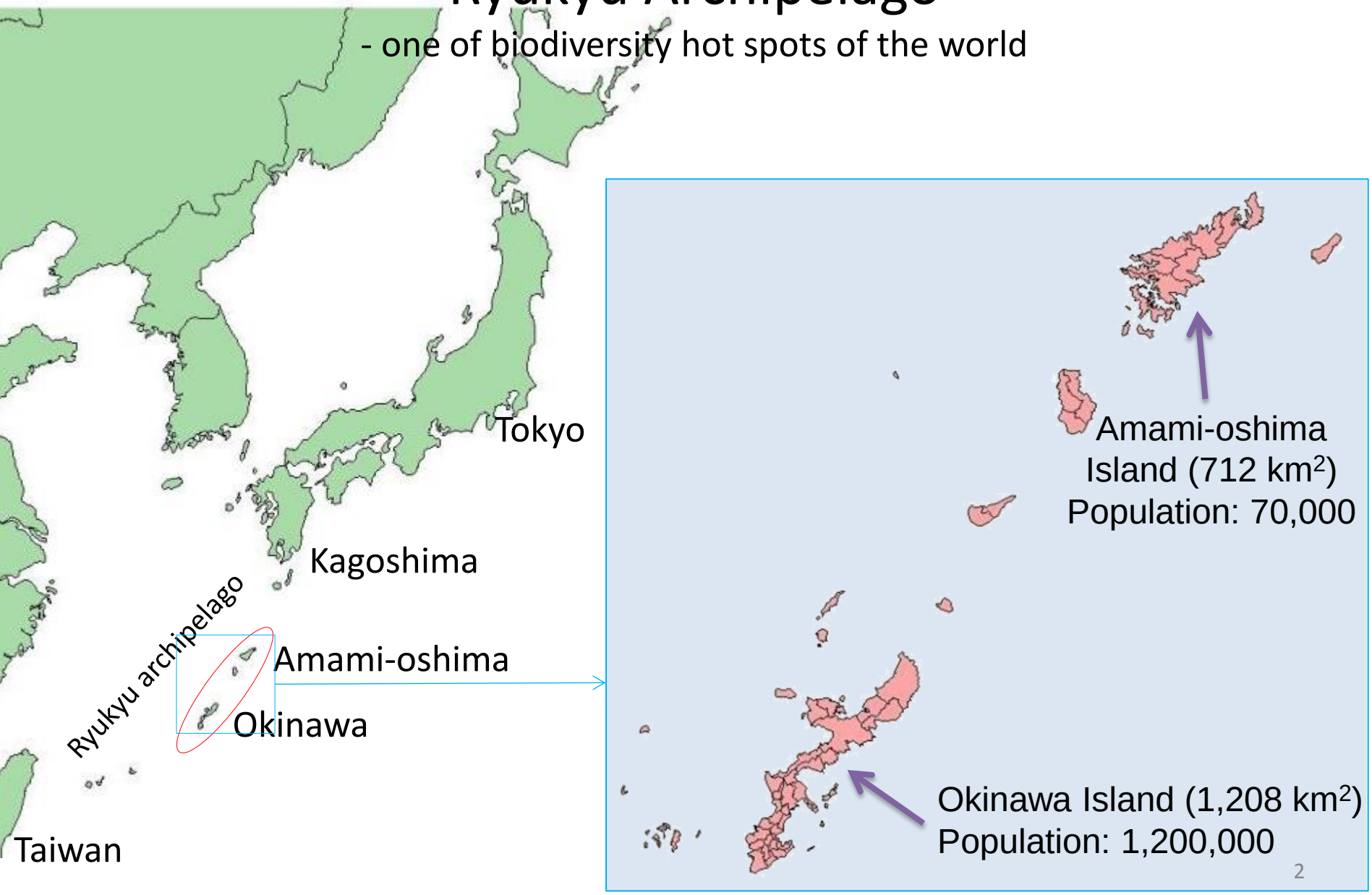
Eradication project of invasive alien mongooses in Japan
- Okinawa and Amami-oshima Island-

Office for Alien Species Management, Wildlife Division,
Nature Conservation Bureau,
Ministry of the environment

Masato Morikawa

Ryukyu Archipelago

- one of biodiversity hot spots of the world



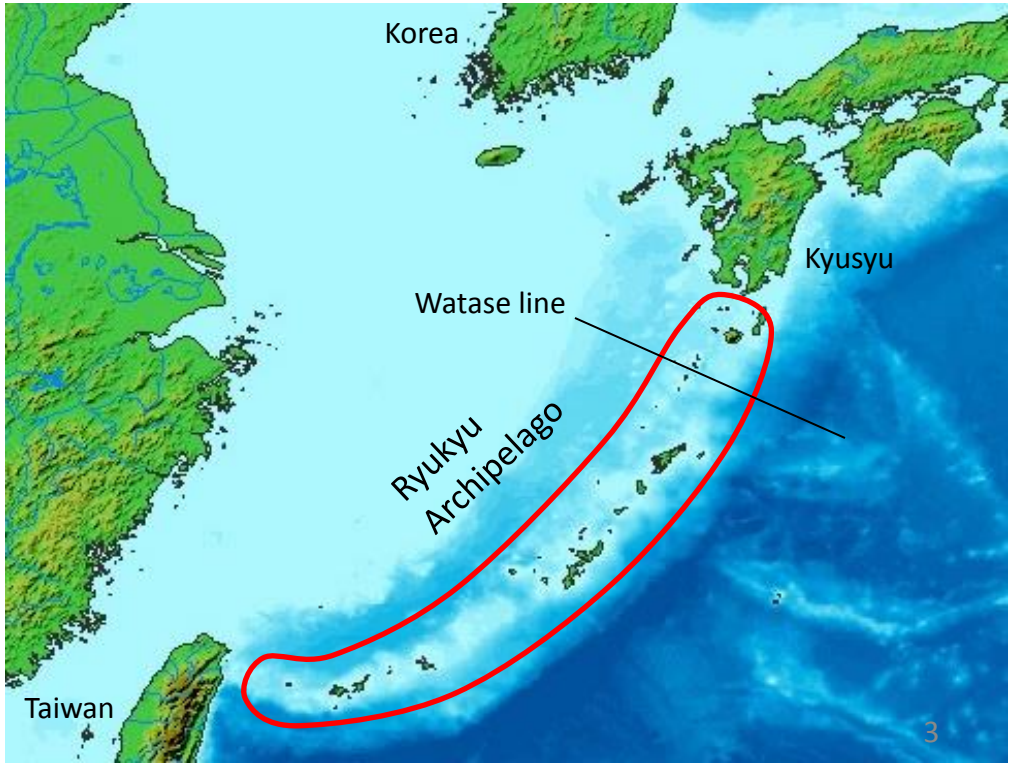
Ryukyu Archipelago

- one of biodiversity hot spots of the world

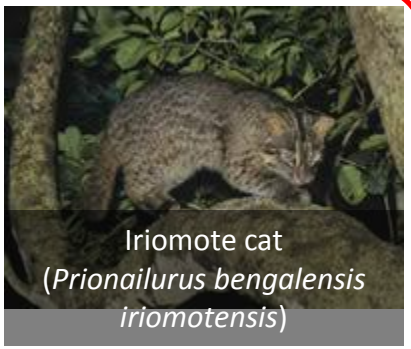
- Biogeographically, border of Palearctic and Oriental region.
- Isolated from the continent about 2 - 1.7 million years ago.

  c.f. Mainland Japan : isolated about 10 000 – 20 000 years ago.
- Many endemic species inhabit with limited predator species

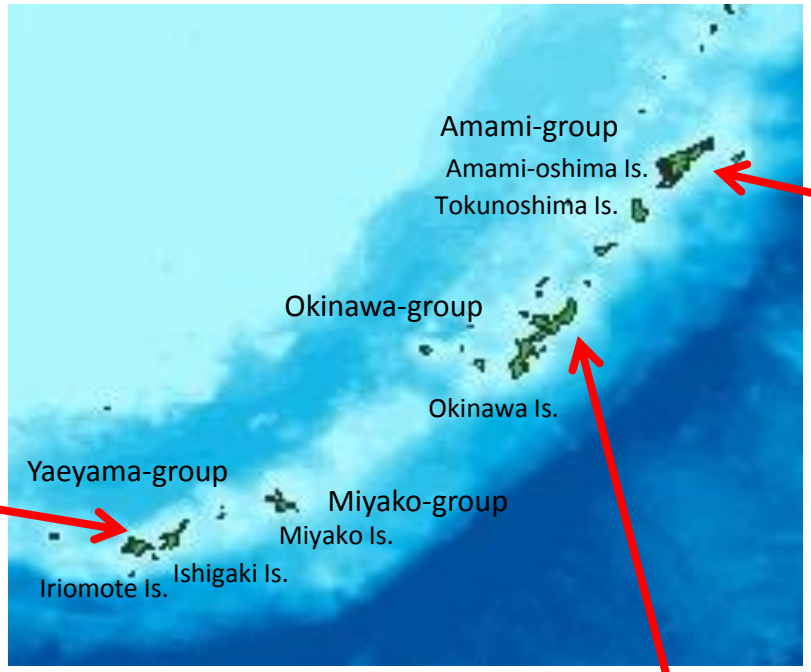
Islands of poisonous snake, habu



Native wildlife in the Ryukyus evolved in the absence of predatory mammals


Iriomote cat
(*Prionailurus bengalensis iriomotensis*)

Crested Serpent Eagle
(*Spilornis cheela perplexus*)




Amami rabbit
(*Pentalagus furnessi*)

Amami woodcock
(*Scolopax mira*)


Okinawa woodpecker
(*Dendrocopos noguchii*)


Okinawa rail
(*Gallirallus okinawae*)


Yambaru long-armed scarab beetle
(*Cheirotonus jambar*)


Amami thrush
(Zoothera dauma major)

Small Indian Mongoose

(*Herpestes auropunctatus*)


Small Indian mongoose

- A small, slim-bodied predator native to areas from Iran, through India to Myanmar, VietNam.
- It has been introduced to many islands to control rats, particularly in sugar cane fields of tropics.
- The mongoose has had a major impact on native species in the areas where it has been introduced.

Small Indian Mongoose (*Herpestes javanicus (auropunctatus)*)


Photo: Jack Jeffrey Photography

This voracious and opportunistic predator is native to areas from Iran, through India to Myanmar and the Malay Peninsula. It was introduced to Mauritius and Fiji and to the West Indies and Hawai'i in the late 1800s to control rats. Unfortunately, this early attempt at biological control has had disastrous impacts. Island populations of native fauna, which had evolved without the threat of a fast-moving, mammalian predator, were no match for the mongoose. It has caused the local extinction of several endemic birds, reptiles and amphibians and threatens others including the rare Japanese Amami rabbit (*Pentalagus furnessi*). The small Indian mongoose is also a vector of rabies.

100 of the worst invasive alien species by ISSG, IUCN

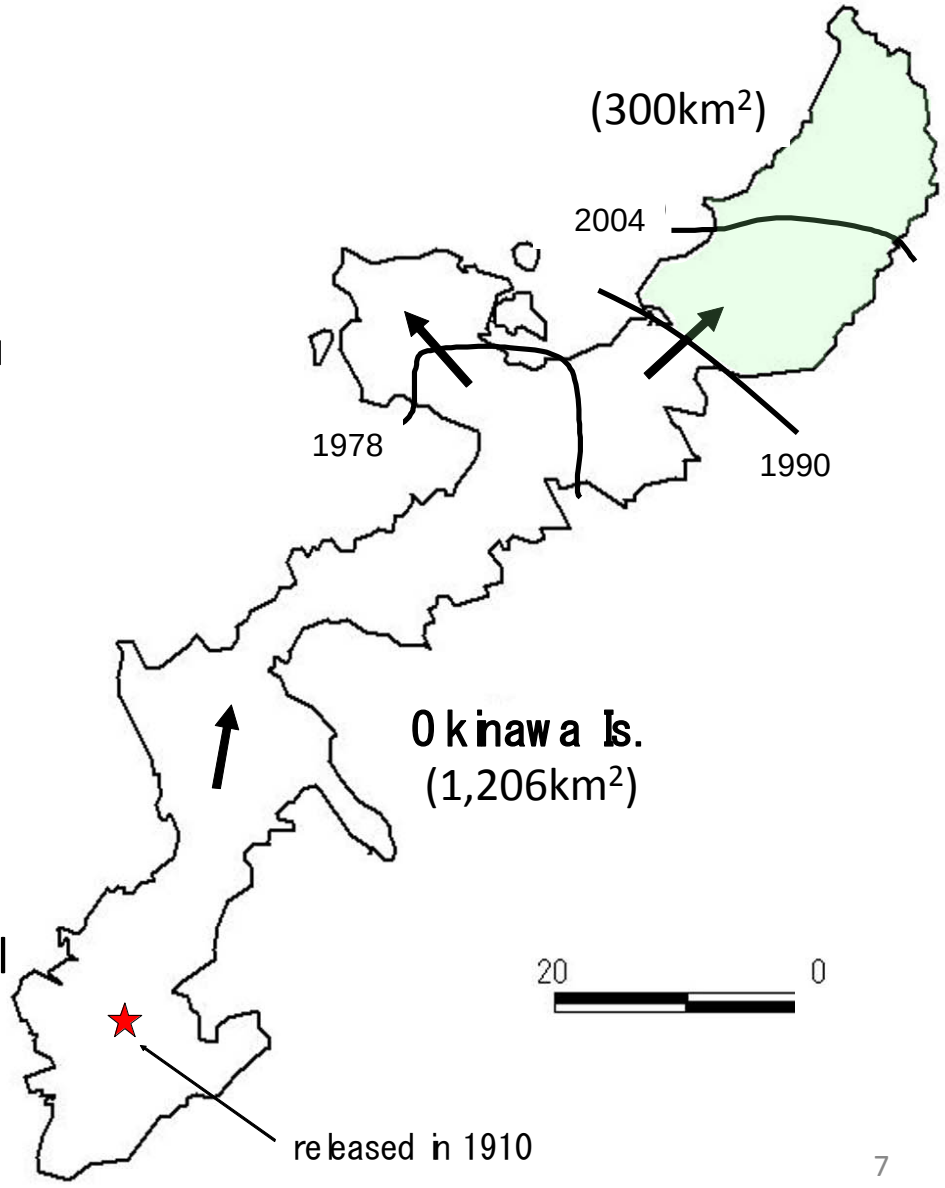
More than 70 islands/areas introduced

FIGURE 2. Native range and routes of introduction of the small Indian mongoose.

(Hays & Conant, 2007)

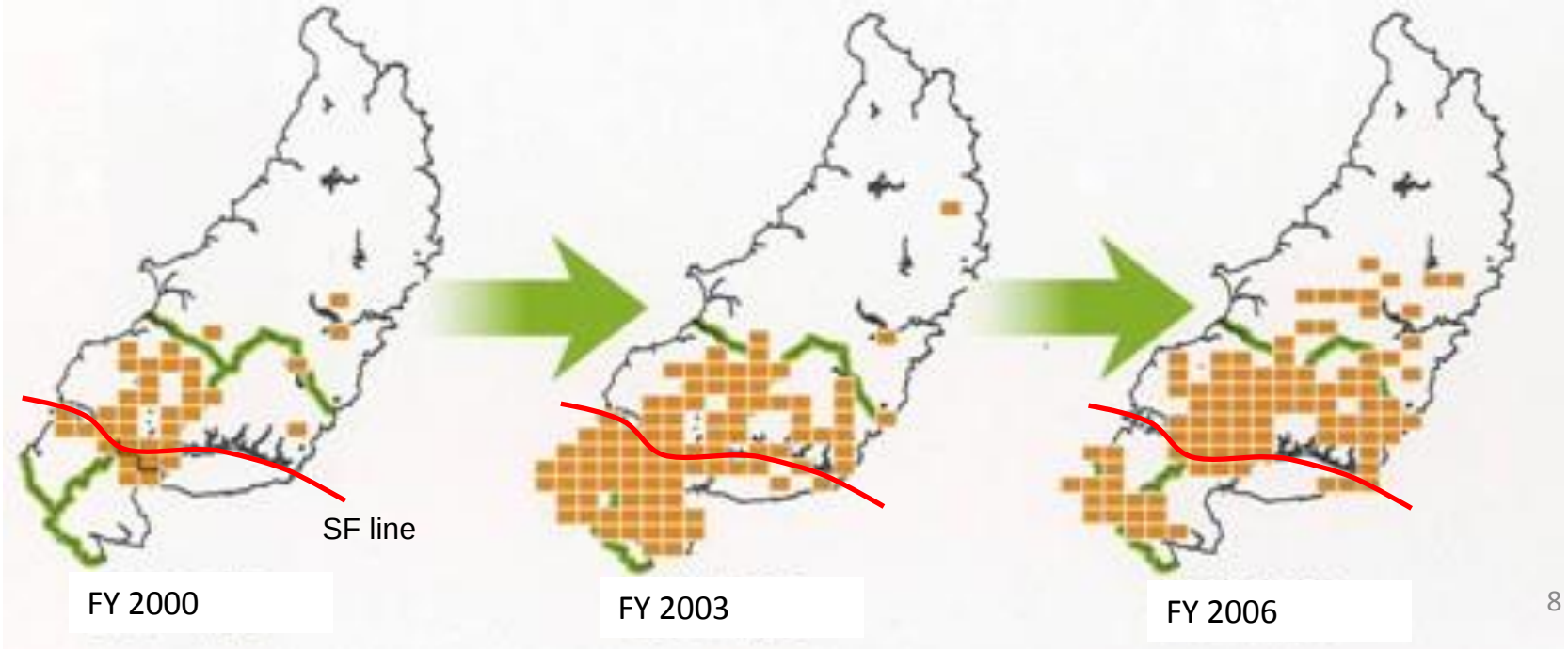
1910: First introduction to Japan

- Dr. Watase, the famous biologist in Japan was advised by foreign scientists to import mongooses to control poisonous snake Habu and harmful black rat
- Released around southern part of Okinawa and settled and spread gradually
- 1990s: Expand to Yamabaru region(northern Okinawa) , the hotspot of wildlife
- Mongoose Control measure launched by Okinawa Prefectural Government & MOE launched from 2000



Starting control efforts

- In 2000, the Okinawa Prefectural Government began cull efforts.
- In 2005, control efforts began with the enforcement of the Invasive Alien Species Act.
- The mongoose population continued to expand until 2006, causing the Okinawa rail population to retreat.
- Mongoose proof fence installed in 2006 in SF line to prevent mongooses from spreading north.



Outline of control measures

- Control initiatives began with cage-type **live traps**, which required daily checking. Trappers installed traps along logging roads.
- The introduction of tube-type **kill traps** for which checking frequency can be set as desired (usually every two to four weeks) and the use of kill traps and live traps as required brought about a drastic increase in the number of traps managed.
- Trappers began related work in forests in FY 2007.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Live trap	●	→	→	→	→	→	→	→	→	→	→	→	→	→
Forest work								●	→	→	→	→	→	→
Kill trap									●	→	→	→	→	→
Sensor cameras										●	→	→	→	→
Sniffer dogs										●	→	→	→	→
Native species monitoring									●	→	→	→	→	→

Preventing damage of indiscriminate capture

- Kill traps were first introduced in 2003
- Deploy endemic rats are absent and/or in low density.

Amami spiny rat (*Tokudaia osimensis*)

Ryukyu long-haired rat (*Diplothrix legata*)

■ **Live trap**

…Everyday checking is necessary

…Used in habitat of endangered native species

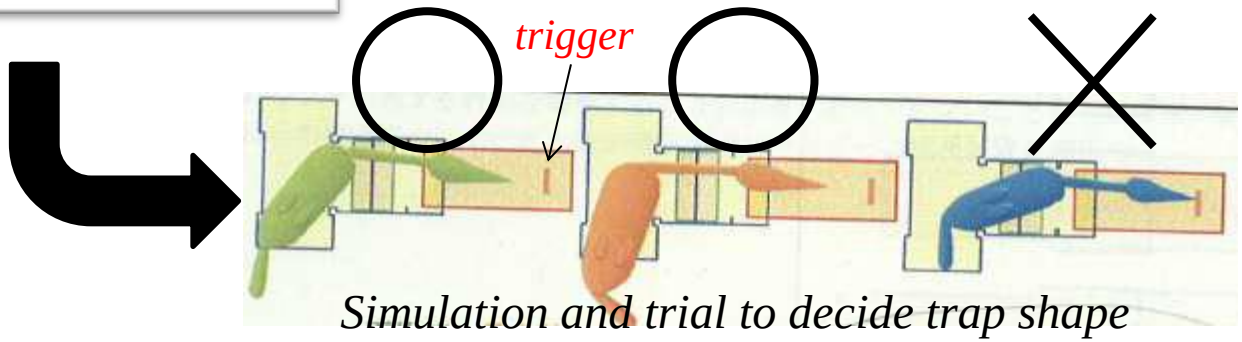
■ **Kill trap** (Pipe- trap)

…Efficient (Lightweight, Set for 2-4 weeks)

…Birds : discriminable

Rats : indiscriminable

Okinawa rail

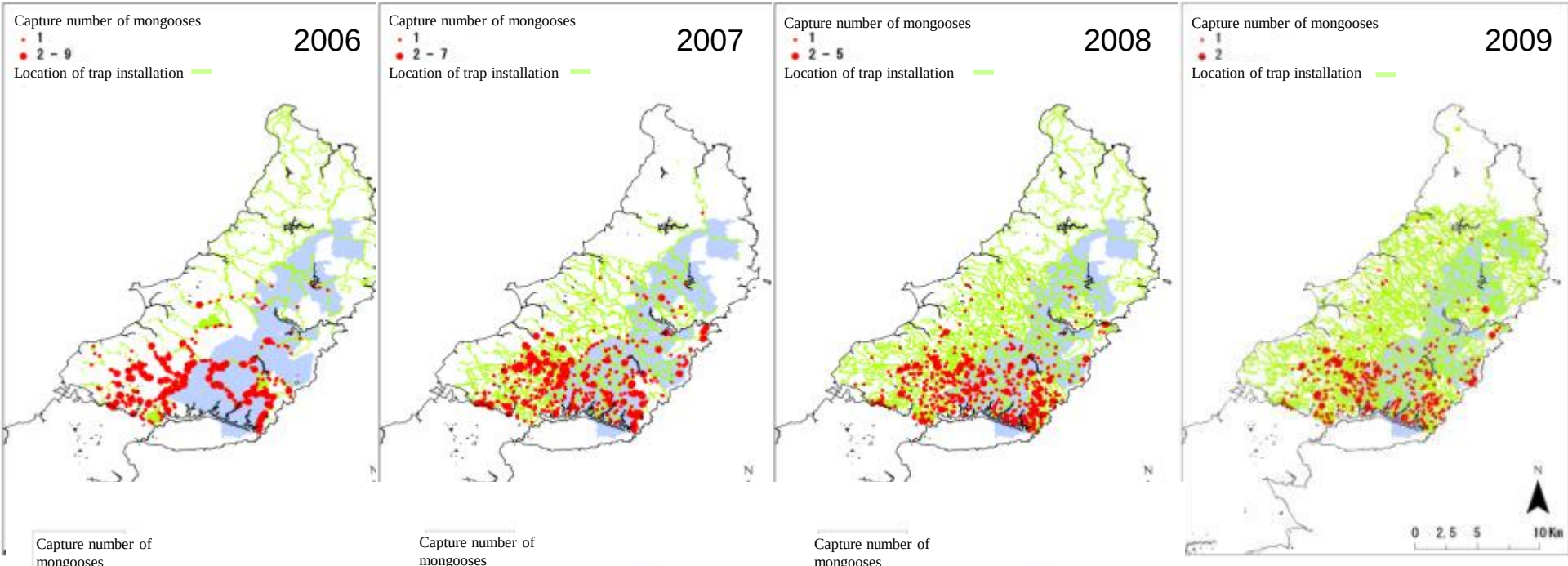


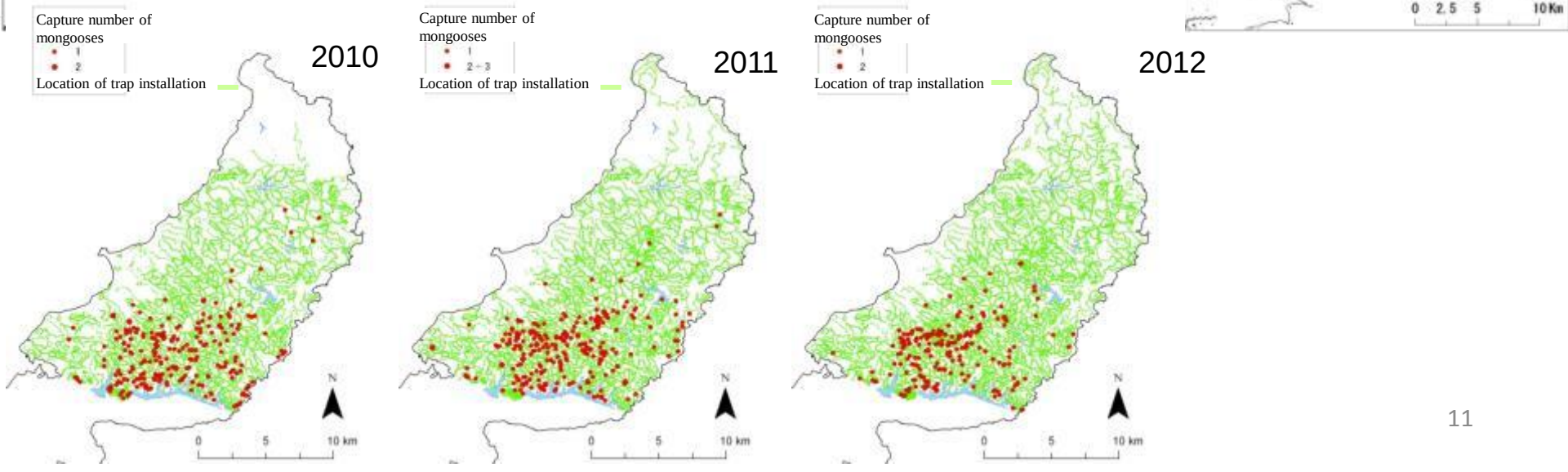
Simulation and trial to decide trap shape for preventing endemic birds

Amami jay

Changes in capture status

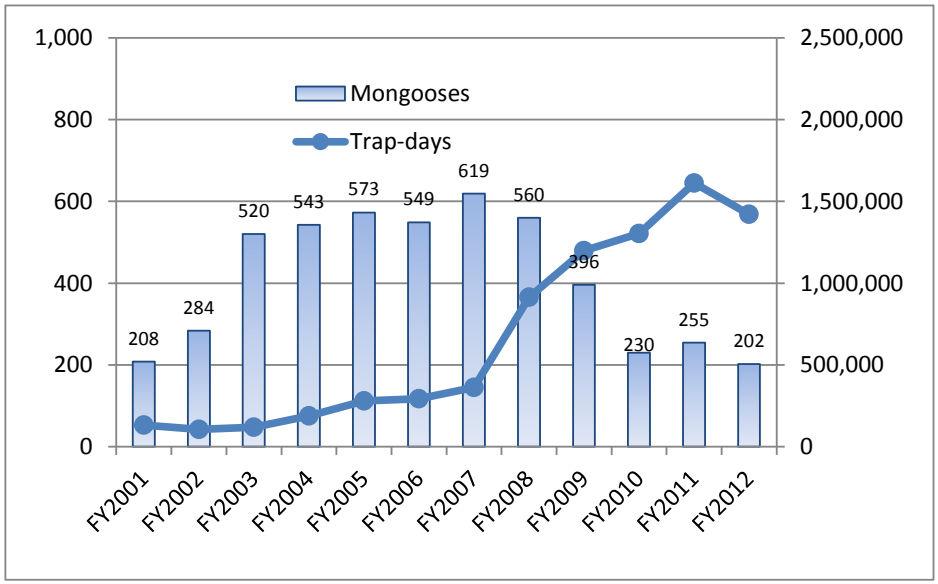
Distribution of mongooses have decreased

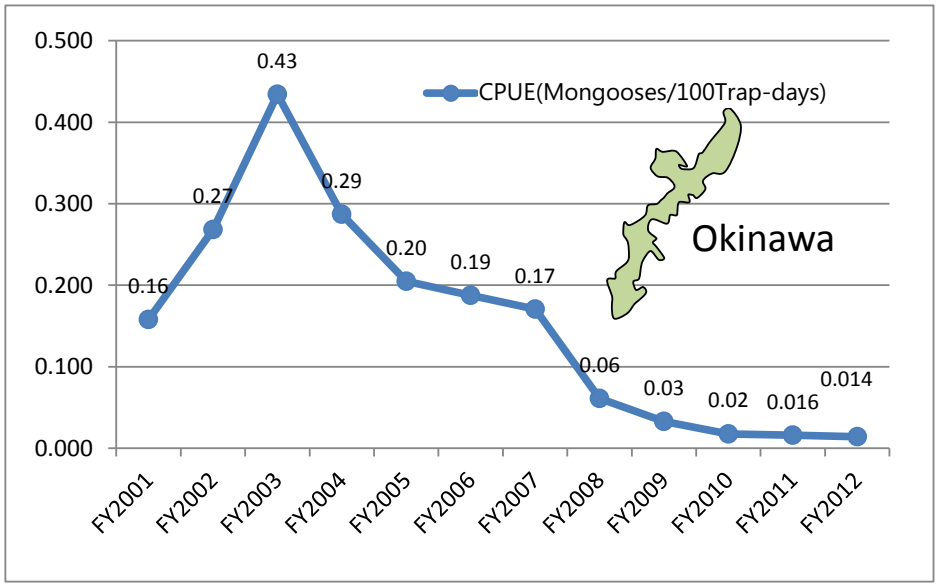




Changes in capture status

Mongooses have steadily decreased

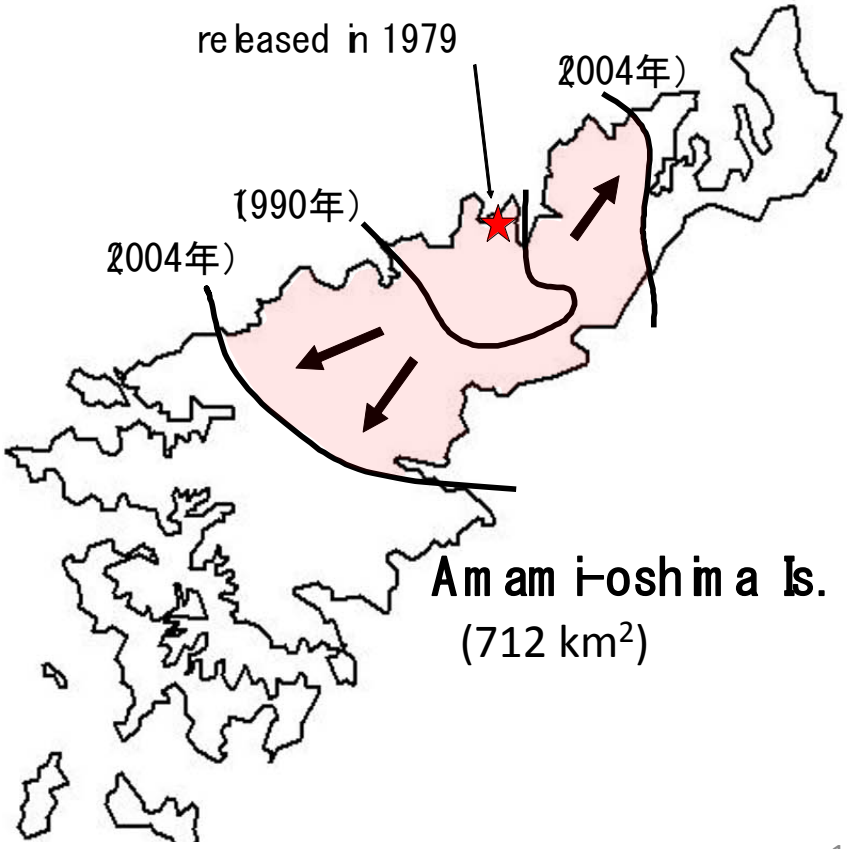




- Since the Yambaru Mongoose Busters started its activities, there has been a drastic increase in the total number of traps (see the line graph). The total number of trap days has kept around 1.5 million every year since 2011. The number of mongooses caught (see the bar graph) has shown a declining trend since 2008, and been a significant drop in the number in recent years.
- CPUE, an indicator of mongoose population size, has continued to decrease.

1979: Introduction into Amami from Okinawa Island

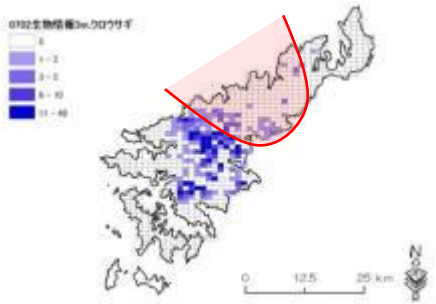
- There are few records about introduction into Amami
- Mongooses were brought in from Okinawa Island (Sekiguchi et.al.,2001)
- Mongooses successfully settled on Amami and expanded their distribution
- Damages on farming and poultry gradually appeared from 1983
- Some research by Amami Mammalogical Society from 1989
- Pest control by local government began from 1993

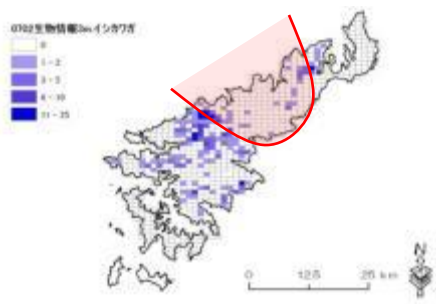


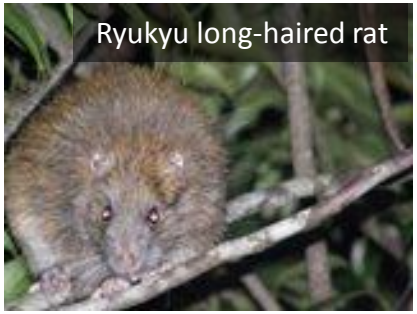
Strong negative impacts on native vertebrates

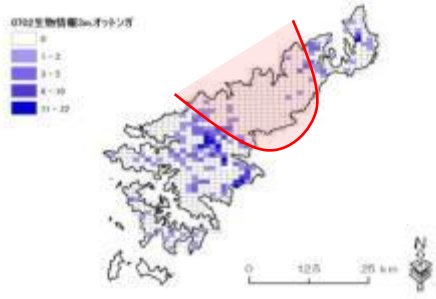
Partial extinction of mammals and amphibians in range of mongooses

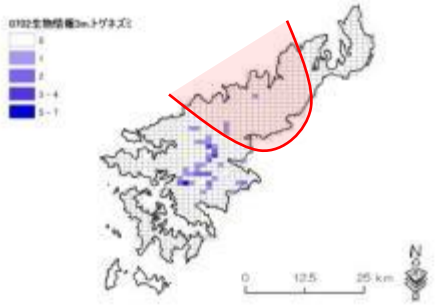
: distribution of native vertebrates : core area of range of mongooses

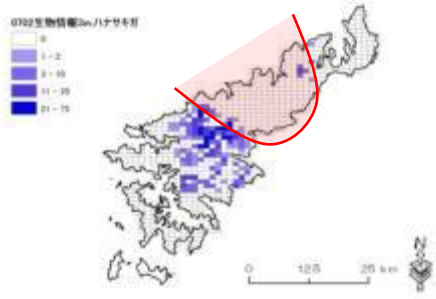












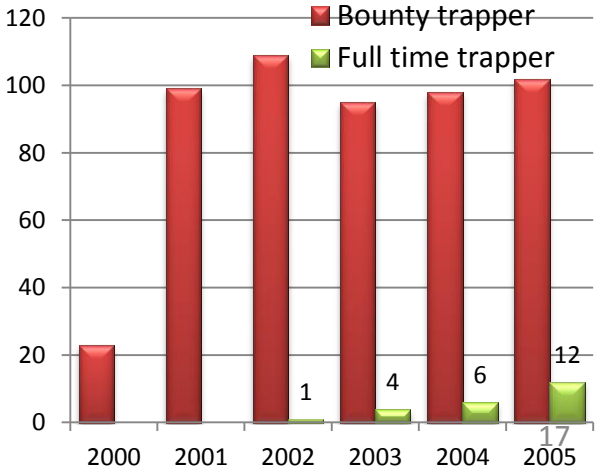
Amami Wildlife Conservation Center from 2000 to 2006

1993-: Pest control by local government

- Pest animal that causes harm to crops and chicks
- Local government launched control to reduce damages of crops
- Licensed trapper were paid JPY 2,200 for a mongoose
- 8,234 mongooses were captured in seven years (1993-1999)
- Most of them captured around the center of distribution, high density area

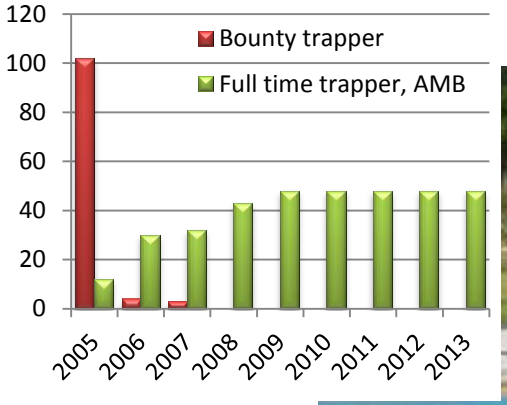
2000-2004: Control program by bounty trapper

- At the beginning, mongooses were live trapped by one hundred bounty trappers
- To keep incentive to trap, bounty increased from JPY 2,200 (2000) to JPY 4,000 (2001-02) and JPY 5,000 (2003-04)
- Trapping data of bounty trappers were collected with using standard grid square (about 1 km^2 mesh)
- A small number of trappers were employed to set traps at low density area and in bushes. 1 trapper in 2002, 4 in 2003, and 6 in 2004
- 14,558 mongooses were caught in this five year trapping 2000-2004



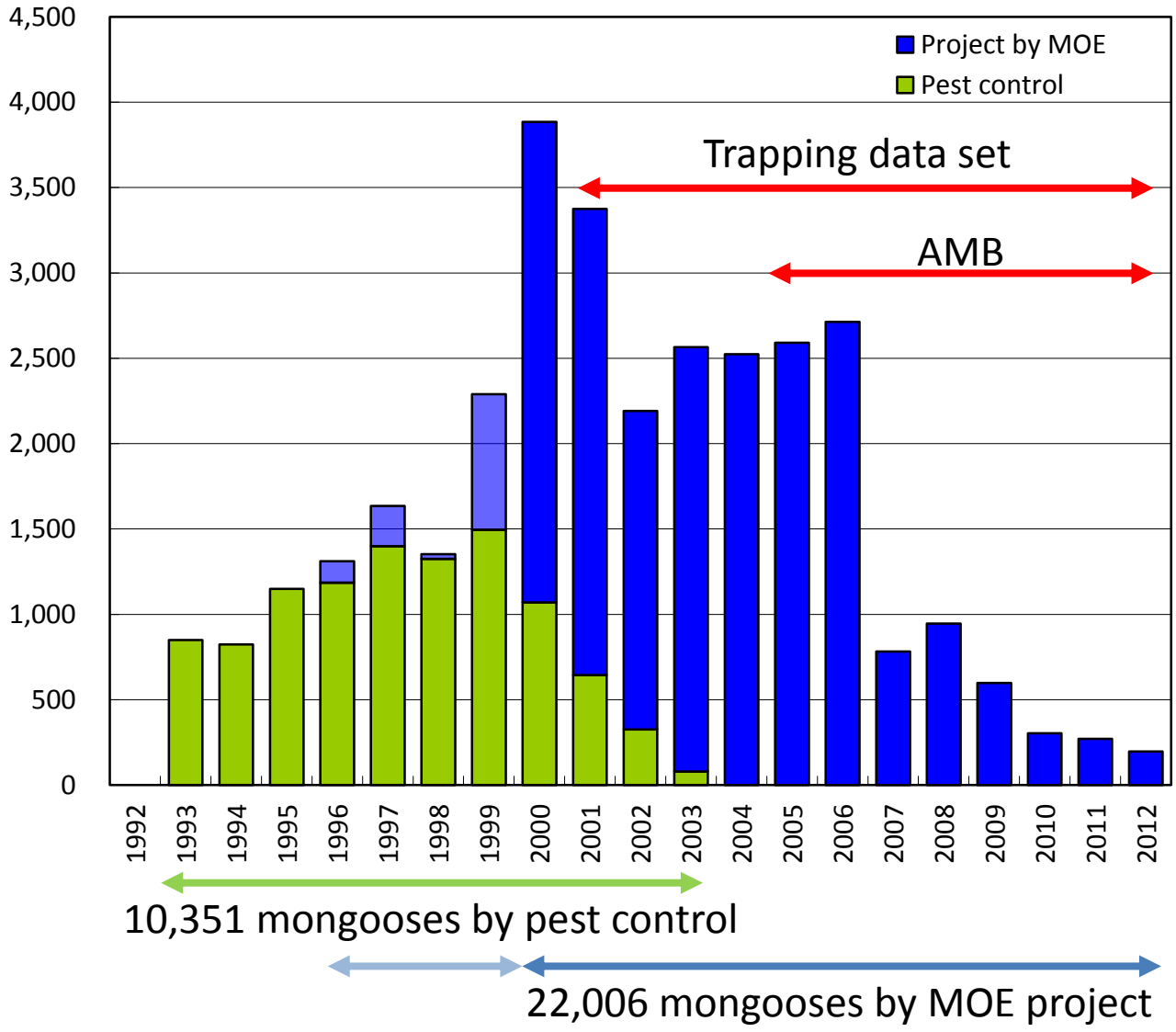
2005- Organizing Amami Mongoose Busters (AMB)

- Invasive Alien Species Act was enforced in 2005
- MOE launched a mongoose eradication project, hiring trapping experts, “Amami Mongoose Busters (AMB)”.

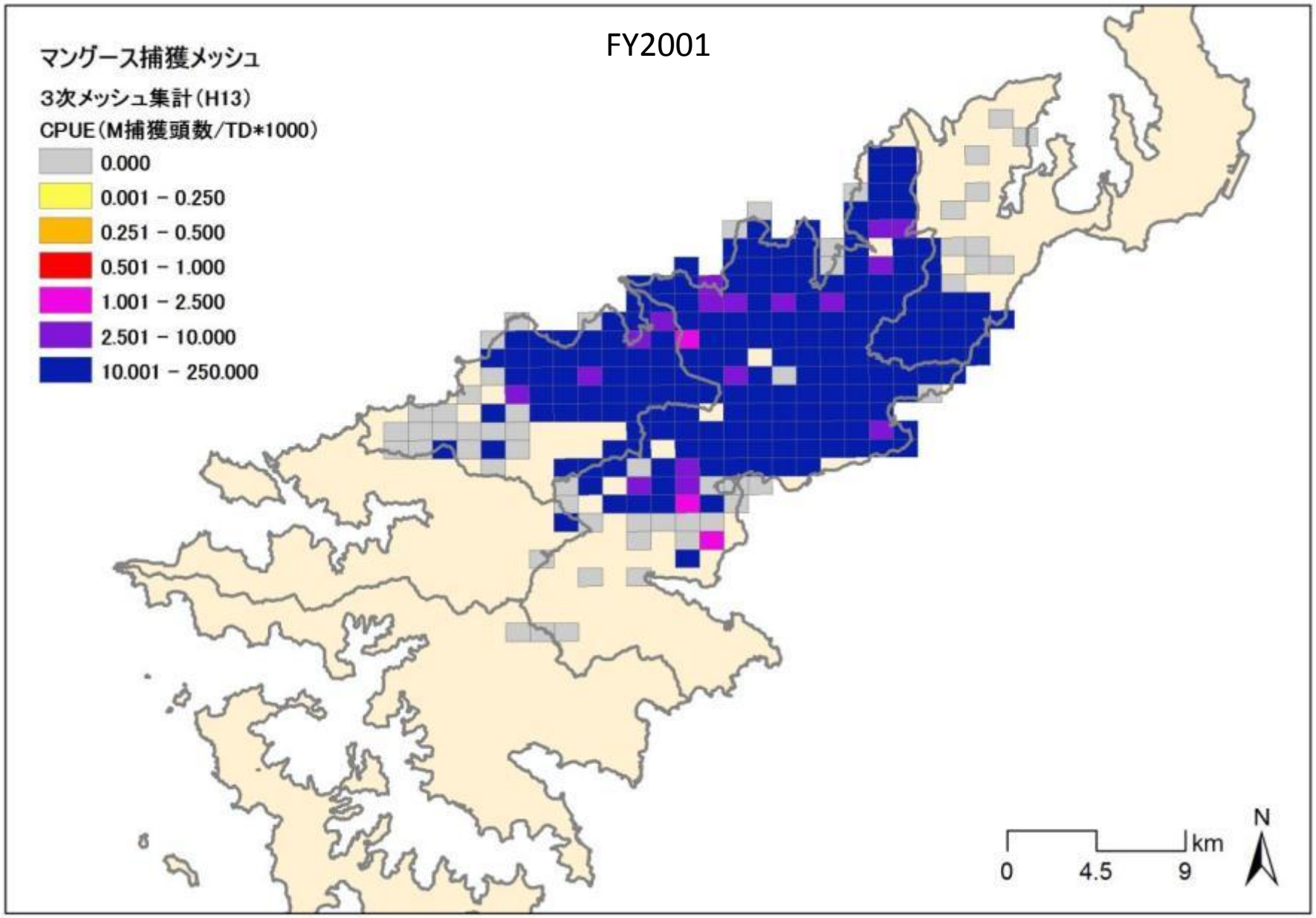


2013: AMB and trained sniffer dogs

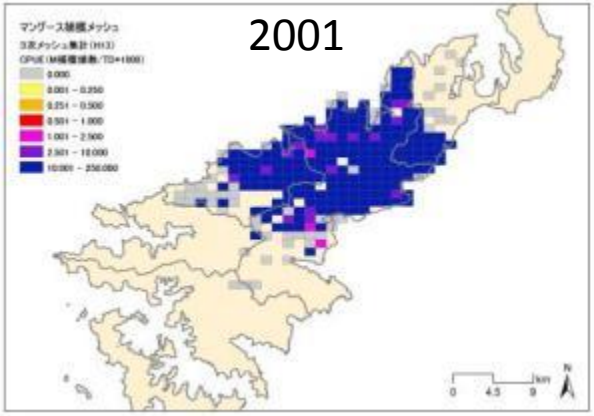
32,357 mongooses caught in 20 years

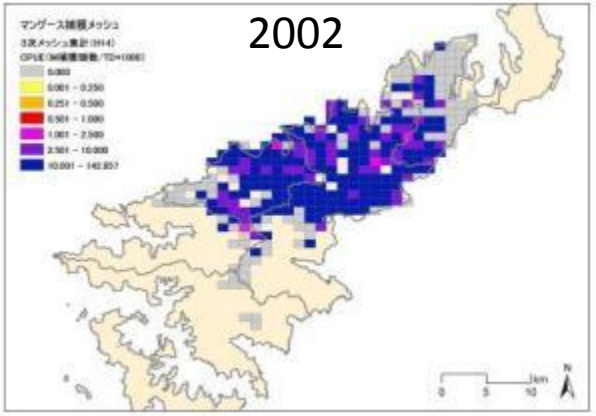


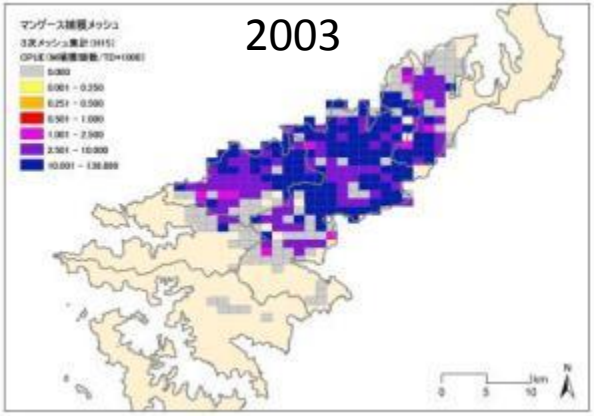
CPUE (Capture/1000trap-days) distribution

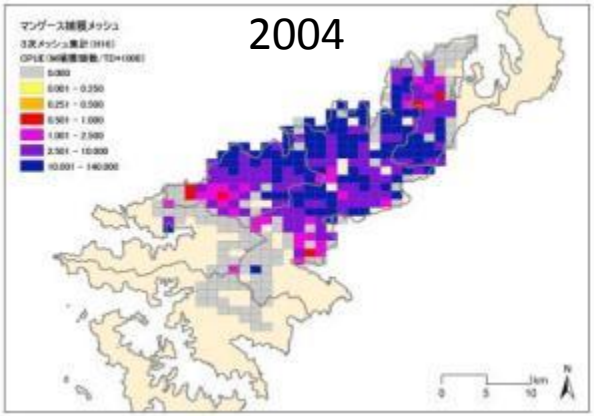


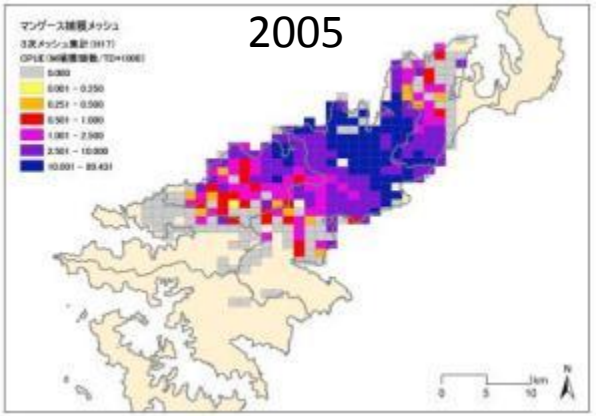
CPUE (Capture/1000trap-days) distribution

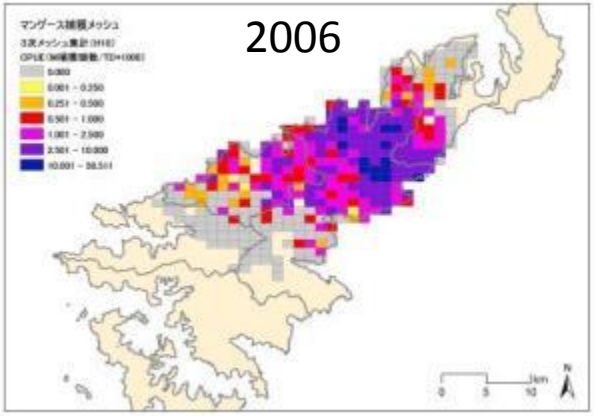


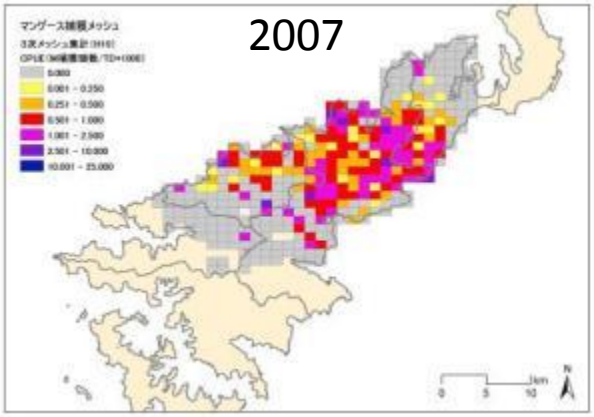


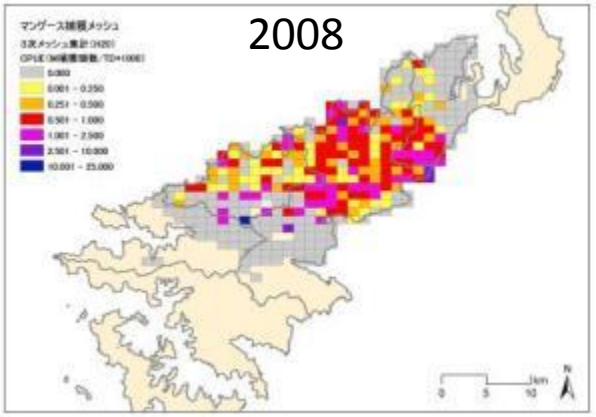


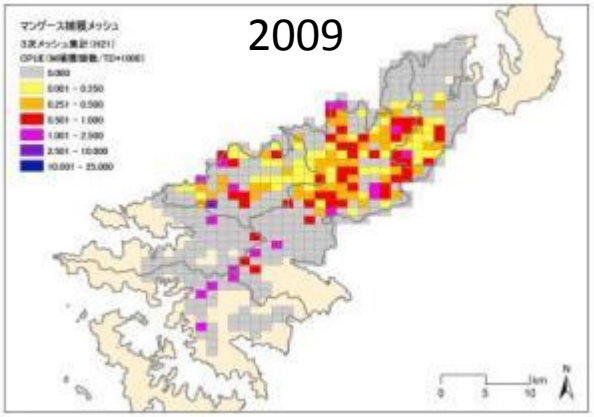


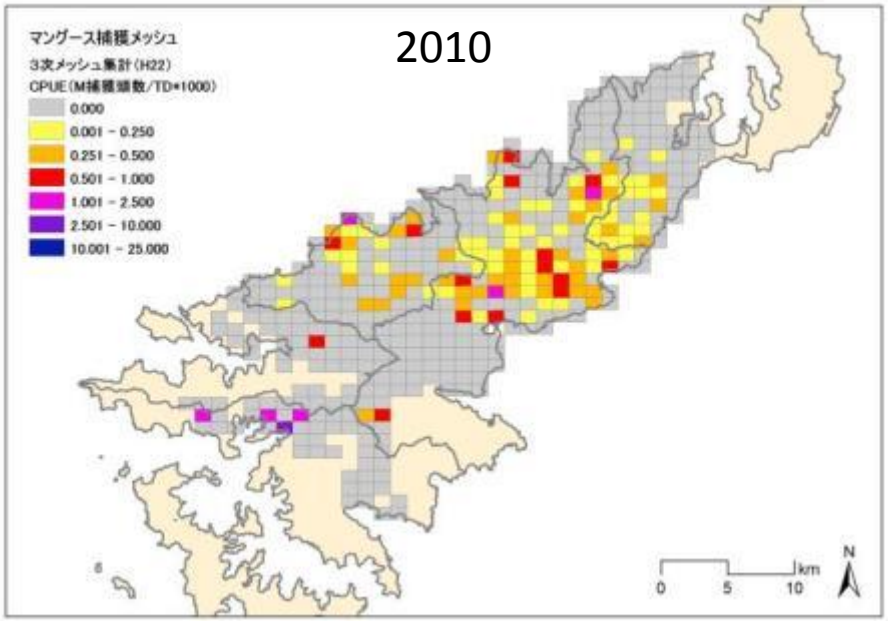


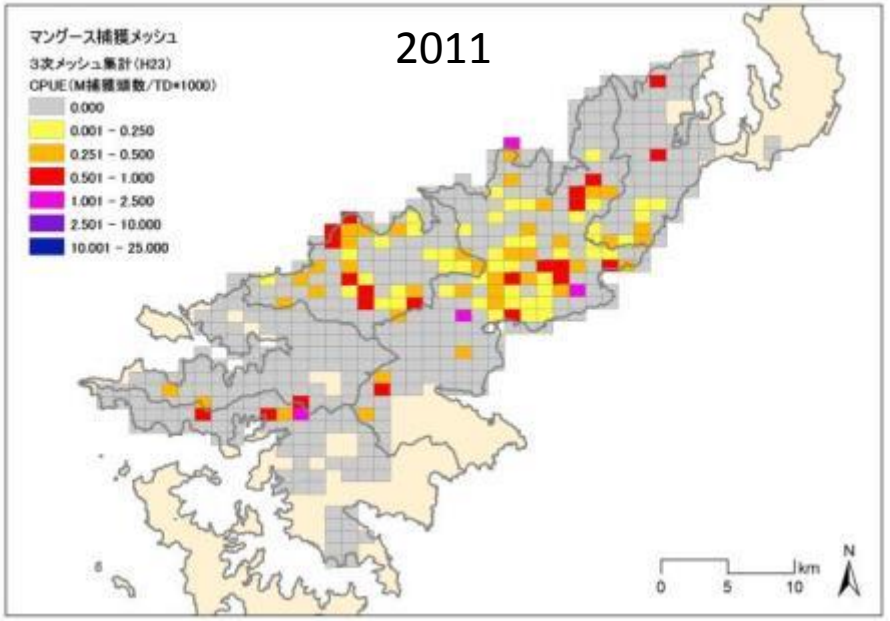


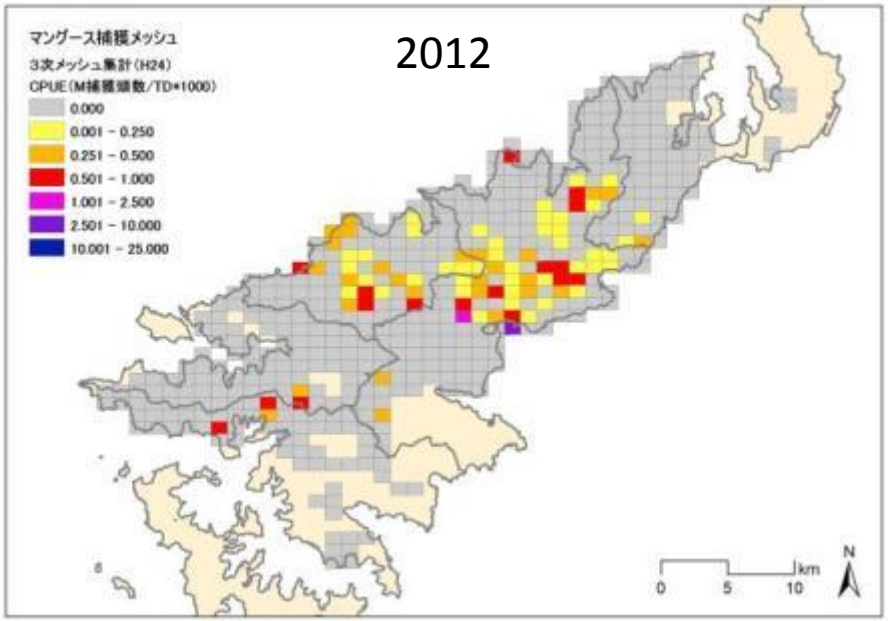


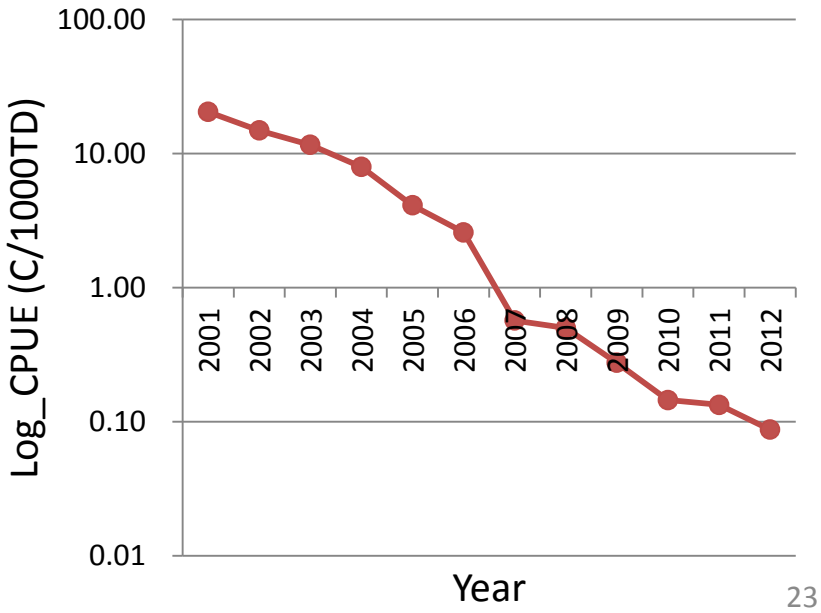





マングース捕獲メッシュ
3次メッシュ集計(H22)
CPUE(M捕獲頭数/TD*1000)
0.000
0.001 - 0.250
0.251 - 0.500
0.501 - 1.000
1.001 - 2.500
2.501 - 10.000
10.001 - 25.000
2010
0
5
10
km
N

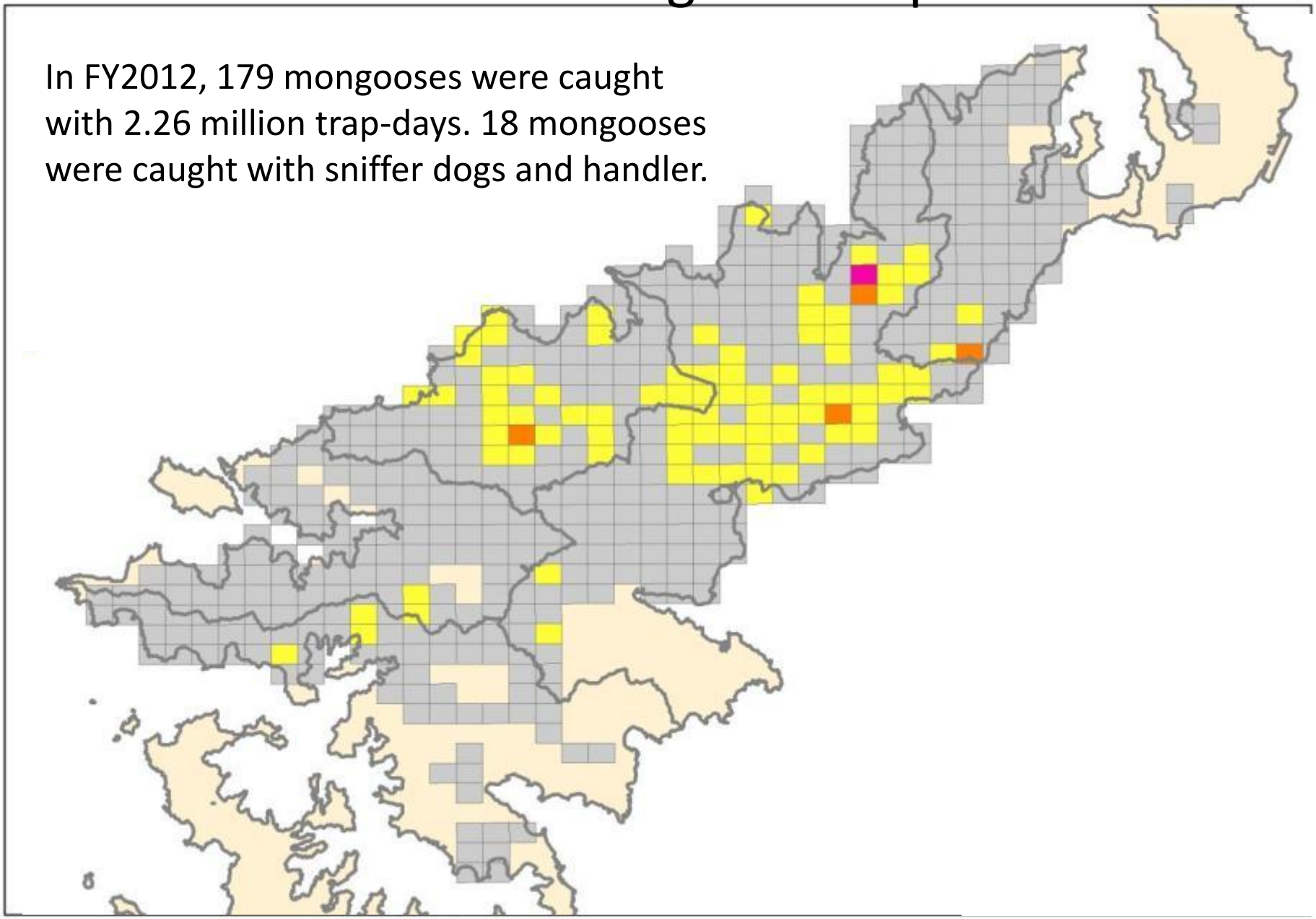

マングース捕獲メッシュ
3次メッシュ集計(H23)
CPUE(M捕獲頭数/TD*1000)
0.000
0.001 - 0.250
0.251 - 0.500
0.501 - 1.000
1.001 - 2.500
2.501 - 10.000
10.001 - 25.000
2011
0
5
10
km
N


マングース捕獲メッシュ
3次メッシュ集計(H24)
CPUE(M捕獲頭数/TD*1000)
0.000
0.001 - 0.250
0.251 - 0.500
0.501 - 1.000
1.001 - 2.500
2.501 - 10.000
10.001 - 25.000
2012
0
5
10
km
N

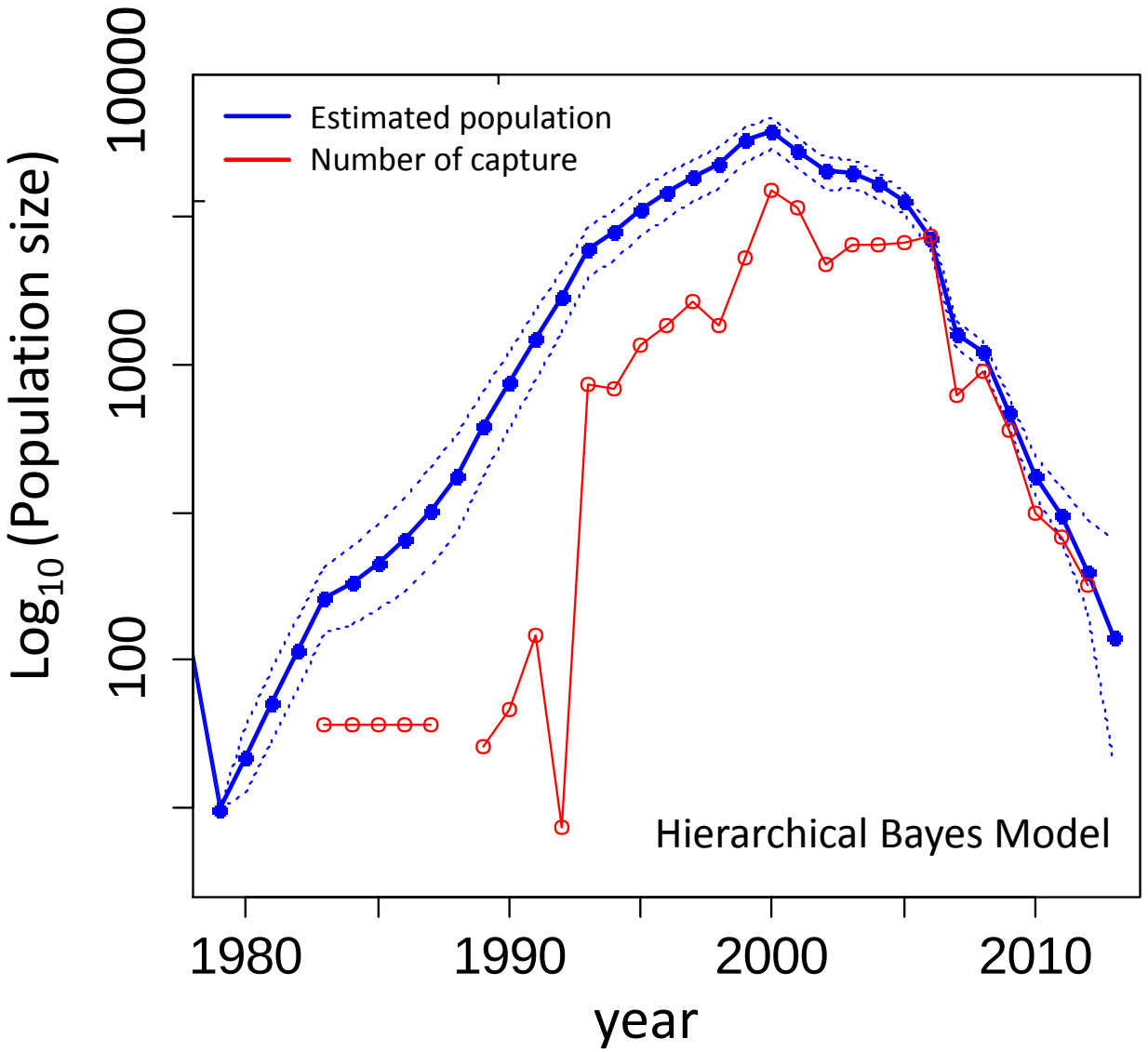

100.00
10.00
1.00
0.10
0.01
Log_CPUE (C/1000TD)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year

FY2012: 197 mongooses captured

In FY2012, 179 mongooses were caught with 2.26 million trap-days. 18 mongooses were caught with sniffer dogs and handler.



Abundance dynamics of mongooses



Recovery of native species 1

Fukasawa et al., 2013a
Proc. R. Soc. B

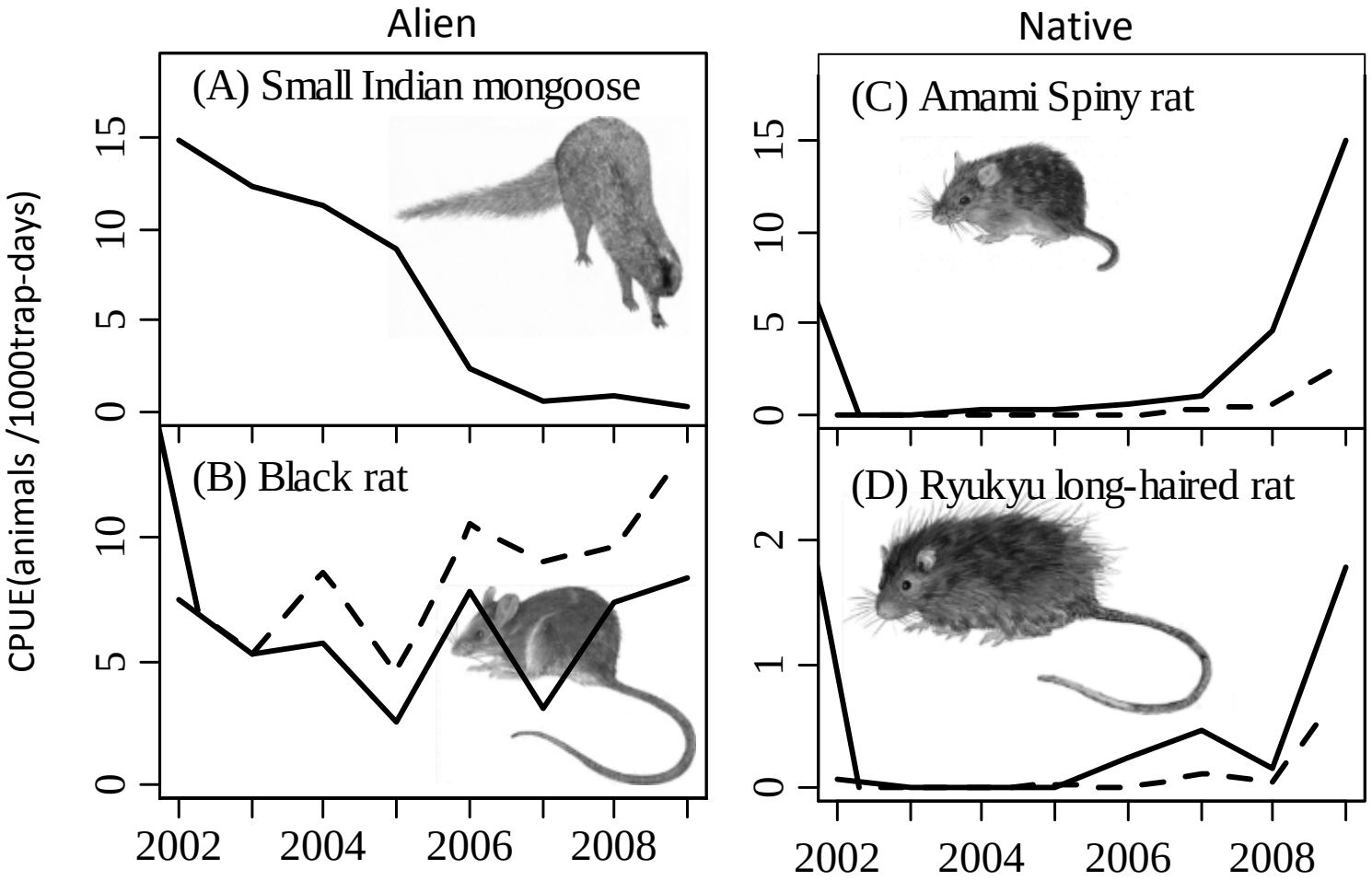


Figure 2. Temporal changes in catch per unit effort . For the rat species, the solid and dashed lines indicate the areas of mild (habitat alteration index, HAI<0) and intensive (HAI >0) habitat alteration, respectively.

Recovery of native species 2

Watari et al., 2013
Ecology and Evolution

Scientists surveyed the population densities along logging road of four endangered species threatened by the mongoose.

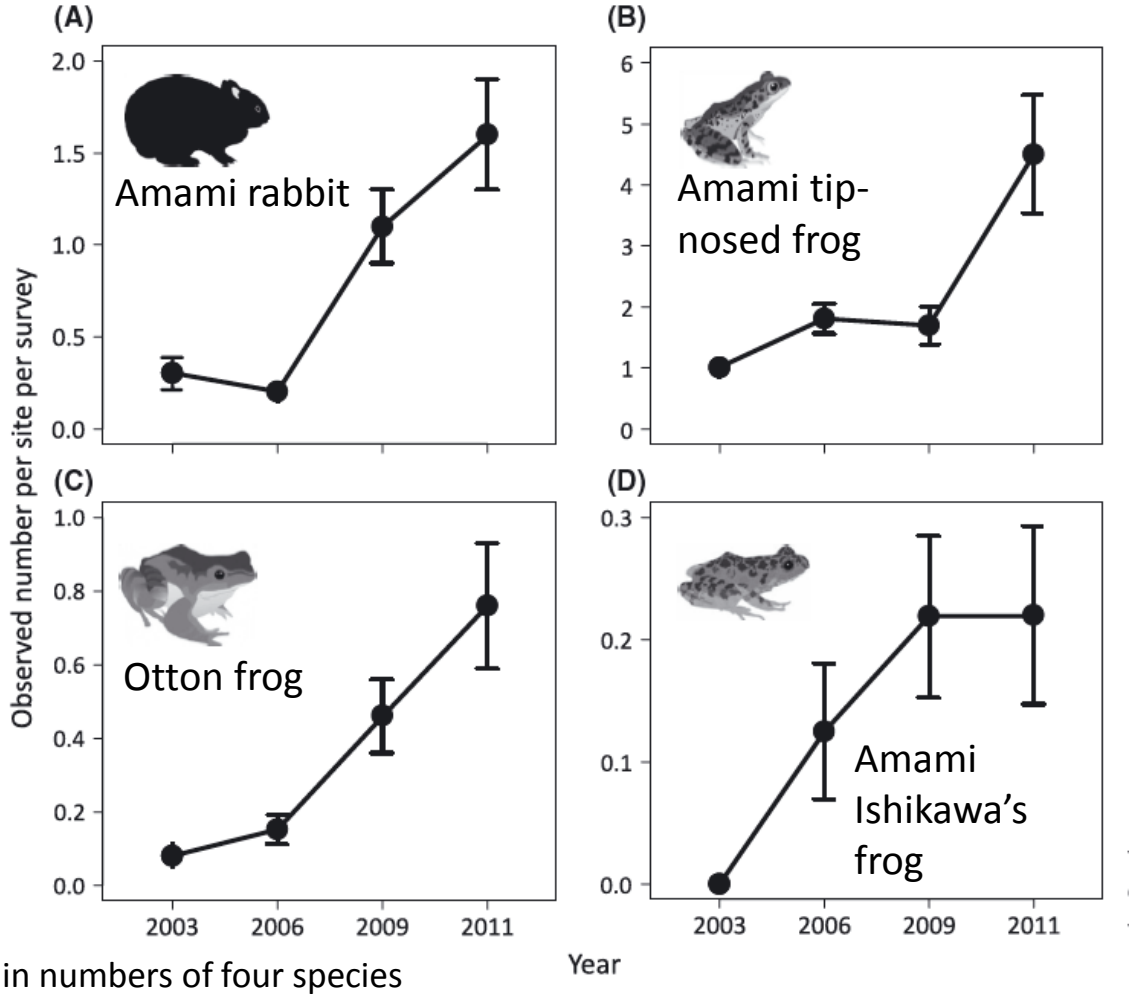
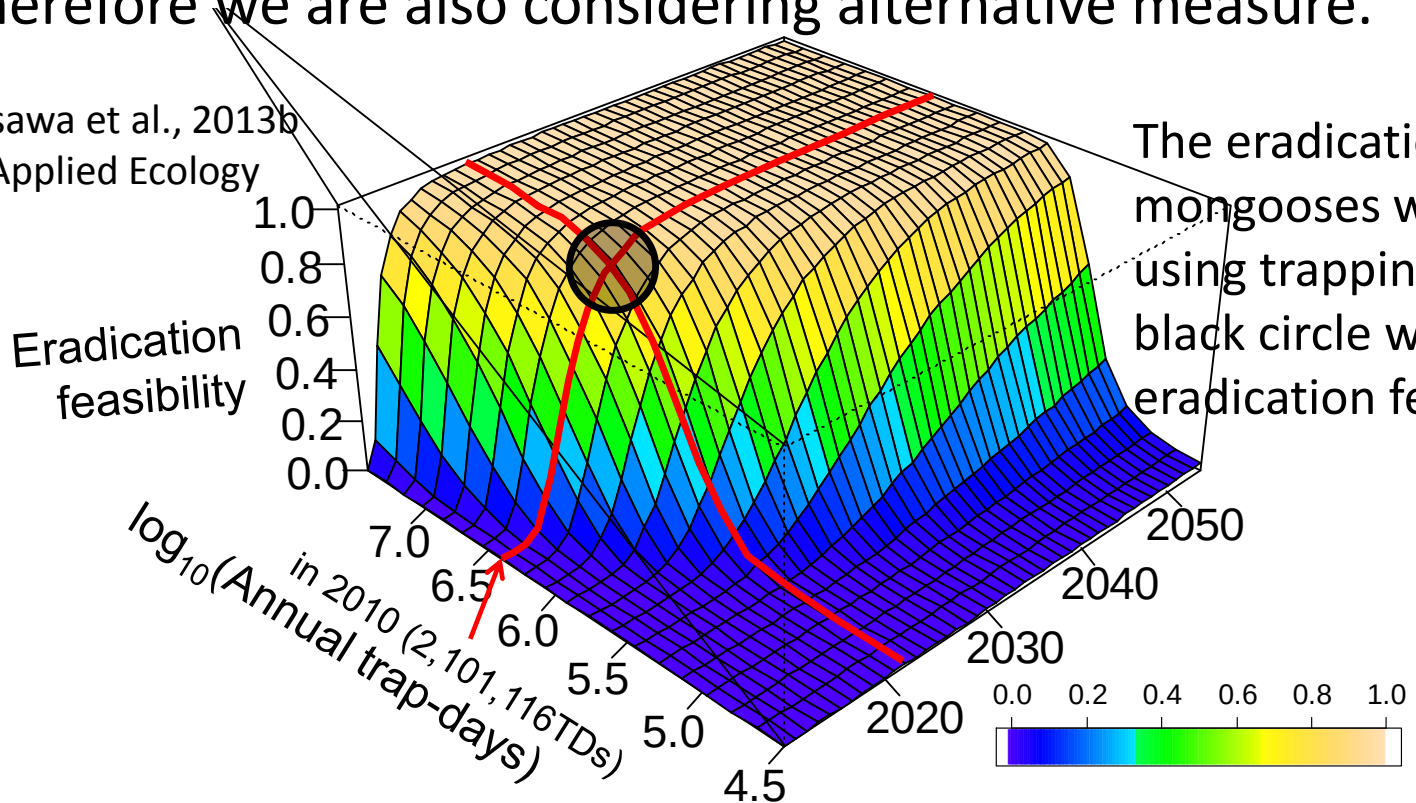


Figure 3. Temporal changes in numbers of four species observed per site per survey (mean SE).

Probability of eradication success

- This simulation shows the current capture efforts of 2010 is the most cost-effective way to eradicate mongooses in this island.
  The eradication success might be feasible if eradication action same capture efforts of 2010 is continued over the next decade.
- However, we think that the most difficult point of eradication of mongooses is one final push (Trapping final 10 mongooses).
  Therefore we are also considering alternative measure.

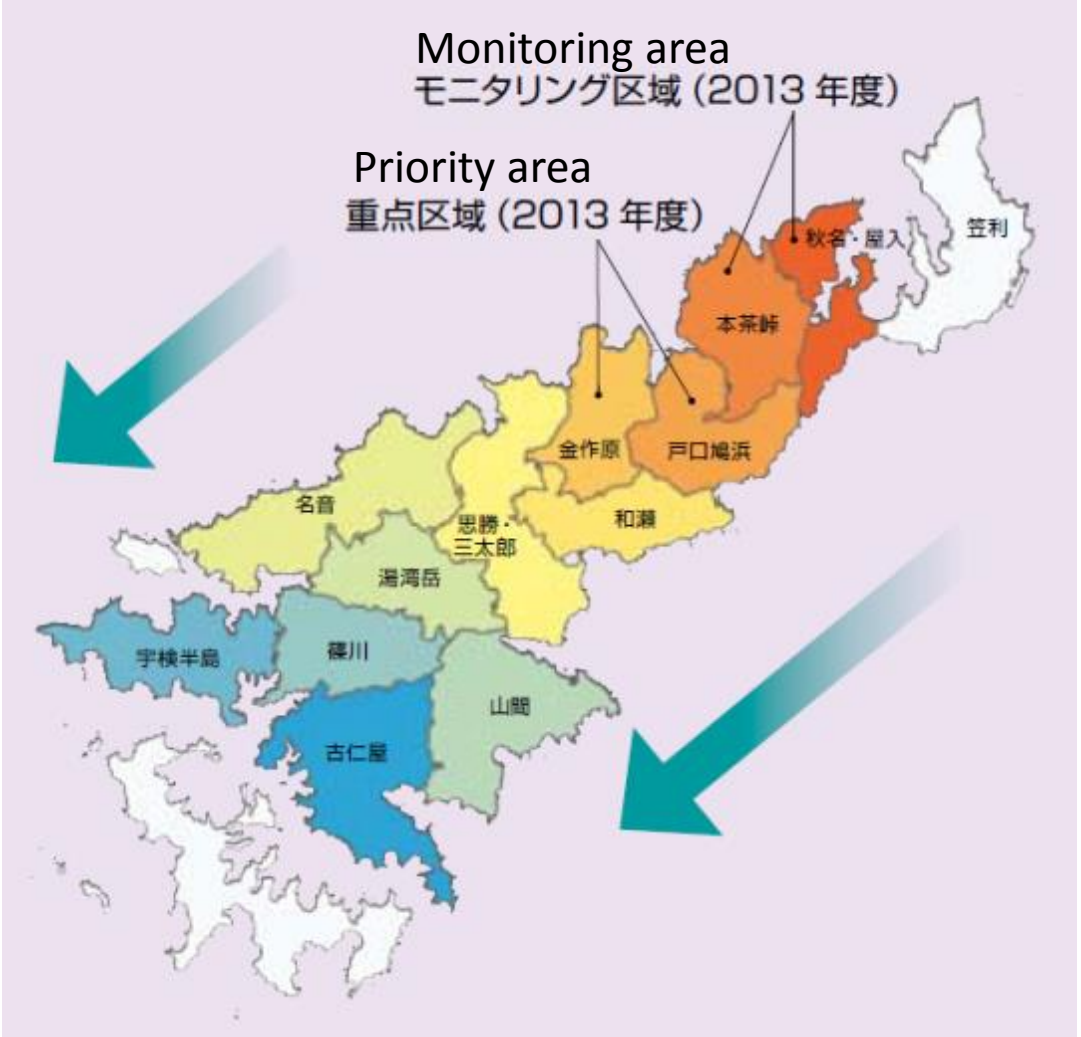
Fukasawa et al., 2013b
J. Applied Ecology



The eradication feasibility of mongooses was estimated using trapping data. (see black circle which indicate eradication feasibility.)

Eradication action plan by 2022

- New ten year mongoose eradication plan was settled on from FY2013 to 2022.
- The challenges are to eradicate small number of mongooses scattered in a large area, and to ensure that no mongoose survives in every area, with using sniffer dogs, camera traps and hair traps.



http://kyushu.env.go.jp/naha/wildlife/data/gairai/boujyo/130425b.html

Education & Awareness

Pamphlet for the mongoose eradication measure

http://kyushu.env.go.jp/naha/wildlife/data/gairai/boujyo/131017a.pdf

Thank you for your attention