Perspective

The sluggard has no locusts: from persistent pest to irresistible icon

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Abstract

1. The twin shocks of locusts and COVID-19 are threatening the food security of millions of people and devastating economies in eastern Africa and northern India. The ongoing outbreak of desert locusts (*Schistocerca gregaria*) is the largest in seven decades.
2. These events give us cause to reflect on the natural history of locusts, our fraught relationship with them, and how they are represented in popular culture.
3. Symbolic representations span millennia and most have roots in the natural life cycle of locusts—they transform, they swarm, they devastate specific food crops—even if we tend to exaggerate individual body sizes and the effectiveness of our control efforts. Expressions of human futility are rare except in the form of ironic humor.
4. We conclude by suggesting that we indulge in hyperbole and humor to normalize and inure ourselves to what is psychologically unbearable, and simultaneously impel us toward creative anti-locust technologies.
5. The social, political, and economic importance of these technologies is expected to increase with projections of increased cyclone activity in the northern Indian Ocean.

KEYWORDS

desert locust, *Schistocerca gregaria*, film and media studies, cultural studies

1 | INTRODUCTION

Locusts are grasshoppers (Orthoptera: Acrididae) capable of extreme phenotypic plasticity, known as density-dependent phase polyphenism (Simpson & Sword, 2008). In a family exceeding 12,000 species, fewer than 20 express this ability, which has evolved independently in different lineages globally (Song et al., 2017). The distinct phenotypes, or phases, develop in response to local population density. Low densities produce the shy, camouflaged solitary phase, whereas crowded conditions produce the aggregating, migratory gregarious phase (Figure 1). Gregarious phase locusts assemble into enormous groups and embark on spectacular mass migrations, travelling as marching bands of flightless juveniles and vast flying swarms of winged adults. The psychological trauma of past irruptions is deeply embedded in agrarian cultures; indeed, the term locust is derived from the Latin, *locus ustus*, meaning “burnt place”—an allusion to the denuded landscape left in the wake of a ravenous swarm.

Even now the trauma is fresh. The current upsurge of desert locusts (*Schistocerca gregaria*) is the largest in seven decades, threatening the food security of millions of people and devastating economies in eastern Africa and northern India. So immense is the scale that news reports struggle to put it into familiar terms. In July 2020, *The Economist* calculated that a swarm of 200 billion locusts in Kenya was eating as much in a day as the entire population of Germany. The comparison is fitting for alluding to food competition. Locusts eat our favorite cereal crops (wheat, maize, barley, sorghum, millet) and the grasses that sustain our livestock. The United Nations Food and Agriculture Organization describes the problem as a food chain crisis and estimates that 10% of the global population is at risk, whereas the World Bank puts the cost in monetary terms, projecting \$8.5 billion in agricultural damages.

Against this backdrop, the aims of our Perspective are threefold. First, we orient readers to the natural history and current upsurge of desert locusts, relating selected life stages to representations in popular culture. Second, we call attention to recurring motifs in history, such as our tendency to exaggerate the size of individual locusts and the effectiveness of our control efforts. Third, we wrestle with a basic question, why do we indulge in such hyperbole? We conclude by suggesting that the imagery and discourse around locusts serves a psychological purpose, to normalize and inure ourselves to the unbearable and simultaneously impel us toward new solutions.

2 | OUTBREAK

The father of acridology, Sir Boris Uvarov, described phase polyphenism in *Locusts and Grasshoppers* (1929). It was a landmark achievement for essentially solving the mystery of how an unknown insect—i.e., the gregarious phase of a familiar species—could appear and disappear so suddenly as devastating swarms (Waloff & Popov, 1990). In the case of *S. gregaria*, the solitary phase is found in low numbers throughout the deserts of North Africa, the Middle East, and southwest Asia. It survives in isolation by sheltering on sparse annual vegetation and laying eggs in moist sandy soil after intermittent rains. This arid/hyperarid region is some 16 million km² in size and extends across 30 countries. It is called the recession area and calm periods without widespread infestation are called recessions (Cressman, 2016).

Uvarov believed that outbreak centers existed within recession areas. He thought that if centers could be located it would be possible to prevent swarms. He hypothesized that one center lay in the Rub' al Khali desert or Empty Quarter of southern Arabia, where dry watercourses drain the Dhofar mountains. He reasoned that heavy rains from occasional cyclones would drain inland and support dense patches of ephemeral vegetation at the edge of the sands. To investigate this premise, Uvarov sent the legendary explorer and travel writer Sir Wilfred Thesiger, whose account of the journey in *Arabian Sands* (1959) is one of the greatest travelogues of all time.

2.1 | Outbreak and upsurge 2018-2020

A cyclone (Mekunu) hit the Empty Quarter in May 2018 (Figure 2), causing vegetation to flourish and locusts to increase 400-fold over the next six months. As the habitat dried, food became depleted and large numbers of locusts concentrated on the remaining patches of vegetation. The sight and smell of other locusts can trigger the phase change, but direct contact with other locusts is the most powerful stimulus (Simpson & Sword, 2008). This process is termed gregarization, and it begins with groups of hoppers (wingless nymphs) and adults that fuse to form dense bands. Transformation between the solitary and gregarious phase is called the transient phase, and these locusts are referred to as transiens (Cressman, 2016). It is an astonishing process, with changes in outward appearance, nutritional and reproductive physiology, metabolism, endocrinology, molecular biology, immune responses, and pheromone production (Simpson & Sword, 2008). Even the brain transforms, growing 30% larger in the gregarious phase, with greater proportions allocated to sensory processing (Ott & Rogers, 2010). No wonder transiens captured the attention of surrealist painters (Figure 3).

Another cyclone (Luban) hit the Empty Quarter in October 2018 (Figure 2), and three generations of breeding went undetected and uncontrolled. When two or more generations of transient-to-gregarious breeding occur in succession, it is called an upsurge (Cressman, 2016). By March 2019, the upsurge had increased 8000-fold and headed to southern Iran, crossing territory that hadn't seen the insects in 50 years, and moved east into India and Pakistan. Many locusts flew south with prevailing winds into Yemen, where civil war prevented any spraying of pesticides. The swarms then moved to Ethiopia and Somalia in October 2019, a familiar pattern of migration (Everard, 2019).

Yet another cyclone (Pawan) hit the Horn of Africa in December 2019 and more breeding ensued (Figure 2). By the end of that month, growing swarms had entered Kenya. In January 2020, the swarms spread across the Horn of Africa laying eggs, which hatched in March and swelled numbers further. At the time of writing (July 2020), prolific swarms were devastating vast areas of eastern Africa and northern India. A period of one or more years of widespread and heavy infestation is called a plague, and a major plague exists when two or more regions are affected simultaneously.

3 | VISIONS IN POPULAR CULTURE

Preceding paragraphs touched on the factors that gave rise to current conditions. It is, as one headline put it, "The Terrifying Science Behind the Locust Plagues of Africa" (*Wired* magazine, February 2, 2020). This expression of terror has deep roots in popular culture. For example, the X-men comic book series featured a character named August Hopper, a professor of entomology at Metro College in New York City. Hopper turned to supervillainy when he was denied tenure, transforming himself into The Locust (Figure 4a). Using a "Magno-Ray," he ionized eggs to produce gregarious nymphs, raising them in a wheat field to produce enlarged adults. With admirable eloquence, he describes the "krunch!" of crop destruction as a "song of mounting menace." Eventually, the X-men (a subspecies of human born with superhuman abilities) subdued the giant locusts with "high-grade pesticides." It is a sequence of images and actions—of transformation, crop consumption, immense size, and triumph through technology—that serves as a practical starting point, for it exemplifies recurring motifs in human history.

Oversized grasshoppers, "whopper hoppers", were a favorite subject of American tall-tale postcards during the early 20th century (Morgan, 1981; Rubin & Williams, 1990). In one example from 1937 (Figure 4b), a migratory grasshopper falls victim to a farmer and his Model 94 Winchester rifle, itself an icon of technical innovation and American industry. It is perhaps no coincidence that 1937 was a recession year

within the Great Depression, and the pinnacle of Dust Bowl-induced privations. To give some weight to the dark humor of this image, we used the known length of the rifle (37.5 inches) to estimate the length of the insect's tibia (≈ 35.5 cm), a structure that scales with body mass (Katz & Gosline, 1992). We can therefore calculate a mass of 3.3 kg, an imagined size that embodies the anxieties of American farmers who were then facing the worst outbreak since 1874–76 (Lockwood, 2004). A problem with this farmer's solution (and presumed satisfaction) is that insects have a low-pressure circulatory system. A hole in the exoskeleton, even from a 30-caliber rifle, will bleed little and seal quickly because insect hemolymph has excellent clotting characteristics. More gratifying and effective, perhaps, was the solution, also in 1937, of the US National Guard—soldiers used flamethrowers and slow-moving trains to battle swarms in Colorado.

Locusts grew even larger during the “Big Bug” era (1954–58) of Hollywood filmmaking (Figure 4c). In the film *Beginning of the End* (1957), a USDA test of radioactive fertilizers produced a swarm of school-bus-sized locusts that ate much of downstate Illinois. They reached Chicago despite the military's use of chlordane, a powerful pesticide that was eventually banned in the USA in 1988. It fell to entomologist Ed Wainwright (played by Peter Graves) to explain the risks to Pentagon top brass: “Despite the fact that we have developed powerful insecticides, the locust still inflicts damages to the tune of 25 million dollars in the United States alone”. In order to save the American economy, the army decided to destroy the beasts and Chicago with a nuclear weapon.

The film is notorious camp, but it is edifying. It alludes to the social behavior of locusts by recognizing their gregariousness—indeed, the A-bomb is the ultimate density-dependent solution (Berenbaum & Leskosky, 1992). At the same time, it offers a parable on the limits of technology, suggesting that some solutions (chlordane) can lose their potency, whereas others (nuclear weapons) offer a cure worse than the disease. The “Big Bug” movies of the 1950s and “Creature Features” of the 1960s are usually interpreted as symbolic manifestations of prevailing Cold War anxieties (Sontag, 1965; Mertins, 1986; Leskosky, 2006), but Tsutsui (2007) has argued that they reflected growing misgivings about the safety and effectiveness of modern insecticides, a prelude to the era of silent springs.

In *Giant Insects*, a touring exhibit now at the Science Museum of Virginia, Fredericksburg, USA (January 18 – August 30, 2020), there is a model of *S. gregaria* with a 20-foot wingspan (Figure 4d). This choice of species and phase would win the prize for timely outreach if not for the current COVID-19 pandemic and closure of the museum. Outsized models are useful for making small anatomical details visible and

potentially explaining the size limits set by the respiratory system of locusts (Harrison et al., 2013). The tracheal system is a series of tubes for gas exchange, and the rate of oxygen diffusion is proportional to the concentration gradient, inversely proportional to length, and directly proportional to cross-sectional area. But, as insects increase in size, the demand for oxygen will increase in proportion to length cubed, whereas the diffusion rate will only increase as length squared. Thus, as frightening as it is to imagine massive locusts, the exaggerated body sizes in Figure 4 lie well behind the physical limits imposed by current atmospheric conditions (Whitman, 2008).

3.1 | Locusts in discourse

If hyperenlargement is one means of expressing cultural anxiety (Dominy & Calsbeek, 2019), then using locusts to symbolize outsiders (or simply others) is another. Foreign armies were described as locusts in ancient Egypt (Figure 5a), whereas European settlers in Africa are equated to locusts in *Things Fall Apart* (1958), a classic novel by Nigerian author Chinua Achebe. In the Pixar animated film, *A Bug's Life* (1998), it is a gang of locusts that terrorizes a colony of hardworking ants. At its worst, this rhetorical equation “threatening outsiders = locust swarm” is used as a dehumanizing and demagogic trope (Lerner, 1999; Small, 2013; Sautman & Yan 2015), including the recent Brexit campaign (Spinzi & Manca, 2017).

In some cases, we see the effects of proportionality bias, or the tendency to assume that big chaotic events have big causes, such as divine vengeance, a common theme in Hebrew and biblical scriptures (Thompson, 1955; Nevo, 1996). In the Bible, 40 of 98 references to arthropods are focused squarely on grasshoppers, hoppers, or locusts (Kritsky, 1997), a pattern that has led some ecclesiastical institutions to transform the locust into a sober warning (Figure 5b), a symbol of angry, God-sent punishment for moral shortcoming or sin (Lockwood, 2004). Christian orthodoxy on the subject is based on the views of Thomas Aquinas, a 13th century philosopher and Dominican friar, who argued that animals are innocent of their misdeeds. Blame for locusts was therefore directed inwards; immediate repentance by a populace was the only suitable response to troublesome swarms.

“The sluggard has no locusts” is a proverb of the Lovedu people, and like many African proverbs it has both a surface meaning (scorn for indolence) and an underlying irony; a philosophical acceptance of locusts as an indiscriminate, devastating force. For hand-to-mouth subsistence farmers, it is an example of dark humor in the face of calamity, but the expression of equanimity and futility sets it apart from the

supernatural views above. There is no divine attribution and no potential for penance to mitigate the damage.

3.2 | Locusts as economic instruments

One measure of social and political importance lies in the instruments of commerce. In ancient Babylon, the system of weights was based on the talent, or the average load that could be carried by a man or animal (about 30 kg). It is a harvest-based system of weights and measures, and it is ironic that some standard weighing stones were shaped into locusts (Figure 5c), the very thing that depleted yields. Links between locusts and harvests are explicit in the Astronomical Diaries, a series of observations on planetary movements and historical events, including more than 20 references to locust invasions (Pirngruber, 2014). They also contain meticulous records of prices for six basic commodities, among them barley, date, and sesame. At least one locust irruption in 346 BC precedes a steep rise in the price of barley (Figure 5c).

In some cases, the act of economic damage is portrayed directly on currency. A few ancient medallions and coins illustrated interactions between locusts and important food crops (Figure 6a), including barley (Figure 6b). This puzzling pattern of locust imagery would repeat itself 2000 years later in Cape Verde, which issued a banknote in 1989 that practically invites two gregarious adults of *S. gregaria* to consume a stalk of maize, a vital food crop for the country (Figure 6c). We assume it was intended as a daring symbol of defiance and resilience.

4 | CONCLUSIONS

Representations of locusts span millennia, and most have roots in their natural life cycle—locusts transform, they swarm, they devastate specific crops—even if we tend to exaggerate individual body sizes and overestimate the effectiveness of our control efforts. Expressions of human futility are rare, except in the form of gallows humor, which begs the question: *why do we imagine locusts, and why so large?* Sontag (1965) argued that we imagine disaster to normalize and inure ourselves to what is psychologically unbearable. This explanation fits many of the images and discourses described here, but we also magnify our penchant for innovative and industrious solutions. If positive affirmation is the first step toward creation, then imagining locust damage may serve an important practical purpose: it is the

wellspring of creative anti-locust technologies. Recent technologies include remote monitoring tools, computational models, citizen science cell phone apps, and a fungus (*Metarhizium anisopliae*)-derived toxin marketed under the name Green Muscle (Enserink, 2004; van Huis et al., 2007; Cressman, 2008; Chudzik et al., 2020). The importance of these tools is expected to increase in lockstep with increasing cyclone trends in the northern Indian Ocean (Murakami et al., 2020), suggesting that desert locusts will only continue to invade the fertile fields of our imagination as they transform into a metaphor for climate change.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA ACCESSIBILITY

This paper does not include any data.

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REFERENCES

Berenbaum, M. R. & Leskosky, R. J. (1992) Life history strategies and population biology in science fiction films. *Bulletin of the Ecological Society of America*, 73, 236-240. www.jstor.org/stable/20167381

- Chudzik, P., Mitchell, A., Alkaseem, M., Wu, Y., Fang, S., Hudaib, T., Pearson, S. & Al-Diri, B. (2020) Mobile real-time grasshopper detection and data aggregation framework. *Scientific Reports*, 10, 1150. <https://doi.org/10.1038/s41598-020-57674-8>
- Cressman, K. (2008) The use of new technologies in desert locust early warning. *Outlooks on Pest Management*, 19, 55-59. <https://doi.org/10.1564/19apr03>
- Cressman, K. (2016) Desert locust. *Biological and Environmental Hazards, Risks, and Disasters* (eds J. F. Shroder & R. Sivanpillai), pp. 87-105. Academic Press, Boston.
- Dominy, N. J. & Calsbeek, R. (2019) A movie monster evolves, fed by fear. *Science*, 364, 840-841. <https://doi.org/10.1126/science.aax5394>
- Enserink, M. (2004) Can the war on locusts be won? *Science*, 306, 1880-1882. <https://doi.org/10.1126/science.306.5703.1880>
- Everard, C. (2019) *Desert locust plagues: controlling the ancient scourge*. I.B. Tauris, London.
- Harrison, J. F., Waters, J. S., Cease, A. J., VandenBrooks, J. M., Callier, V., Klok, C. J., Shaffer, K. & Socha, J. J. (2013) How locusts breathe. *Physiology*, 28, 18-27. <https://doi.org/10.1152/physiol.00043.2012>
- Katz, S. L. & Gosline, J. M. (1992) Ontogenetic scaling and mechanical behaviour of the tibiae of the African desert locust (*Schistocerca gregaria*). *Journal of Experimental Biology*, 168, 125-150.
- Kritsky, G. (1997) The insects and other arthropods of the Bible, the New Revised Version. *American Entomologist*, 43, 183-188. <https://doi.org/10.1093/ae/43.3.183>
- Kritsky, G., Mader, D. & Smith, J. J. (2013) Surreal entomology: the insect imagery of Salvador Dalí. *American Entomologist*, 59, 28-37. <https://doi.org/10.1093/ae/59.1.28>
- Leitmeir, F. (2017) Locusts, grasshoppers and cicadas as muses: different ways of visualising insect music in antiquity. *Greek and Roman Musical Studies*, 5, 219-232. <https://doi.org/10.1163/22129758-12341302>
- Lerner, B. D. (1999) Timid grasshoppers and fierce locusts: an ironic pair of biblical metaphors. *Vetus Testamentum*, 49, 545-548. www.jstor.org/stable/1585417
- Leskosky, R. J. (2006) Size matters: big bugs on the big screen. *Insect poetics* (ed E. C. Brown), pp. 319-341. University of Minnesota Press, Minneapolis.
- Lockwood, J. A. (2005) *Locust: the devastating rise and mysterious disappearance of the insect that shaped the American frontier*. Basic Books, New York.
- Mertins, J. W. (1986) Arthropods on the screen. *Bulletin of the Entomological Society of America*, 32, 85-90. <https://doi.org/10.1093/besa/32.2.85>
- Morgan, H. (1981) *Big time: American tall-tale postcards*. St. Martin's, New York.

- Murakami, H., Delworth, T. L., Cooke, W. F., Zhao, M., Xiang, B. & Hsu, P.-C. (2020) Detected climatic change in global distribution of tropical cyclones. *Proceedings of the National Academy of Sciences USA*, 117, 10706-10714. <https://doi.org/10.1073/pnas.1922500117>
- Nevo, D. (1996) The desert locust, *Schistocerca gregaria*, and its control in the Land of Israel and the Near East in antiquity, with some reflections on its appearance in Israel in modern times. *Phytoparasitica*, 24, 7-32.
- Ott, S. R. & Rogers, S. M. (2010) Gregarious desert locusts have substantially larger brains with altered proportions compared with the solitary phase. *Proceedings of the Royal Society B: Biological Sciences*, 277, 3087-3096. <https://doi.org/10.1098/rspb.2010.0694>
- Pirngruber, R. (2014) Plagues and prices: locusts. *Documentary sources in Ancient Near Eastern and Greco-Roman economic history: methodology and practice* (eds H. D. Baker & M. Jursa), pp. 163-186. Oxbow, Oxford.
- Rubin, C. E. & Williams, M. (1990) *Larger than life: the American tall-tale postcard, 1905–1915*. Abbeville, New York.
- Sautman, B. & Yan, H. (2015) Localists and “Locusts” in Hong Kong: creating a yellow-red peril discourse. *Maryland Series in Contemporary Asian Studies*, 2015, 1. <https://digitalcommons.law.umaryland.edu/mscas/vol2015/iss2/1>
- Simões, P. M. V., Ott, S. R. & Niven, J. E. (2016) Environmental adaptation, phenotypic plasticity, and associative learning in insects: the desert locust as a case study. *Integrative and Comparative Biology*, 56, 914-924. <https://doi.org/10.1093/icb/icw100>
- Simpson, S. J. & Sword, G. A. (2008) Locusts. *Current Biology*, 18, R364-R366. <https://doi.org/10.1016/j.cub.2008.02.029>
- Small, C. A. (2013) *Global antisemitism: a crisis of modernity*. Martinus Nijhoff, Leiden.
- Song, H., Foquet, B., Mariño-Pérez, R. & Woller, D. A. (2017) Phylogeny of locusts and grasshoppers reveals complex evolution of density-dependent phenotypic plasticity. *Scientific Reports*, 7, 6606. <https://doi.org/10.1038/s41598-017-07105-y>
- Sontag, S. (1965) The imagination of disaster. *Commentary*, 40, 42-48.
- Spinzi, C. & Manca, E. (2017) Reading figurative images in the political discourse of the British Press. *Textus*, 30, 241-256.
- Thompson, J. A. (1955) Joel's locusts in the light of Near Eastern parallels. *Journal of Near Eastern Studies*, 14, 52-55. <https://doi.org/10.1086/371242>
- Tsutsui, W. M. (2007) Looking straight at *Them!* Understanding the big bug movies of the 1950s. *Environmental History*, 12, 237-253. www.jstor.org/stable/25473065

- 345 van Huis, A., Cressman, K. & Magor, J. I. (2007) Preventing desert locust plagues: optimizing
346 management interventions. *Entomologia Experimentalis et Applicata*, 122, 191-214.
347 <https://doi.org/10.1111/j.1570-7458.2006.00517.x>
348
- 349 Waloff, N. & Popov, G. B. (1990) Sir Boris Uvarov (1889-1970): the father of acridology. *Annual Review of*
350 *Entomology*, 35, 1-26. <https://doi.org/10.1146/annurev.en.35.010190.000245>
351
- 352 Whitman, D. W. (2008) The significance of body size in the Orthoptera: a review. *Journal of Orthoptera*
353 *Research*, 17, 117-134. <https://doi.org/10.1665/1082-6467-17.2.117>

Figures and captions

FIGURE 1 Solitary and gregarious phase locusts of *S. gregaria* differ in brain size, body size, and body shape, as well as many internal traits (Simões et al., 2016). One of the most striking outward differences of is that larval and adult solitary locusts are camouflaged, whereas larval and adult gregarious locusts are aposematic (figure by Jeremy Niven, reproduced with permission).

FIGURE 2 Chronology and map of outbreaks, migrations, and invasion areas (May 2018–March 2020) beginning with a series of cyclones in the northern Indian Ocean. Map produced by the Locusts and Other Migratory Pests Group, United Nations Food and Agriculture Organization, reproduced with permission.

FIGURE 3 The surrealist painter Salvador Dalí was a lifelong sufferer of acridophobia, and grasshoppers or locusts feature in many of his works (Kritsky et al., 2013). Pictured here is Dalí's *Locust and Grasshopper* (1967), a lithograph on rag paper (48.3 x 34.9 cm). The subject matter—locust phase transformation, a human skull, and ants—is usually interpreted as symbolic of death and decay.

FIGURE 4 (a) X-men #24 (September 1966) and corresponding scenes with The Locust, wingless nymphs, crop devastation, and super-enlarged adults. (b) Exemplary tall-tale (“whopper hopper”) postcard; the caption reads “Grasshopper shot near Miles City Mont © Coles Studio Glasgow Mont.” (c) Theatrical release poster for the film *Beginning of the End* (1957). (d) Large model of *S. gregaria* in its gregarious phase on display at the Science Museum of Virginia, Fredericksburg, USA (produced by Kokoro Exhibits, Canoga Park, USA; photograph by the Arizona Science Center, reproduced with permission).

FIGURE 5 (a) Relief at Medinet Habu, mortuary temple of Ramses III (ca. 1156 BC, photograph by Mike Shepherd, reproduced with permission). (b) Grotesque of Jerónimos Monastery, Lisbon, Portugal (16th century, photograph by Dmitri Logunov, reproduced with permission). (c) Hematite weight, Babylonian period, and a clay cuneiform tablet, Late Babylonian period, describing a locust invasion in 346 BC and a steep rise in the price of barley (no. 46229, © Trustees of the British Museum, reproduced with permission).

385 **FIGURE 6** (a) Silver medallion dating to the 4th century BC, Nahavand, Iran. The insect, which resembles
386 a larval locust, is eating grapevine blossoms and possibly stridulating (Leitmeir, 2017); i.e., producing
387 sound from the hindlimbs (photograph by Renate Kühling, reproduced with permission). (b) Silver stater
388 of Metapontum, a city state of Magna Graecia in modern-day Italy. The reverse shows an adult locust
389 and ear of barley, ca. 500-473 BC. (c) Reverse side of the Cape Verde 1000 Escudo banknote issued in
390 1989, showing *S. gregaria* in profile and flight and facing a maize stalk in the upper right corner.

Solitarious phase

larval

adult

Gregarious phase

larval

adult

a

b

c

d

a **b** **c**