

3rd Revised

# Mongoose Eradication Project in Yambaru, Okinawa

For restoring forest ecosystem and native animals in Yambaru







# Animals Only Found in Yambaru

In Yambaru, there live many endemic animals which cannot be found anywhere else in the world.

## About Yambaru

Yambaru, which means the northern mountainous area of Okinawa Island, had referred to the region of Onna-son and northward before. Recently, the word is more commonly used to the region further north, which might be caused by improved transportation facilities.

Yambaru will, hereafter, refer to the SF Line, a fence line which extends from Shioya to Fukuji Dam, and the area northward.



## Forests inhabited by endemic species

Amami and Okinawa Islands are considered to be isolated from the continent at least 1.7 million years ago. Such long time and further repeated isolation and reunion of the islands have caused speciation and phylogenetic diversification of terrestrial organisms. As a result, the islands are currently inhabited by higher proportion of endemic species. In the Okinawa Island, a lot of endemic species inhabit Yambaru in which Fagaceous forests extend.



Okinawa rail

CR NEWF NNM



Okinawa woodpecker

CR NEWF SNM

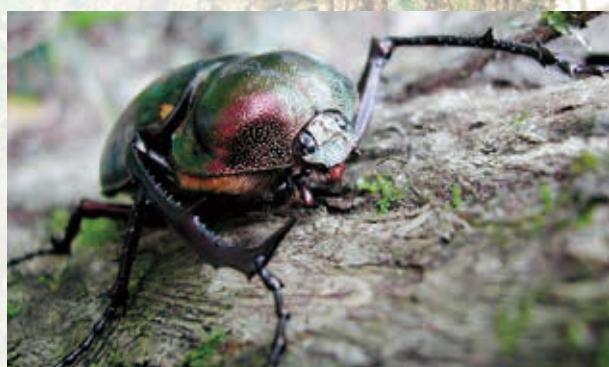
| Endemic to Yambaru                                       | Endemic to the Amami and Okinawa Islands |
|--|--|
| CR Critically endangered                                 | EN Endangered                            |
| NEWF National endangered species of wild fauna and flora | VU Vulnerable                            |
| SNM Special natural monuments of Japan                   |  |
| NNM National natural monuments of Japan                  |  |
| PNM Prefectural natural monuments                        |  |





Okinawa Ishikawa's frog

EN NEWF PNM



Yambaru long-armed scarab beetle

EN NEWF PNM



Okinawa spiny rat

CR NEWF PNM



Ryukyu long-haired rat

EN NEWF PNM



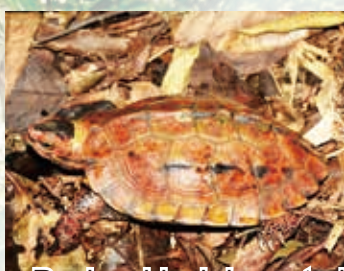
Ryukyu robin

(※Endemic subspecies) EN NEWF PNM



Amami woodcock

VU NEWF PNM



Ryukyu black-breasted leaf turtle

※Endemic species of the Okinawa Islands (those that cannot be found on Amami Oshima) VU PNM



Kuroiwa's ground gecko

※Endemic subspecies of the Okinawa Islands VU NEWF PNM



Namie's frog

EN NEWF PNM



Anderson's crocodile newt

VU NEWF PNM



Ryukyu tip-nosed frog

VU



Holst's frog

※Endemic species of the Okinawa Islands (those that cannot be found on Amami Oshima) EN NEWF PNM

## A Vulnerable Ecosystem

The Yambaru ecosystem which lacks carnivorous native mammals have caused unique adaptations to the native fauna and flora, such as non-volant Okinawa rails and Okinawa woodpeckers which forages on the ground. A unique ecosystem of Yambaru has been formulated by the interaction among such organisms.

Since the Yambaru ecosystem has been developed in an isolated environment, it is very vulnerable to the impact by invasive species, especially carnivorous mammals.



# 2 Introduction of Mongooses

Mongoose brought from the Gandis Delta were released on the Okinawa Island in 1910.

## About the mongoose

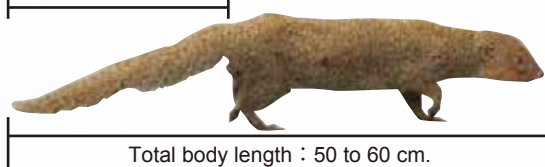
English name : Small Indian Mongoose

Scientific name : *Herpestes auropunctatus*

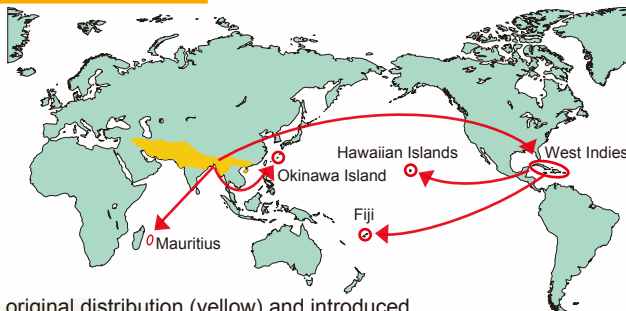
\*Recently the Javan mongoose was scientifically classified into two species: the Javan mongoose and small Indian mongoose. The mongoose introduced into Okinawa Island is the small Indian mongoose.

Tail length is nearly half the size of total body length.

Weight: Males : 0.5 to 1kg;  
Females : 0.3 to 0.6kg



## Distribution



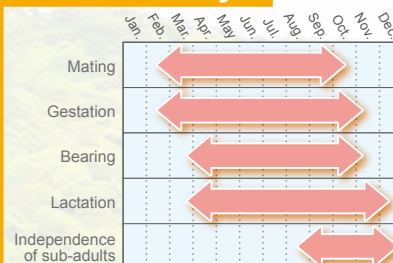
The original distribution (yellow) and introduced regions (red allows)

Original distribution of small Indian mongooses is very wide from Western Asia to Southeast Asia. They were introduced into about 70 islands in tropical areas, including the Hawaiian, Fiji and West Indies Islands, during the late 1800s, in order to control rat and poisonous snake populations.

## Ecology

- They are diurnal and rest under rocks or in hollows at tree bases at night.
- They are solitary and their home range size is 3–9 ha.
- They are good jumpers and can jump over a fence up to 80cm in height and climb over a fence. However, they rarely climb up trees in the wild.
- Although the life span of mongooses in Okinawa Island has yet to be known, it is estimated as one to three years, five years at the longest in other areas.

## Life History



Mongooses reach sexual maturity in 180 days after birth. Once to twice a year, they bleed 2-3 pups with 49 days gestation period.

## Diet

Mainly feeding on insects and reptiles but they eat a variety of food items: mammals, birds, amphibians, arthropods, and even plants and fruits.

I love to eat a variety of food!



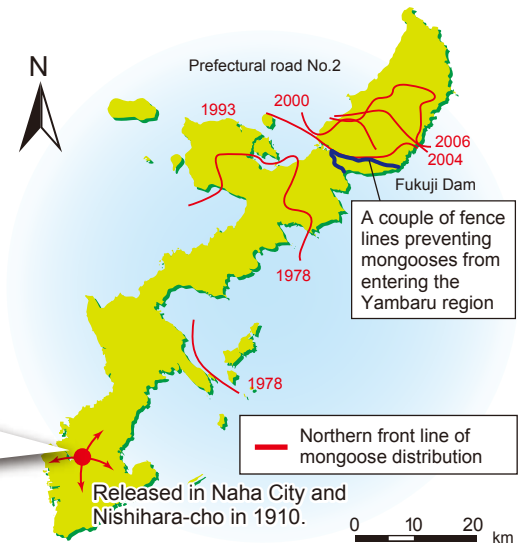


# Why mongooses came to Okinawa?

Seventeen mongooses were released in Naha and Nishihara, southern part of Okinawa Island in 1910, in order to control the number of rats which ate sugar canes, and venomous Habu snakes which harmed humans.

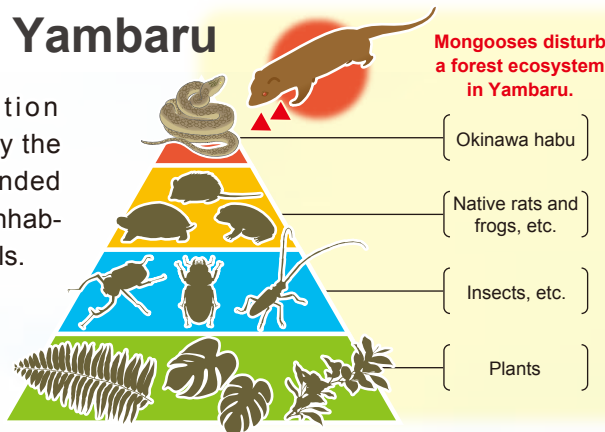
## Just 17 mongooses spread across Okinawa Island.

The only 17 mongooses has increased their population and expanded their distribution to the northward of the island.



## Invasion into Yambaru

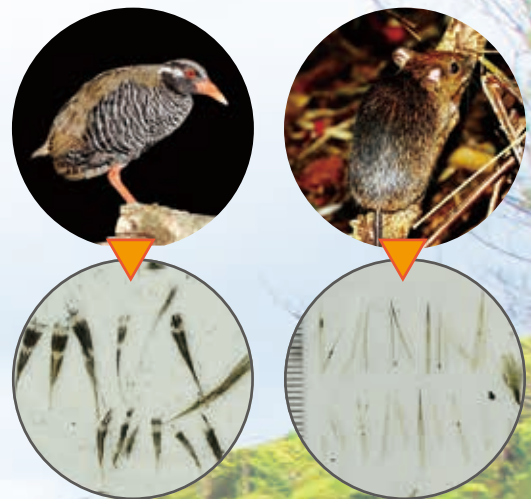
Mongoose distribution reached to Ogimi-son by the early 1990s, then expanded to the Yambaru forests inhabited by threatened animals.



Mongooses have entered a forest ecosystem in Yambaru in which the Okinawa Habu snake is the top predator. Native animals in Yambaru are suitable preys for mongooses, because they have never adapted to protect themselves from carnivorous mammals.

## Will native animals in Yambaru be extinct?

Stomach and fecal contents analysis made it clear that mongooses fed on more than 30 animal species in Yambaru, including insects, lizards, frogs, birds and mammals. Endemic animals to Yambaru, such as Okinawa rails, Okinawa woodpeckers and Okinawa spiny rats were also found in them. In particular, Okinawa rails have been found less and less in the area where mongooses have invaded. Their distribution range has been decreased to 60% from the range when they were first discovered in 1981. If we leave mongooses in Yambaru, there would be extinction crisis for the native animals.



Stomach contents of mongooses  
(Left : Okinawa rail; Right : Okinawa spiny rat)

### Don't mongooses eat Okinawa Habu snakes?

Despite the fact that mongooses were introduced to control Habu snakes, they don't actually prefer to eat the snakes. It is believed that these two animals rarely encounter, because mongooses are diurnal but Habu snakes are nocturnal.



### Animals forced to be extinct by mongoose predation.

In the West Indies, Hawaiian Islands, Fiji and Mauritius, many native animals including small mammals, birds, snakes and frogs are forced to be extinct or declined by introduced mongooses. If we don't take measures, the same thing will happen in Yambaru.





# To Restore Forest Ecosystem in Yambaru

Central and prefectural governments launched mongoose capturing projects in 2000s.

## History of measures to control mongooses

In 1985, University of the Ryukyus (UR) started its basic research. In 1993, the Northern Dams Office, Okinawa Development and Promotion Bureau (NDO) started capturing mongooses. In 1999, "Council for Measures to Invasive Animals of Okinawa" was organized by relevant organizations including Ministry of the Environment (MOE), the Northern Dam Office, Okinawa Prefectural Government (OPG) and UR. OPG in 2000 and MOE in 2001 started mongoose capturing projects across the Yambaru area.

### Mongoose designated as "Invasive Alien Species (IAS)"

In 2005, the Invasive Alien Species Act was enforced to prevent IAS from harming ecosystem, human health, and agriculture, forestry and fishery industries. Feeding, bleeding, keeping, transporting and importing IAS are prohibited under the act. The mongoose was designated as IAS, since they damage ecosystems and agricultural industry.

In accordance with the act, MOE and OPG drew up "Mongoose Eradication Action Plan" aiming to eradicate mongooses from Yambaru in 10 years, strengthen their projects with enormous capturing efforts.

## Prevent mongooses from invading Yambaru

### Barrier fence against mongoose invasion



1st Fence (SF Line)



2nd Fence (ST Line)

In order to prevent mongooses from invading Yambaru, OPG and NDO constructed the 1st Fence (4.13km in length) between Shioya, Ogimi-son and Fukuji Dam, Higashi-son in 2006. To enhance effectiveness of the barrier, OPG, furthermore, completed the 2nd Fence (7km in length) between Shioya and Taira, Higashi-son in 2013.

The height both of the fences is 1.2m. Metal plates are attached at the top of the fences, and the fences under the metal plate have vertically longer mesh structure, which make mongooses unable to climb over them. In addition, the fences are bent in L-shape at their bottom on the ground so as to prevent mongoose from digging holes. The 2nd Fence has, furthermore, narrower mesh structure and is attached metal plates at its bottom to prevent invasive snakes from passing through. Moreover, OPG installed the 3rd Fence between Genga, Nago-city to Arime, Higashi-son, to strengthen effort to prevent invasion of mongoose.

1985 ~

Basic Research  
(UR and NDO)

2000

OPG started capturing  
mongooses.

2001

MOE started capturing  
mongooses.

2005

Invasive Alien Species Act  
enforced.  
Mongoose Eradication  
Action Plan drawn up.

2006

The 1st Fence  
completed along SF Line.

2008

Yambaru Mongoose  
Busters organized.

2013 ~

The 2nd Term Mongoose  
Eradication Action Plan devel-  
oped and The 2nd Fence  
completed along ST Line.

2013

Mongoose Proof Fence  
No. 2 completed.

2016

Yambaru National Park  
designated.

2017 ~

The 3rd Term Mongoose Era-  
dication Action Plan developed  
and The 3rd Fence completed.





# The Yambaru Mongoose Busters

The Yambaru Mongoose Busters (YMB) organized in 2008 plays a key role at the frontline of the mongoose eradication project. Since the project has now declined the number of mongooses, hit-or-miss trapping could no longer succeed in the capturing. YMB is working harder for more effective and efficient capturing through daily observation and long experience, and by analysing huge amount of accumulated data.



## ●Trapping and monitoring methods

Only a single method is not enough to eradicate mongooses. We combine a variety of tools and methods in order to implement the project more effectively. We are also conducting surveys to investigate remnant mongoose and the recovery of native animals.

### Capturing tools



**Live trap**

Steel mesh frame box traps are used for the capturing in the area which native rare animals inhabit. The trap must be checked everyday to avoid killing native animals.

**Soft catch**

This trap puts the legs between jaws covered with rubber so as to capture mongooses alive without injured.



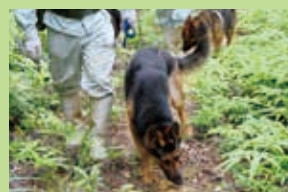
**Kill trap**

Cylindrical kill traps are checked once a month, therefore, can be set more traps and are much more efficient than live traps. We limit the area and period to use kill traps taking into account by-catch of native animals.



## Detecting remnant mongooses

The Mongoose Busters use a variety of methods to detect remaining mongooses.



**Mongoose sniffer dogs**

A pair of a sniffer dog and handler detects a mongoose itself and its feces and smell.



**Camera trap**

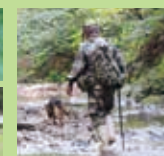
A camera with a passive infrared sensor takes pictures of animals when they pass in front of the camera trap. It can monitor not only mongooses but also native animals.

**Hair trap**

A sticky sheet set on the trap collects mongoose hairs.

### Sniffer dogs and their handlers .....

A handler instructs a sniffer dog to detect mongooses. They are always together and forming trusting relationship.



## ●One day of Mongoose Busters

Mongoose Busters not only capture mongooses but also monitor native animals using a variety of methods, e.g. recording their witness, feces and voice, etc.

9:00 a.m. Morning Meeting  
9:10 a.m. Head for the forests.

### Trapping Team: Set up and check on traps.

Each member heads for their assigned area. They check on the condition of the traps, replace the bait, and check whether any animals have been captured.



### Dog Team: Search for mongoose traces.

Sniffer dogs and handlers search for mongooses and their feces and inform their detection to the trapping team.



2:30 p.m. Finally lunch time!

### Recording and preparation.

Record results of today's works and prepare for trapping tomorrow.

### Training.

The dogs are trained to keep their capacity and get higher skill.



5:00 p.m. Evening Meeting

Roll call for each team and confirming today's work.

Roll call for each team and confirming the works tomorrow, finally sharing and reviewing today's activities.





# Mongoose population decline

The effects of the project are becoming evident.

## The number of mongooses has extremely declined.

- Trapping efforts is expressed as “trap days” = the number of traps x trapping days. For instance, if 100 traps are set for two (2) days, “trap days” is 200 trap days.

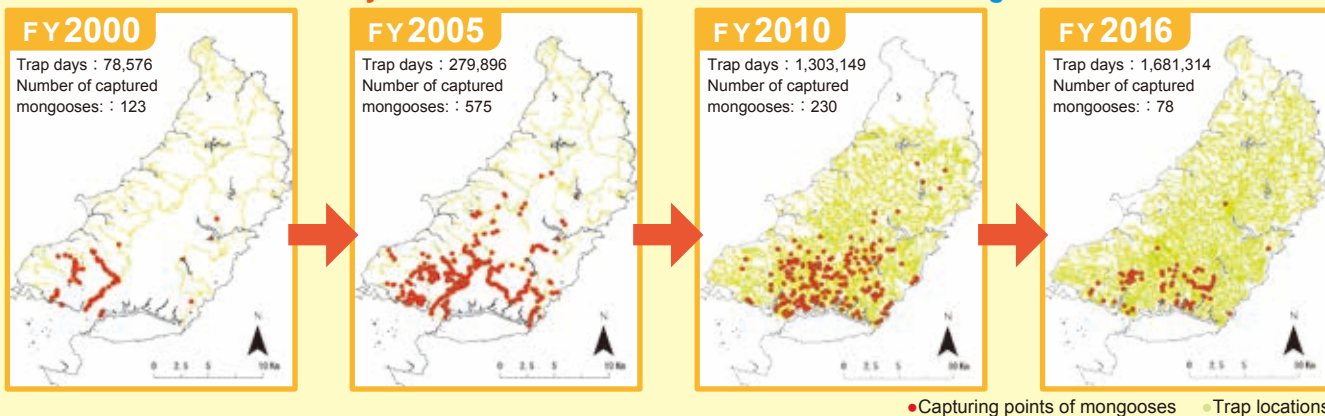
What does this mean?

This result suggests that the mongoose population is decreasing.

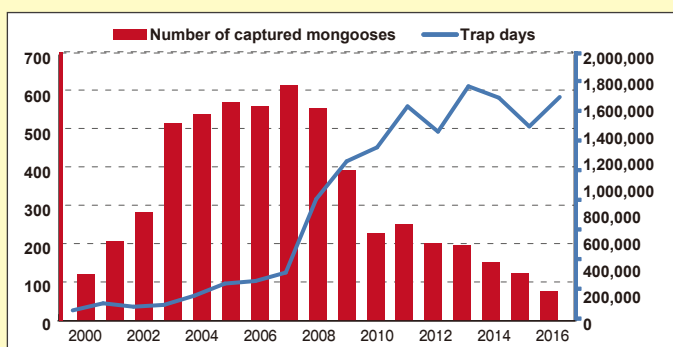
### Mongoose-captured sites and trapping sites

The more traps were set up, the more mongooses were captured, during the first several years.

Despite increased trapping efforts (trap days), the number of captured mongooses has been declining since 2009.

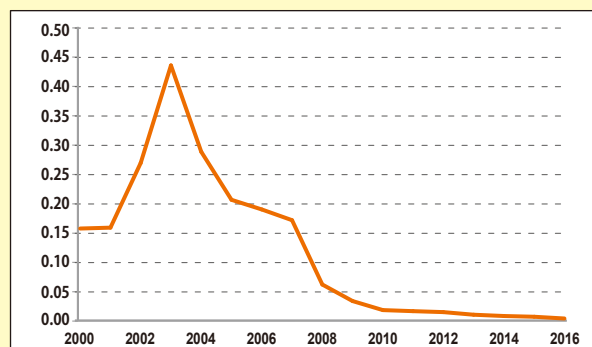


### Number of captured mongooses and trapping efforts (trap days)



Despite less than 400,000 trap days, more mongooses had been captured until 2007. However, the number of captured mongooses has declined since 2008 though much more trapping efforts have been done.

### Number of captured mongooses per 1000 trap days

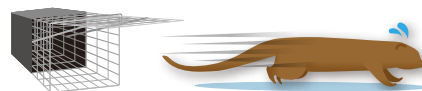


The number of captured mongooses per 1000 trap days reached its peak in 2003, then turned to declining. It has been further declining with very low value since 2010. This shows that the density of mongooses in Yambaru has now got to extremely low.

### As mongoose population has declined, can we decrease trapping effort?

No! The hard works are still ahead. The capturing works are more difficult after the density gets lower. Even though an experienced staff of the Busters fully works out, it becomes very difficult to capture only a mongoose. However, once we loosen the capturing, all efforts we have made would go to waste.

Remember that only 17 mongooses first released have spread throughout Okinawa Island. We have to continue the capturing effort until mongooses in Yambaru get to zero in order to restore Yambaru to such forests as native animals live safely.





# Okinawa rails are coming back to the south area of Yambaru!

## Monitoring survey on Okinawa rails

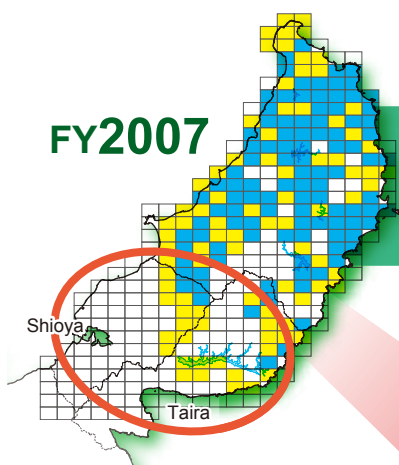
To monitor the population and distribution of Okinawa rails, since 2007, Ministry of the Environment has been conducting playback surveys, which sound the rail's calls with a speaker, then count call-back from wild rails respond to the sound.



When first discovered in 1985, Okinawa rails were found in the area between Shioya and Taira. Their distribution area had, however, been smaller toward the northern area with invasion of mongooses.

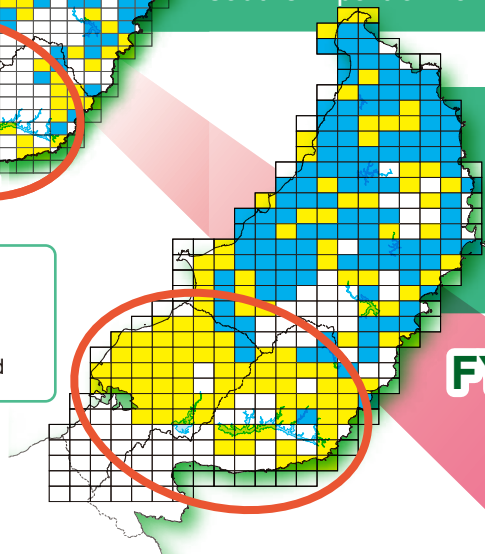
**FY2007**

In FY 2007 when the number of captured mongooses reached its peak and exceeded 600, we couldn't confirm Okinawa rails in the southern part of Yambaru.



In FY2010, the number of captured mongooses drastically declined and reached to the 200s. However, few rails have confirmed in the southern part.

**FY2010**

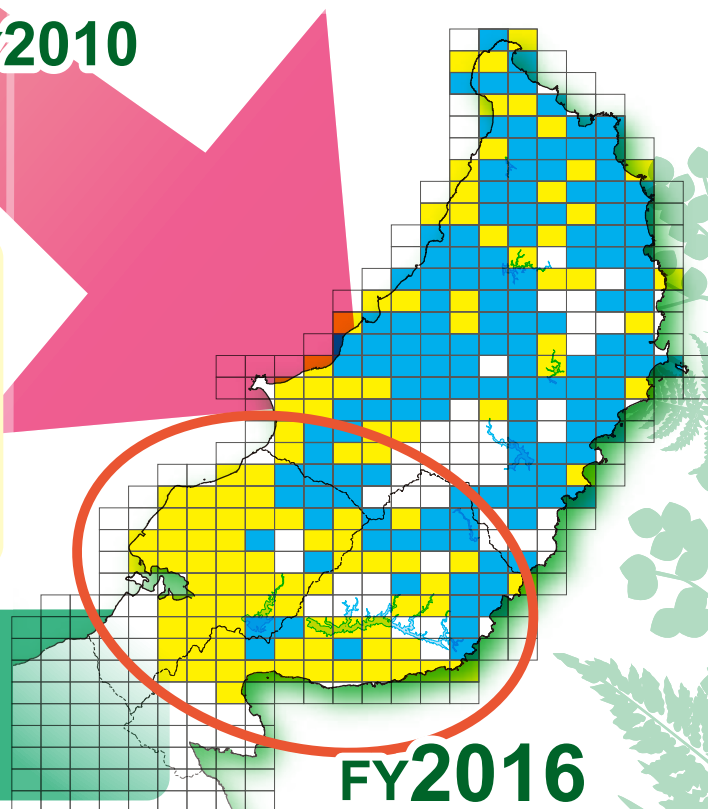


Since 2012, adult and young rails were found in the southern part of Yambaru, which indicated that the rail recovered its distribution.



A chick of Okinawa rail

In these days, the rails were found in many areas and their distribution expanded to the south area of Yambaru.



**FY2016**



# Action Plan of the Mongoose Eradication Project in Yambaru

Ministry of Environment and Okinawa Prefectural Government drew up the 3rd term Action Plan of the Mongoose Eradication Project in 2017 and are implementing the plan

## Project Goal

In order to restore the forest ecosystem in Yambaru inhabited by a number of endemic and threatened species, eradicate mongooses from the Shioya-Fukuji line and northward area by FY 2026 and prevent their re-invasion into the area.

**Target 1** Eradicate mongooses from Yambaru.

**Target 2** Prevent re-invasion of mongooses into Yambaru.

**Target 3** Restore native animals.

Conducting monitoring surveys on threatened animals.

**Target 4** Enhance effectiveness of the project by developing new techniques.

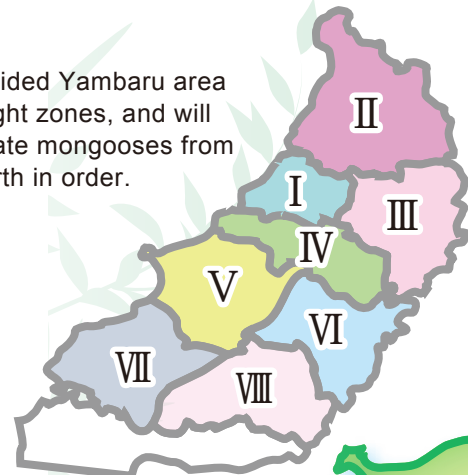
Collaborating with research institutes, we will develop more effective traps, mongoose prevention fences, and monitoring tools.

**Target 5** Increase public awareness through various publicity activities.

**Target 6** Evaluate implementation and effectiveness of the project and improve the action plan and activities when necessary.



We divided Yambaru area into eight zones, and will eradicate mongooses from the north in order.



Using the two fences to block out mongooses

Shioya (S)

ST Line (Fence)

SF Line (Fence+dam lake)

Taira (T)

A buffer zone for preventing the invasion of mongooses.

Apart from "The 3rd Term Mongoose Eradication Action Plan", OPG is conducting its own plan "Action Plan of the mongoose Eradication Project of Okinawa", in order to reduce their population and habitat significantly until FY 2026. That Action Plan is conducted in the area between south of ST line to prefectural road 14, called as "priority measures region".



## Steps for Eradication

### 1 Reduce the density

As a first step, reduce the density in a zone inhabited by a number of mongooses.

### 2 Remove remnants

In a low density zone where capturing efficiency has reduced, we also concentrically set traps in the area where more information on mongoose existence has been gathered from trapping and sniffer dog's surveys.

### 3 Eradication check

Verify eradication of mongooses in the zone using concentrate monitoring by sniffer dogs, camera traps and hair traps.

If no mongoose information for another year and more

### 4 Keep eradicated status

Continue trapping and monitoring to keep eradicated status in the zone.

**Eradication completed!**



# GOAL!!!



**Target areas for eradicating mongooses**

Fukuji Dam (F)

**Amami-Oshima Island, Tokunoshima Island, the northern part of Okinawa Island and Iriomote Island is candidate for world natural heritage registration.**

Two important points to be registered in the World Natural Heritage are "to exist outstanding and universal value" and "to protect its value in the future". We will continue preparing for registration the fifth world natural heritage in Japan, including measures of mongoose at Yambaru





This forest belongs to  
Yambaru's native species...

**Visit the following websites for information on invasive species**

About the Invasive Alien Species Act ..... <http://www.env.go.jp/nature/intro/>  
About measures against invasive species in the  
Ryukyu Islands ..... <http://kyushu.env.go.jp/naha/wildlife/gairai.html>  
Database of invasive species, National Institute for  
Environmental Studies ..... <http://www.nies.go.jp/biodiversity/invasive/>



It's not the mongoose's fault  
**Do not bring any  
invasive species into  
Yambaru**

Although mongooses are treated as pests disturbing the ecosystem in Yambaru, they are an essential component of the ecosystem in their original habitats like in India. The introduction of mongooses by humans caused them to disturb the ecosystem in Okinawa Island. Therefore, we have to recognize that it's our fault. In order to conserve native animals in Yambaru, it's absolutely indispensable to eradicate mongooses from the region.

It is important for us to be aware of invasive species in our daily lives. We need to remember three principles for measures against invasive species: **"Do not let them in", "Do not release them",** and **"Do not them spread"**.



**Mongooses are "Invasive Alien Species" designated by the law**



Transporting and keeping living mongooses is prohibited by the Invasive Alien Species Act. In addition, mongooses are not purchased by governmental bodies. "Mongoose Busters" is capturing mongooses with special permission.



What you can do for Yambaru's future.

**It is not just mongooses. Please don't abandon your pet.**



Abandoned dogs and cats will turn to feral and eat native endemic and rare animals. Living with humans is what makes pets happy. ....

Making your pets happy will make wild animals in Yambaru happy.

If abandoned pets turn to feral, **they will attack native wild animals.**



※The above dog and cat are both feral ones taken pictures in Yambaru.

※Abandoning pets is prohibited by law.

**Regulations for handling a house cat enacted by municipal governments in Yambaru, Kunigami, Higasi and Ogimi**

- A microchip shall be implanted in a pet cat.
- Application for the registration shall be submitted within 30 days after acquisition of the cat.
- The owner who doesn't want breeding of his/her cat shall endeavor the breeding control.
- Feeding stray cats is prohibited.

Municipal governments in Yambaru: Kunigami, Ogimi and Higashi, enforced the "Ordinance on Welfare and Management of Cats" on 1 April, 2005.



**Ministry of the Environment  
Naha Nature Conservation Office**

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1-15-15 Higawa, Naha City, Okinawa Prefecture,  
900-0022  
TEL:098-836-6400 / FAX:098-836-6401



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