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Wanda I. Lugo, Héctor L. Santiago, Rohanie Maharaj, and Wilfredo Colón

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Secretariat CFCS
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or from:

CFCS Treasurer
Agricultural Experiment Station
Jardín Botánico Sur
1193 Calle Guayacán
San Juan, Puerto Rico 00936-1118

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ASSESSMENT OF THE GIANT AFRICAN SNAIL (*ACHATINA FULICA*) ERADICATION PROGRAMME IN TRINIDAD AND TOBAGO 2008 – 2012

A. Balfour, S. Gosine, N. Ali, and J. Surijlal. Ministry of Food Production, Trinidad and Tobago

ABSTRACT: The giant African snail (*Achatina fulica* Bowdich) was introduced into Trinidad in October 2008. Immediately the government embarked upon an eradication programme using USDA's "New Pest Guidelines: Giant African Snails" as a guide. By 2012 the pest was well distributed throughout the highest populated districts of the Diego Martin Valley. The main components of the eradication programme were public awareness, surveillance and chemical treatment. These activities by 2012 targeted four (4) core zones and eighteen (18) satellite areas. *A. fulica* continued to be successfully confined to the Diego Martin Valley. The rest of the island and Tobago were pest free. The data received from the collection of snails (live and dead) between October 2008 and December 2012 showed an annual increase until 2011, followed by a marked decrease (50%) in 2012. The decline in snail populations in 2012 occurred despite high rainfall, flooding and an increase in satellite areas. This decreased resulted through increased surveillance and baiting. Throughout the duration of the programme the total number of snails collected was 34,747 by the end of 2012. An average of 8.2 times more snails were collected in the wet season than in the dry season. The hotline call response methodology acted as a detection system for the pest in Trinidad and Tobago. All valid calls received were investigated and all positive results were within the Diego Martin Valley. The total expenditure from 2009 to 2012 amounted to \$6,080,000.00. The total average annual expense for that period was \$1,520,000.00. Recommendations made included the continuation of night surveillance and the incorporation of specialized teams.

Keywords: eradication, vector, aestivation, infestations.

Introduction

The giant African snail, *Achatina fulica* Bowdich (Mollusca: Achantinidae), is native to East Africa but is now widely distributed in the Indo-Pacific region. It is an invasive alien species (IAS) which was reported to be one of the worlds worst 100 IAS (AQIS, 2008). Since the 1980s the pest has been present in the Caribbean region. It was reported from Guadeloupe in 1988 (FAO, 1989).

In 1989 it was found present in Martinique and in 2000 in St. Lucia, Dominica and Barbados (Robinson et al., 2004). Several other islands have since been infested with *A. fulica*.

The giant African snail (GAS) normally feeds on decaying plant and animal matter, however, it has been reported to forage on over 500 different plant species having a preference for breadfruit (*Artocarpus* sp.), cassava (*Manihot esculenta*), cocoa (*Theobroma cacao*) and most species of legumes and curcubits (Lambert, 1999).

The snail is also a vector of the rat lungworm *Angiostrongylus cantonensis* which causes eosinophilic meningitis in mammals including man (USDA-APHIS, 2005). It therefore poses a threat to agriculture, the environment and public health.

As the GAS Eradication Programme begins a fifth year of operation, it continues to play a vital role in pest management and crop protection, as the pest remains limited to the Diego Martin Valley and excluded from other areas of Trinidad and Tobago. The statistical trends indicate that the action on monitoring and baiting significantly reduces the population of outbreaks to zero within an average of two (2) weeks. This proved to be more frequent in 2012 than with previous years.

After two visits in 2009 and 2011 by the hired consultant on Dr. Coupland (expert malacologist), his recommendations highlighted the success of the eradication programme and pointed towards the high potential for eradication of the pest in this country.

Biology of *Achtina fulica*

Species within the family *Acatinidae* need significant amounts of calcium for shell formation and successful reproduction. Many sources are found in their habitats such as calcium rich soils, cement structures and even other snails within large populations.

The average life span of *A. fulica* is 3-5 years with a maximum of nine years. Adults are hermaphrodite, but reciprocal copulation is required to produce viable eggs. The snails reach sexual maturity in less than 1 year. Fertilized eggs can be laid repeatedly after a single mating (Robinson 2002).

Eggs – Snails can begin laying eggs at 5-6 months. Laying can begin 8-20 days after copulation. Eggs are laid in batches of 10 – 400 and hatch by 11 days. The juveniles feed on their own shell and then search for other food sources. They then burrow and remain underground for a 5-15 days.

Juveniles remain close to the nesting area for a few weeks. They feed on plant primarily and tend to explore feeding on decaying material as they mature.

Aestivation can occur in condition deficient of moisture. However it is believed that aestivation can also be cyclical. During harsh conditions snails burrow 10-15 cm deep in soil; and can become inactive for 1 year. During this period it can lose up to 60% of body weight (USDA 2007). High infestations are known to develop due to condition with high moisture. The snail is active mostly at night, GAS can disperse at an estimated rate of 125 meters per month (Tomiyama and Nakane 1993).

Methodology

The GAS Eradication Programme adopted an integrated approach based on the location of the biology of the snail, environmental and ecological factors, locations of infestations and demographic. The components included baiting, monitoring and removal of snails which directly impacted on population levels are employed with public awareness, surveillance, field sanitation and legislation.

Baiting, Monitoring and Removal

Team leaders were assigned to each of the core zones to execute and report on the eradication activities in each pocket. Within the core zones of Alyce Glen, Goodwood Gardens, Blue Range and Westmoorings every plot of land (including households, empty lots, abandon lots, parks, road edges, drains and rivers) within a 200 m radius (core zone) was surveyed. Beyond the core zone (200 m radius protection zone) random checks were made 50 m apart. Pockets of infestation which occurred via passive distribution ('hotspots' or satellite areas) were also baited and monitored.

At each location, snails were sought under leaf litter, discarded boxes, on walls and shrubs, in drains, brick holes and crevices. All *A. fulica* found (dead and alive) were counted, bagged, labeled and sent to the laboratory. Snail bait containing 3.0% metaldehyde were applied to all areas within each core zone every two weeks.

Collected snails were enumerated and transported to the Central Experimental Station, Centeno where they were frozen and later destroyed via incineration. Live samples of snails were periodically delivered to the Animal Production and Health Division for testing for the Rat Lungworm (*Angiostrongylus cantonensis*).

To facilitate Baiting and Monitoring exercises an average annual cost of \$ 350,000.00 was spent.

Table 1. Areas of Core Zones and Satellites treated for GAS

List of Core Zones	List of Satellite areas
Blue Range	Persad Street, Tru Valu Supermarket, Jasper Ave
Alyce Glen	President Wiseman Ave., Chuma Monka Ave
Goodwood Gardens	Crystal Stream-WASA Pumping Station, St. Anthony's College, Victoria Ave., The Y – Four Roads, Union Roads
Westmoorings	River
Other Satellites/Hotspots	Charles Ave, Ann Ave., Vander Pool Lane, Nagib Elias Drive, Rich Plain
Key Sites	Victoria Ave. Dump Site (Min of Works)



Figure 1. Distribution of giant African snail in Trinidad, 2012

Field Sanitation

This exercise enhanced the effectiveness of the baiting operation. Over grown lots inhibited the contact of the bait to the snails and ability to be located. As a member of the Task Force Committee and a stakeholder in the programme, CEPEP assisted by clearing lots during 2012. Due to the lack of a dedicated labour force their assistance was curtailed. The URP was then engaged to assist with clearing of these lots and was carded to begin in January 2013. The following areas hosted lots which were scheduled for cutting of over grown grass and herbicide application.

- Vanderpool Lane
- Along River Bank
- Nagib Elias Dr.
- Benjamin Dr.
- Tru Vale Supermarket

Public Awareness

This remained a key component in the eradication of *A. fulica*, and acts as a form of passive surveillance. Public participation served to inform the team of new outbreaks as well as assist with the proper sanitation methods to control the snail populations. Public awareness efforts encompassed advertisements/ notices/ supplements in the mass media (television, radio and newspapers), posters, factsheets, digital boards, billboards, community, town meetings, training, meetings with official stakeholders and sensitization of schools in affected areas. All public awareness media contained the ministry's hotline (646-6284) and email (snailreport@gmail.com), to facilitate reporting of snail sightings. An average annual cost of \$ 850,000.00 was spent on Public Awareness.

Television and Radio

The Research Division in collaboration with the Corporate Communication Division produced a 30-second video and radio advertisements. These were aired on three (3) television stations (TV6, CNMG, CNC3), and two (2) radio stations (Sweet 100, 97.1).

Newspapers and Fliers/Posters/Factsheets

Full-page flier advertisements for *A. fulica* were placed in the Express and Guardian Newspapers several times to promote the programme and advise the public on the notifiable status of the pest. Approximately 15,000 fliers/posters/factsheets were distributed in the Protection and Public Outreach Zones (areas outside of known infested zones), county agricultural offices, schools, health centers, pesticide shops and markets. Factsheets were also distributed during advertising exercises at three locations within the core zone by Pearl and Dean Mobile Advertising (Table 2).

Digital Boards and Movie Towne

Two PowerPoint® presentations of five and ten slides were displayed on digital boards located at:

- Cocorite on the Western Main Road, before entering Diego Martin
- West Mall Car Park, Hi Lo compound
- Movie Towne car park and located in Westmoorings.

The 30-second television advertisement was also displayed at ten cinema screens at pre-feature times in November and December, 2011.

Seminars

Eight exhibitions were conducted in seminars hosted by NIHERST (National Institute of Higher Education, Research, Science and Technology) the Ministry of Labour and Guiaco Secondary School, Agri-Society and the Ministry of Food Production.

Training exercises

The following members of agencies were trained in GAS identification and handling:- County Caroni, St George West, St George East, St Patrick East, Victoria, Diego Martin Regional Corporation and their respective Public Health Inspectors.

Table 2. Advertising Media used for *A. fulica* Public Awareness Campaign

Advertising Company	Advertisement mode	Description
Pearl & Dean	Mobile Truck	Digital screen for 6 hours on mobile truck at Starlite shopping plaza
Sign Tech	Digital Billboard	10 & 30 sec digital board ad at Cocorite
Creative Advertising	Digital billboard	10 sec digital billboard advertising at Hi-Lo compound Westmoorings
Movie Towne (POS)	Pre-feature ads in cinemas	30-sec ad in cinemas 1-10
CNMG- C TV	Television	36 40-sec spots at news, pre-news, first-up, prime time, weekend news
CNC3	Television	45 30-seconds television ad spots
CCN TV 6	Television	32 spots at crime watch live & repeat, 8-9pm
Gayelle	Television	4 30-sec spots per day at 6-7pm, 7-8pm 8-9pm and 7pm every Monday
CNMG - Sweet 100.1 fm	Radio	52 30-sec Spots between 6-8 am & 4-6 pm
CNMG - 91.1 Talk City	Radio	52 30-sec spots between 6-8am & 5-7pm

Other Modes of Advertising for *A. fulica* Public Awareness Campaign 2008-2012

Activity	Details
Poster and Flyer production	Trinprint
Flyer Distribution	15000 flyers during surveillance in all core zones 10,000 via Newspapers as inserts
Magnetic Strips	10,000 produced distributed to stakeholders and residents

MFPLMA Website

Technical and promotional information on *A. fulica* has been submitted for presentation on the website of Ministry of Food Production. This entailed fliers/posters/factsheets and summary/updates of the giant African snail programme. None of this information had been uploaded.

Surveillance

Surveillance was conducted in two forms. Active surveillance involved rapid reconnaissance surveys of areas within the infested zones on a periodic basis or after

acute events such as floods. Areas were zoned and assigned to teams for action. Survey personnel checked the premises of every five houses within a street and completed questionnaires with the occupants. Sampled houses were tagged positive or negative for the presence of GAS.

The second method involved passive surveillance, where the hotline phone number (646 6284) was used to receive calls from the public on any sighting of the snail. Calls were serviced within three days and the site marked positive or negative for the pest. Preliminary photographic identification of *A. fulica* had been facilitated by email response (snailreport@gmail.com).

Legislation

Regulations Regarding *A. fulica*

A. fulica has been made a Notifiable Pest under the Agricultural Act of 1975; the public is therefore required by law to report any sighting of the pest. To the MFPLMA, this component is the forerunner for Regulations for *A. fulica* and declaration of pest free areas under IPPC - ISPM 4 (International Plant Protection Convention – International Standards for Phytosanitary Measures 4: Requirements for establishment of Pest Free Areas). Three other components are necessary for the IPPC to declare the rest of Trinidad and Tobago pest free:

- 1) The pest has restriction with respect to movement of the pest/commodities in and out of the infested area
- 2) Surveillance activities are conducted to ensure pest free status
- 3) Data is readily available upon request from importing countries

Items 1) and 2) cannot be effectively implemented without regulations being declared for *A. fulica*.

Results

Baiting, Monitoring and Removal

The data on snails collected in table 3, showed that throughout the collection regime between 2008 and 2012 there was a total of thirty four thousand seven hundred and forty seven (34,747) snails collected. However, the total number of snails collected in 2012 was less than 50% of that collected in 2011, and 66% of that in 2010 (Table 3, Figure 2).

As displayed in Figure 2, while there was a progressive annual increase in snail populations from 2008 up to 2011, the trend was interrupted, by a decrease in snails collected in 2012. This decrease was observed in spite of the increase of the number of satellites where snails were collected, from 4 in 2009 to 18 in 2012. The reduction in snails can be attributed to the increase in nocturnal surveillance, which increased the

access to some properties and also allowed the team to gain direct contact with snails which were more active at night.

Any trend displaying a decrease in the number of snails collected in the next two years, can point towards a sound and defined forecast of true eradication.

Table 3. Total number of GAS collected during Baiting and Monitoring Exercises - October 2008 – December 2012

Year	No of Snails Collected
2008 (Oct - Dec)	1,349
2009	4,644
2010	9,744
2011	12,754
2012	6,256
TOTAL	34,747

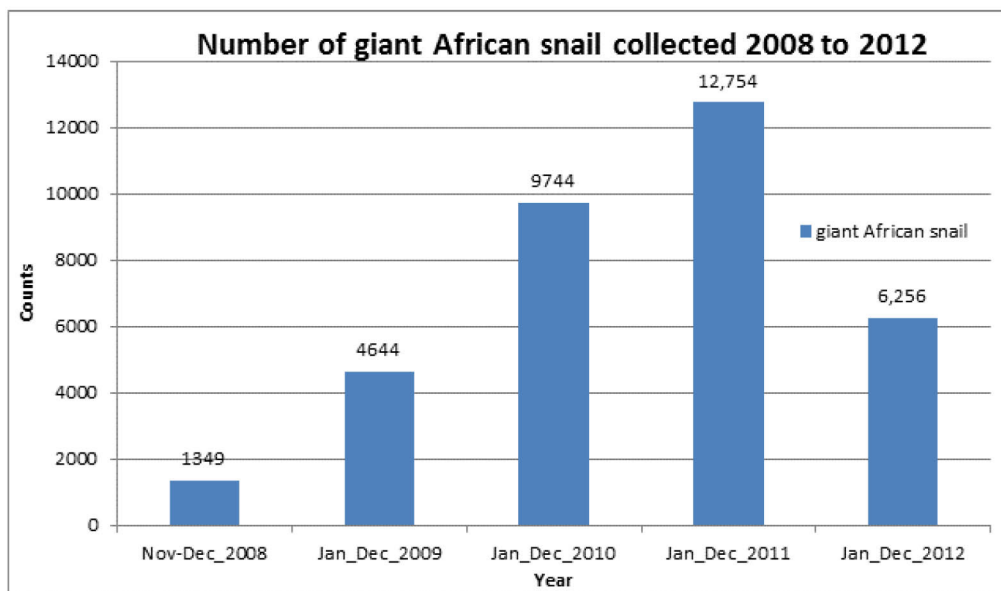


Figure 2. Total number of giant African snails collected in the Diego Martin Valley, 2008 to 2012

Table 4. Total Number of Snails Collected by Dry & Wet Season from 2009 to 2012

Dry Season	
Year	No. of Snails
2009	500
2010	279
2011	1916
2012	1280

Wet Season	
Year	No. of Snails
2009	4154
2010	9465
2011	9409
2012	4976

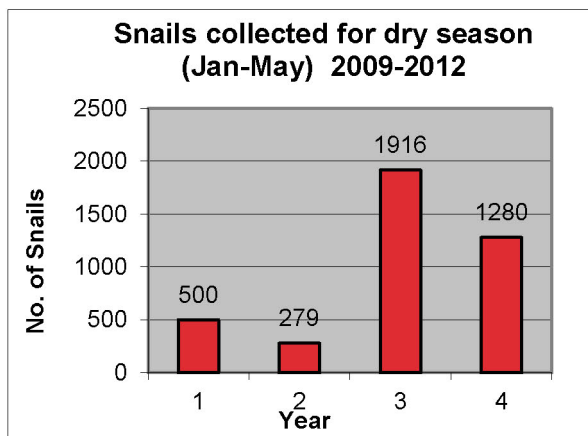


Figure 3. Wet season snails collected

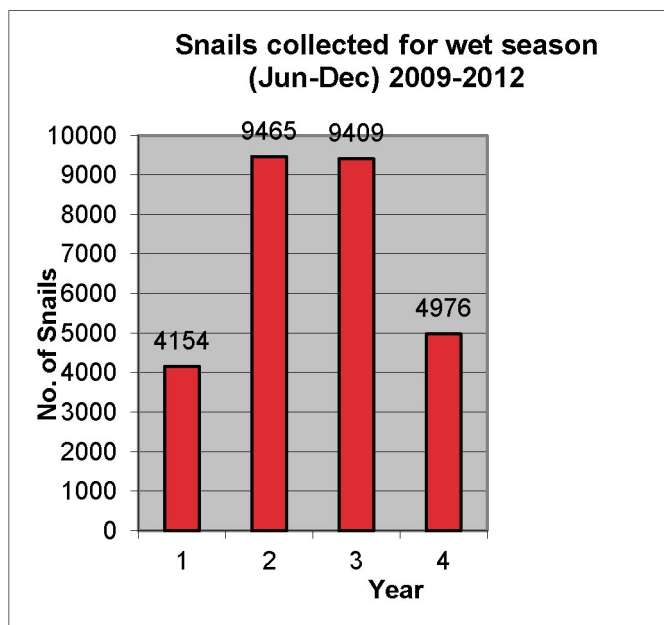


Figure 4. Dry season snails collected

By comparison, wet season and dry season data on the total number of snails collected showed that for most of the years (2009 to 2011), there was an average of 8.2 times more snails collected in the wet season than in the dry season (Table 4). However, in 2012 the same comparison was only 3.8 times. Table 5 shows that the difference of snails collected between dry and wet seasons was highest in 2010 and lowest in 2009. The year 2012 had unusually high rain fall with two severe flooding episodes within the Diego Martin Valley. This can account for 2012 generating the second lowest differential between the seasons. Members of The giant African snail Eradication Team. Research Division

- The giant African snail Task Force Committee
- The Director and Deputy Director of the Research Divisions
- The Diego Martin Regional Corporation
- Animal Production and Health, Ministry of Food Production

The increased numbers of snails in the wet season was expected as the population of *A. fulica* increases with increased rainfall and this is reflected in the data when comparing the seasons. However, the dry seasons of 2011 and 2012 manifested unusually high rainfall and hence the figures were significantly higher than proceeding years.

It should be noted that more night surveillance was conducted in the rainy season due to the increase in snail populations and available resources.

Table 5. Difference of snails between dry and wet seasons

Year	2009	2010	2011	2012
Difference in snail populations	3654	9286	7489	3696

Field Sanitation

This exercise enhanced the effectiveness of the baiting operation. In 2011 and 2012 areas where field sanitation exercises were conducted there were longer periods between re-infestations and lower populations if occurred

Public Awareness

The following table reveals the cost of advertising for 2012. This was considerably lower than 2011, which generated approximately \$1,000,000.00. The heightened public awareness in 2011 was followed by increase in hotline calls. This lead to quicker action taken against infestations and lower populations in 2012.

Table 6. Composite Advertising (Jan – Dec 2012)

Period	Mode of Advertisement	Cost (\$)	Total (\$)
Jan – Mar 2012	Television	179,173.04	226,645.04
	Radio	25,047.00	
	Electronic Board	22,425.00	
Apr – Jun 2012	Television	185,437.50	209,817.50
	Radio	18,630.00	
	Electronic Board	5750.00	
Jul – Sep 2012	Television	185,437.50	204,021.50
	Radio	12,834.00	
	Electronic Board	5750.00	
Oct – Dec 2012	Television	162437.50	175271.50
	Radio	12834.00	
	Electronic Board	-	
Jan – Sept 2012	Other		
Grand Total on Advertising (Jan – Dec 2012)			815,755.54

Surveillance

Active Surveillance was conducted in August 2012 as a response to the severe floods which occurred in the Diego Martin Valley. The surveillance was interrupted due to a lack of human resources.

Rapid responses to the hotline calls encouraged quick eradication action in areas not scheduled to be monitored. The hotline calls also facilitated the detection and monitoring of the spread of *A. fulica*. The extension county offices of RAN and RAS have agreed to assist with conducting visits responding to calls outside of the infested area. However this system had not been consistent in its operation. Hence the officers at the Crop Protection Sub-Division completed these outstanding visits.

The introduction of aggressive advertising was generally followed by an increase in hotline calls and email responses. By the end of 2012 there were no outstanding snail calls to be serviced.

Total Hotline Calls from 2008 to 2012:-

- 4238 calls were received
- 4238 calls investigated
- 157 calls positive (all within Diego Martin Valley)

GAS Hotline calls received from index to December 31st 2012

	2008	2009	2010	2011	2012
Calls received	16	852	1587	1070	713
Calls investigated	16	852	1587	1070	713
Positive	0	23	20	43	71

Legislation

Due to the lack of staffing in the Legal Department attached to MFPLMA, efforts to complete the appropriate legislation were delayed. Liaison with the Legal Advisor was re-established and a cabinet note was drafted and submitted to the Legal Department for appropriate action. The outstanding proclamation remained crucial to establishing pest free status according to ISPM #4 and to support the eradicating the *A. fulica*.

National Task Force

A National Task Force for giant African snail was established and mandated to expedite matters relating to the eradication of this pest. Eight meetings were conducted to date. The Task Force comprised of representatives of the Ministry of Food Production (Research, Regional Administration North, Regional Administration South, Planning, Extension Training and Information Services, Animal Health and Cooperate Communications) External members included Forestry Division (Ministry of Environment), the Diego Martin Regional Corporation (DMRC) and CEPEP.

Through the Task Force Committee collaborations were established with DMRC which facilitated the clean up programmes after flooding and field sanitation exercises.

SUMMARY OF EXPENSES FOR GAS ERADICATION PROGRAMME 2009 – 2012 (TT)

Average Annual Cost of Bait	\$ 350,000.00
Average Cost of Material (Field Materials; PPE, Pesticide Applicators, Stationery)	\$ 200,000.00
Average Annual Cost of Labour (Hiring of 2 contract workers)	\$ 120,000.00
Average Annual Cost of Public Awareness	\$ 850,000.00
Total Ave. Annual Expenses for period 2009 - 2012	\$ 1,520,000.00
Total Expenditure 2009 - 2012	\$ 6,080,000.00

Immediate to Short-Term Recommendations

Maintain Night Surveillance

This activity is vital to eradication as the snail is a nocturnal creature, hence more specimens would be collected during this time. Additionally, some residents would be available after working hours and the eradication team can gain access to more properties.

Maintenance Teams

The partnering with URP to provide teams to assist with the cutting and pesticide application on overgrown lots is crucial to treat with existing and latent snail populations. Due to its prolific nature it is important to swiftly implement eradication applications on all potential sites. Often overgrown lots which protect the snails from baiting and collection serve as sources for future outbreaks and spread of the pest. This can nullify the effectiveness of the previous eradication activities.

Increase in Staff

Human resource shortages has affected the implementation of the programme. Four staff members (2 Agricultural Officers I, 1 Agricultural Assistant 1, 1 Agricultural Assistant II) have been promoted or reassigned out of the GAS programme. In effect, the GAS Eradication Team is severely short staffed. The hiring of contract workers has been included in the budget for this programme and employment of contract workers or OJTs is greatly needed to augment the activities of the programme.

Enhanced Public Awareness

It has been advised by the previous Corporate Communication Director, the GAS Eradication Team and several communications specialists that new television and radio advertisement need to be produced. The current advertisement had been airing for three (3) years and a new one should include updated information as well as a human element which can impact on the viewing audience.

Comprehensive Survey

Since the floods of August 2012 and the potential movement of snails to uninfected areas, the GAS Eradication Team embarked upon a comprehensive survey of the Diego Martin Valley in September 2012. The surveillance operation was halted as it was difficult to conduct the survey and the eradication programme simultaneously. It is advised that the survey be completed with the hiring of temporary teams.

Economic Analysis

An economic impact analysis of the GAS Eradication Programme is required to assess the feasibility of the programme and its potential to continue, in the light of the heavy recourses administered.

Conclusion

The giant African snail is still confined to the Diego Martin Valley, 4 years and 3 months after being discovered in Trinidad, October 2008. Dr. Coupland in his report of 2011 referred to this accomplishment as significant and presents a positive outlook for eradication. The reduction of snails collected in 2012 by 50% of 2011 is encouraging, especially following a trend which displayed an annual increase.

In concurrence with the recommendations of Dr. Coupland's report, The Task Force Committee agreed that the components of the GAS programme should be intensified "in a push towards eradication" (Coupland 2011). In 2013 an economic analysis is to be conducted on the GAS Eradication Programme. This will not only assess the feasibility of the project but inform on future work and the continuance of the programme. Further annual decreases in snails collected points towards greater potential for zero populations. According to USDA recommendations to declare eradication of the giant African snail there needs to be an absence of snails for two years, during continued monitoring.

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- The Giant African Snail Task Force Committee
- The Director and Deputy Director of the Research Divisions
- The Diego Martin Regional Corporation
- Animal Production and Health Division, Ministry of Food Production

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