Pacific Community
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RESCCUE

Giant African Snail, *Achatina Fulica*

Project note

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1. BIOLOGICAL AND ECOLOGICAL CHARACTERISTICS

1.1. Taxonomy

2 sub-genus of Achantinidae exist: Achatina and Arachantina. The biggest species are Archatina marginata and Achantinz achatina.
Achatina Fulica is the most common species, originated from Africa and largely spread in pre-equatorial regions of West African, Asia and Oceania (Stiévenart C. & Hardouin J., 1990.).

1.2. Reproduction

Achatina fulica is a hermaphrodite species. Transferred sperm can be stored within the body for up to two years: thus, these snails can lay eggs over a period of several months after only one mating. A snail may lay 5-6 clutches per year, with 200 eggs per clutch. Eggs are laid in damp places and show a hatching viability of about 90%. Thus, it breeds rapidly, out-competes native species of snails and reaches large numbers in short periods due to their prolific breeding habits.[1]

1.3. Predators

The hermit crab, coconut crab, domesticated duck and other mammals such as the wild pig prey on *Achantina fulica*.

2. PACIFIC INTRODUCTION

The GAS was first introduced into the region from its origin in East Africa in 1938.
In 2013, it was established in Cook Island, Federated States of Micronesia, French Polynesia, Guam, Marshall Islands (on Kwajalein atoll), New Caledonia, Northern Marianas, Palau, Papua New Guinea, Philippines Wallis/Futuna, Samoa, Timor, Vanuatu (Ministry of Primary Industry, New Zealand Government, 2013).

GAS has been spread by man in large parts of the world. They were either introduced accidently (with food transport from their original home countries for example) or voluntarily to be cultivated. In the Pacific, GAS was first introduced in Tahiti and Moorea in 1967 and in the Marquesas Islands in 1973 as an alternative source of food. It appeared that the expected economic success of GAS cultivation did not really happen: the GAS were put into nature, left to themselves and became an invasive species. In New Caledonia, the snail was picked for the first time in 1972 (Yohann Soubeyran, 2008).

3. DAMAGES

3.1. Human health

GAS is carrier of *Angiostrongylus cantonensis*, a roundworm responsible for eosinophilic meningitis[2]. He is actually an intermediary host, final hosts are rodents (Rattus norvegicus). There is a risk for human health when GAS are consumed raw or poorly cooked, and when manipulated with bare hands. In New Caledonia, 3 to 10 cases are identified each year. However, the disease can also be contracted by eating salads, fruits, vegetables, even water polluted by intermediary hosts (Patrick Barrière, CEN, pers. com.).

Properly cooked, GAS should not be dangerous for health anymore, since once properly boiled, pathogens are destroyed.

[1] http://eol.org/pages/452699/details#reproduction
[2] http://www.cabi.org/isc/datasheet/2640

3.2. Ecological damages

GAS is an herbivory, consuming more than 500 different plant species, causing a tremendous impact on flora. Nutrient cycling can be altered, with large amount of plant material

The snail spreads diseases through the transmission of plant pathogens: phytophtora palmivora in Ghana (Cacao), Oomycete (black pepper, coconut, papaya, vanilla), P. colocasiae (taro) and P.parasitica (aubergine, tangerine).

Finally, GAS has a crucial adverse effect on indigenous gastropods: directly by competition for resources and space, and indirectly with eradication strategy of GAS (having involved in some countries introduction of another snail for controlling GAS… which finally became another predator for indigenous snail).

3.3. Economic and social impacts

Loss of crop yield and the cost associated with opportunities lost with enforced changes in agricultural practices.

Huge cost of control or eradication. For example, having infested some states in USA, were declared eradicated in 1973, with more than 18,000 snails collected at an equivalent cost of 4 million of dollars. The species has become again invasive since then (US Fish and Wildlife services, 2016; Mead Albert R, 1961).

Finding them near human habitation: they can eat plaster and stucco from walls for the calcium they need to replenish their shells[3]. Their important spread in some places can lead to car accidents.

4. POSSIBLE USE

4.1. Human nutrition

From a nutritional point of view, GAS appears to be a real interesting product, with high protein, low fat and cholesterol content. They also contain almost all the amino acids needed by the body.
Transformation (cooking) could be a great track: brochettes, flesh in sauce, dried, salted or smoked flesh (longer conservation), cooked “fully” or separated from shell, stuffed, in soup, pâté or fritter… Eggs can also be sold and eaten: cooked, pasteurized or spicy (snail caviar).[4]
Some recipes:
http://macuisineamoi.blogspot.com.au/2009/10/jai-mange-des-escargots-geants-dafrique.html
http://www.cuisineaz.com/recettes/kedjenou-d-escargots-epices-7797.aspx

In West Africa, from Guinea to Angola, GAS are an important source of food and a delicacy. It can be used for human consumption locally (sold alive or after a short preparation on marketplaces in some African villages, or in restaurants) or for exportation. They were picked up in nature, but the increasing demand caused a significant diminution of the population, leading to breeding: it demonstrates that human pressure for consumption can be sufficient to decrease the snail population (Stiévenart C. & Hardouin J., 1990). The strong demand for food is still recognised especially considering the increase of Africa’s population: it created an opportunity in the market for snail breeders and farmers who now cultivate GAS on small farms and in their backyards for impressive profits.[5] Some GAS breeding exist now in West Africa: ex of a farm in Togo, helped by “Elevage sans frontière”, breeding GAS since 2008

[3] https://www.livescience.com/28714-giant-african-land-snails.html
[4] http://www.fao.org/docrep/v6200t/v6200T0b.htm
[5] http://www.smallstarter.com/browse-ideas/snail-farming/

(more than 1,000 specimens today): rewarding activity, they can now send their children to school and have medical care when needed.[6]
Case analysis of GAS selling in Abidjan's markets: monthly average price between 650 Fcfa/kg (118 xpf /kg) and 1,220 Fcfa/kg (222 xpf /kg).[7]

In Vanuatu, certain communities in Santo Island have been eating GAS and confirmed it is good eating. In the past (1990s), there was a snail factory on the island of Santo that processed snails and exported to some foreign countries (Glen Alo, fisheries department, Vanuatu's Government, pers. com.).
Another interesting fact: at some point, GAS were included in their menu by European touristic restaurants in Santo (Muriel Dagobert, Vanuatu Agricultural Research and Technical Center, pers. com.).

In Apia, Samoans were encouraged to eat giant African snails to help rid the country of an infestation of the agricultural pest, in 1998. A local recipe involves isolating the snails for four days and then boiling them several times before adding garlic and coconut cream.[8]

In Papua New Guinea, some people consumed GAS as food (Ilagi Pauna, Land Resource Division, Pacific Community, pers. com.).

In New Caledonia: canned GAS are currently imported and sold in supermarkets (Hubert Géraux, WWF New Caledonia, pers. com.).

4.2. Animal nutrition

4.2.1. Cattle feeding: pigs and poultry

Depending on the size of the snail and on the animal fed, GAS can be distributed entirely or transformed in flour.

The most simple and less expensive method is picking and crushing GAS for pig or poultry feeding. The collection can be easy with positioning some snails shelters consisting in a simple sheet metal or flat stone. This seems the most effective way of implementation, to promote at the family, tribal or associative scale. Some points we have to make sure:

- A simple crush prevents GAS from escaping the feeding zone
- GAS are attractive and consumable enough for animals
- People collecting snails have to be protected by gloves

(Patrick Barrière and CEN team, pers. com.)
This seems to be particularly interesting for pigs, since they are used to eat snail, are less selective than other animals, so the entire snail can be valorised (CIRAD-GRET, Ministère des affaires étrangères, 2006. Memento de l'agronome).
In the Loyalty Islands in New Caledonia, the impact of GAS on agriculture and the environment is high. People sometimes collect and crush them, but they are not consumed, contrary to the Bulime, really appreciated.
Some breeders feed their pigs with GAS, boiled most of the time, as a protein intake. Usually, protein rate in pigs' ration is insufficient (as pigs are largely fed with coconuts and vegetal). Sometimes, pigs can eat raw GAS, when accustomed. 10 to 50 farmers are counted to use snail for cattle feeding. There is no commercial breeding, just family breeding (1-25 animals) (Antoine Barnaud, Loyalty Island province in New Caledonia, pers. com.).

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[6] http://www.elevagessansfrontieres.org/des-escargots-geants-en-afrique/
[7] http://www.lrrd.org/lrrd20/4/koua20058.htm
[8] http://www.pireport.org/articles/1998/05/05/samoans-encouraged-eat-african-snails

In Vanuatu, Livestock department (Vanuatu's Government) have been feeding GAS to chicken and pig in the past (Glen Alo, fisheries department, Vanuatu's Government, pers. com.).
In Solomon Island, some people used GAS to feed pigs in small-scale piggeries (Ilagi Pauna, Land Resource Division, Pacific Community, com. Pers.).

Another way to feed cattle with GAS is to incorporate it in the daily ration, dehydrated or transformed in flour as a substitute to imported meat and fish flour (which can be really expensive and difficult for pacific communities to import). A portion of the Achatina shell could also be ground up and combined with the snail meat as an added source of calcium carbonate (it's better to use them separately, in order to control the ration's mineral balance). Snails have to be boiled for 15 minutes, so the growth inhibiting molecules and the pathogens can be destroyed.

4.2.2. Aquaculture

According to FAO, it is totally possible to feed fishes with food leftovers, or agricultural waste, oilseed meal, rice bran or snails (FAO, 2014. Guide aquaculture).

In Vanuatu, some incentives existed to encourage people collecting snails and give it for composting for a fee given by the Government.
There were some trials to use it as a food ingredient for freshwater tilapia fish. This looked promising, especially regarding the high nutritional value of GAS: it was collected, boiled and then mixed up and ground with Copra waste and Kassava flower, as flour. It was an interesting substitute for fish feeding (fishes grew well). However, this experience could not be maintained, since people in Vanuatu did not buy fishes grown up with snail flour. The cultural barrier was too important, since most people in Vanuatu do not eat snails and rejected the idea of a food grown up with it (Robert Jimmy, Fisheries, Aquaculture and Marine Ecosystems division, Pacific Community, pers. com.).
There was also a feed trial for local fresh water prawn (Glen Alo, Fisheries department, Vanuatu's Government, pers. com.).

Several studies presented fish of fresh water prawn feeding trials with other kinds of snails, mainly freshwater snails such as the golden apple snail (Bombeo-Tuburan & al., 1996).

4.2.3. Making fertilizers

An observation of GAS use as fertilizer was made in Chichi Jima (Japan): mostly the small, thin-shelled snails were collected in metal oil drums. These were allowed to stand in the hot sun until the snails died and had reached a high degree of putrefaction. These rotting, maggot-infested snails were then scooped out, the shells were crushed, and the putrid, slimy, odoriferous mess was added as a fertilizer to young vegetable plants. This led to great results of plant growth, but the crushed shells changed the pH-balance of the soil in basic way. More recently, the latter disadvantage has been eliminated in the similar use of snail fertilizer in Guam in that only the "liquor" is drawn off and diluted with ten parts of water before being added to the soil. So, in a perspective of proposer use of GAS as fertilizer, two kinds of products could be proposed: with and without shell fragment, depending on the kind of soil (acid of basic one) (Mead A. R, 1961).

A process for transforming golden apple snail into liquid bio-fertilizer or Compost has been described in a study realised by the Department of Agricultural in Thailand (Sinives S.).

4.2.4. Cosmetic and pharmaceutical industry

In common with a number of other molluscan species, A. fulica has been used as a source of biological compound in cosmetic, clinical and experimental laboratories. It has been widely utilised in

neurobiology and electrophysiology, endocrinology, comparative biochemistry and physiology, reproductive biology, parasitology, immunology and molecular biology.[9]

In particular, β-glucuronidase used in the pharmaceutical industry, can be found in the snail's digestive gland (Stiévenart C. & Hardouin J., 1990.).

Achatine is traditionally widely used in Africa for traditional medicine.[10]
They might also help in stopping tumour growth in cancer[11].

4.2.5. Small-scale solution against ocean acidification

Alkalinisation could be useful in coastal environments. Some studies show that the numbers of live shellfish in buffered sediment increased. Such small-scale sediment buffering may be a potentially important management strategy to decrease dissolution mortality in coastal environments.
So an idea could be to valorize GAS shells by grinding and spreading them into seawater (Billé R., pers. Com.; Billé et al., 2013)

4.2.6. Shell transformation

In some Pacific countries, green snail shells are transformed and used to make furniture, buttons, jewellery, souvenirs… (Pakoa K & al., 2014)

5. A WORLD MARKET FOR GAS EXPORT?

5.1. Process for export

Several processes exist for snail meat exportation, which has to be processed with great care. An example is described below.

1. Snails starved for about 24h
2. Enough quantity of water prepared by boiling at approximatively 70°C
3. Add enough lumps of alum (potassium or ammonium aluminium sulphate)
4. Transfer the snails into hot water and cover up
5. After 2,3 minutes, open the lid and pour off the resulting dirty from the hot water
6. Cool under running tap
7. With ease, shake off each snail from its shell into clean, cool water
8. Remove offal
9. Rinse in two changes of clean cool water →Immediate consumption or packaging for export

Packaging for export:

- Cellophane (impervious to moisture) and refrigeration for local or foreign market
- Sun drying/Oven drying, them kept in a neat, aerated enclosure till when needed
- Live snails could also be packaged in a wooden box, basket or cellophane with maximum ventilation for export[12]

Approximate estimates for Australia of the cost of production for a well-managed and intensive snail farm (300,000 snails per year, estimated in 2000):

Capital requirement (green and shade house, processing equipment…	$AUS 22,590
Variable cost (water, feed, electricity…)	$AUS 7,585
Fixed cost (insurance, market development)	$AUS 1,975
TOTAL	$AUS 32,150

[9] http://www.cabi.org/isc/datasheet/2640
[10] http://www.fao.org/docrep/v6200t/v6200T0b.htm
[11] http://eol.org/pages/452699/details
[12] http://www.homebusinessmanuals.com/2012/02/processing-and-marketing-of-snail-for.html

(Murphy B., 2001)

5.2. International market

As seen above, local demand in Africa is high for GAS, especially because of its biological cycle in this region: snails are dormant during dry season, they become increasingly scarce during this period and the market is starved.

The GAS demand in Europe is quite high, with various channels (hotel, restaurants, stores, supermarkets, corporate such as wedding, celebration…). It appears that many people abroad like to keep them as pets and keepsakes due to their size.[13]

Thus, it creates opportunities for snail breeders. A case study of an African breeder, receiving demands from the US, the UK, and Holland for GAS exportation (although she didn't have covered the local demand).[14]

It was reported in Raut & Barker 2002 that GAS was exported to Europe but also to America from Taiwan, China and other Asian countries (Mead 1982). It appeared that the interest in *A. fulica* as an edible snail has led to its establishment in regions of Brazil, such as Sao Paulo, Rio de Janeiro, Minas Gerais, Parana and Santa Catarina (Teles *et al*. 1997, J. Coltro pers. comm. 2000, in Raut & Barker 2002).

An article made reference to the potential export market of GAS, explaining that Australian restaurants are serving GAS for about $US 10 a dozen, while Tahiti has the French delicacy listed on some of its menus.[15]

5.3. Previous exportation of green snail in the Pacific

In the past, Papua New Guinea, Solomon Islands and Vanuatu have been exporting green snail (Wright A. and Hill L., 1993).

Some conclusions from the information learned through this report

- A global market currently exists for the giant African snail: in West Africa but also in Europe as well as in America
- Implementing new local use of GAS seems to be the most simple and profitable way in the Pacific to help decreasing the pressure of the invasive species while having direct benefit for local communities
- Cattle feeding, especially pig fed with whole snails, seems quite simple and effective to implement, with an easy collection and process, coherent feeding for the pigs (which naturally consume snails) and a social acceptability easier to reach than with other sectors (aquaculture for example)
- An important work of information, communication has to be made with local communities, especially about the safety of the GAS once properly cooked and the tremendous nutritional interest of it. Indeed, GAS could be a particularly interesting substitute either for human or animal nutrition
- It seems important to replace the snail in recognised and accepted food chains
- Culinary/gastronomic tests, with recognised ambassadors, could help raising the awareness and interest for this unusual species for some communities

[13] http://www.smallstarter.com/browse-ideas/snail-farming/

[14] http://www.africanews.com/2017/04/28/nigerian-entrepreneurs-rush-for-growing-snail-market/

[15] http://www.pireport.org/articles/1998/05/05/samoans-encouraged-eat-african-snails

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References

Bombeo-Tuburan & al., 1996. Use of the golden apple snail, cassava, and maize as feeds for the tiger shrimp Penaeus monodon in ponds.

Billé R. & and al., 2013. Taking action against ocean acidification, Environmental Management, Springer.

Mead A. R, 1961. GAS a problem in economic malacology, The University of Chicago press.

Murphy B., 2001. Breeding and growing snails commercially in Australia, Rural Industries Research and Development Corporation, Australian Government.

Reglain A. & al. Giant African Snails: a potential broiler feed component in Barbados.

Sinives S. Golden apple snail, new economic animal in future for Thailand, Sakda Sinives, Biological Agriculture Management Institute, Department of Agricultural, Bangkok Thailand.

Soubeyran Y., 2008. Espèces exotiques envahissantes dans les collectivités françaises d'outre-mer, Yohann Soubeyran, UICN.

Stiévenart C. & Hardouin J., 1990. Manuel d'élevage des escargots géants africains sous les tropiques, Centre Technique de coopération Agricole et rurale (CTA).

Wright A. and Hill L., 1993. Nearshore marine resources of the South Pacific

CIRAD-GRET, Ministère des affaires étrangères,2006. Memento de l'agronome.

FAO, 2014. Aquaculture, écoles pratiques d'agriculture et de vie pour jeunes (JFFLS), guide de l'animateur.

Ministry of Primary Industry, New Zealand Government, 2013. Giant African snail.

US Fish and Wildlife Service, 2015. GAS, ecological screening summary.

Websites

http://www.domtomnews.com/Ne-laissez-pas-vos-enfants-jouer-avec-les-escargots.html#.WUH2WWjygdU

https://www.aquaportail.com/fiche-terrariophilie-2120-achatina-fulica.html

http://www.iucngisd.org/gisd/species.php?sc=64

http://www.columbia.edu/itc/cerc/danoff-burg/invasion_bio/inv_spp_summ/Achatina_fulica.htm#Benefits

http://www.sun-sentinel.com/news/florida/fl-african-snails-20150323-story.html

http://aquaculture.ifremer.fr/Fiches-d-information/Filiere-Poissons/Aliments-de-substitution-pour-les-poissons-d-elevage

http://www.lrrd.org/lrrd20/1/diom20002.htm

https://www.googlesciencefair.com/projects/en/2015/76560cfecb45f5dc9e96bf3061b1a2e3aad6bdaf6518e2982dbd485a2147f507

https://www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant/giant-african-snail