

Grasshoppers, Locusts and their Population Control

Systematics L3

Imperial College
London

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Orthoptera: Acrididae

What is the difference between a grasshopper and a locust?

Hieroglyphus daganensis: a grasshopper of the Sahel



Locusts & grasshoppers of the Sahel: booklets

- Locust spp. in several families

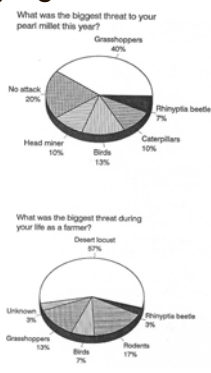


Abbreviations for names:
SGR: Schistocerca gregaria
OSE: Oedaleus senegalensis

Threats to (marginal) agriculture



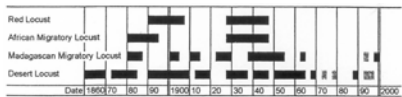
Senegalese grasshopper
Oedaleus senegalensis



Migratory locust
Locusta migratoria (LMI)



African locust plagues



Asian species ...

- *Locusta migratoria manilensis*
- *Nomadacris (Patanga) succincta*
Bombay locust



- Rice grasshopper - *Oxya* spp.



- Grasshopper complex in N. Asian pasture

Nymphs of the desert locust, *Schistocerca gregaria* (SGR)

Solitary



Gregarious



From B.P. Uvarov (1966)
"Grasshoppers and Locusts"
(discovery 1921)

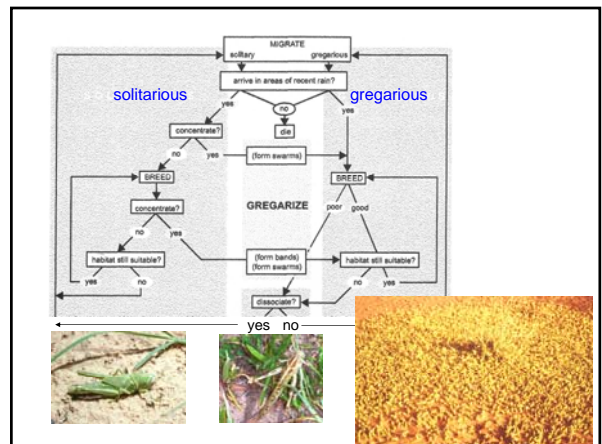
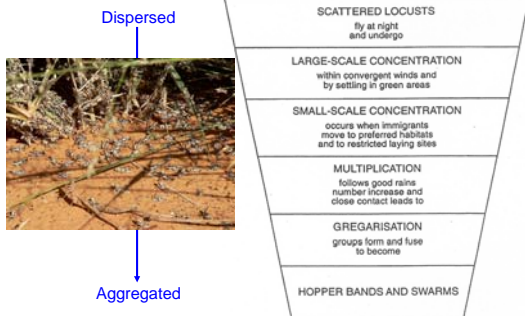
Young adult SGR

period of maturation before flight and swarming



photos: FAO

Gregarisation



Cues for gregarisation

- ❖ Periods suitable for locust breeding followed by vegetation drying - leading to clumping of vegetation and concentration of population
- ❖ Crowding causes increased physical contact between individuals (especially hind legs)
- ❖ Visual and pheromonal stimulation effects
- ❖ Bands may merge leading to greater crowding
- ❖ Band behaviour affected by vegetation cover and uniformity

Haegerle, B.F. & Simpson, S.J. (2000) *J. Insect Physiology*, 46, 1295-1301.
Simpson, S.J., et al. (2001) *Proc. Nat. Acad. Sci., USA* 98, 3895-3897.

Triggering gregarisation



Solitary individuals can be made to become gregarious simply by buffering them with small balls of papier mâché, or millet seeds.



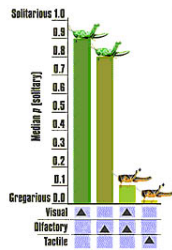
% Gregarious
0-25 26-50 51-75 76-100

Experiments with solitary SGR - in cages where they can neither see nor smell other individuals

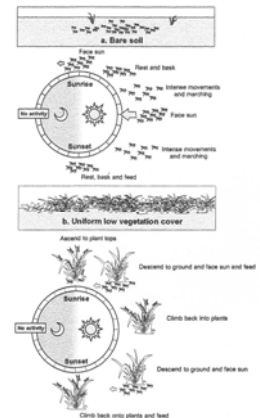
TOUCH (not chemicals): the major trigger of swarming, i.e. contact between crowded individuals makes them become gregarious. <http://www.bbsrc.ac.uk/life/crowd/index.html>

Sight and Smell

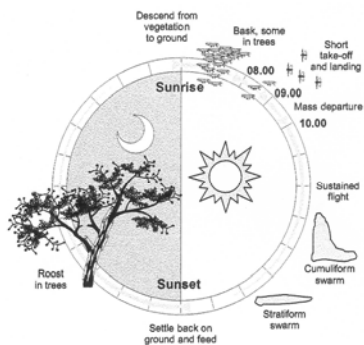
- ❖ Sight and smell together can also stimulate swarming, but each is ineffective on its own.
- ❖ **SMELL** keeps the swarm together: symbiotic bacteria in locust's hindgut produce phenolic compounds that help to prevent disease. Locusts use two of these volatile compounds as pheromones.



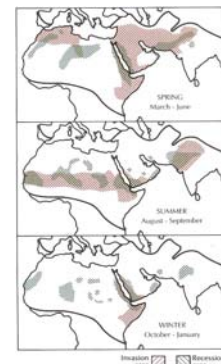
Effect of Vegetation cover on hopper migration



Diurnal behaviour



SGR Migration



How to find hopper bands and swarms?

Forecasts: <http://www.fao.org/news/global/locusts/locuhome.htm>

Decline of plagues

- Large-scale migration to areas unsuitable for breeding
- Failure of seasonal rains
- **Control operations**
 - chemical
 - biological (mycoinsecticides)

The terrain (Mauritania)



Application: if all (or some) of these conditions apply ...

- large area of land to treat
- rapid response required
- little or no water for mixing with pesticide
- logistical problems for supplies
- difficult terrain: poor access to target site

Best technical solution:

Ultra-low volume (ULV) application
0.25 - 2 Litres / ha, oil-based formulations

Vehicle-mounted ULV equipment

'Ulvamast'



E.N.S.



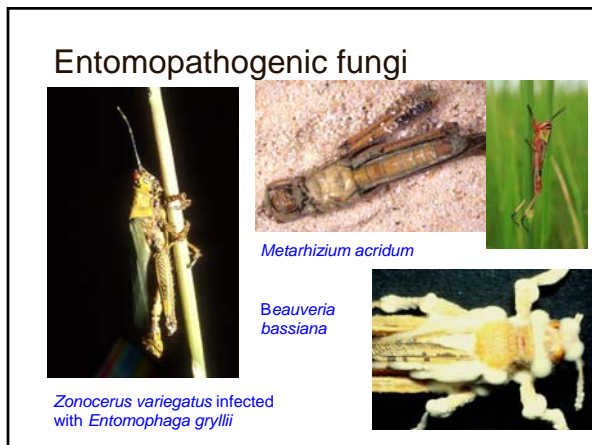
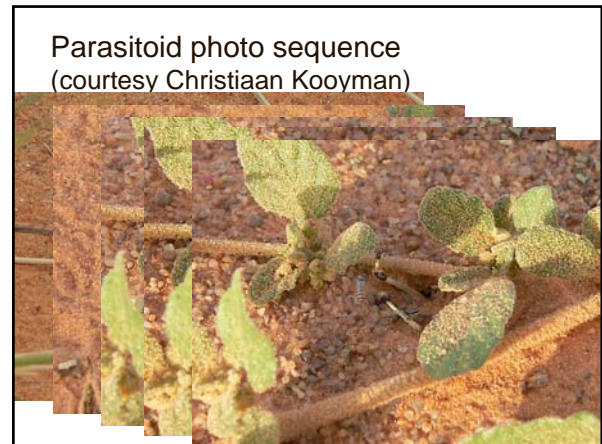
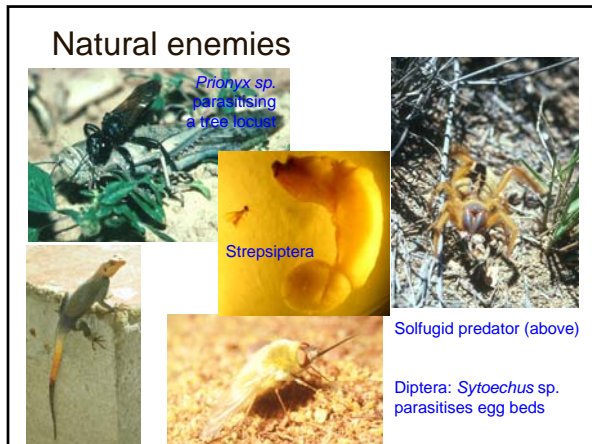
Aerial spraying



Chemical insecticides



- many are toxic
- high environmental impact
- diverted to inappropriate uses
- disposal of unwanted stocks



Biological Control Agents for Acrididae: summary

Agent	Mode of action	Suitability
Deuteromycetes: <i>Metarhizium</i> & <i>Beauveria</i>	Contact	History of effective products, with known production systems
<i>Entomophaga grylli</i>	Contact: epizootics	<i>In vivo</i> production
Protozoa: <i>Nosema</i> & <i>Malamoeba</i>	Ingestion	Ditto; laboratory but not field efficacy
Entomopox viruses	Ingestion	<i>In vivo</i> production
Nematodes: <i>Mermis</i>	Ingestion	Ditto, v. low mortality
Bacteria: <i>Serratia</i>	Ingestion	Low efficacy, safety?
Arthropods, vertebrates	Predators, parasitoids	Typically <10% mortality in Africa



Management of Australian plague locust: *Chortoicetes terminifera* using *Metarhizium*

photo: CSIRO

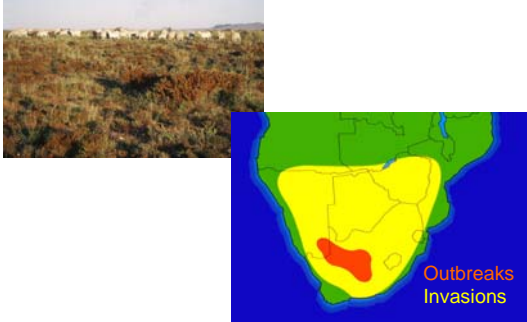
Figure: Expansion of widespread plague of Australian plague locust, *Chortoicetes terminifera*. Movements of gregarious population during the plague of 1919. From France 1960.

J.N. Garth

Pedionomus torquatus

- ✓ Pesticide free (organic) beef
- ✓ Protection of rare indigenous fauna
- ✓ Application near water-courses
- ✓ 'Green Guard' now >12% market

South African example
Brown locust (*Locustana pardalina*) LPA



Control of LPA:



LPA control - issues

- unique Karoo fauna including Lentulids
- fever response: problem for 'Green Muscle'



Summary

- Locusts are grasshoppers that change morphology and behaviour on crowding ...
- ... continuum with several "grasshopper" species - that are pests in their own right
- "locust" species appear independently in different acridid sub-families
- very difficult to find hopper bands etc. - so swarms appear "suddenly"
- normal method of control is ULV spraying
- entomopathogenic fungi most promising biological control agents.