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GIANT AFRICAN SNAIL IN THE CARIBBEAN SUB-REGION

Gene V. Pollard[1], Angela Fields[2] and Bret Taylor[3]; [1]Trinidad and Tobago; [2]Department of Biological and Chemical Sciences, The University of the West Indies, Cave Hill, Barbados; [3] Ministry of Agriculture and Rural Development, Graeme Hall, Christ Church, Barbados. Email: Phone: (+) 868 662 2002 Ext 4055 (Office); E-mail: gene.pollard@sta.uwi.edu .

ABSTRACT. The giant African snail (GAS), Achatina fulica, is native to East Africa, and is now very widely distributed and established across the Indo-Pacific region. In 1984, this pest was first reported in the Caribbean sub-region in Guadeloupe and has spread since to several other countries. The only other report for the wider Caribbean Basin is for Florida, United States of America, where the pest was introduced in the late-1960s. GAS has been described as the most damaging land snail world-wide, reportedly attacking over 500 plant species inclusive of tree crops, ornamentals, vegetables and root crops; it has also been reported to vector several plant pathogens. Achatina fulica is therefore considered a major agricultural and horticultural pest species. Additionally, GAS is of public health concern being an intermediate host and vector of the parasitic rat lungworm, Angiostrongylus cantonensis, the agent of the human disease, eosinophilic meningitis (or cerebral angiostrongyliasis). However, in most of the affected countries in the Caribbean, the snail has not proved to be a major pest, mainly affecting household gardens and uncultivated or semi-wild areas; the few reports of agricultural losses involve mainly vegetables. Management of this pest in several of the affected countries consists mainly of the use of chemical baits and physical collection of snails combined with limited public awareness programmes. While its spread to date has been slow, the establishment of the giant African snail in the Caribbean is a cause for concern for the agricultural sector and, lesser so, as a potential public health problem. However, it should be noted that the spread of GAS has not been anywhere near the rapid spread of other recently introduced invasive alien species in the Caribbean sub-region, e.g. hibiscus mealybug or red palm mite and neither has the impact been as devastating.

KEYWORDS: Giant African snail, Caribbean sub-region, distribution, management

INTRODUCTION

Achatina fulica or giant African snail (GAS), native to East Africa, is now very widely distributed across the Indo-Pacific region where it has become well established in most of those countries to which it has been introduced (Mead, 1961; Raut and Barker, 2002). In 1984, this pest was first reported in the Caribbean sub-region in Guadeloupe (Frankiel, 1989 cited in Raut and Barker, 2002) and, in 1988, from neighbouring Martinique. In 1995, GAS was reported from two other French West Indian islands, Marie Galante and Saint Martin (F.D.G.D.E.C., Guadeloupe, 2004). Since that time, there had been no further reports of this pest into any country in the Caribbean sub-region until Saint Lucia reported its introduction in July 2000. Subsequently, GAS was positively identified in 2000 in Barbados (Fields et al., 2006) and Anguilla (Connor, 2006), in Dominica in 2007 (Ministry of Agriculture, pers. comm.); Antigua in 2008 (Ministry of Agriculture, pers. comm.).

The only other report for the wider Caribbean Basin was the introduction and establishment in Miami, Florida, United States of America, in 1966 (Mead, 1979).

ECONOMIC IMPORTANCE IN AGRICULTURE AND HORTICULTURE

According to Mead (1961), as quoted by Mead and Palcy (1992), GAS is considered the world's most economically important snail pest in agriculture and horticulture, reportedly attacking over 500 different plant species inclusive of tree crops, ornamentals, vegetables and root crops (Plant Protection Service Secretariat of the Pacific Community, 1999). Additionally, it can scavenge on decaying organic matter and can frequently be seen at waste rubbish tips and on animal dung. Because of its wide host range, Achatina fulica is considered of serious economic importance, being deemed a major agricultural and horticultural pest species. Data from Samoa, for example, indicate agricultural losses of between 45 to 85 percent in root crops [Alocasia spp., yam leaves and stems (Discorea spp.), taro petioles and above ground tubers (Colocasia)], vegetables (brassicas, sweet and green peppers, pumpkins) as well as young banana leaves, especially Cavendish varieties (Matalavea, 1997, unpubl.). These are also major crop groups in the Caribbean sub-region. Other major crops of economic importance in this sub-region which may be attacked by GAS include cacao (particularly seedlings), coffee, banana, citrus fruit and seedlings, breadfruit and papaya. Mead (1979), quoting several authorities, also reported that GAS has been shown to vector plant pathogens such as Phytophthora palmivora of black pepper, coconut, betel nut, papaya and vanda orchid, P. colociae of taro and P. nicotianae parasitica of eggplant and tangerine. One must note that P. palmivora is an important pathogen in the Caribbean sub-region. Several other instances of serious economic damage to agriculture and horticulture due to GAS activity have been reported. For example, one report from the state of Bihar in India indicated GAS causing ... severe damage to vegetables, paddy, banana, papaya and a host of other economic and ornamental plants: between 30-80 percent in kitchen gardens and 15-25 percent in field crops (Birat, 1971). Srivastava (1973) also reported on the economic importance of GAS in India.

However, there are contrasting views on the pest status of GAS. One authority was of the view that this pest probably has got a worse reputation than it might deserve although recognising that damage may be total in small plots, e.g. vegetable and flower gardens including a variety of seedlings and cuttings; such damage was believed to be greatest when the pest has been newly established and is in a phase of increasing population growth. Mead (1979) further suggested that "damage is fairly localized and not catastrophic or devastating on a broad scale as so often portrayed"; further, he indicated that "The negative factor creating the greatest and most lasting impression ... is that of the sheer numbers and concentration of individuals". One report, for example, (as quoted in a GAS leaflet of the Australian Plant Inspection Service, AQIS, 2000), indicated that two years after GAS was introduced into America Samoa in 1975, one million snails were hand-collected; during June/July 1980, 135 tonnes (about 5.4 million snails) were collected and in September of that same year, 21 million individuals (http://www.aqis.gov.au/docs/plpolicy/gas/htm). According to Mead (1979) it is such numbers that ... intensifies the nuisance factor, often to the point where it is the principal, if not indeed the only tangible reason for objecting to the presence of the snails. The presence of slime trails and excreta in gardens or even on walls of houses and the stench from large numbers of dead and

decaying snails, especially when a chemical baiting programme is being implemented, are major factors contributing to the "nuisance factor" identified by Mead (1979).

PUBLIC HEALTH IMPORTANCE OF GIANT AFRICAN SNAIL

Apart from its agricultural pest status, GAS is of public health concern. It is an intermediate host and vector of the parasitic rat lungworm, Angiostrongylus cantonensis, the agent of the human disease, eosinophilic meningitis (or cerebral angiostrongyliasis) (Beaver and Rosen, 1964). This is a major disease in Southeast Asia and the Pacific Islands (Aguiar et al., 1981; Andersen et al., 1986; Lindo et al., 2004). Molluscs other than GAS can vector this parasite, and the nematode has been reported from a number of countries in the Caribbean sub-region including the Bahamas, Cuba, Dominican Republic, Haiti, Jamaica and Martinique and Puerto Rico (Aguiar et al.,1981; Andersen et al., 1986; Lindo et al., 2002; Raccurt et al., 2003; De Meuron, 2005; Vargas, et al., 1992). Cases of the disease have been reported from Cuba (Pascual, et al., 1981), Puerto Rico and Jamaica (Lindo et al., 2002; 2004), Martinique (De Meuron, 2005) and Dominican Republic (Leone et al., 2007). The death of a child from eosinophilic meningitis associated with Angiostrongylus cantonensis infection has been reported from Jamaica (Lindo et al., 2004). In Jamaica, both Rattus norvegicus and R. rattus serve as primary hosts (Lindo et al., 2002).

Consumption of raw or improperly cooked snail meat is thought to be the most common cause of the disease, but cases have occurred after ingestion of raw vegetables (Slom et al., 2002) or raw vegetable juice (Tsai et al., 2004) contaminated with third-stage larvae or the consumption of infected paratenic hosts such as frogs (Lai et al., 2007). However, there are reports that infection occurred in Taiwanese children through contact with GAS. Apart from man, other mammalian species like rodents, dogs and horses can be infected (Robinson, 2000).

GIANT AFRICAN SNAIL IN THE CARIBBEAN – DISTRIBUTION AND MANAGEMENT

GAS in Guadeloupe and Martinique. According to Philippe Tormin (personal communication), GAS was first reported in 1984 in Guadeloupe in the National Park in the centre of the island and since that time has spread to practically all of the country. The pest was reported for Martinique in 1988. In Guadeloupe, GAS attacked a number of agricultural crops including cucumber, banana, yam, dasheen, citrus, papaya, hibiscus; indirect damage also resulted. Management of the pest was mainly through the use of metaldehyde bait, physical collection of snails and implementation of a public awareness campaign. Nearly 20 years after its first reporting, GAS is still a problem in Guadeloupe but somewhat less so. For example, the amount of metaldehyde bait applied has been reduced drastically from 24 tonnes in 1995 to 8.4 tonnes in 1999. However, there has not been sufficient research on the pest to allow for an improved management strategy.

GAS in Saint Lucia. Though first identified in June 2000, the pest may have been introduced for at least one year prior to this, if not longer, judging by the size (6-7 cm) of some of the existing specimens collected at that time. Initially, distribution was limited to the north-western region of the country; however, the pest has continued to spread island-wide. A large number of plant

species were initially attacked and included various fruit trees (papaya, mango, breadfruit, coconut, citrus), pineapple, tannia and ornamentals (viz. hibiscus, glyricidia, variegated immortelle, croton, aloe, ficus, ornamental palms).

On first reports of the pest, the Ministry of Agriculture unsuccessfully attempted to eradicate the pest through the implementation of several actions. These included:

[1] A pest surveillance programme to determine the extent of infestation
[2] Sourcing of as much information as possible (e.g. through the internet and from CABI Bioscience)
[3] Proclaiming GAS a notifiable pest under the plant protection regulations of the country so as to allow for necessary legal authority for any actions as declared by the government
[4] Initiating a community-based programme to physically collect and destroy snails, at least from residential areas
[5] A chemical baiting programme using methaldehyde
[6] limited public awareness activity

These actions proved to be unsuccessful. The pest is still mainly a problem for home gardens though a few farmers have complained about pest damage. In those cases, mainly vegetable crops were attacked and this has been mitigated through hand collections of snails and application of molluscicides.

According to a Ministry of Agriculture spokesperson, certain studies still have to be done, e.g. a new survey to determine the current extent of spread; a search to determine whether any natural enemies have emerged; determination of the presence/absence of the rat lung worm; the impact of the GAS on local molluscs.

GAS in Barbados. In Barbados, GAS was first identified in the south-west of the island at one locality in the parish of St Michael at Spring Garden, in September 2000 and subsequently spread to other parishes. This was believed to be aided in part by illegal dumping and inadvertent transport by vehicles (Fields et al., 2006). At present, the pest can be found in all parishes, widely distributed throughout the country, in gullies, other wooded habitats and in residential areas. While the snails feed mainly on detritus, fallen fruit and faecal matter (Fields, 2007) there have been unconfirmed reports of GAS damage to cabbages, cucumbers and breadfruit. However, as in Saint Lucia, GAS is still mainly considered a pest of residential areas.

Following introduction of GAS, a management programme was developed consisting mainly of the use of metaldehyde-based baits. However, according to Fields (2007), preliminary studies suggested that the baiting programme implemented in several gullies was not very effective.

GAS in Anguilla. GAS is found in all habitat types sampled, in grasslands, scrublands and woodlands. The snail is well established on the island and is considered a pest. An eradication programme initiated by the government was aborted due to resident's concerns about molluscicide use (Connor, 2006).

GAS in Dominica. Dominica was particularly at risk of the introduction of GAS given the fact that they maintain active trade links and passenger contacts with Guadeloupe and Martinique

(there is regular ferry service with these French islands) and Saint Lucia, as well as Barbados on a more limited scale; and all these countries are infested with GAS. The snail was first reported in Dominica in March 2007 in Dos D'Ane in the north of the island in an area of about 10,000 m^2. This was a sparsely inhabited area with only two dwellings close by. One farmer had found one snail and then another the following day, after which he called the Ministry of Agriculture. The public awareness campaign run by the Ministry was most likely the cause of concern by the farmer.

Immediately on the identification of GAS, an area of 0.6 ha was cleared and burnt. A drain was built along the edge of this area which abutted a forested region, in an effort to provide a physical barrier. Additionally, a chemical control programme was initiated using metaldehyde bait as well as hand picking of snails. The last sighting of GAS individuals was in June 2007 and continual monitoring has not revealed any snails since[3]. The Ministry of Agriculture in Dominica is convinced that GAS has been eradicated from the country. However, wider surveys still need to be conducted.

GAS in Antigua. GAS was identified in Antigua in April 2008 in two areas in the south-west of the island, Jolly Hill and Bolans New Extension. The pest had not been reported in Barbuda. At the time of reporting in April 2008, the Government had implemented internal quarantines, a public education programme and surveillance in the infested areas as part of its GAS management efforts.

ASSISTANCE TO THE CARIBBEAN SUB-REGION.

Following the introduction of GAS into Saint Lucia and Barbados in 2000 and, given the real threat posed to the wider Caribbean by this invasive species, several countries approached the Food and Agriculture Organization of the United Nations (FAO) in 2000 for technical assistance under FAO's technical cooperation programme. Under this programme, a two-year project for the management of GAS was approved in 2002 for USD 193,000. The overall objective of the project was to strengthen the capacity within the beneficiary countries of the Eastern Caribbean region to implement a sustainable integrated and environmentally sound management strategy for GAS.

The expected outputs of the project were different for infested and un-infested countries. For Saint Lucia and Barbados, the specific outputs of the assistance were to develop and implement an IPM programme inclusive of a monitoring and surveillance system; to train plant protection and quarantine and extension officers and farmers in management of the pest; and to develop and initiate a public awareness programme. For the non-infested countries at the time (Antigua and Barbuda, Dominica, Grenada, St Kitts and Nevis, St Vincent and the Grenadines, Trinidad and Tobago), the specific outputs were to develop and implement detection surveys; to train plant protection and quarantine and extension officers in all aspects of GAS management; and to develop and initiate a public awareness programme. This project was implemented with collaboration of other agencies, particularly with the Caribbean Area Office of USDA-APHIS

[3] (Personal Communication – As of March 2008, according to the senior plant protection officer, Ministry of Agriculture).

and the Inter-American Institute for Cooperation on Agriculture (IICA). The objectives of this project were mainly achieved (FAO, 2004, unpubl.).

Additionally, USDA APHIS, in collaboration with several regional partners, convened a meeting of a GAS Working Group in Barbados in July 2008, to further the work on the management of GAS in the Region.

DISCUSSION AND CONCLUSIONS

Mead (1979), in commenting on the June 1966 introduction of GAS into Miami, Florida, suggested that the turn of events could be regarded as .. almost standard format: surreptitious introduction, unsuspected establishment, uninhibited reproduction, insidious spread, explosive appearance, alarmed discovery, frantic quarantines, protracted controls, secondary infestations, near-eradication, cautious optimism, uncertain prognosis and indefinite anticipation; this author further commented that ... In every known, investigated, major, established infestation in the past, this series of events predictably and relentlessly evolved into: multiple foci, peripheral spread, unfeasible quarantines, impractical control, abandoned control, maximum population, disease syndrome, population decline, population decimation, population stability and simulated endemism.

One might venture to suggest that the current situation in the Caribbean lies squarely in the first half of Mead's thesis on establishment, i.e. ... explosive appearance, alarmed discovery, frantic quarantines, protracted controls, and with the existing reaction being ... unfeasible quarantines, impractical control, abandoned control. Time would determine whether the scenarios in Saint Lucia and Barbados would fully follow the hypothesis of Mead. In fact, the impact of GAS in Guadeloupe has diminished since its introduction in 1984 and so appears to be following Mead's thesis.

The Caribbean sub-region has had recent and previous experience with the spread of several invasive alien species, e.g. hibiscus mealybug (HMB), Maconellicoccus indica and red palm mite, Raoiella indica. HMB, for example, was first reported in Grenada in 1994 and within 4 to 5 years it was distributed from South America (Guyana and Venezuela) into Central America (Belize) and North America (southern California) and in the majority of Caribbean islands (Kairo et al, 2000). Within a decade, HMB was in practically every Caribbean country and continued to spread in the Americas. While the spread of GAS to date has been slow, the establishment of this invasive pest in the Caribbean is a cause for concern not only for the agricultural sector, but is also, very importantly, a public health problem. However, it should be noted that the spread of GAS has not been anywhere near the rapid spread of other recently introduced invasive alien species in the Caribbean sub-region.

While eradication of GAS is possible, as has been shown for Miami in the 1970s, this requires a great concerted effort. As was outlined for the Miami experience, eradication involved immediate quarantine of infested areas; demarcation of adjacent buffer zones; a continuing publicity programme and cooperation of the public; frequent surveys including hand collection and destruction; elimination of shelters; regulation of refuse disposal; and chemical control even months after the last live specimen was found (Mead, 1979). It is doubtful whether there are

resources available in Saint Lucia or Barbados for such a sustained eradication programme. Nonetheless, Dominica seems to believe that they have eradicated the pest after determining its establishment at a very early phase and then taking immediate eradicative measures. Implementation of an effective management programme might be more feasible in the other instances in Barbados and Saint Lucia. For the other countries in the Caribbean where this invasive species has not yet been known to occur, it is imperative that increased quarantine procedures for this pest be immediately implemented; this should include increased port vigilance especially for goods and vessels from infested countries as well as a monitoring and surveillance programme developed and implemented, if this has not as yet been done.

REFERENCES

Aguiar, P. H., Morera, P., and Pascual, J. 1981. First record of Angiostrongylus cantonensis in Cuba. The American Journal of Tropical Medicine and Hygiene 30(5): 963-965.

Andersen, E., Gubler, D. J., Sorensen, K., Beddard, J., and Ash, L. R. 1986. First report of Angiostrongylus cantonensis in Puerto Rico. The American Journal of Tropical Medicine and Hygiene 35(2): 319-322.

Australian Plant Inspection Service (AQIS) 2000. Giant African snail, No.3. (http://www.aqis.gov.au/docs/plpolicy/gas/htm).

Beaver, P. C. and Rosen, L. 1964. Memorandum on the first report of Angiostrongylus in man by Nomura & Lin. 1945. American Journal of Tropical Medicine and Hygiene 13(4): 589-590.

Birat, R.B.S. 1971. Field observations on the control of the giant African land snail Achatina fulica Bowdich in Bihar. Pesticides Annual, December 1971: 76.

Connor, R. 2006. Distribution, habitat association, species abundance and perceptions of residents towards Achatina fulica in Anguilla. MSc thesis, University of Exeter, 41pp.

De Meuron, K. 2005. Angiostrongylose en Martinique. II Congrès de la Société Antillo-Guyanaise de Pédiatrie: 10-12.

FAO 2004. Report: Evaluation Workshop on the Management of the Giant African Snail, 29-30 June 2004, Grenada, 10pp, unpublished.

F.D.G.D.E.C. (Fédération Départmentale des Groupments de Défense Contre les Ennemis de Cultures) Guadeloupe 2004, Achatine or giant African snail, 20 years later in the French West Indies. Paper presented at the Regional Evaluation Workshop on Assistance for the Management of Giant African Snail, 29-30 June 2004, Grenada. 4pp; unpubl. Food and Agriculture Organization of the United Nations, Sub-Regional Office for the Caribbean.

Fields, H. A., Gibbs, I. & Taylor, B. 2006. Colonisation of Barbados by the giant African snail, Achatina fulica Bowdich 1822. Journal of the Barbados Museum and Historical Society 52: 233-241.

Fields, Angela. 2007. Giant African Snails (GAS) and Barbadian Gullies. A Report to the Ministry of Energy and the Environment, pp 23.

Kairo, Moses T.K., Pollard, G.V., Peterkin Dorothy D. and Lopez, Vyjayanthi F. 2000. Biological control of the hibiscus mealybug, Maconellicoccus hirsutus Green (Hemiptera: Pseudococcidae) in the Caribbean. Integrated Pest Management Reviews 5: 241-254.

Leone, S., De Marco, M., Ghirga, P., Nicastri, E., Esposito, M., & Narciso, P. 2007. Eosinophilic meningitis in a returned traveler from Santo Domingo: case report and review. Journal of Travel Medicine: 14(6):407-410.

Lai, C., Yen, C., Chin, C., Chung, H., Kuo, H., and Lin, H. 2007. Eosinophilic meningitis caused by Angiostrongylus cantonensis after ingestion of raw frogs. The American Journal of Tropical Medicine and Hygiene 76(2): 399-402.

Lindo, J. F., Waugh, C., Hall, J., Cunningham-Myrie, C., Ashley, D., Eberhard, M. L., Sullivan, J. J., Bishop, H. S., Robinson, D. G., Holtz, T., and Robinson, R. D. 2002. Enzootic Angiostrongylus cantonensis in rats and snails after an outbreak of human Eosinophilic Meningitis, Jamaica. Emerging Infectious Diseases 8(3): 324-326.

Lindo, J. F., Escoffery, C. T., Reid, B., Codrington, G., Cunningham-Myrie, C., and Eberhard, M. L. 2004. Fatal autochthonous eosinophilic meningitis in a Jamaican child caused by Angiostrongylus cantonensis. The American Journal of Tropical Medicine and Hygiene 70(4): 424-428.

Matalavea, S. 1997. Progress Report on Giant African Snail Project (TCP/SAM/6612), pp 13, unpublished.

Mead, A.R. 1961. The Giant African Snail: A Problem in Economic Malacology. University of Chicago Press: Chicago, Illinois. 257 pp.

Mead, A.R. 1979, Economic Malacology with particular reference to Achatina fulica. Pulmonates, Volume 2B, Edited by Vera Fretter and J. Peake, 150 pp. Academic Press.

Mead, A.R. and Palcy, L. 1992. Two giant African land snail species spread to Martinique, French West Indies. The Veliger 35 (1): 74-77.

Pascual, J., Planas Bouli, R., and Aguiar, 1981. H. Eosinophilic meningoencephalitis in Cuba, caused by Angiostrongylus cnatonensis. The American Journal of Tropical Medicine and Hygiene, 30(5): 960-962.

Plant Protection Service Secretariat of the Pacific Community. 1999. Giant African Snail, Pest Advisory Leaflet/ Secretariat of the Pacific Community, no.6 (revised), 3rd edition.

Raccurt, C. P., Blaise, J. & Durette-Desset, M. C. 2003. Présence d'Angiostrongylus cantonensis en Haiti. Tropical Medicine and International Health 8(5): 423425.

Raut, S. K. and Barker, G. M. 2002. Achatina fulica Bowdich and other Achatinidae as pests in tropical Agriculture pp. 55-114. In Molluscs as Crop Pests, ed. G. M. Barker. CAB International, Wallingford.

Robinson, David G. 2000. Public health concerns: Mollusk-vectored Angiostrongyliasis, Unpublished report, USDA-APHIS-PPQ P7RA National Identification Services; Updated 05/16/2000.

Robinson, David G., Zimmerman F. J. and Fields A. 2004. The terrestrial malacofauna of Saint Lucia, 16 pp, unpublished.

Slom, T. J., Cortese, M. M., Gerber, S. I., Jones, R. C., Holtz, T. H., Lopez, A. S., Zambrano, C. H., Sufit, R. L., Sakolvaree, Y., Chaicumpa, W., Herwaldt, B. L., and Johnson, S. 2002. An outbreak of eosinophilic meningitis caused by Angiostrongylus cantonensis in travellers returning from the Caribbean. New England Journal of Medicine, 346(9): 668-675.

Srivastava, P.D. 1973. The giant African snail and its control. Indian Farming, December 1973: 33-36.

Tsai, H., Lee, S., Huang, C., Yen, C., Chen, E. & Liu, Y. 2004. Outbreak of eosinophilic meningitis associated with drinking raw vegetable juice in southern Taiwan. American Journal of Tropical Medicine and Hygeine, 71(2): 222-226.

Vargas, M., Gomez-Perez, J.D. & Malek, E.A. 1992. First record of Angiostrongylus cantonensis (Chen, 1935) (Nematoda: Metastrongylidae) in the Dominican Republic. Tropical Medicine and Parasitology 43(4): 253-255.