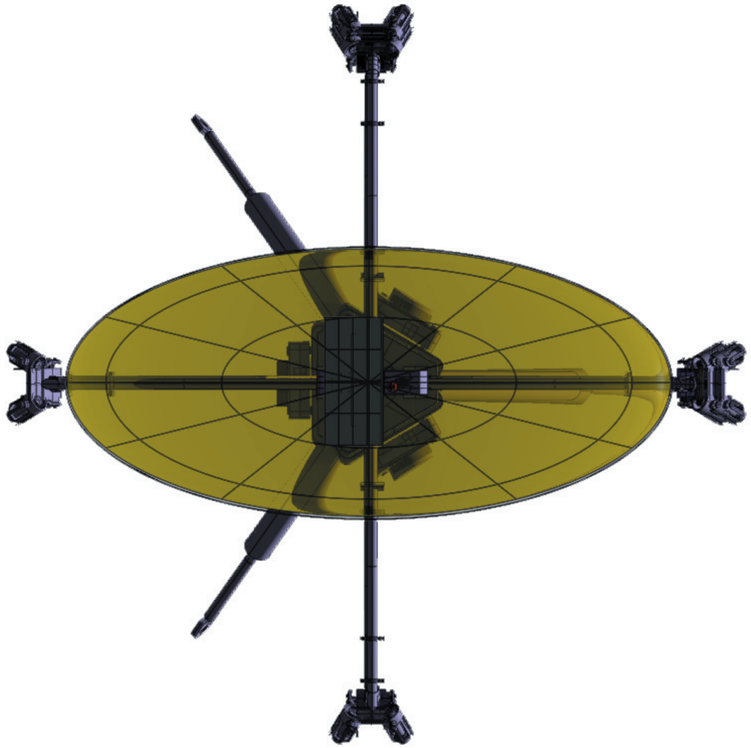
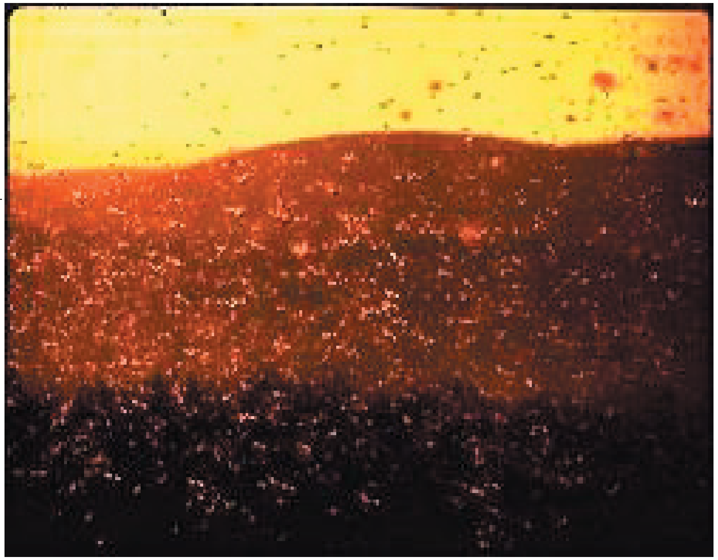
LocuSent

LocuSent is a proposal for a massive monitor and control system for the desert locust.
It's an extensive sensor network system that can survey vast and remote areas in order to prevent outbreaks and thereby prevent the terrible famine and the disastrous economical losses that follows in the trail of the locust.



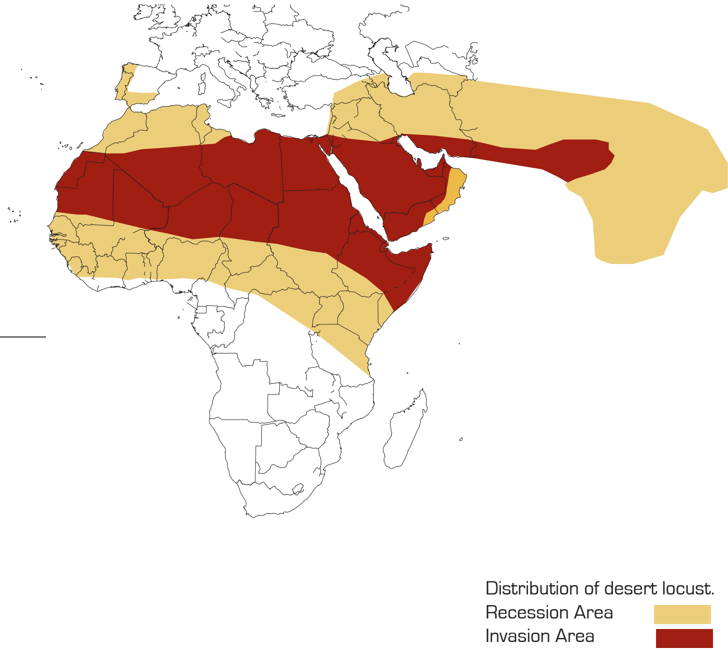
Locust is the name given to the swarming phase of short-horned grasshoppers of the family Acrididae. The origins and apparent extinction of certain species of locust—some of which reach 15 cm in length—are unclear.

There are species that can breed rapidly under suitable conditions and subsequently become gregarious and migratory. They form bands as nymphs and swarms as adults both of which travel great distances during which they can strip fields rapidly and in so doing greatly damage crop yields. An exacerbating factor in the damage to crops caused by locusts is their ability to adapt to eating almost any food plant.



Plagues of desert locust, Schistocerca gregaria, have been recognized as a threat to agricultural production in Africa and western Asia for thousands of years. Locust scourges are referred to in the Christian Bible and the Islamic Koran. In some places, locust plagues have been held responsible for epidemics of human pathogens, such as cholera (this is because of the massive quantities of decomposing locust cadavers that would accumulate on beaches after swarms flew out to sea and drowned). Published accounts of locust invasions in North Africa date back to about AD 811. Since then, it is known that desert locust plagues have occurred sporadically up until the present.

Normally, the desert locust is a solitary insect that occurs in desert and scrub regions of northern Africa, the Sahel (region including the countries of Burkina Faso, Chad, Mali, Mauritania, and Niger), the Arabian Peninsula (e.g., Saudi Arabia, Yemen, Oman), and parts of Asia including western India. During the solitary phase (yellow area on map), locust populations are low and present no economic threat. After periods of drought, when vegetation flushes occur in major desert locust breeding areas (e.g., India/Pakistan border), rapid population build-ups and competition for food occasionally result in a transformation from solitary behaviour to gregarious behaviour on a regional scale (red area on map). Following this transformation, which can occur over two or three generations locusts often form dense bands of flightless nymphs and swarms of winged adults that can devastate agricultural areas.



Desert locusts can consume the approximate equivalent of their body mass each day (2 g) in green vegetation: leaves, flowers, bark, stems, fruit, and seeds. Nearly all crops, and non crop plants, are at risk, including millet, rice, maize, sorghum, sugarcane, barley, cotton, fruit trees, date palm, vegetables, rangeland grasses, acacia, pines, and banana. Crop loss as a result of desert locust infestation is difficult to characterize, but it will be important for developing intervention strategies on a demonstrably cost-effective basis.

In 2004, West Africa faced the largest desert locust outbreak in 15 years. The costs of fighting this outbreak have been estimated to have exceeded US$60 million and harvest losses were valued at up to US$2.5 billion which had disastrous effects on the food security situation in West Africa. The countries affected by the 2004 outbreak were Algeria; Burkina Faso; the Canary Islands; Cape Verde; Chad; Egypt; The Gambia; Guinea; Libyan Arab Jamahiriya; Mali; Mauritania; Morocco; Saudi Arabia; Senegal; Sudan; Tunisia; Yemen and it was one of the main factors contributing to the famine in Niger.

Monitoring locust populations during recession periods to anticipate the onset of gregarious behavior and to locate locust bands and swarms for control operations during outbreaks and plagues is a difficult task that has become increasingly technologically sophisticated. Model-generated forecasts of locust population events and general patterns of swarm movement during outbreaks and plagues are attempted using weather and vegetation index information gathered from satellite platforms, meso-scale and synoptic-scale weather patterns, soil mapping, and probabilities based upon historical knowledge about locust population dynamics throughout the recession and plague distributions. Though useful, these tools are not always accurate or timely.

Despite the existence of such elaborate technology for roughly guiding locust scouts, the discovery of locust bands and swarms is accomplished through visual and audial surveillance.

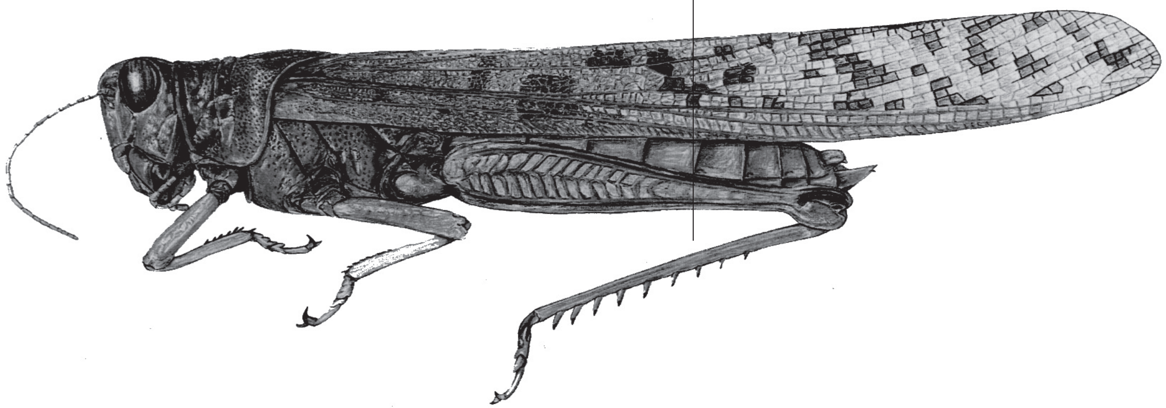
Comparatively effective, quick-to-apply and cheap control methods became available in the late 1950s which were based on persistent organochlorine pesticides like dieldrin. These were discontinued when it became clear that they posed unacceptable risks to human health and the environment. The current methods require that pesticides are applied in a more precise manner directly onto locusts. This means more resources are needed to locate and treat infestations. At present the primary method of controlling desert locust swarms is with organophosphate insecticides applied in small concentrated doses by vehicle-mounted and aerial sprayers. The insecticide must be applied directly to the insect.

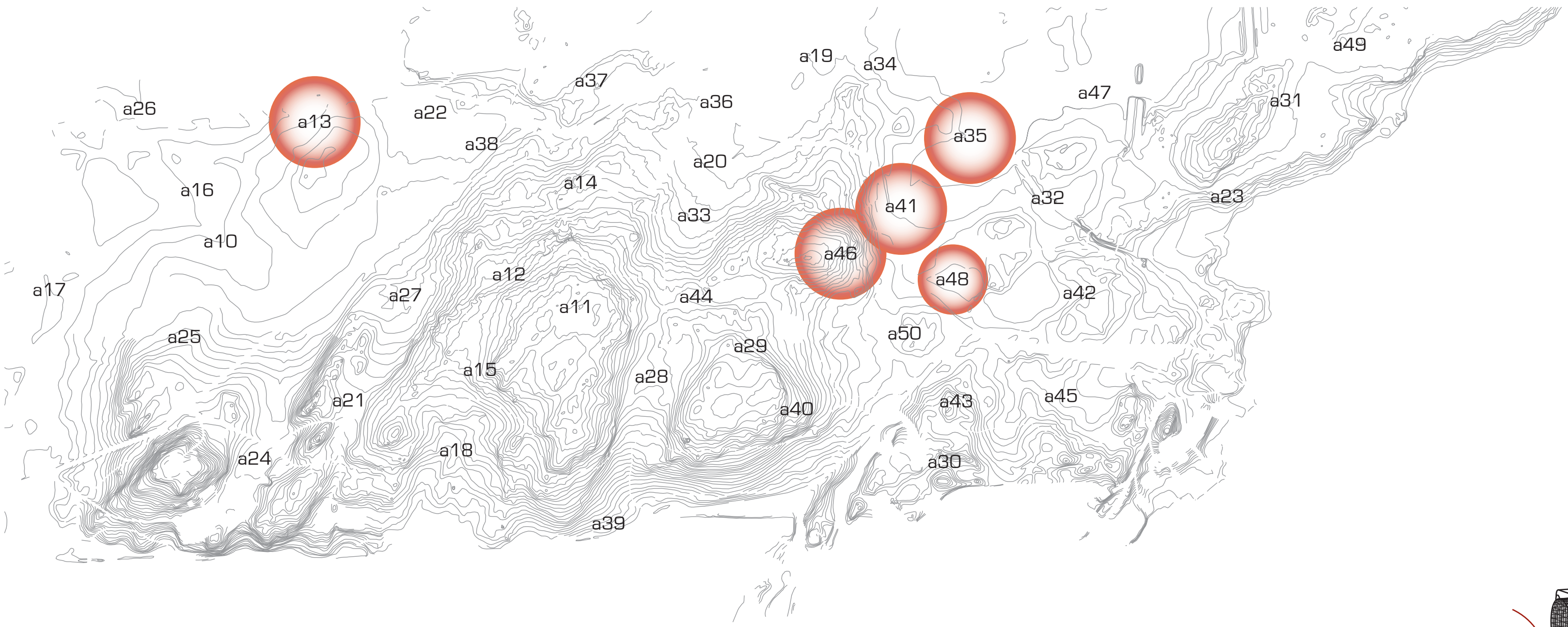
Grasshoppers, locusts, crickets and katydids belong to a group of insects known as orthopterans (meaning 'straight wings'). One of the most recognisable features of this group is their ability to produce sounds by rubbing together certain parts of their body. This is known as stridulation. Usually only the males sing to attract females but, in a few species, the female also produces sound.

Grasshoppers and locusts have a row of pegs like a comb on their back legs. They scrape these pegs against the hard edges of the front wings to make sounds.

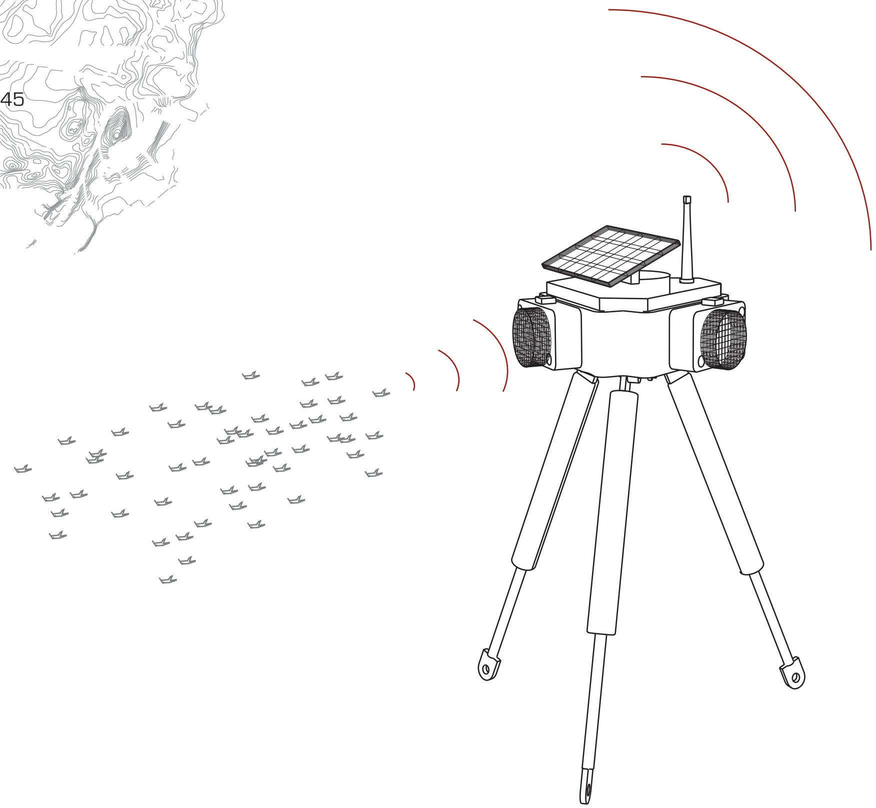
Experts are able to identify the different species of grasshopper by the sound they make. Since each species has a slightly different arrangement of pegs on their legs, the sound they make is unique. It's therefore possible to distinguish the desert locust from other grasshoppers and insects by their sound only.

The LocuSent is triggered by the unique sound of the desert locust. Its sensors are set to detect the specific sound frequency produced by the stridulation of a swarm. Once it detects a swarm, it reports its id-number and position to a central monitor system.

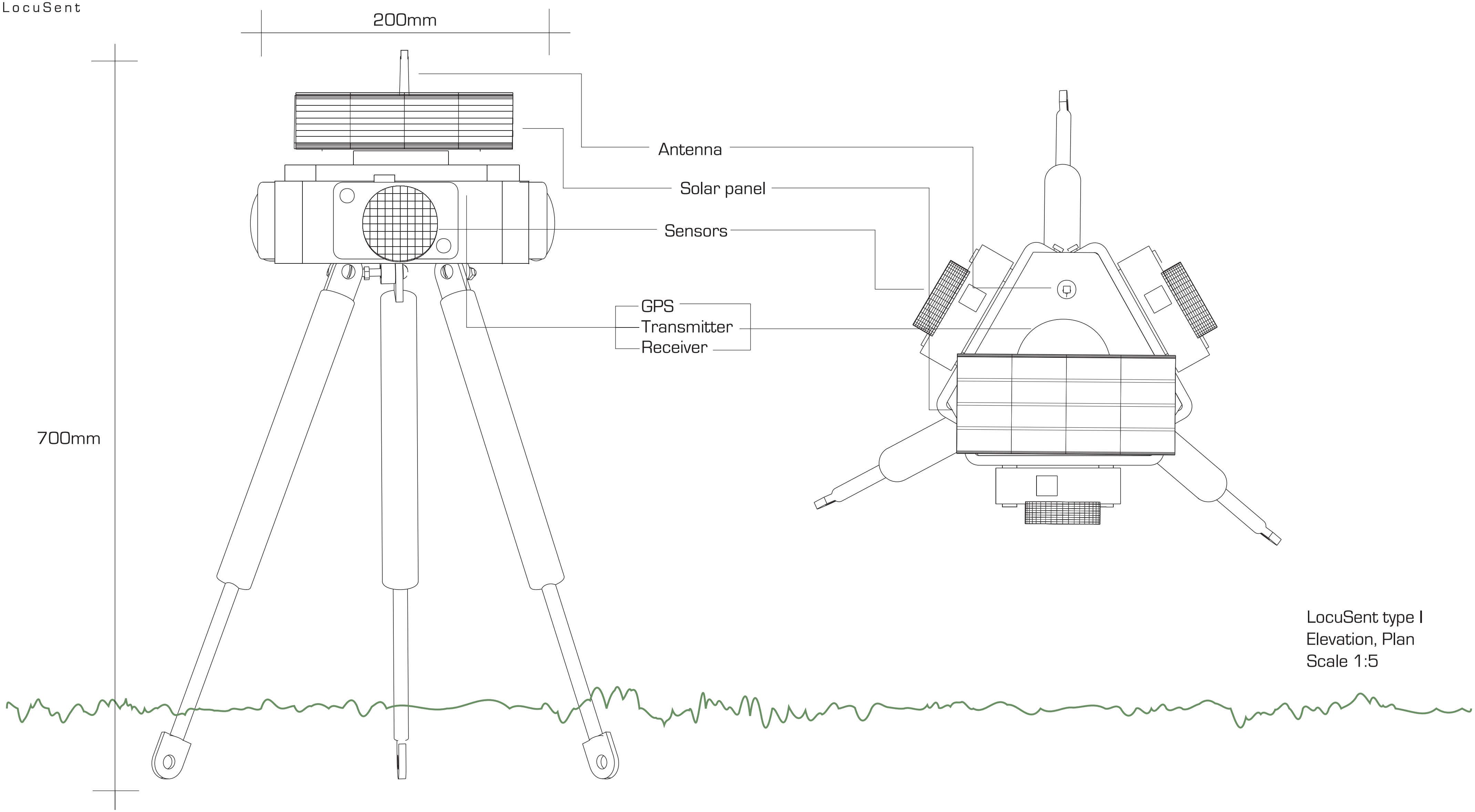




The desert locust is a difficult pest to control, and control measures are made more difficult by the large and often remote areas (16-30 million sq. km) where locusts can be found. Undeveloped basic infrastructure in some affected countries, limited resources for locust monitoring and control and political turmoil within and between affected countries further reduce the capacity of a country to prevent swarms.

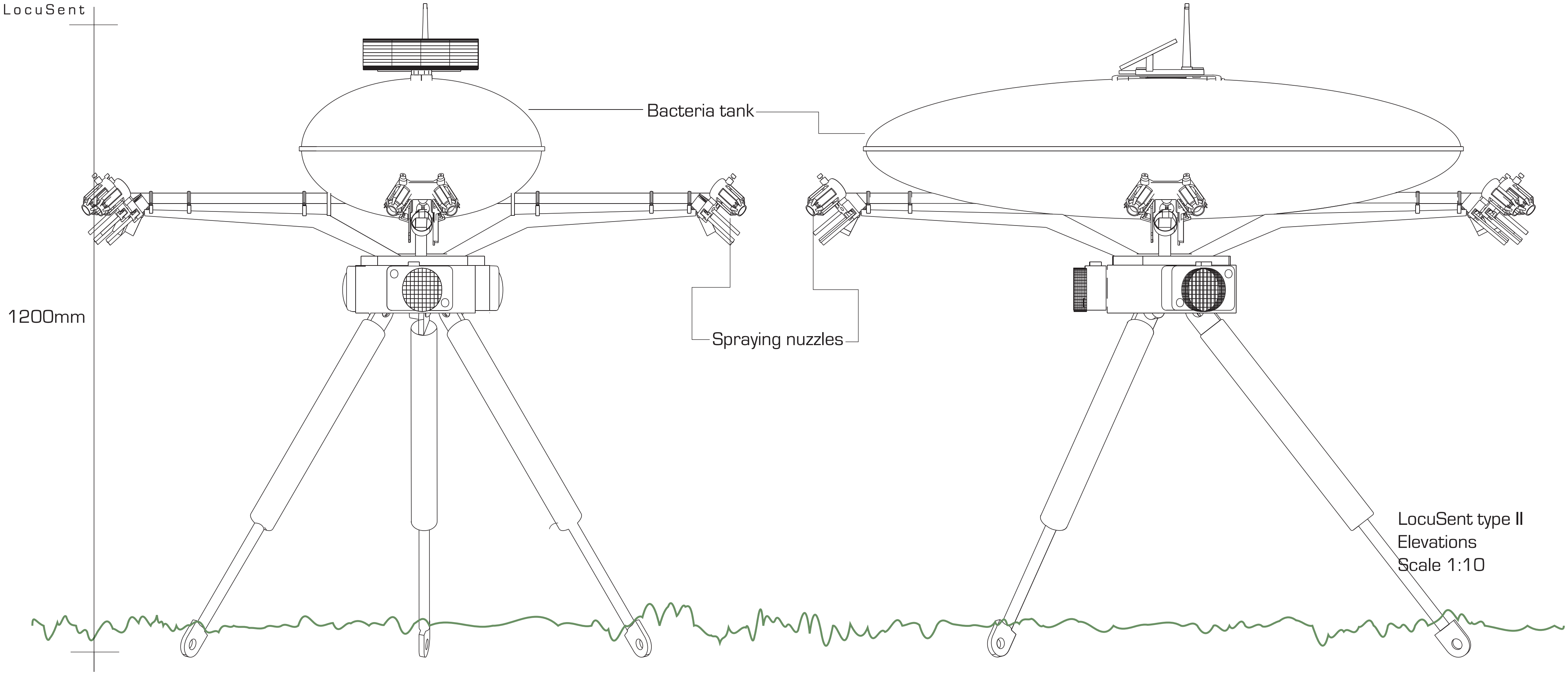


By placing large quantities of LocuSents in the affected areas, and making an extensive network of self-sustained monitor sensors that communicates with each others as well with a central monitor system, it would be possible to map the desert locust and prevent outbreaks. Once the sensors detects the sound of a bigger swarm of the desert locust, the LocuSent reports its id-number and its location to the surrounding LocuSents and to the central monitor system.



LocuSent type I
Elevation, Plan
Scale 1:5

The design in this proposal is a tripod model which is placed manually by jeeps, helicopters or small airplanes. It is also possible to make smaller, more simple and robust units that can be dropped from the air without having to land.



A biological control product has been available since the late nineties. It is based on a naturally occurring entomopathogenic (i.e. infecting insects) fungus, Metarhizium anisopliae var. acridum. The species M. anisopliae is widespread throughout the world infecting many groups of insects, but it is harmless to humans and other mammals and birds. The variety acridum has specialised on short-horned grasshoppers, to which group locusts belong, and has therefore been chosen as the active ingredient of the product. The product is available under different names in Africa and Australia. It is applied in the same way as chemical insecticides but does not kill as quickly. At recommended doses, the fungus typically takes two to three weeks to kill up to 90% of the locusts. For that reason, it is recommended for use mainly in the desert, far from cropping areas, where the delay in death does not result in damage. The advantage of the product is that it affects only grasshoppers, which makes it much safer than chemical insecticides. Specifically, it allows the natural enemies of locusts and grasshoppers to continue their beneficial work..

It is crucial to be able to detect locust as early as possible in these remote areas. In this phase the Metharizium anisopliae bacteria is a very good substitute for the dangerous chemical insecticides necessary in later phases and closer to inhabited areas.

By equipping the LocuSent with a tank for the bacteria and a spraying system that is triggered by the sound of the locust, it would be possible, not only to monitor, but also to fight the locust in remote and hard accessed areas without going there. It is also possible to put up barriers of LocuSents in the expected route of existing swarms and creating “mine fields” that is completely harmless to everything except the desert locust.