Small Indian mongoose

(Urva auropunctata)

Managing the small Indian mongoose on the nesting sites of sea turtles on Martinique

French National Forestry Agency (ONF)

■ The French National Forestry Agency (ONF) is a public organisation in charge of managing public forests. It is supervised by the Agriculture and Ecology ministries.

■ On Martinique, ONF manages 16 000 hectares of public forests (State, territorial, those of the Seaside and Lake Conservation Trust), certain mangroves and littoral State forests. In all these areas, one of the main objectives is to preserve biodiversity while continuing to welcome the public.

■ On Martinique and Guadeloupe, ONF runs two national action plans (PNA) under the management of the Environmental Directorate (DEAL), including the PNA for sea turtles in the French Caribbean.

■ Biological reserves (RB) are the instrument used to manage natural areas of high ecological and patrimonial importance. There are five RBs on Martinique, including three fully-protected biological reserves (RBI) and two managed biological reserves (RBD).

■ ONF is also involved in managing invasive alien species (IAS) in the framework of the PNAs and the management plans for the biological reserves, including the RBD for sea turtles.

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Intervention site

■ The work took place on three nesting sites of sea turtles:
- Anse Lévrier (Lévrier Cove) and Anse à Voile in the town of Prêcheur, part of the Prêcheur Grand'Rivière RBI;
- Anse Trabaud in the town of Sainte-Anne, part of the Sea Turtle RBD;
- a group of small beaches between Pointe Rouge and Pointe à Bibi on the Caravelle peninsula.

■ The trapping campaigns took place in 2012, 2014, 2018, 2019 and 2020. The initial campaigns were carried out in the framework of the first PNA for sea turtles in the French Caribbean (2010-2015). The work halted from 2015 to 2017 due to the lack of a PNA manager during the transfer from ONCFS to ONF, but then restarted in 2018 in the framework of the second PNA.

1 - Map showing the beaches where the work took place

Table 1. Trapping sites and years.

Sites		Years				
Northern coves (Anse Lévrier and Anse à Voile)		2012	2014	2018	2019	2020
		*	*	*	*	*
Anse Trabaud						
			*	*	*	*
Caravelle peninsula						
						*

■ The sites were selected due to the high level of predation observed during monitoring work on sea-turtle nesting sites. The monitoring work is undertaken each year to assess the relative importance of each nesting site and changes in the population numbers of sea turtles.

■ The beaches on the Caravelle peninsula were added to the trapping campaign in 2020 following reports of intensive predation by the volunteers doing the monitoring work on the sea turtles.

Disturbances and issues involved

■ The small Indian mongoose is considered one of the 100 most invasive species worldwide.

■It was introduced on Martinique in 1891 to reduce the numbers of rats and the poisonous Martinican pit viper (*Bothrops lanceolatus*). The introduction was not successful in reducing the targeted species, but was the cause of the decline and even the disappearance of native species. It is considered the main cause of the extinction of several reptile species and of other vertebrates such as the Martinique muskrat (*Megalomys desmarestii*), Lacépède's ground snake (*Erythrolampus cursor*) and two skinks (*Mabuya mabouya* and *Mabuya metallica*).

■ The mangoose is opportunistic and added turtle eggs to its diet. Three species of sea turtles lay eggs on the beaches of Martinique and are threatened with extinction according to the IUCN national Red List:
- the Leatherback sea turtle (*Dermochelys coriacea*), ranked Vulnerable (VU);
- the Green sea turtle (*Chelonia mydas*), ranked Endangered (EN);
- the Hawksbill sea turtle (*Eretmochelys imbricata*), ranked Critically Endangered (CR).

■ The mongoose is also suspected of eating the eggs of other threatened species such as the White-breasted thrasher (*Ramphocinclus brachyurus*) and the iguana endemic to the Lesser Antilles (*Iguana delicatissima*), both ranked Critically Endangered (CR).

■ Sea turtles on Martinique are confronted with numerous threats due notably to the degradation of their nesting sites and accidental catches by fishing vessels. The small Indian mangoose is a factor in the reduced productivity of the rare nesting sites not severely affected by human activities and by other threats.

■ A number of studies have indicated that mangoose predation rates on the nests of sea turtles can reach 80 to 100% if no management work is undertaken.

Interventions

■ Objective

■ The objective of the work was to reduce the population of small Indian mangooses during the nesting season of sea turtles (March to October) in order to limit the predation of the nests. Complete eradication of the small Indian mangoose is not a realistic objective given its high population numbers on Martinique.

■ Monitoring of sea-turtle nesting sites was carried out in parallel with the trapping campaigns in order to improve knowledge on the nesting sites and the numbers of nesting female turtles.

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2 - A small Indian mangoose attacking a sea-turtle nest.
3 - Predation on a sea-turtle egg.
4 - A mongoose cage trap (old model).
5 - Transporting the cage traps to the nesting sites.

■ Equipment used

■ The trapping work was undertaken by forest technicians, agents from the PNA for sea turtles, ONF interns and volunteers from the Arompei non-profit. Counting operations for signs of nesting by sea turtles also involved ONCFS personnel and volunteers from the L'asso-mer, Reflet d'culture and Sepanmar non-profits.

■ Non-harmful (cage) traps are used during 4 to 15 day periods between the months of April and September. The length of periods depends on the availability of participants and on the observed predation.

■ Between 30 and 40 cage traps were set during each period, among three different types:

1) double-entry tomahawk traps in 2012 and 2014;

2) home-made traps made with wire mesh in 2018 and 2019;

3) custom traps made by the BTTm company in 2020.

■ A pellet gun (19.9 joules) was used to put the animals to death.

■ Two coolers were required to transport the animals to the storage place.

■ The traps were attached to trees using 18 chains and padlocks for the duration of each period and to avoid theft.

■ Nine different types of bait were used to learn what the mongooses like best, to avoid the animals becoming habituated to one type and to adjust the system to achieve greater effectiveness. The bait most commonly used was frozen chicken sausage.

■ The animals were transported in a cooler, then stored at the ONF site in a freezer used for the management of invasive alien species. The rendering service was called when the quantity of animals reached 40 kilograms, the point at which the service is free of cost.

■ Trapping work

■ The traps were transported by backpack or by boat to the Anse du Prêcheur and the Anse de la Caravelle, and by car to the Anse Trabaud. The precise GPS location of each trap was noted when the trap was set.

■ Several inspections took place each day with at least 90 minutes between each in order not to scare off the mongooses and to put to death or release any non-targeted animals, to reset and rebait the traps, to note the status of each trap (active, inactive, trapped animal) and to register the biometric data of the trapped animals (sex, weight, size). The traps remained in place overnight, except in 2018.

■ Captured mongooses, rats and mice were put to death using a pellet gun (compressed air, 19.9 joules), then frozen and finally sent to the public rendering service.

■ Below is a description of a day of trapping along the northern coves.

6 and 7 - A small Indian mongoose captured in the custom-made cage trap.

Table 2. A day of trapping along Anse à Voile et Anse Lévrier.

Time of day	Interventions
AM	Check and reset traps at Anse Lévrier
	Count signs of nesting by sea turtles at Anse Lévrier
	Check and reset traps at Anse à Voile
	Count signs of nesting by sea turtles at Anse à Voile
Mid-day pause	
PM	Check and reset traps on the two beaches
	Count signs of nesting by sea turtles at Anse Couleuvre (part of another monitoring programme, but included here to optimise organisation of field work)
	Count signs of nesting by sea turtles at Anse Céron (part of another monitoring programme, but included here to optimise organisation of field work)
	Check and reset traps on the two beaches

■ Monitoring protocols for nesting by sea turtles

■ The observers walked near the nesting area, along the forest edge, to detect signs of nesting in the sand and of nest predation by mongooses. The recorded data include the species of sea turtle, the width of turtle tracks, the result (eggs laid or not) and the GPS data of the nest (or of the predation), etc.

Technical results

■ Captures

■ A total of 381 mongooses were captured during 109 days of trapping spread over five nesting seasons. Eight non-targeted species were also captured. black rats (*Rattus rattus*), brown rats (*Rattus norvegicus*) and house mice (*Mus musculus*) were put to death, whereas cats (*Felis catus*), common opossums (*Didelphis marsupialis*), the Blue land crab (*Cardisoma guanhumi*), the Red land crab (*Gecarcinus lateralis*) and the Caribbean hermit crab (*Coenobita clypeatus*) were released.

■ Crustaceans represented over 70% of the captures at Anse Trabaud and considerably reduced the effectiveness of the trapping work.

■ The sex ratio of the captured mongooses was uneven with 80% of male animals in 2019 and 2020. In addition, clear geographic differences in the sex ratio were noted between beaches and depending on the distance to the beach. The reasons for these imbalances are not known to date.
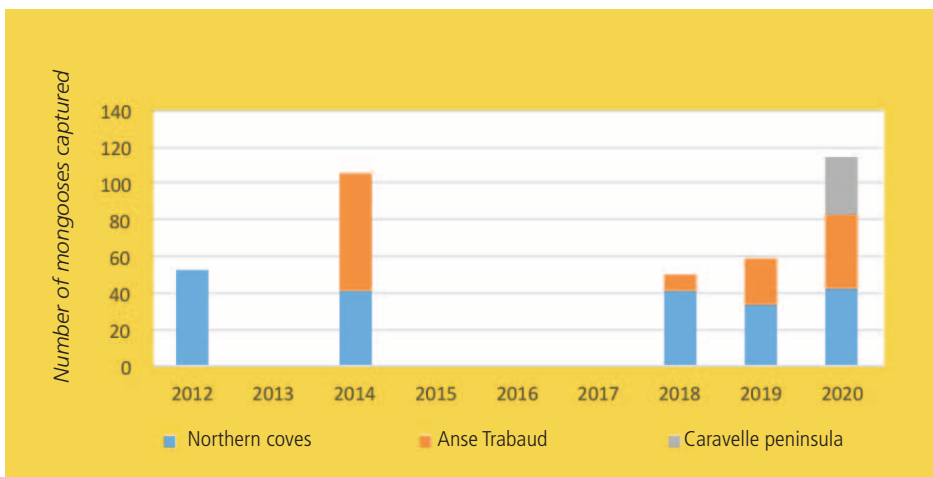
Number of captured mongooses per year and per site.
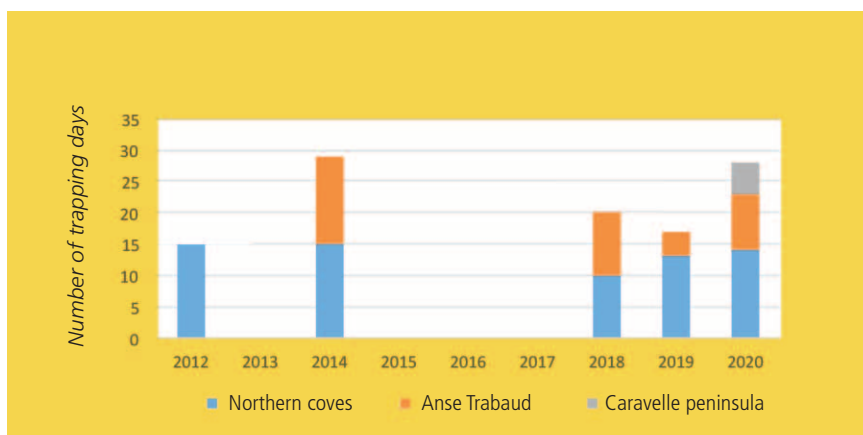
Number of trapping days from 2012 to 2020.

Table 3. Table showing annual CPUE values, i.e. captures per unit of effort (numbers of captured mongooses divided by the number of trapping days in the field).

Sites	Years				
	2012	2014	2018	2019	2020
Northern coves (Anse Lévrier and Anse à Voile)	6.07	7.07	5	2.54	2.16
Anse Trabaud	/	4.64	0.9	6.5	4.44
Caravelle peninsula	/	/	/		6.6

■ In the northern coves, CPUE values have dropped since 2014 (Table 3). It will be necessary to check the results in future years to determine whether the trapping effort is sufficient to limit predation of sea-turtle nests by mongooses or whether the mongooses have learned how to avoid the traps.

■ In 2018 at Anse Trabaud, the very low CPUE value was due to the massive arrival of sargassum seaweed and consequently a small number of turtle nests, making the area less attractive for mongooses.

■ Success rates of different baits tested in 2019

■ Nine different types of bait were used and the bait was renewed 416 times. The capture success rate for each type of bait was calculated as (number of captured mongooses per bait x 100) / number of times the bait was used.

■ Crab meat would appear to have the highest success rate. It should be noted, however, that this bait was used on only one site, Anse Trabaud, where a high density of mongooses had been observed. The success rate was not due exclusively to the use of crab meat as the bait, but to the high concentration of mongooses on the site.

■ Beef-flavoured canned dog food and chicken sausage also produced acceptable results, with the latter being the most used because most practical.

■ Chicken sausage was the easiest to use with good results and was therefore used most often.

Table 4. Success rates of different baits.

Bait	Peanut butter	Canned sardines	Chicken sausage	Mackerels	Crab meat	Salmon-flavoured canned cat food	Beef-flavoured canned dog food	Sausage
Success rate (%)	0	11	15.5	9	21	0	16.5	14

Financial aspects

■ The five years of trapping work cost 108 219.63 €, i.e. 21 643.93 € per year.

■ The project was funded by FEDER, the regional council, ONF and DEAL for the work in 2012-2014 (PNA 2010-2015 funding) and by MTES in the framework of general funding projects for biodiversity, DEAL and AFB (later OFB) in the framework of the "Overseas initiatives" call for projects for the period 2018-2020.

Table 5. Breakdown of costs.

	Payroll	Equipment and services	Internships	Total
2012-2014	42 859.00 €	7 541.92 €		50 400.92 €
2018-2019-2020	47 615.00 €	4 251.41 €	5 952.30 €	57 818.71 €
Total for the five years				108 219.63 €
Annual cost				**21 643.93 €**

Information on the project

■ Very little information was made public or published on the social networks given the risk of opposition to the trapping campaigns.

■ Posters to raise awareness were nonetheless created for the public visiting the beaches during the trapping campaigns.

■ The informational caravan on sea turtles is operated by the non-profits in the network for sea turtles each year during various events (patron saint fiestas, science days, etc.) and it informs on the impact of mongooses on sea turtles.

■ A page presenting the work may be found on the internet site of the network for sea turtles in Martinique (www.tortuesmarinesmartinique.org).

Outlook

■ Better assess the benefits of the operation

■ The distance to sites makes it difficult to count all nesting sites and to estimate the level of predation. Predation monitoring several times per season will help to better assess the effectiveness of trapping in protecting the nests.

■ Two methods to assess the predation pressure on nests by mongooses were tested in 2020, namely the installation of baited camera traps and the creation of false nests. Analysis of the data will tell us if these indicators are useful in measuring the predation pressure on sea-turtle nests by mongooses.

■ Analysis of the stomach contents of mongooses will inform on the species consumed and make it possible to assess qualitatively the benefits of trapping of the other native species.

■ Improve the effectiveness of trapping

■ Analysis of the cumulative capture data indicates that, in spite of the trapping effort, not all the capturable mongooses were in fact captured. Predation of sea-turtle nests has occasionally been observed during or after trapping periods.

■ Other nesting sites are subject to intense predation pressures but were not included in the programme due to the excessive distance.

■ The use of lethal traps such as the Goodnature E2A24 (a self-resetting trap using CO_2 cartridges) and the DOC 250 (a spring-operated trap placed in a tunnel trap) could increase trapping effectiveness and make it possible to trap on more remote sites. These traps require less maintenance than non-harmful traps.

■ Raise public awareness

■ Food scraps left by the public on beaches represent a significant food resource for mongooses and rats, a contributing factor for their reproduction. The posting of signs on the most important sites could help to limit the quantities of food left by people.

■ Mongooses have a positive image with the public because thay are part of the insular culture and are assumed to kill the poisonous Martinican pit viper (*Bothrops lanceolatus*) feared by the population on Martinique. Correcting this image could facilitate its management.

8 - Informational caravan for the conservation of sea turtles during an event in Sainte-Anne.
9 - Sign posted at beaches where trapping was under way to inform the public on the management work.
10 - A Goodnature A24 trap attached to a tree.

Regulations

■ The introduction of the small Indian mongoose on Martinique is prohibited by the ministerial decree dated 8 February 2018 on preventing the introduction and propagation of animal IASs on Martinique.

■ The species is also on the list in the decree dated 7 July 2020 prohibiting the detention, transport, use and/or trade of IASs on Martinique.

■ The species is named in the prefectoral order dated 8 July 2013 authorising the capture and killing of certain IASs, including mongooses, by certain competent organisations, including ONF.

■ Finally, the species is listed in Appendix II-1 of the ministerial decree dated 14 February 2018 on preventing the introduction and propagation of animal IASs in continental France.

For more information...

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