 2000, FAO 2002), remote sensing of green vegetation (Tappan *et al.* 1988, PANOS Institute 1993), ground-based and synoptic weather patterns (FAO 2002), historical spatial and temporal desert locust activity (Pedgley 1981), improved communication links among locust-affected countries (FAO/EMPRES 1999), and adoption of global positioning units for pinpointing locations of locusts, particularly in remote areas (FAO/EMPRES 2000). These tools, however, have not yet been demonstrated in outbreak situations (Showler 2003).

Although research on control tactics has not produced much in the way of applicable results (Showler 2002), limited progress has occurred. Environmental concerns led to bans on the use of organochlorinated pesticides for locust control after the late 1980s (Wiktelius & Edwards 1997); so conventional short residual insecticide application has been the sole tactic for lack of choice (USAID 1991, Showler 1995a). Fipronil, a pyrazole, is a long-residual insecticide that might be more selective than banned insecticides such as dieldrin and fipronil and might be useful for barrier or block applications (Price *et al.* 1996, Rachadi 1999, Lockwood *et al.* 2000). Also, several virulent isolates of *Metarhizium flavoviride* were found in Eritrea (Swanson 1997) and Sudan (Kooyman & Abdalla 1998), and a South African isolate of *M. anisopliae* was formulated for commercial use (Lomer *et al.* 1997, Neethling & Dent 1998). Botanicals, mainly neem oil (Wilps *et al.* 1992) and *Melia* extracts (Nasseh *et al.* 1993) have shown potential in field tests (Diop & Wilps 1999) but neither have been operationally tested. Insect growth regulators (*e.g.*, benzoylphenylureas, diflubenzuron, teflubenzuron, and hexaflumuron) have shown promise against African migratory locusts, *Locusta migratoria* (Saussure), possibly as barrier treatments (Scherer & Rakotanandrasina 1993, Coppen & Jepson 1996, Coppen 1999). The paucity of breakthroughs on desert locust survey and control (Showler 2002) means that for both preventive or proactive control (Showler 1997), direct access to the breeding areas is essential. Major constraints to desert locust survey and control, as currently practiced, are summarized below.

Funding.— Locust-infested countries in the recession distribution, where the solitary phase of the desert locust exist between plagues (Steedman 1988), especially in the famine-prone Sahel and Horn of Africa, are unable to mount campaigns without international donor assistance. Many of these countries simultaneously appeal for food aid because of drought, armed conflict, and the effects of other agricultural pests (Showler 1995). Insufficient funding and lag between requests for resources and their delivery are sometimes crippling. Those few countries with sufficient funds to have created strong locust-control units (*i.e.*, India, Oman, Pakistan, Saudi Arabia) do not assist poorer countries in order to prevent outbreaks from invading their own borders. Heavy reliance on bilateral and multilateral aid contributes to "donor fatigue" because the problem appears to be solvable, but incessant (Lockwood *et al.* 2001).

Training.— Indigenous training programs for desert locust control have been initiated by aid agencies, but their sustainability has not been measured. Personnel turnover in the ministries of agriculture, shortages of funds, and competing priorities have hindered the establishment of national training activities (Showler 2002). Poor training is associated with reduced survey and control efficiency and safety (USAID 1991).

Weak regional organizations.— The only functional regional organization is the Desert Locust Control Organization for Eastern Africa (DLCO-EA), but it lacks funding (it relies to some extent on international aid) for salaries and aircraft maintenance.

Rugged and remote terrain.— Many desert locust breeding areas are located in vast, remote, and rugged desert terrain (Pedgley 1981, Steedman 1988). Rapid deployment of scarce resources is often problematic because of harsh conditions, long distances, and poor infrastructure (Showler 2002).

Armed Conflict

The most intractable challenge to overcome, and possibly the chief cause for desert locust outbreaks that reach plague status, is armed conflict (Showler 2001). Following are salient examples of insecurity arising from armed conflict in important recession-area countries, from the beginning of the 1986 to 1989-plague until 2002, that has either directly or indirectly impaired locust survey and control. Countries in which insecurity is particularly important are presented alphabetically.

Algeria.— Violence by Islamic extremists in Algeria began after a general election was cancelled by the government in Jan 1992, one which Islamic fundamentalists were expected to win (Roberts 2003). During 10 y, 100,000 to 150,000 people were killed (BBC 2001a). The scale of the terror tactics, from assassinations to massacres by Islamic militant groups, have impeded travel to and within Algeria. During this time, however, no large-scale desert locust outbreaks occurred in the breeding areas around Tamanrasset and the Ahaggar Mountains. Although the government is in a state of political paralysis (BBC News 2002a), no intensive or widespread locust control operations have been required. It is conjectured that any large-scale operations mounted by the government could be hindered by the nationwide insecurity.

Chad.— The border with Libya was tense and off limits to travelers, especially during the 1980s and early 1990s, after Libya and Chad waged war when Libya tried to annex the Aouzou strip in northern Chad (BBC News 2000d, 2002b; Collins 1999); this is part of the desert locust's Tibesti breeding area (Pedgley 1981). Civil war, mostly in the Tibesti, between the government and the Movement for Democracy and Justice in Chad National Resistance Army (BBC News 2003a), has also impaired travel there. Systematic desert locust control in northern Chad during the 1986 to 1989 desert locust campaign was not possible, partly because of insecurity. In August 1995, swarms of African migratory locusts, *Locusta migratoria migratorioides* Saussure, suspected, because of prevailing winds and historical locust activity, to have originated in the contested Tibesti of northern Chad, invaded the central highlands of Eritrea.

The southern Chad border with the Central African Republic has been the site of military clashes involving both countries (BBC News 2002d). The armed forces for the Federal Republic of Laouken have also skirmished with Chadian troops in the south (BBC News 1997a,b). Continued armed conflict in Chad, especially the Tibesti, could affect future desert locust operations.

Egypt.— Islamic militants mounted terror operations in Egypt from 1986 to 2002. This became known globally when 58 foreign tourists and 2 Egyptians were shot and hacked to death at the Temple of Queen Hatshepsut in Luxor (BBC News 2001b); the terrorism was reportedly financed by al-Qaeda (BBC News 1999a). Terrorism in Egypt has resulted in heightened travel advisory cautions, but it did not appear to impair desert locust survey and control in early 1998 (swarms arrived from the rebel-held southern coast of Sudan). Thousands of hectares were sprayed, and the swarms were eliminated before breeding (Showler 2002a).

Eritrea.— Eritrea's Red Sea coast, especially north of Massawa, is, combined with the southern coastal plains of Sudan, arguably the world's most prolific desert locust breeding area. In 1962, Eritreans began a 30-y war for independence from Ethiopia under the Soviet-backed Dergue regime led by Miriam Mengistu Haile (Papstein 1991). Warfare between the Ethiopian military and the Eritrean People's Liberation Front guerrilla army escalated to tank and artillery battles that rivaled those of North Africa in World War II. Fighting enveloped all of Eritrea except for the capital city of Asmara (Papstein 1991). The largest and most costly desert locust plague in the last 20 y began in 1986 on the Red Sea coast of Eritrea and Sudan (Showler & Potter 1991). The Eritrean war for independence prevented timely intervention against the early stages of the plague which, over the course of 4 years, spread to 23 countries in Africa and Asia: it cost the international aid community US$310 million to finance a reactive campaign (Showler 1997) that eventually declined because of climatic factors (Showler & Potter 1991). Land mines from the war still make off-road travel in parts of Eritrea's coastal and western lowlands, including key breeding areas near Mersa Gulbub, potentially dangerous. Therefore, some survey and control operations must be conducted by DLCO-EA's aging aircraft. Similarly, the desert locust upsurge of 1992 to 1994 began on the coastal plains of Eritrea and Sudan. In Eritrea, unpreparedness immediately after 30 y of war, seriously impeded early control. The infestation spread to 18 countries in Africa and Asia, and the campaign cost the international donor community ≈ US$18.5 million (Showler 1995b).

In 1996, Eritrean military units displaced Yemeni forces from the Hanish islands in the Red Sea (BBC News 1998a). This clash disrupted communication and travel between the 2 countries until the dispute was resolved in 1998 at an international court (BBC News 1998a, Showler 2001a). In 1996, Islamic insurgents, reputedly from Sudan, shot Eritreans and Belgians on 2 or 3 occasions on Eritrea's Filfil escarpment road that leads directly from the highlands between Asmara and Keren to the coastal plain's Shelshela desert locust breeding area. As a result, the Filfil road was closed for several months (Showler 2001a).

Ethiopia launched 2 air strikes against Asmara in June 1998, and Eritrea responded with an air strike against Mekele in Ethiopia's Tigray province, after months of escalating tensions over border areas and trade issues (Showler 2001a). The air attacks prompted a sporadic but full-blown war involving tanks, jets, helicopters, artillery, and, on occasion, massive human wave assaults by Ethiopia (in one battle, Ethiopia lost ≈ 10,000 troops killed). Though poorly reported, this conflict was the largest military confrontation in the world at that time, until the conflagration ended in a stalemate in June 2000 when Ethiopia invaded portions of southwestern Eritrea. United Nations peacekeeping forces were requested by both governments, and they remain in place as of this writing in February 2003. The war diverted resources, including crop protection personnel, to active military duty and it closed travel and communication between the 2 countries. Many development projects funded by international aid agencies were frozen for more than a year after hostilities ended. Although the 1998 to 2000 war did not occur during a desert locust

outbreak, the 1997 to 1998 regional outbreak that began on the coasts of Eritrea and Sudan was ended through human intervention 1 mo. before the June 1998 air strikes (Showler 2001b). Peace in Eritrea at that time permitted control operations as soon as gregarious desert locust populations were detected. This campaign, which involved 7 countries in Africa and Asia at a cost to the donor community of US$30,000, suggests that, in light of the 1986 to 1989 and 1992 to 1994 campaigns, lack of armed conflict in Eritrea is critically important to success (Showler 2001b, 2002).

The western lowlands of Eritrea that border Sudan are also problematic because some areas are still mined from the war for independence, and tensions with Sudan are often heated. The sources of these tensions are two-fold: Eritrean support for Sudanese rebel armies (BBC News 2000a) and Sudanese Islamic insurgency within Eritrea (*e.g.*, the attacks on the Filfil road). These tensions caused intermittent and prolonged (up to 6-y) closures of mutual embassies (BBC News 2000b) and movement within parts of the lowlands in Eritrea was restricted by the military. In the summer of 1999, an Eritrean ministry of agriculture technician and a driver who had strayed near the border were forcibly detained in Sudan for 41 d.

Ethiopia.— Oromo, Somali, and other ethnic groups skirmished with government troops under the Amhara and the Tigray regimes that have ruled Ethiopia for the period 1986 to 2002. These insurrections and the wars with Eritrea cost the Ethiopian government resources that otherwise could have been used by the ministry of agriculture. Some uprisings have occurred in the Ogaden Desert (eastern Ethiopia) where desert locusts occasionally breed. Parts of the Ogaden have been unsafe for travel because of rebel activity and banditry (Showler 2001a). In 1992, a French-piloted desert locust survey helicopter was presumably shot down by rebels or bandits near the Somalia border, killing 2 of the 3 persons on board. In 2000, Kenya claimed that Ethiopian soldiers were repeatedly crossing the border, killing Kenyan civilians and police, and rustling cattle (Showler 2001a). The Ethiopian border with Sudan has also been intermittently tense during the period 1986 to 2002.

India-Pakistan border.—The desert locust's recession distribution extends to encompass western India (Steedman 1988). The Tharparkar and Cholistan deserts along the southern border between India and Pakistan are the easternmost key breeding areas (Pedgley 1981). Ever since the partition of Pakistan from India more than 50 y ago, both countries have harbored animosity rooted in religion and history, and this has recently escalated into an arms race involving nuclear weapons (Ganguly 2002, Jones 2002). During the period 1986 to 2002, the main source of tension between the 2 countries has been Kashmir, located on the northern border. Military skirmishes have occurred along the Kashmir border, and terrorism over Kashmir has occurred inside the borders of both countries (BBC News 2001h). During the desert locust campaigns of 1986 to 1989 and 1992 to 1994, both of which involved breeding in the southern border deserts, locusts were controlled before spreading (Showler & Potter 1991, Showler 1995b), but cooperation between India and Pakistan was limited to occasional exchanges of information on locust activity. Because India and Pakistan are well-equipped for unilateral survey and control, hostilities have not seriously impeded efficiency.

Libya.—Tension between the USA and Libya was high in 1986 because of Libya's ties with international terrorism. In early 1986, US military forces sank 2 Libyan patrol boats in the Gulf of Sirte (El-Kikhia 1998, BBC News 2001g). A month later, a bomb exploded in a West Berlin disco, killing 2 US servicemen and a Turkish woman (BBC News 2001g). Ten days later the US retaliated with air strikes against Tripoli and Bengazi, killing Libyan leader Muammar Qaddafi's daughter and 15 other civilians (BBC News 2001g). Libya has been isolated by much of the international community and international sanctions were imposed against it in 1992 for its connection with the 1988 bombing of a passenger airliner over the Scottish town of Lockerbie (BBC News 2003b). In 1999, however, Libya extradited the Lockerbie suspects for trial in Europe, and the United Nations suspended its air, weapons, and diplomatic sanctions (BBC News 2001f). The US, however, extended its own unilateral sanctions against Libya for 5 y in 2001 (BBC News 2001g).

Libya harbors potential desert locust breeding areas of secondary importance to many of those mentioned elsewhere in this article (Pedgley 1981). The areas are primarily located in the southern desert from Algeria to Sudan, but during the period 1986 to 2002, no major desert locust activity occurred. If an outbreak had occurred in Libya, international assistance would likely not have been rendered, although assistance from the US and other donors was provided for New World screwworm fly, *Cochliomyia hominivorax* Coquerell, eradication (Showler 1991). Libya's relatively weak agricultural ministry and lack of infrastructure in the south would likely have impaired early control.

Mali and Niger.— The Adrar des Iforas Mountain region of northern Mali and the Tamesna and Aïr Mountain regions of northern Niger are all important desert locust breeding areas (Pedgley 1981). The 2 countries are considered together because they have been relatively peaceful, and because the chief source of armed conflict in both has been comprised of Tuareg rebellions. The Tuareg, descended from the Berbers of North Africa, inhabit the Sahara and Sahel regions from Mali to Libya (Nicolaisen & Nicolaisen 1997). Beginning in the early 1990s, the Tuareg turned from occasional banditry (BBC News 1998h) to rebellion in Mali and Niger. In 1994, 5 Malian military escorts with a desert locust survey team were killed in a battle with Tuareg rebels (Showler 1997). Tuareg insurrection made travel to and within the key breeding areas dangerous and subject to restriction (Showler 1995b). Although some of the Tuareg groups have laid down arms, others remain active (BBC News 1998i).

Mauritania.— Mauritania is largely desert and much of it is favorable to desert locust breeding (Pedgley 1981). Extensive breeding occurred in Mauritania during the 1986 to 1989 and 1992 to 1994 campaigns (Showler & Potter 1991, Showler 1995b). Although Mauritania has mostly been peaceful, tracts of northern Mauritania are strewn with land mines, which limits complete accessibility to potential breeding areas (Showler 1995b).

Saudi Arabia.— Saudi Arabia's ministry of agriculture unilaterally conducts desert locust survey and control with its own personnel, vehicles, and aircraft, so its policies and any conflicts that could affect the international donor community's ability to render assistance is moot. Desert locust breeding mainly occurs along the Red Sea coast, the southern part of which, called the Tihama, extends into Yemen: it is notably prolific (Pedgley 1981). Areas of secondary concern include the south central Rub al-Khali (Empty Quarter) and the north-central desert where survey and control are challenged by lack of infrastructure, not armed conflict. Limited internal Islamic terrorism, confined to large urban centers, has had little or no effect on desert locust control, nor did Iraq's invasion of Kuwait on 2 Aug

1990, and the US-led coalition's Gulf war, involving Saudi Arabian military forces and bases, that began on 17 Jan and ended 28 Feb 1991 (Blair 1993). Border clashes with Yemen occurred from 1998 to 2000 (see section on Yemen) (BBC News 1998c, 2000e). Locust operations in 1992 to 1994 in the Tihama and the north-central interior (Showler 1995b), and along the Tihama in 1998 (Showler 2002a) were largely successful.

Somalia.— Since President Siad Barre was overthrown by opposing Somali clans in 1991, Somalia has been without an effective central government (Peterson 2000). Fighting between rival warlords and inability to deal with famine and disease has led to the deaths of up to one million people (BBC News 2002m). In 1993, US soldiers were deployed in Mogadishu to assist United Nations peace keeping forces ensure food distribution for famine relief; but heavy fighting erupted between US forces and Somali warlords that resulted in 18 American soldiers and at least 500 Somali fighters and civilians killed (Bowden 1999). US forces were subsequently withdrawn, and the UN's attempt to establish a stable coalition government was aborted (Bowden 1999). Factional fighting continued even when a transitional government was put in place in 2000 (BBC News 2002n). A UN arms embargo on Somalia has been in place since the early 1990s and, in 2002, the UN Secretary General, Kofi Annan, stated that Somalia was still too dangerous to open a UN office in Mogadishu (BBC News 2002o). In 1996 to 1997, the al Qaeda-linked Somali group, al Ittihad, carried out a series of attacks and bombings in Ethiopia. Ethiopia responded with incursions into southern Somalia in both years to crush al Ittihad (BBC News 2002r). In 2002, Ethiopian troops were reported to be moving into the self-declared autonomous region of Puntaland in north-central Somalia, and into parts of southern Somalia (BBC News 2002p,q). Al Ittihad was reputedly still linked to al Qaeda and was operating in Somalia in 2002 (BBC News 2002s).

The chaos of Somalia has prevented the formation of a functional ministry of agriculture, and desert locust survey during the late 1990s was conducted by a single UN volunteer, one Somali counterpart, and occasional FAO-funded aerial missions for the Desert Locust Control Organization for Eastern Africa (DLCO-EA) (Showler 2001a). During the 1997 to 1998 desert locust campaign, old stocks of insecticides had to be trucked from Djibouti to Hargeisa, Somaliland (northern Somalia). However, several swarms apparently developed in Somaliland and flew into the Ogaden region of eastern Ethiopia where they were eliminated before reaching the highlands (Showler 2002b). Any serious desert locust outbreak in Somalia would almost certainly magnify without effective intervention. Somalia is an example of how armed conflict, widespread and chronic, can eliminate national desert locust survey and control.

Sudan. — The Red Sea coastal plain, particularly around the Tokar Delta and southward to the Eritrean border, is one of the most prolific desert locust breeding areas (Pedgley 1981). The southern plain, however, has been held by the Beja Congress rebel army. The only swarms to escape control in their initial breeding grounds in Eritrea and Sudan, 1997 to 1998, came from the Beja Congress-held coastal plains (Showler 2001b, 2002a). The northernmost part of coastal Sudan around Halaib was contested during the 1986 to 2002 period by Sudan and Egypt (BBC News 1988b). The Halaib area was occupied by the Egyptian military and was off limits to desert locust scouts from both countries. The eastern lowlands of Sudan around, and sometimes including, Kassala has been held by National Defense Alliance rebels for more than a decade (BBC News 2000c).

The government of Sudan has been fighting against other rebel armies, mostly based in the south, in addition to the Beja Congress and the National Defense Alliance, since its independence in 1956 (except between 1972 and 1983) (BBC News 2002l). The biggest rebel force is the 40,000-strong Sudan People's Liberation Army (Salopek 2003). The military costs of these civil wars have been debilitating to other government sectors, including the ministry of agriculture. Shortages of vehicles, equipment, and funds for salaries have impeded survey and control (Showler 2001a).

Sudan's capacity to embrace an effective early desert locust and control strategy was further hindered by its isolation from international aid agency assistance for harboring terrorist cells, including al Qaeda. This was underscored by the 1997 US missile strike on a "pharmaceutical plant" in Khartoum suspected of manufacturing chemical weapons.

Western Sahara.— Western Sahara is largely held and laid claim to by Morocco, but supporters of the pro-independence movement, the Polisario Front, have been at war with Morocco since 1975 when Spain pulled out (BBC News 2001d, 2002j). Many of the Polisario take refuge from Morocco's military in Algeria (BBC News 2001e), which has heightened tensions between Morocco and Algeria. Also, the Polisario has held ≈ 1360 Moroccan prisoners-of-war in Algeria as bargaining chips, some for more than 20 y (BBC News 2001e, 2002k). In 1988, 2 US C-130 desert locust spray aircraft, enroute from Senegal to Morocco, were hit with Polisario shoulder-launched surface-to-air missiles. One C-130 crashed, killing the entire crew. Desert locust survey and control is not possible in Western Sahara because of Polisario activity there. During the 1986 to 1989 desert locust plague, swarms entering Western Sahara from Mauritania and Algeria could not be tracked or controlled until they emerged in Morocco (Showler & Potter 1991). Since then, Western Sahara has not had much desert locust activity, but if desert locusts were to develop to plague status in West Africa, or to begin breeding and gregarizing in Western Sahara, Western Sahara could become highly problematic.

Yemen.— The modern Republic of Yemen was formed in 1990 when traditionalist North Yemen and Marxist South Yemen merged after years of skirmishing (Dresch 2001, BBC News 2002e). The division of Yemen until 1990 was partially responsible for the spread of the 1986 to 1989 plague because of chronic conflict. There are 2 main breeding areas in Yemen: the Tihama along the Red Sea coast (North Yemen) and the Hadramawt (South Yemen) (Pedgley 1981). In mid-1994, after the 1992 to 1994 desert locust campaign, which involved breeding and largely ineffective control operations in the Tihama (Showler 1995b), a civil war erupted for several weeks that ended in defeat for separatist southern Yemenis (BBC News 2002e). Although no desert locust activity was underway, the civil war involved damage to and looting of ministries, including the ministry of agriculture, which weakened Yemen's preparedness.

A dispute over ill-defined tribal homelands and frontiers in the Arabian peninsula has engaged Yemen and Saudi Arabia since the 1930's (Smith & Auchterlonie 1998, BBC News 2000f). As an example of the intensity of tensions, the Yemen government in 1998 accused Saudi Arabia of violating its border 73 times over a 4-w period; transgressions included military deployments, shelling of the military and civilians, and violations of Yemeni air space and territorial waters (BBC News 1998d, e). The border conflict impaired communication and travel between the 2 countries, and locust surveillance on the border. (For Yemen's conflict with Eritrea over the Hanish Islands, see the section on Eritrea.)

Yemen's interior ministry estimated there are about 60 million firearms in Yemen, or about 3 for every citizen. Machine guns, land mines, hand grenades, rocket launchers, and myriad light firearms are sold on blankets or in stalls from various arms bazaars (BBC News 2002f). The ubiquity of weaponry in Yemen, and the tribalism accompanied by long standing inter-clan enmities, have resulted in numerous clashes between clans and with government forces (BBC News 1998f; 1999b, c; Dresch 2001). Yemeni tribes and clans have used foreign hostages (*e.g.*, Americans, Australians, British, Chinese, French, Germans, and Swedes), usually, but not always, without harming the victims, in order to extort funds or improvements to infrastructure from the government (BBC News 1998g; 1999d, e; 2000g, h). In 1999, an Islamic fundamentalist imam exhorted Moslems in Yemen to kill all "infidels" in the country (Showler 2001a).

In 2000, Yemen became the site of al Qaeda terrorism when the USS Cole was attacked by suicide bombers on a boat in the Port of Aden (BBC News 2001c, 2002f). Since then, al Qaeda bombed a French tanker in the Gulf of Aden (BBC News 2002f) and US and Yemeni military forces attacked al Qaeda by air and ground mainly in the remote Marib and Hadramawt areas (BBC News 2002g,h). Insecurity because of border tensions, clan rivalries, hostage taking, Islamic zealotry, and international terrorist activity has resulted in chronic travel difficulties to and throughout much of the country, including within the capital, Sana'a, which has hindered locust survey and related development activities.

Potential Solutions

Desert Locust Strike Forces.—The idea of special multinational desert locust operations teams, such as the Maghrebian Strike Force (Showler 1995), which could conduct cross-border operations when certain countries could or would not perform them, has been raised in international conferences. The Maghrebian Strike Force was formed by the Commission de Lutte Contre le Criquet Pelerin en Afrique du Nord-Oest (CLCPANO) using Islamic Development Bank, Food and Agriculture Organization (FAO), and member country (Algeria, Libya, Mauritania, Morocco, and Tunisia) funds (CLCPANO 1991). in the early and mid 1990s, while the strike force existed it conducted operations mostly in Mauritania and Mali, the latter of which is not a member of CLCPANO. The problem with promoting regional teams is that they are as vulnerable to insecurity as national units. The DLCO-EA, for example, does not operate in war zones, and must pay high insurance rates and protection fees for storage and aircraft refueling or loading in northern Somaliland. Also strike forces like the DLCO-EA, would depend to a large extent on member country contributions. In the case of DLCO-EA, most member countries have not paid their fees for years; the DLCO-EA is in arrears and cannot always pay the salaries of its staff; maintenance and renovation of its aging aircraft has been highly problematic for the last decade or more. Some regional locust control organizations, such as the Organisation Commune de Lutte Anti-Acridienne et de Lutte Anti-Aviaire (OCLALAV), are no longer functional and others, like the Organisation Internationale Contre le Criquet Migrateur Africain (OICMA), have been abolished.

Assistance to Rebel Armies.—Rebel armies in one country are often supported by neighboring countries. Eritrea and Ethiopia, for example, have provided support to the SPLA and other rebel groups in Sudan, and Sudan has supported insurgency in Eritrea and Ethiopia. In situations where a desert locust outbreak develops in rebel-held territory adjoining a sympathetic country, as was the case in 1997 to 1998 on the Beja Congress-held southern coast of Sudan, Eritrea could conceivably assist the rebels to conduct desert locust control by providing equipment (either as donations or loans) and training in secure rebel-held areas or across the border in Eritrea itself. It is also conceivable that neighboring countries could conduct the operations in rebel-held territory. This approach, however, is fraught with potentially negative political ramifications. Tensions could be heightened if the collaboration were discovered, and this could be further complicated if equipment or funds originated from bilateral or multilateral aid organizations. There have been suggestions at international meetings about convincing warring groups to permit control operations by independent teams, but this is unlikely given the potential dangers to the team and intelligence-related concerns that the opposing sides would certainly harbor. This approach has not been attempted, quite possibly because neither side is likely to permit such incursions.

Conclusion

Although remote sensing is not a panacea for early intervention against developing desert locust outbreaks, it appears to have potential if used together with global information systems technology, climate and weather patterns, and historical desert locust activity aimed at enhancing forecasting (Showler 2003). There are areas that should receive greater priority than others for remote sensing and the building of composite maps for probabilistic forecasting. While recession breeding areas are more important to preventive strategies (FAO 1995) than other areas, some recession breeding areas would certainly benefit more than others from remote sensing because of their inaccessibility. Inaccessibility mostly occurs because of remote, rugged terrain, poor infrastructure, or because of armed conflict. Although remote sensing will not necessarily contribute toward control within contested areas, it can assist by enhancing locust control preparedness in adjacent and accessible areas. However, African and western Asian conflicts can be long-term or sporadic; they can be fluid, as civil wars, ethnic strife, and border wars erupt, then subside. Hence, for remote sensing to be of immediate use during those times, the technology must be adaptable to changing conditions and areas on an 'as-needed' basis (Showler 2003). The FAO has also been focusing on the development of contingency plans on a national scale (FAO 2000), and these plans should account for areas of armed conflict that overlap with key breeding areas. Anticipation by neighboring countries that could be affected by swarms emanating from the conflicted country, might be the only way of coping with the inaccessibility of insecure breeding areas. This, of course, entails the formulation of various possible scenarios and of case-by-case contingency plans for dealing with each. Because there appears to be no one modality by which every instance of inaccessibility related to armed conflict can be approached, this conundrum likely needs to be addressed in the most flexible manner in order to meet a range of possibilities once desert locusts begin breeding.

The inability to intervene against desert locust populations in contested areas remains an intractable problem, more difficult to overcome than other challenges to desert locust control because of the unacceptability of sacrificing human life for pest management purposes, as well as for the political complexities that can arise. While some scenarios might conceivably be dealt with successfully within conflict zones, possibly by desert locust strike forces or by assisting rebel groups to conduct control themselves, most instances of

locust activity in contested areas are not likely to be abated through human intervention as long as hostilities are ongoing.

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