

Retraction Notice

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no

Comment:

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The Martinican Population's Perception of the Conservation of the Lesser Antillean Iguana's (*Iguana delicatissima*)

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Abstract

The Lesser Antillean Iguana (*Iguana delicatissima*) is a valuable endemic species of the French West Indies, but it is facing serious threats that are putting its survival at risk. The species is currently critically endangered in Martinique, as evidenced by its listing on the International Union for Conservation of Nature (IUCN) Red List. Threats include both environmental and anthropogenic factors, making conservation efforts crucial to its preservation. To protect the Lesser Antillean iguana, several measures have been put in place, notably the regulation of the common iguana (*Iguana iguana*) population. This invasive species is in competition with and hybridizes with the endemic species. A biotope protection decree secures the main habitat of the endemic iguana against anthropic threats, ensuring a safer environment for this vulnerable species. Through a survey, we have collected the opinions of the population of Martinique concerning the conservation of the *Iguana delicatissima* and its habitat. The Martinique population expresses an interest in the conservation of this species. They see it as part of their natural heritage, and therefore a species to be protected. They are also ready to participate in conservation programs. Finally, a SWOT (Strengths, Weaknesses, Threats and Opportunities) analysis of Lesser Antillean Iguana conservation in Martinique was carried out, based on survey responses and selected data from the literature. This study refers to data collected in my Master 2 thesis in environmental management at the University of the Antilles Martinique Campus during the year 2023-2024.

Keywords

Iguana delicatissima, *Iguana iguana*, Ecology, Conservation, Biodiversity, Martinique, Lesser Antilles

1. Introduction

Listed among the world's top four biodiversity zones, the French West Indies possess exceptional ecological wealth, surpassing that of continental Europe in terms of the diversity of endemic species, particularly plants and vertebrates [1] [2]. However, this biodiversity is seriously threatened by the invasion of exotic species, whose numbers sometimes exceed those of endemic species, putting the latter at risk of extinction [3].

Invasive exotic species (IES) have been identified as one of the main causes of biodiversity loss, ranking second on the IUCN Red List of Threatened Species [4]. They affect around 30% of birds, 15% of plants, 11% of amphibians and 8% of mammals [2]. In Martinique, the Lesser Antillean Iguana population has undergone a major decline over the last few generations, mainly due to urbanization, anthropization, competition and hybridization with the Green Iguana [5] [6].

The Lesser Antillean Iguana (*Iguana delicatissima*), a region-endemic species, is a key component of local biodiversity. However, it faces serious threats such as habitat destruction due to human development (urbanization, tourism, deforestation) [7] [8]. Interactions with invasive species, which on the one hand are predators of eggs and juveniles (small mongoose, cat, hermit-crab) [9]. On the other hand, its direct competitor, the common iguana (*Iguana iguana*), which was introduced in the 1960s by the priest Pinchon, rapidly proliferated and became invasive, hybridizing with the endemic iguana [10]-[13].

However, the largest population of Lesser Antillean Iguana currently present in Martinique is found on the islet Chancel, in the municipality of Le Robert [14]. This spot is protected by French law, notably the decree of February 17, 1989 and that of July 31, 2013, prohibiting any form of destruction, capture or transport of the species [15]. In addition, this island was designated as a protected zone by a biotope decree in 2005, due to its fragile ecosystem [12]. Protecting the Lesser Antillean Iguana requires in-depth knowledge of the species and its habitats, particularly feeding, breeding and resting areas.

In response to the threat of extinction of the Lesser Antillean Iguana in Martinique, conservation strategies are being considered, such as protecting its habitat, regulating the green iguana and raising public awareness. This article uses surveys to explore Martinique citizens' perceptions of conservation efforts for the endemic iguana (*Iguana delicatissima*), its ecological contribution and the actions required to preserve this species.

2. Materials

2.1. Ecology of *Iguana delicatissima*

Lesser Antillean Iguana (Figure 1), is a species endemic to the French West Indies [16]. It is smaller than green iguanas, generally measuring between 45 and 60 centimeters in length [4] [17]. It is arboreal and spends most of its time in trees, where it feeds on vegetation (leaves, fruit, and seeds) [15]. Due to habitat loss and other threats, it is classified on the International Union for Conservation of Nature

(IUCN) Red List as Vulnerable or Endangered and is therefore the focus of conservation efforts [6].



Figure 1. *Iguana delicatissima*. PIERRE P. 2024, Ilet Chancel.

The species is protected by prefectural decree (decree no. 050589 of Feb. 28, 2005 and decree no. 053644 of Nov. 21, 2005) in the French overseas departments, including Martinique [18]. This protection targets not only its natural habitat against urbanization and anthropization, but also its direct competitor, the common striped iguana, *Iguana iguana*, which remains the biggest obstacle to the iguana's survival in the Lesser Antilles.

2.2. Ecology of *Iguana iguana*

The common, striped or green iguana (*Iguana iguana*) (Figure 2), is a big lizard native to Central and South America. It can be recognized by its imposing size, generally measuring between 1.2 and 1.7 meters in length [17] [19]. Its body is covered with rough scales and its color is variable from bright green to gray-brown.



Figure 2. *Iguana iguana* PIERRE P. 2024, Le Carbet.

Arboreal, they spend most of their time in trees, feeding on leaves, fruit and flowers. They are strictly herbivorous. They lay eggs in nests dug into the ground, and the young hatch after a few months. It remains a major competitor to the endemic species [6].

2.3. Iguana Reproduction

Iguanas are polygamous and reproduce between April and August [9]. Males display territorial and courtship behaviors to attract females, including vocalizations and ostentatious movements [16]. Copulation, which may be repeated several times during the season, takes place via double reproductive organs, the hemipenis.

Males can mate with up to twelve females to maximize their chances of reproduction [9] [20].

Females carefully select nesting sites, often sunny and well-drained, where they lay between 1 and 20 eggs in holes they dig in the ground [6] [21]. Egg incubation depends on ambient temperature, which also determines the sex of the embryos: warmer temperatures favor females, while lower temperatures favor males [11] [22].

Young iguanas reach sexual maturity between 2 and 5 years of age, depending on sex. Reproduction and survival of the species are highly dependent on the protection of natural habitats, particularly nesting sites and food resources [23].

2.4. Study Locations

Martinique is located in the center of the Lesser Antilles archipelago in the Caribbean Sea. It has a latitude of 14°N and a longitude of 61°W (14°40'N, 61°00'W) (WGS84) (Figure 3). The island has a total surface area of 1128 km² and is marked by the highest point, Montagne Pelée, which reaches a height of 1395.79 m [24]. This study was carried out in several of the island's villages, selected for the presence of at least one of the two iguana species. This presence was detected either in the literature or from local accounts. Fort-de-France, Carbet, Prêcheur, Robert and Trinité were selected (Figure 3). In each of these towns, at least one site was visited. One visit was made to a site in Morne Rouge, Carbet, Schœlcher and Robert, two visits to Prêcheur and four to Fort-de-France.

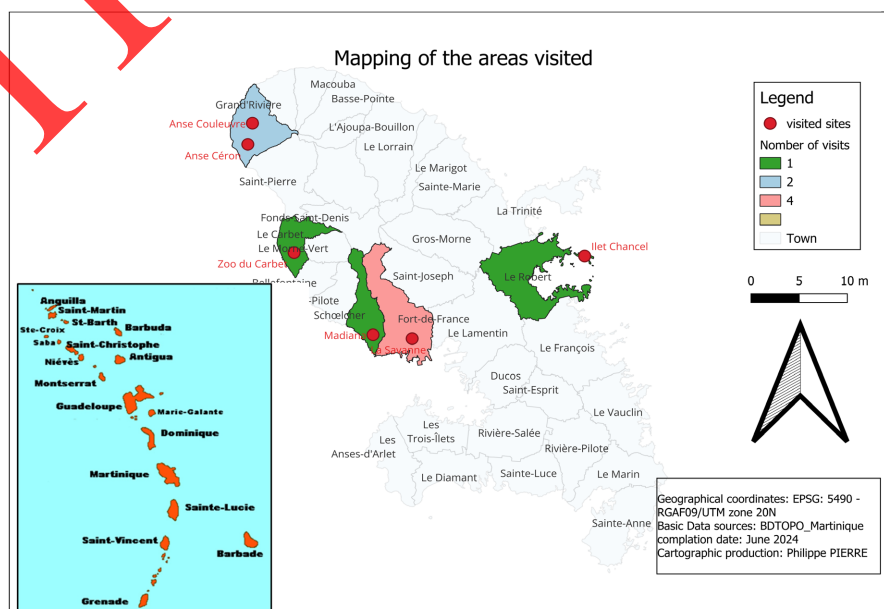


Figure 3. Mapping of the areas visited. PIERRE P. 2024.

3. Methods

3.1. Field Visits and Surveys

During our visits to each site, we combined direct observation with surveys of the local population to gather comprehensive information.

We conducted interviews with local residents to gather their perceptions of the *Iguana delicatissima*, its conservation and the state of the environment. These discussions also covered the conservation actions undertaken by the French authorities as part of the National Action Plan (PNA). The main aim of these surveys was to understand how the local population perceives the species and its role in the ecosystem, and to assess their level of awareness of conservation issues.

In order to detect the presence of iguanas, particularly Lesser Antillean iguanas (*Iguana delicatissima*), we made direct observations in the field in parallel with the surveys. We counted the number of individuals observed at each site at the time of the visit, taking care not to disturb them.

3.2. Data Analysis

This study, carried out as part of a six-month master's internship, explores population trends in conservation of the Lesser Antillean Iguana in Martinique. A sample of 82 people was interviewed. Data were collected via surveys processed with Google Forms, then visualized in the form of diagrams. A factorial correspondence analysis (FCA) was carried out to explore the links between variables and identify specific trends and groupings in opinions and perceptions concerning the *Iguana delicatissima* and its conservation. A SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of iguana conservation was also carried out, based on survey responses and literature data. Although modest in size, the sample is justified by the exploratory nature of the study, serving as the basis for my PhD thesis on the ecology of iguana species in Martinique. The results of this pilot study provide valuable information to guide future research and conservation actions.

4. Results

4.1. Public Perception of Lesser Antillean Iguanas, Their Habitat and Conservation

As part of this study on the ecology of Lesser Antillean iguanas, we assessed perceptions and knowledge of their conservation in Martinique. Surveys were carried out among 82 local people. The aim of the survey was to gather information about public awareness of this endangered species, attitudes and behaviors towards conservation efforts.

4.1.1. Surveys Profile

The survey was carried out with professionals from a variety of backgrounds, without prejudice to their specific identity, provided they are from the area. Twenty-one of the 82 respondents (26%) were students, 6 (7%) worked in the fields of environment, biodiversity or agriculture, 2 (4%) were fishermen or farm-

ers, and 52 (63%) were from other fields (**Figure 4**).

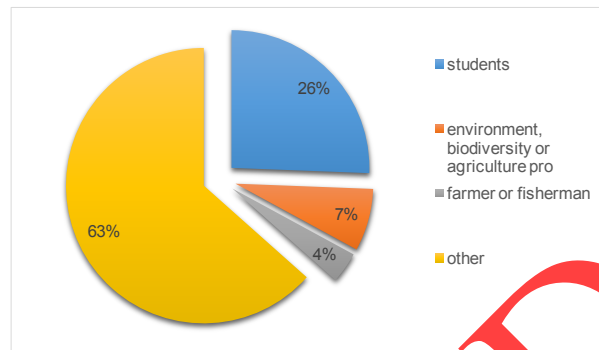


Figure 4. Distribution of respondents by occupation.

The survey covers a wide range of ages, from 18 to over 50, with intervals of 10 years. Of the 82 participants, 33 (40.7%) are aged between 18 and 28, 16 (19.8%) are aged between 29 and 39, 11 (13.6%) are aged between 40 and 50, and 21 (25.9%) are aged 50 or over (**Figure 5**).

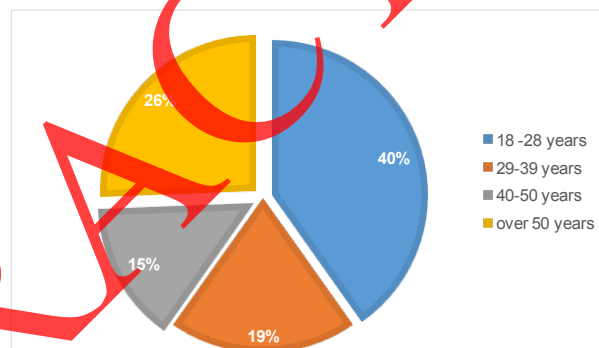


Figure 5. Distribution of respondents by age.

4.1.2. Knowing and Identifying the Lesser Antillean Iguana by the Public
Conservation of the Lesser Antillean iguana must also involve the participation of the population. Respondents were asked about the number of iguana species present in Martinique, both endemic and non-endemic. They were also asked to identify the local species from among several images presented to them. Of the 82 people surveyed, six (7.3%) replied that there was only one species. Four respondents, or 4.9%, said there were three.

Fourteen survey respondents, or 17.1%, said they didn't know how many species of iguana exist in Martinique. On the other hand, 58 respondents (70.7%) answered that there are two species of iguana in this region (**Figure 6**).

They were also asked to identify the local species from among several images they were shown. To assess the population's knowledge of the Lesser Antillean Iguana, respondents are asked to identify the endemic species from the three images above. **Figure 7** shows a male Lesser Antillean iguana in its adult stage. **Figure 8** shows a green female common iguana with a striped tail. **Figure 9** shows a

male common iguana with striped body and large tympanic patch.79 responded to this question, while 3 chose not to answer.

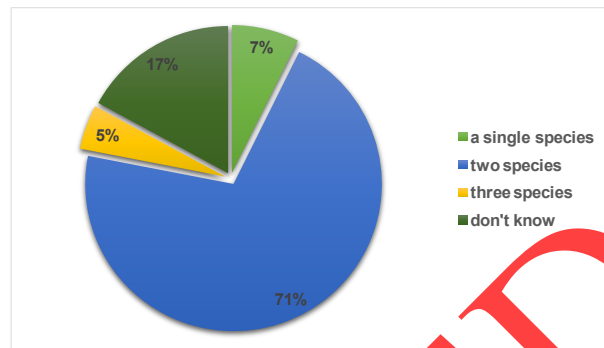


Figure 6. Iguana knowledge test.



Figure 7. Male of *Iguana delicatissima* [25].



Figure 8. Female of *Iguana iguana* [25].



Figure 9. Male of *Iguana iguana* [25].

Of the 79 responses, 48 people (61%) (Figure 10) chose the correct image (Figure 7), which is exactly the Lesser Antillean Iguana.

All the others (31 people) got it wrong. And of those who got it wrong, 25 people (32%) (Figure 10) chose the female *Iguana iguana* with the striped tail, and 6 people (7%), the adult male common iguana with the large tympanic plaque (Figure 9).

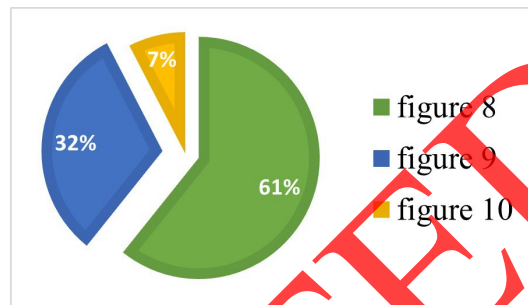


Figure 10. Identification of *Iguana delicatissima* by local residents.

4.1.3. Recognition of its Ecological Value

Protecting the iguana and its habitat is crucial to preserving Martinique’s biodiversity and maintaining the ecological balance of the island’s ecosystem. The surveys aim to assess the population’s awareness and understanding of the importance of protecting the Lesser Antillean Iguana and its environment.

Among those questioned 69% or 56 people answered categorically that the iguana should be protected. On the other hand, 30% expressed some uncertainty, qualifying the need for protection as doubtful or with a higher degree of uncertainty. However, only 1% of respondents thought that the iguana and its habitat were not worth protecting (Figure 11).

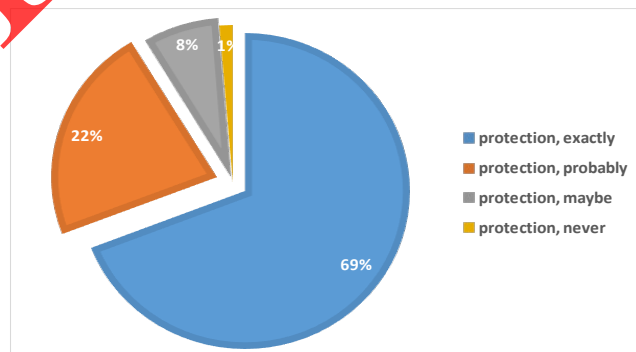


Figure 11. Recognition of the Iguana’s ecological value.

Respondents also gave their perceptions of this endemic species. 53% of respondents (43 people) considered the Lesser Antillean Iguana to be of ecological importance, and able to control insect pests. 42% of respondents (34 people) considered it a cultural heritage, while only 5% (4 people) saw it as a potential disturbance (Figure 12).

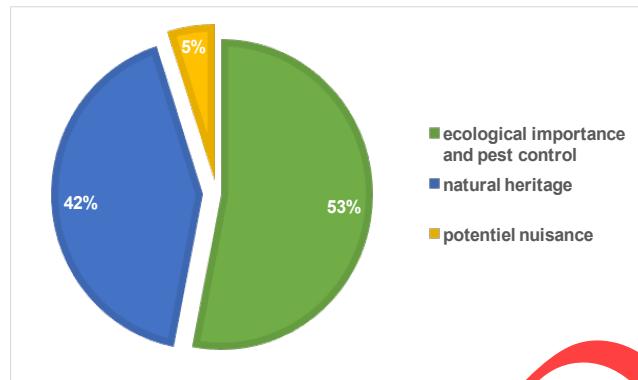


Figure 12. People's perception of *Iguana delicatissima*.

4.2. Extinction Threats and Legal Protection

The status of the Lesser Antillean Iguana's protection in Martinique seems to be well known by the population. Of the 82 people surveyed, 73 (89%) said they were aware of the Lesser Antillean Iguana's protection status (Figure 13).

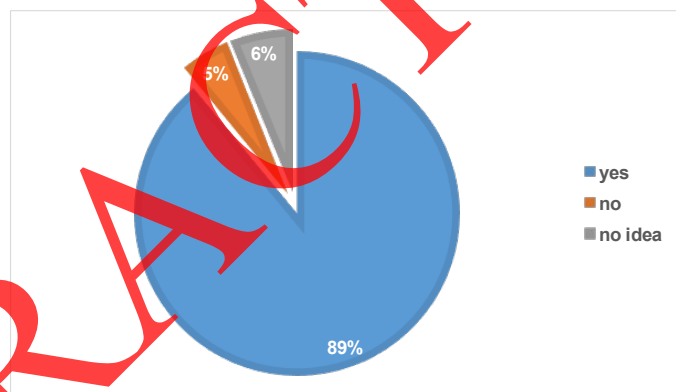


Figure 13. *Iguana delicatissima* protection status.

On the other hand, 11% (9) of respondents either don't know whether the species is protected, or don't follow news about biodiversity and the protection of endemic species in Martinique at all.

Whether or not they are aware of its protection, respondents all agree that the Lesser Antillean Iguana population is declining more and more in Martinique. The decline in the Lesser Antillean iguana population is a worrying phenomenon recognized by the local population.

During the survey, out of 82 people questioned, only one did not answer the question about the causes threatening the survival of the Lesser Antillean iguana in Martinique. However, 81 people shared their views on the causes of this decline and proposed protection measures. A majority of 67%, identified the common or striped iguana as the main threat to the Lesser Antillean iguana and its habitat. They felt that this invasive species represents a direct danger by competing for resources and disrupting the ecological balance (Figure 14).

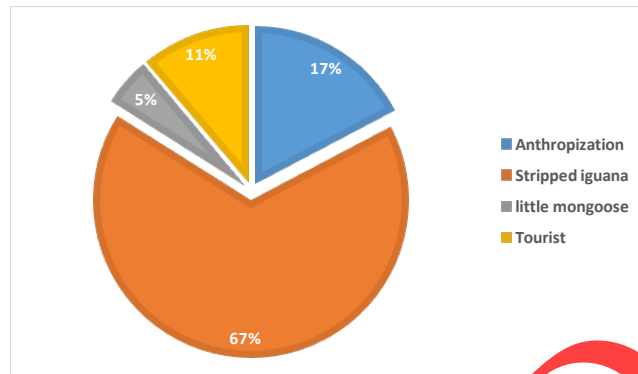


Figure 14. Main causes of *Iguana delicatissima* extinction.

In addition, 17% of respondents (14 people) attributed the decline in the Lesser Antillean iguana population to destructive human activities. They point to urbanization, deforestation and other forms of land use that degrade the iguana’s natural habitats, reducing their living and breeding areas. A further 5% (3 people) consider the small mongoose to be a greater threat.

These respondents suggest that mongoose predation plays a significant role in the decline of the Lesser Antillean iguana.

Finally, 11% of respondents (9 people) thought it was crucial to regulate tourism to Lesser Antillean iguana sites. They point out that the influx of visitors can disturb sensitive habitats and contribute to the stress and vulnerability of the species (Figure 14).

Given the ecological value of the Lesser Antillean Iguana and its status on the IUCN Red List, protection decisions are taken to conserve this species in its natural habitat.

Therefore, the authorities via the funding of the National Action Plan (NAP) to the tune of 50,000 Euros in August 2021 proposer a clear roadmap for the implementation of essential conservation measures, such as population monitoring, invasive species management, and public awareness.

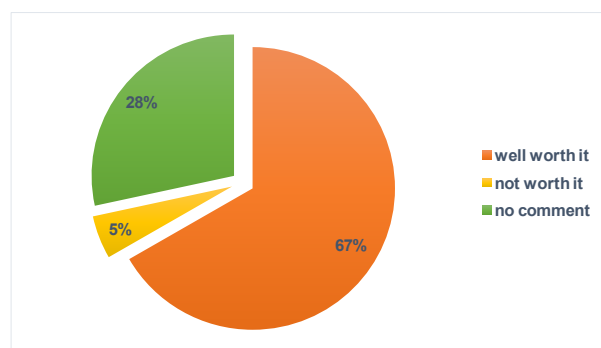


Figure 15. Views on spending on iguana conservation.

In our survey, 67% of respondents felt that spending money on iguana protection was a good thing, while only 5% disagreed, and 28% refused to comment

(Figure 15).

Respondents were also asked to evaluate conservation efforts for the Lesser Antillean Iguana in the region. They expressed their level of satisfaction by giving a score from 0 to 10 (Figure 16). The opinions gathered show a wide range of perceptions. Of the 82 people surveyed, two did not answer this question.

Among the 80 respondents, average ratings (5 - 6) were given by 56%, reflecting a moderate opinion of the conservation efforts undertaken. Below-average scores were given by 27% of respondents.

Above-average ratings ranging from satisfactory to very satisfactory were also given by 17% of respondents, showing higher satisfaction and acknowledging the positive efforts made to protect the Lesser Antillean Iguana (Figure 16).

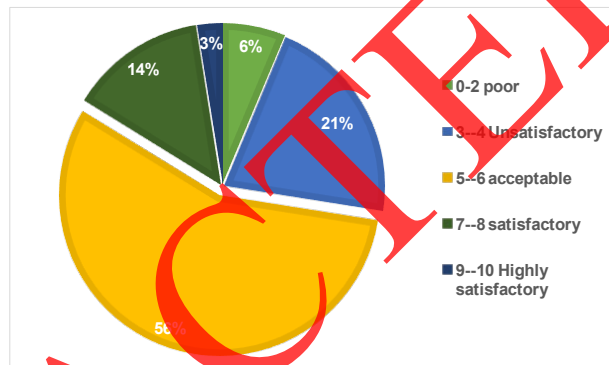


Figure 16. Population satisfaction levels.

Faced with the threat of extinction and population decline, observing the presence of the Lesser Antillean iguana in an area can help assess its conservation status. Respondents were asked to recall the last time they had seen a Lesser Antillean Iguana. Of the 82 people interviewed: 7 people (9%) had never seen an iguana.

6 people (7.3%) had seen an iguana during the week of the survey.

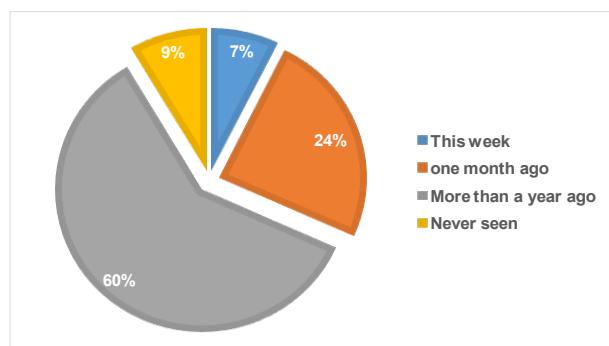


Figure 17. Frequency of sightings of the Lesser Antillean Iguana.

Twenty people (24%) have seen an iguana in the last month, compared with 49 people (59%) (Figure 17) who saw an iguana a year or more ago.

One of the most important conservation measures for the Lesser Antillean

iguana in Martinique involves regulating the population of the common iguana. The population participates by reporting the presence of common iguanas to those responsible for capturing and killing them.

During the survey, it was found that the great majority, 71 people (87%), had never participated in this initiative. Only 6 people (7%) reported the presence of striped iguanas in their area, while only 5 people (6%) said they had actively participated in this control by repeatedly reporting the presence of the common iguana in several areas to the person in charge (Figure 18).

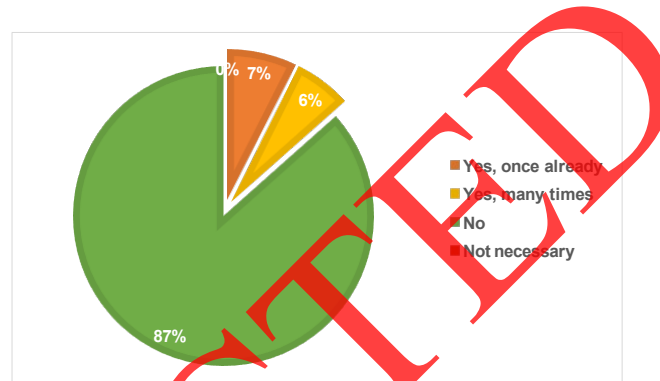


Figure 18. Control of the common iguana.

In response to the imminent threat of extinction of the Lesser Antillean Iguana, the people of Martinique are asking questions and expressing their opinions on the conservation measures to be adopted. During the survey, various perspectives were collected.

Some 20% of respondents thought it was crucial to continue destroying the common iguana. On the other hand, 24% of respondents proposed the controlled introduction of the Lesser Antillean iguana in several suitable areas in Martinique. A relative majority of 44% of respondents advocate a combined approach, combining the removal of the common iguana and the controlled introduction of the Lesser Antillean iguana.

Finally, 12% of respondents believe in other unspecified measures, suggesting initiatives such as increased public awareness, enhanced protection of natural habitats or captive breeding programs (Figure 19).

4.3. Distribution of Lesser Antillean Iguanas in Martinique

4.3.1. Visit to Islet Chancel

The visit to islet Chancel was carried out during the breeding season, which enabled us to observe activity in the surrounding area and at the egg-laying sites. Four spawning sites were visited to assess their condition and check for the presence of females and signs of reproduction.

The egg-laying site located in the maritime zone does not yet appear to have been visited by females during this egg-laying period, unlike the other sites, despite the presence of females and males in this area. On the other hand, pregnant

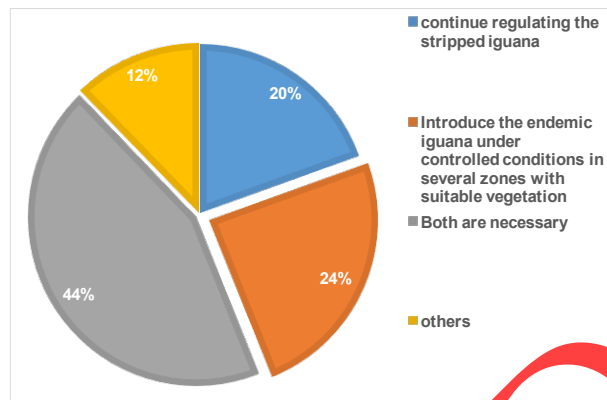


Figure 19. Conservation strategies for the *Iguana delicatissima*.

females were observed around the other sites, and freshly dug nests were also observed in the ground, with tail and leg marks visible on the surface. These signs indicate active egg-laying activity in these areas.

The iguanas present in the area of the public maritime domain frequented by tourists appear tame. They peacefully approach visitors without showing any signs of fear. On the other hand, those living in the private zone are very shy. They live in the hollows of dead tree trunks and quickly take refuge at the slightest unusual disturbance, making them difficult to observe. Nevertheless, we do manage to observe females near their egg-laying sites, as they appear to be in the process of preparing to lay their eggs.

4.3.2. Visit to Northern Martinique

In contrast to islet Chancel, the north of Martinique is densely vegetated. These northern areas offer a relatively intact and favorable habitat for the Lesser Antillean Iguana. However, no individuals were observed during our visits, as conditions were not favorable for observing this species, given its temperature preference. And this population is still unknown, as no in-depth study has yet been carried out.

4.3.3. Visit to the Carbet Zoo

The Zoo of Le Carbet currently has two male Lesser Antillean Iguanas in an enclosure (visit April 2024). An employee found was unable to provide further information as he is not involved in the management or care of the animals. He indicated that these iguanas are not native to the island, but was imported a few months ago.

4.3.4. Visit to Anse Céron and Anse Coulevre (Prêcheur)

In Prêcheur, we visited two sites, Anse-Céron and Anse-Coulevre. Neither *Iguana iguana* nor *Iguana delicatissima* were observed. However, locals report the presence of both species at Anse-Céron. Tourists at Anse-Coulevre reported seeing iguanas on the day of our visit. Unfortunately, they were unable to identify either species.

4.3.5. Visit to Madiana Beach (Schœlcher)

At Madiana Beach, town of Schœlcher, we observed more than a ten individuals, most of which appeared to be young. But no *Iguana delicatissima* was observed.

4.3.6. Visit to La Savane (Fort-de-France)

A small population was observed in the parking lot and vegetation near Fort Saint-Louis. Around twenty individuals were exposed to the sun on the wall of Fort Saint-Louis. However, no *Iguana delicatissima* was seen in the area during our visit to Fort-de-France.

5. Discussions

5.1. Distribution of Lesser Antillean Iguanas in Martinique

Islet Chancel

Islet Chancel remains the site with the highest population of *Iguana delicatissima* in Martinique. However, testimonies from some management agents or people frequenting the small island indicate a reduction in this population. These accounts are based on their day-to-day observations. They indicate a decrease in the frequency with which they observe individuals compared with previous years. Their testimony also reflects the trends observed by Breuil [4] [23] on the vulnerability of island populations to minor disturbances.

Pelée Mountain

The population around of Pelée Mountain has not been extensively studied, and consequently no concrete information has been provided on its viability or size [26]. However, there is evidence that the common iguana is present in the area.

Anse-Céron and Anse-Couleuvre

At Anse Céron and Anse-Couleuvre, a family living in Le Prêcheur reported the presence of the green iguana to the national action plan. The latter captured a female and several juveniles squatting in a tree in their yard. These observations underline the urgency of taking management and conservation measures for the endemic iguana population to prevent any possible hybridization with the common iguana, or to halt it if the process has already begun.

La Savane (Fort Saint-Louis)

In Fort-de-France, especially Fort Saint-Louis, locals consider the *Iguana iguana* to be tame and harmless. The iguanas sometimes come down from the trees to eat the fruit and vegetables that some people leave at the foot of the trees. In their opinion, it is not worth continuing to regulate the *Iguana iguana* population.

Madiana Beach

Observations at Madiana Beach indicate a young, fairly viable population, which is likely to reproduce and expand if no regulatory measures are taken.

5.2. Ex Situ Conservation

Iguanas in captivity in a controlled habitat can be used as subjects for scientific studies to better understand their biology, behavior, and ecological needs. They

may participate in breeding programs aimed at increasing captive populations and reintroducing individuals to their natural habitat in several protected sites in Martinique [27]. This approach would aim to resume the work undertaken on the islet of Ramiers in 2006 [26].

This also presents significant challenges and raises essential ethical considerations. These include the need to maintain the genetic diversity of captive populations, to ensure animal welfare in an artificial setting and to create a natural environment. Despite these challenges, *ex situ* conservation remains a strategy capable of protecting the species, ensuring its reproduction and reintroduction [27] [28].

The Martinique zoo could play a crucial role in public education and *ex situ* conservation of endangered species [29] [30]. In captivity, iguanas could be controlled, protected from external threats such as predation and habitat destruction. In this way, their management and conservation would be productive on several levels.

With only two male Lesser Antillean Iguanas in the zoo, the conservation of the species poses major challenges, particularly in terms of genetic diversity and reproduction. The absence of females hinders natural reproduction efforts, preventing the renewal and survival of the species. It is therefore crucial to introduce females and consider assisted reproduction techniques [31].

5.3. *In Situ* Conservation

In situ conservation of the Lesser Antillean Iguana in Martinique is essential to maintain the species in its natural habitat and preserve vital ecological interactions. This approach promotes biodiversity by maintaining the complex ecosystems in which iguanas live. Natural interactions, such as reproduction and foraging, are conserved, enabling iguanas to adapt to local conditions and resist environmental change [16]. However, the presence of the common iguana poses a major challenge due to competition and the risk of hybridization, which threatens the genetic purity of the Lesser Antillean iguana.

Reintroducing iguanas into existing nature reserves and protected areas (Figure 20) would protect them from human disturbance and control the population of green iguanas and other species such as mongooses and cats [9], thus reducing inter-species competition. In this way, regular monitoring and research into the ecological needs of iguanas to assess their health and reproduction can be carried out under better conditions.

5.4. Environmental Preference

There are two sites of particular note for the presence of this species currently in Martinique: islet Chancel and the area of Mountain Pelée [32]. Each of these sites has distinct ecological characteristics that influence iguana habitat preference [8] [19].

Islet Chancel with its vegetation type is known to harbor the largest population of Lesser Antillean iguanas in Martinique, translating into an appropriate habitat

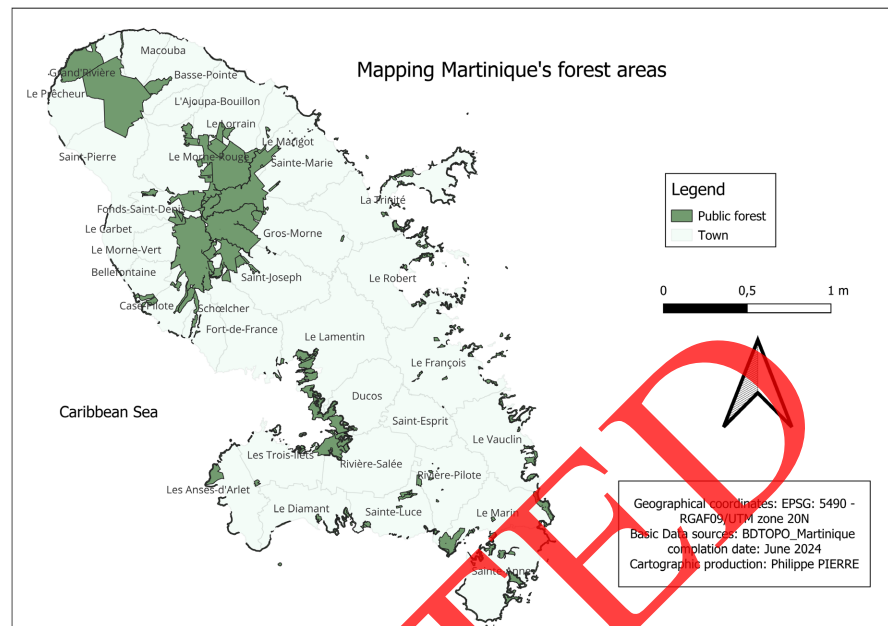


Figure 20. Mapping Martinique's forest areas. Philippe P. 2024.

for iguana survival [33]. The islet offers a relatively protected habitat with abundant vegetation. Nesting areas are suitable, and there are few predators other than hermit crabs, which are found near nesting sites. However, sheep have a tendency to trample the soil, causing compaction that can make it difficult for the females to work, but could also lead to the death of newborns by asphyxiation.

Although the relative geographical isolation of islet Chancel protects iguanas from major anthropogenic disturbances, the flow of tourists remains an element to be taken into account from several angles in the management and conservation of the Lesser Antillean iguana in Martinique.

However, the potential population of Lesser Antillean iguanas around of Mountain Pelée has not been studied in depth. Evidence suggests that iguanas, possibly of the endemic species, have been sighted, but no systematic study has been carried out to confirm population size and status.

The various townships around the Mountain Pelée also offer ideal conditions for the survival of *Iguana delicatissima*. They present a variety of sylvan landscapes ranging from dry forest to humid forest [34].

5.5. Human Behavior and Frequentation

At islet Chancel, iguanas behave in two different ways, depending on the area in which they are found. In the tourist zone, the iguanas seem tame and do not hesitate to approach visitors [20]. Tourism seems to influence the behavior of iguanas, which have become accustomed to the presence of humans and easily wander among people. On the other hand, in the private zone where human access is limited, iguanas are very shy, taking refuge in tree trunks at the slightest movement that seems strange to them. This contrast in behavior underlines the importance

of quiet, protected areas for the survival and reproduction of iguanas.

5.6. Perception and Community Commitment

This graph (Figure 21) reveals significant links between respondents' opinions on the financing of conservation actions for the Lesser Antillean Iguana and their level of satisfaction with the results of these actions. Three main trends emerge: 1) indifference and lack of opinion on funding are associated with a lack of opinion on satisfaction with conservation, suggesting a lack of information or interest; 2) support for funding is correlated with satisfaction with results, indicating confidence in organizations and action plans; 3) criticism of funding is linked to dissatisfaction with results, reflecting skepticism about the effectiveness of actions or a perception of sub-optimal use of funds, or even a lack of interest in biodiversity. These results underline the importance of communication and awareness-raising to improve public engagement in Lesser Antillean iguana conservation.

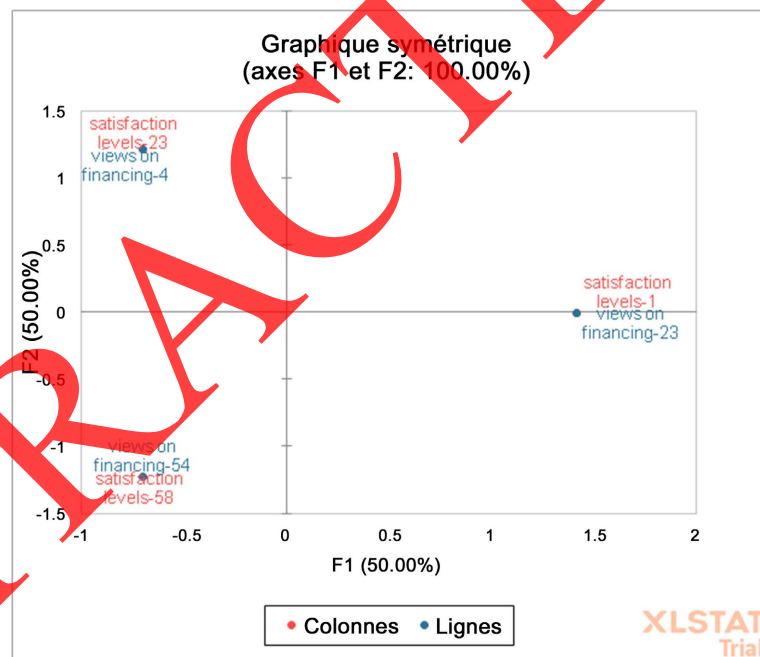


Figure 21. Views on financing and satisfaction levels of the population.

This principal component analysis plot (Figure 22) reveals a significant correlation between respondents' ability to identify iguana species and their attitudes towards conservation, including their level of satisfaction with actions taken. The results indicate that individuals unable to identify the two species, even with images, are less supportive of conservation, highlighting a need for awareness-raising. Conversely, those who correctly identified the species valued the endemic iguana, supported conservation and approved of regulating the invasive green iguana. Incorrect identification is associated with dissatisfaction with conservation outcomes, suggesting a need for improved communication and transparency of efforts.

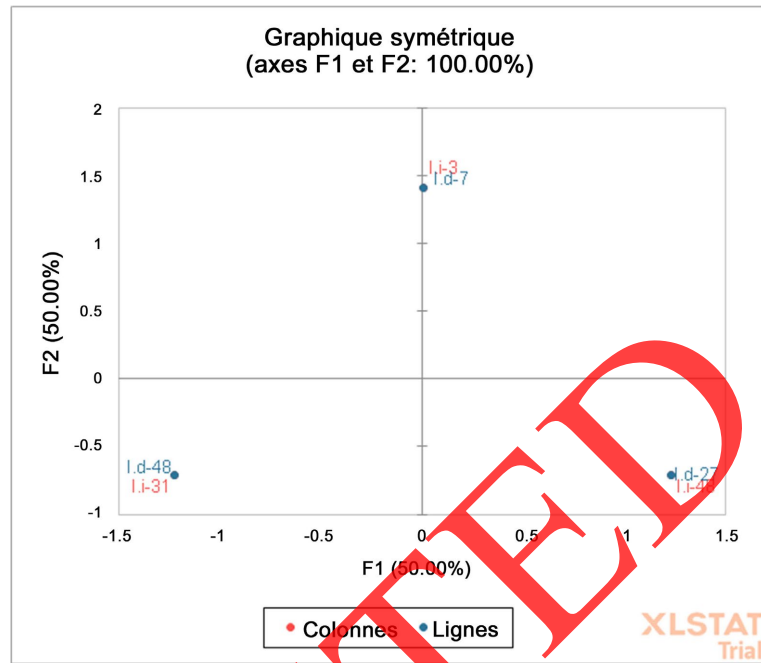


Figure 22. capacity of the population to identify the species.

The graph (Figure 23) shows a correlation between the rarefaction of the Lesser Antillean Iguana and the proliferation of the Green Iguana, underlining the threat posed by the invasive species to the endemic species.

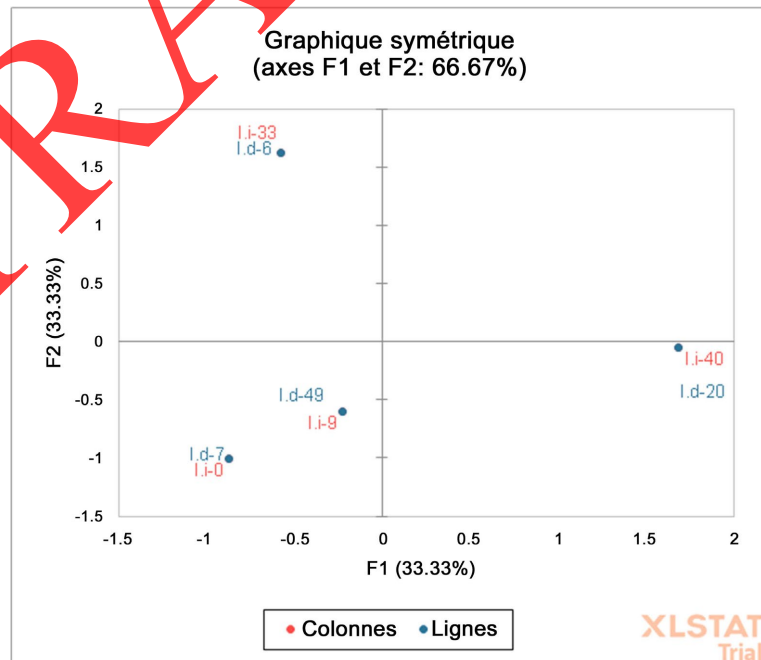


Figure 23. frequency of species sightings by respondents.

The majority of Lesser Antillean Iguana sightings reported by respondents are old, dating back more than a year. This suggests that the species is becoming rarer

near urban or anthropized areas, where there is a greater human presence.

Conversely, a significant percentage of respondents stated that they had observed the Green Iguana recently, either during the week of the survey or in the past month. This frequency of sightings testifies to the expansion of the green iguana and its ability to occupy a variety of habitats, including urban and peri-urban areas.

According to these results, there is a good awareness of Lesser Antillean iguana conservation among local residents. The majority of respondents recognizes the importance of protecting the species and is in favor of conservation measures. In addition to a willingness to take part in the fight to conserve the species, residents propose various strategies to protect Lesser Antillean iguanas, including the creation of protected areas, the eradication of invasive species such as the striped iguana, and ongoing public awareness. More than one suggested restricting tourist access to certain sites to reduce disturbance and improve egg-laying conditions, and erecting informative signs and barriers to protect egg-laying sites. Finally, the reintroduction of iguanas in suitable areas and the use of controlled breeding programs are seen as methods that could prove effective in the long term.

5.7. SWOT Analysis of Lesser Antillean Iguana Conservation in Martinique

Strengths	<ul style="list-style-type: none"> ➤ Alongside all of Martinique's protected sites, islet Chancel, the iguana's main habitat, has been protected since 2005 by an official biotope protection order [14]. ➤ Maintain the stability of the Lesser Antillean iguana population on the îlet Chancel by 2030, by regularly monitoring the population and implementing habitat management actions to promote reproduction, reintroduction and survival of the species.
Weaknesses	<ul style="list-style-type: none"> ➤ The islet Chancel is a limited area, which restricts the space available for population growth and genetic variability. ➤ The reintroduction attempt on Ramiers islet did not achieve the expected results. No juveniles were observed between 2006 and 2013, despite spawning attempts [12]. ➤ There are opportunities for new reintroduction projects on other islets or protected areas in Martinique, taking into account the reintroduction actions that have already been carried out.
Opportunities	<ul style="list-style-type: none"> ➤ Awareness and education campaigns can be set up to protect the iguana's habitat and reduce anthropic threats, in collaboration with the Martinique Zoo and other islands where Lesser Antillean iguanas are present. ➤ The presence of the common iguana, an excellent swimmer just a few tens of meters from islet Chancel, represents a danger for the present population. The same applies to the unknown population in the north of Martinique.
Threats	<ul style="list-style-type: none"> ➤ Habitat degradation due to anthropic factors such as tourism, pollution and coastal development would affect the iguana's survival.

6. Conclusions

The Lesser Antillean Iguana is one of the most endangered reptiles in the world. It is also in a precarious situation in Martinique. Conservation efforts, such as reintroductions in protected areas and the development of egg-laying sites in areas where its presence has been detected are crucial. Habitat preservation, the fight against exotic species and raising awareness in the local community are essential to ensure the survival of this critically endangered species.

The Martinican population's perception of the *Iguana delicatissima* is very positive. This is an important lever for any conservation efforts targeting this species. The population perceives it as a natural heritage, a species to be protected because of its importance to local biodiversity. Many are actively involved in the fight to regulate the *Iguana iguana* and protect the *Iguana delicatissima*. This dynamic offers an opportunity to strengthen and accelerate conservation actions and maintain the species in its natural habitat.

Previous studies have shown that the *Iguana delicatissima* population at islet Chancel is viable and stable. However, reports from observers such as the owner and the site's brigadier-managers cast doubt on the population. They believe the population may be declining, but are unable to provide figures. Population variation could be influenced by several factors, such as the adaptability of iguanas to climate change, anthropogenic factors and inbreeding.

In the north of Martinique, we did not observe any individuals of *Iguana delicatissima* during our visits. However, local residents and some hikers claim to have seen *Iguana delicatissima* in the forests of Anse-Céron and Anse-Couleuvre.

At the Fort-de-France (La Savane) and Schœlcher (Madiana Plage) sites, green iguanas have been observed. At islet Chancel, the presence of several females on egg-laying sites and males in trees was observed.

In view of our results, the local population is in favor of protecting the endemic iguana and its habitat, and is willing to take part in programs to raise awareness, reintroduce and regulate the invasive species.

In short, the reintroduction of Lesser Antillean iguanas to other islets in Martinique depends on the proper preparation of habitats and awareness-raising among local communities. Thanks to ongoing education and the commitment of populations already aware of the importance of protecting the species and its ecosystem, these initiatives would offer real hope of considerably increasing the endemic iguana population in Martinique.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

- [1] Muller, S. (2004) Plantes invasives en France. Muséum national d'Histoire naturelle, 62.
- [2] Soubeyran, Y. (2008) Espèces exotiques envahissantes dans les collectivités fran-

- çaises d'outre-mer. Etat des lieux et recommandations. Collection Planète Nature. Comité français de l'UICN.
- [3] Petit, J. and Prudent, G. (2010) Changement climatique et biodiversité dans l'outre-mer européen. Gland, suisse et Bruxelles, Belgique. UICN.
- [4] Breuil, M. (2013) Caractérisation morphologique de l'iguane commun *Iguana iguana* (Linnaeus, 1758), de l'iguane des Petites Antilles *Iguana delicatissima* Laurenti, 1768 et de leurs hybrides. *Bulletin de la Société Herpétologique de France*, **147**, 309-346.
- [5] Debrot, A.O. and Boman, E.B. (2014) *Iguana delicatissima* (Lesser Antillean Iguana) Mortality. *Herpetological Review*, **45**, 129.
- [6] Van den Burg, M., Breuil, M. and Knapp, C. (2018) *Iguana delicatissima*. *The IUCN Red List of Threatened Species*, **2018**, e.T10800A122936983.
- [7] Hilton-Taylor, C. (2000) IUCN Red List of Threatened Species. IUCN-The World Conservation Union.
- [8] Day, M.L., Breuil, M. and Reichling, S. (2000) *Lesser Antillean Iguana, Iguana delicatissima*. In: Alberts, A., Éd., *West Indian iguanas. Status Survey and Conservation Action Plan*, IUCN/SSC West Indian Iguana Specialist Group, 62-67.
- [9] Breuil, M. (2002) Histoire naturelle des Amphibiens et Reptiles terrestres de l'archipel Guadeloupéen. PSM, 1-339.
- [10] Malone, C.L., Wheeler, T., Taylor, J.F. and Davis, S.K. (2000) Phylogeography of the Caribbean Rock Iguana (*Cyclura*): Implications for Conservation and Insights on the Biogeographic History of the West Indies. *Molecular Phylogenetics and Evolution*, **17**, 269-279. <https://doi.org/10.1006/mpev.2000.0836>
- [11] Malone, C.L. and Davis, S.K. (2004) Genetic Contributions to *Caribbean Iguana* Conservation. In: Alberts, A.C., Carter, R.L., Hayes, W.K. and Martins, E.P., Éd., *Iguanas. Biology and Conservation*, University of California Press, 45-57.
- [12] Legouez, C. (2010) Plan national d'actions de l'iguane des Petites Antilles (*Iguana delicatissima*) 2010-2015. Ministère de l'écologie, du développement durable, des Transports et du Logement, Direction régionale de l'environnement Martinique, cellule Martinique de l'ONCFS Antilles françaises.
- [13] Vuillaume, B., Valette, V., Lepais, O., Grandjean, F. and Breuil, M. (2015) Genetic Evidence of Hybridization between the Endangered Native Species *Iguana delicatissima* and the Invasive *Iguana iguana* (Reptilia, Iguanidae) in the Lesser Antilles: Management Implications. *PLOS ONE*, **10**, e0127575. <https://doi.org/10.1371/journal.pone.0127575>
- [14] Rodrigues, C. (2014) The *Green iguana*. An Invasive Species in the Caribbean. A Recommendation Guide to Prevent the Invasion of the Last Territories Sheltering *Iguana delicatissima*, on Martinique Island and in Guadeloupe Archipelago. ONCFS.
- [15] Breuil, M. (1994) Les iguanes (*Iguana delicatissima*) de l'îlet Chancel (Martinique). Office National des Forêts-Direction Régionale de l'Environnement Martinique et Association des Amis du Laboratoire des Reptiles et Amphibiens du MNHN.
- [16] Knapp, C.R. and Perez-Heydrich, C. (2016) Natural History of *Lesser Antillean Iguana (Iguana delicatissima)* on Union Island, St Vincent and the Grenadines.
- [17] Pasachnik, S.A., Breuil, M. and Powell, R. (2006) *Iguana delicatissima*. *Catalogue of American Amphibians and Reptiles*, No. 811, 1-14.
- [18] Angin, B. (2017) Plan National d'Actions pour le rétablissement de l'iguane des petites Antilles, *Iguana delicatissima*, 2018-2022.
- [19] Breuil, M., Vuillaume, B. and Bourg, F. (2020) Importance of Nesting Sites for the Conservation of the *Lesser Antillean Iguana (Iguana delicatissima)* in Guadeloupe.

Herpetological Journal, **30**, 223-231.

- [20] Knapp, C.R., Buckner, S.D. and Hudson, R. (2006) A Comparison of Survey Methods for West Indian Iguanas. Intensive, Line-Transect, and Removal Sampling. *Herpetological Review*, **37**, 15-18.
- [21] Breuil, M., Vuillaume, B. and Versini, J.J. (2018) *Iguana delicatissima* (Laurenti, 1768) (Squamata. Iguanidae). Première mention de ponte en Martinique (Petites Antilles). *Bulletin de la Société herpétologique de France*, **165**, 87-93.
- [22] Knapp, C.R., Mitzey, A.M. and Beard, K.H. (2019) Early Life History Traits of an Endangered Iguana, *Iguana delicatissima* (Squamata. Iguanidae), and Implications for Conservation. *Caribbean Herpetology*, **70**, 1-13.
- [23] Breuil, M., Vuillaume, B., Schikorski, D., Krauss, U., Morton, M.N., Haynes, P., et al. (2019) A Story of Nasal Horns: Two New Subspecies of *Iguana* Laurenti, 1768 (Squamata, Iguanidae) in Saint Lucia, St Vincent & the Grenadines, and Grenada (Southern Lesser Antilles). *Zootaxa*, **4608**, 201-232. <https://doi.org/10.11646/zootaxa.4608.2.1>
- [24] IGN (2023) Localisation de la Martinique et altitude de la Montagne Pelée. Institut national de l'information géographique. <https://www.geoportail.gouv.fr>
- [25] INPN (2024) *Iguana delicatissima* photographie. Muséum national d'histoire naturelle, Paris. <https://inpn.mnhn.fr>
- [26] Legouez, C., Maillard, J.F., Del Campo, A.V. and Breuil, M. (2009) L'iguane des Petites Antilles. Une espèce menacée en Martinique. Premières mesures de conservation.
- [27] Kirkwood, J.K. (2003) Welfare, Husbandry and Veterinary Care of Wild Animals in Captivity: Changes in Attitudes, Progress in Knowledge and Techniques. *International Zoo Yearbook*, **38**, 124-130. <https://doi.org/10.1111/j.1748-1090.2003.tb02072.x>
- [28] WAZA (2005) Building a Future for Wildlife—The World Zoo and Aquarium Conservation Strategy. WAZA.
- [29] Storfer, A. (1999) Gene Flow and Endangered Species Translocations: A Topic Revisited. *Biological Conservation*, **87**, 173-180. [https://doi.org/10.1016/s0006-3207\(98\)00066-4](https://doi.org/10.1016/s0006-3207(98)00066-4)
- [30] Witzemberger, K.A. and Hochkirch, A. (2011) *Ex Situ* Conservation Genetics: A Review of Molecular Studies on the Genetic Consequences of Captive Breeding Programmes for Endangered Animal Species. *Biodiversity and Conservation*, **20**, 1843-1861. <https://doi.org/10.1007/s10531-011-0074-4>
- [31] Pelletier, F., Réale, D., Watters, J., Boakes, E.H. and Garant, D. (2009) Value of Captive Populations for Quantitative Genetics Research. *Trends in Ecology & Evolution*, **24**, 263-270. <https://doi.org/10.1016/j.tree.2008.11.013>
- [32] Angin, B., Nicolas, J.C., Auguste, L., Maugee, M.M. and Attidore, S. (2015) Étude des populations d'iguanes des Petites Antilles (*Iguana delicatissima*) du Nord Martinique. PNRM—Ardops Environnement.
- [33] Van den Burg, M.P. (2018) Influence of Temperature on Sex Ratio of *Green iguana* (*Iguana iguana*) Hatchlings. *Herpetological Journal*, **28**, 147-152.
- [34] Joseph, P. (2000) Les îlets des singularités au sein de l'écosystème Martinique, Terre d'Amérique/3. GEODE Caraïbe-Karthala, 313-341.

Annex

Survey Questions

6/16/24, 11:42 PM

L'écologie et la conservation des iguanes des petites Antilles à Martinique

L'écologie et la conservation des iguanes des petites Antilles à Martinique

Question sur l'écologie et la perception de la population sur la conservation des iguanes des petites Antilles à Martinique

1. Quel est votre profil ?

Une seule réponse possible.

- a. Je suis Etudiant (e)
- b. Je suis un Professionnel de l'environnement/biodiversité ou agriculture
- c. Agriculteur/pêcheur
- d. Autre

2. Quel est votre tranche d'âge ?

Une seule réponse possible.

- a. 18 – 28 ans
- b. 29 – 39 ans
- c. 40 – 50 ans
- d. Plus de 50 ans

3. Connaissez-vous l'existence de combien d'espèces d'iguanes en Martinique ?

Une seule réponse possible.

- a. Une seule espèce
- b. Deux espèces
- c. Trois espèces
- d. Je ne sais pas

4. Parmi ces images sélectionnez l'iguane peyi ?

Une seule réponse possible.



Image a



Image b

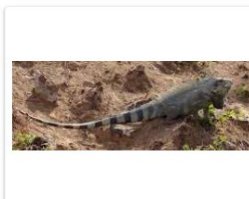


Image c