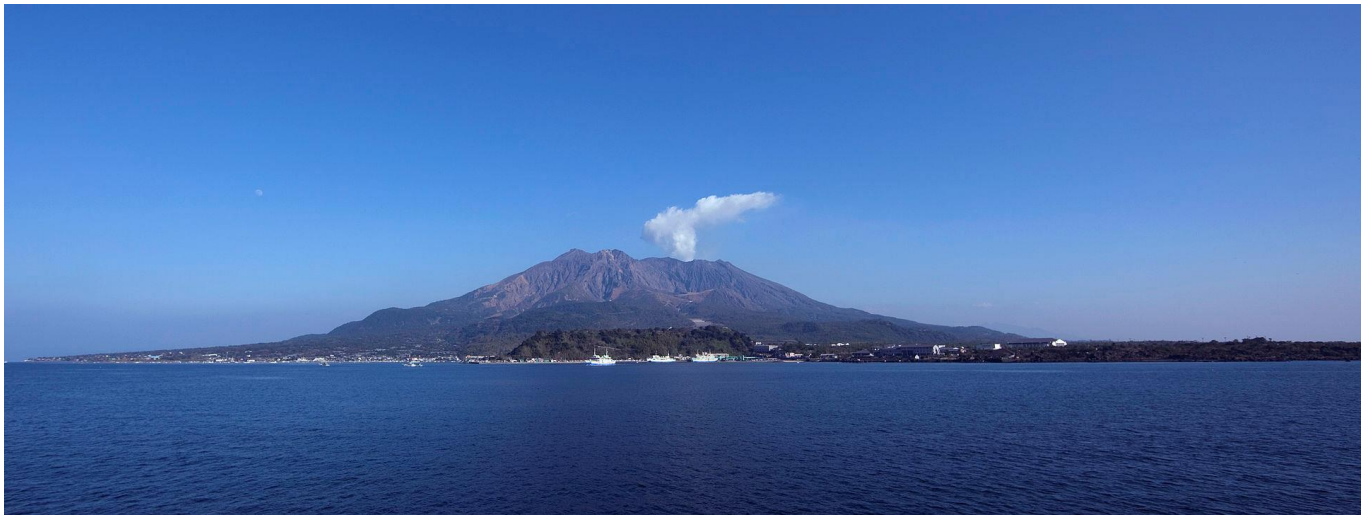
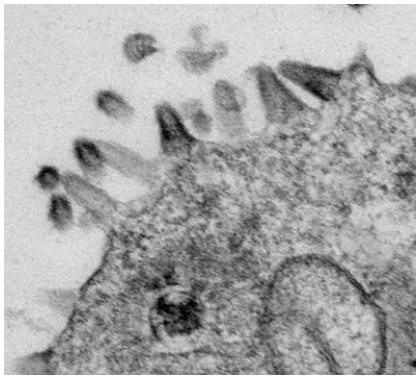
Ruminant arbovirus surveillance in Japan





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Ruminant arbovirus infections impacting on livestock industry in Japan

Teratogenic disease	Encephalomyelitis	Acute febrile illness
		
Akabane disease Aino virus infection Chuzan disease	Postnatal infection with Akabane virus	Ibaraki disease Bovine ephemeral fever
Orthobunyavirus Akabane virus Aino virus Orbivirus Chuzan virus	Akabane virus (Specific genetic lineage)	Orbivirus Epizootic hemorrhagic virus (EHDV)-2: strain Ibaraki virus Ephemerovirus Bovine ephemeral fever virus (BEFV)
Frequent (Akabane) Sporadic (Aino, Chuzan)	Recently increased	Sporadic (in southern Japan)
Vector *Culicoides* biting midges	Vector *Culicoides* biting midges	Vector *Culicoides* biting midges Mosquitoes (BEFV)?

Ruminant arbovirus surveillance in Japan

Passive surveillance

- ✓ Investigation of abortion, congenital malformations and clinical signs

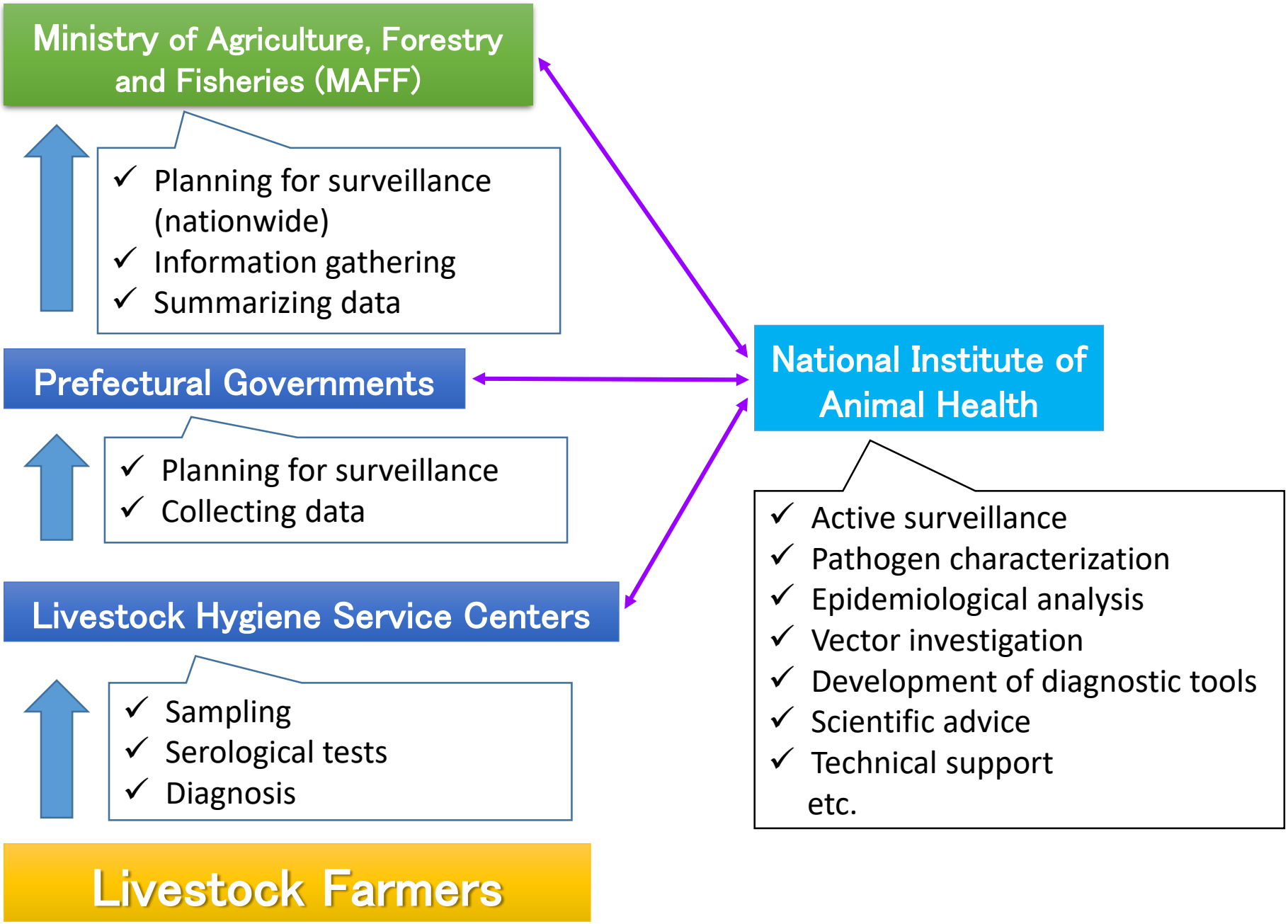
Active surveillance

- ✓ Nationwide sentinel surveillance for pathogens of notifiable diseases

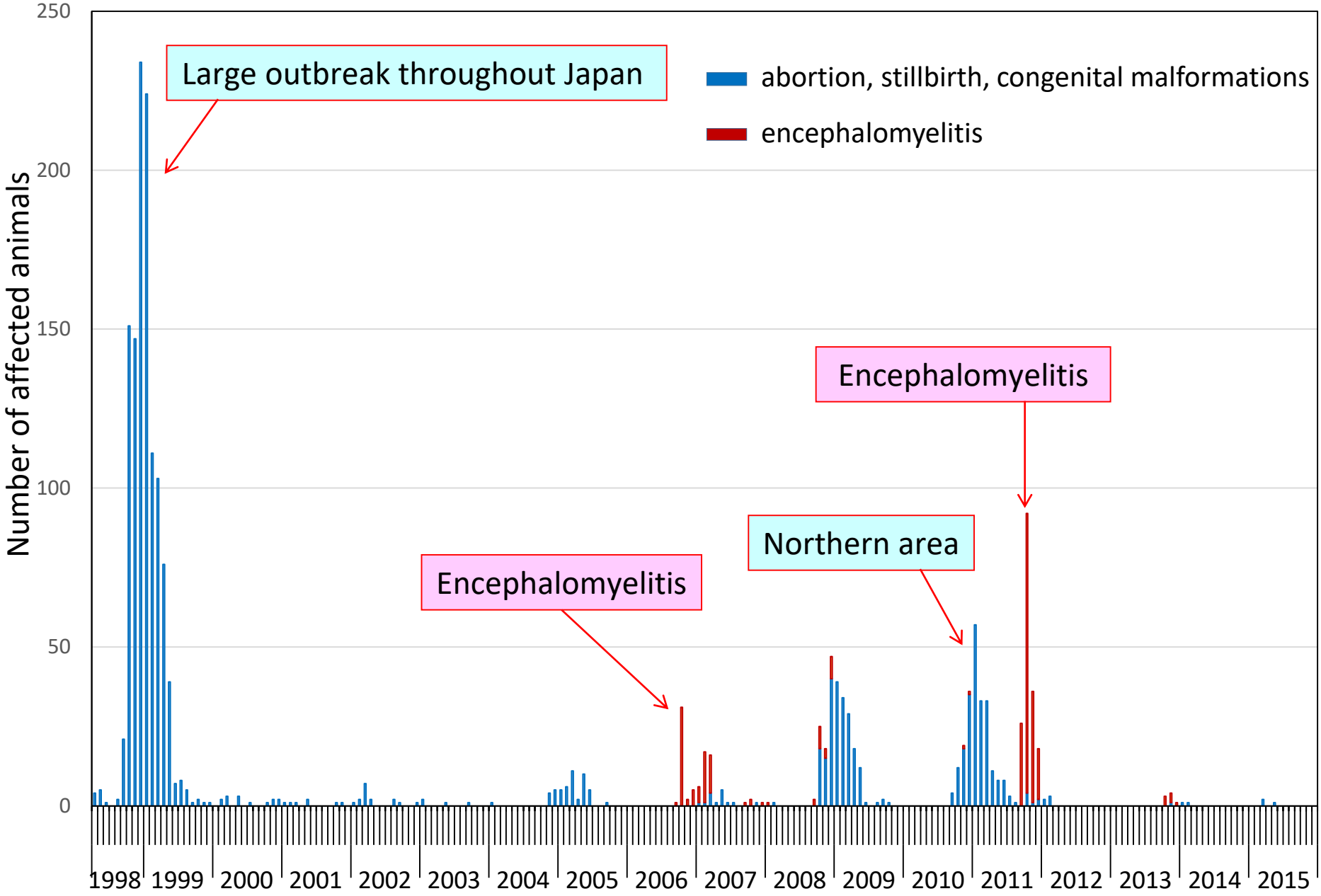
- ✓ Risk-based surveillance
  - Serological surveillance and virus detection in the southern region

- ✓ Vector surveillance (optional)
  - Investigation of vector distribution and structure
  - Virus detection from collected vectors

Structure of Arbovirus Surveillance System in Japan

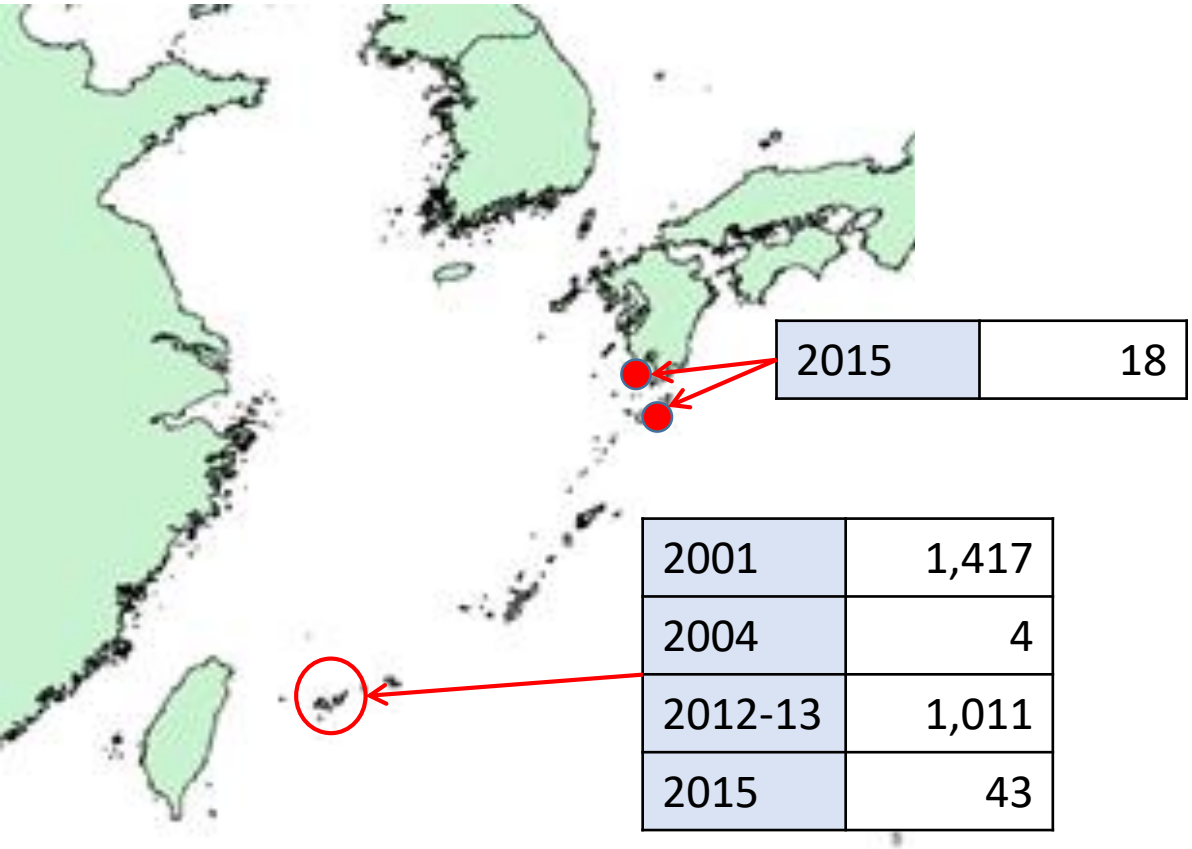


Confirmed cases of Akabane disease in Japan between 1998 and 2015



Bovine ephemeral fever

- ✓ Periodic epizootics have been identified in subtropical islands in the western bordering region.
- ✓ Between 1993 and 2014, no occurrence of bovine ephemeral fever was recorded in mainland Japan. But it reemerged in 2015.



2015	18

2001	1,417
2004	4
2012-13	1,011
2015	43

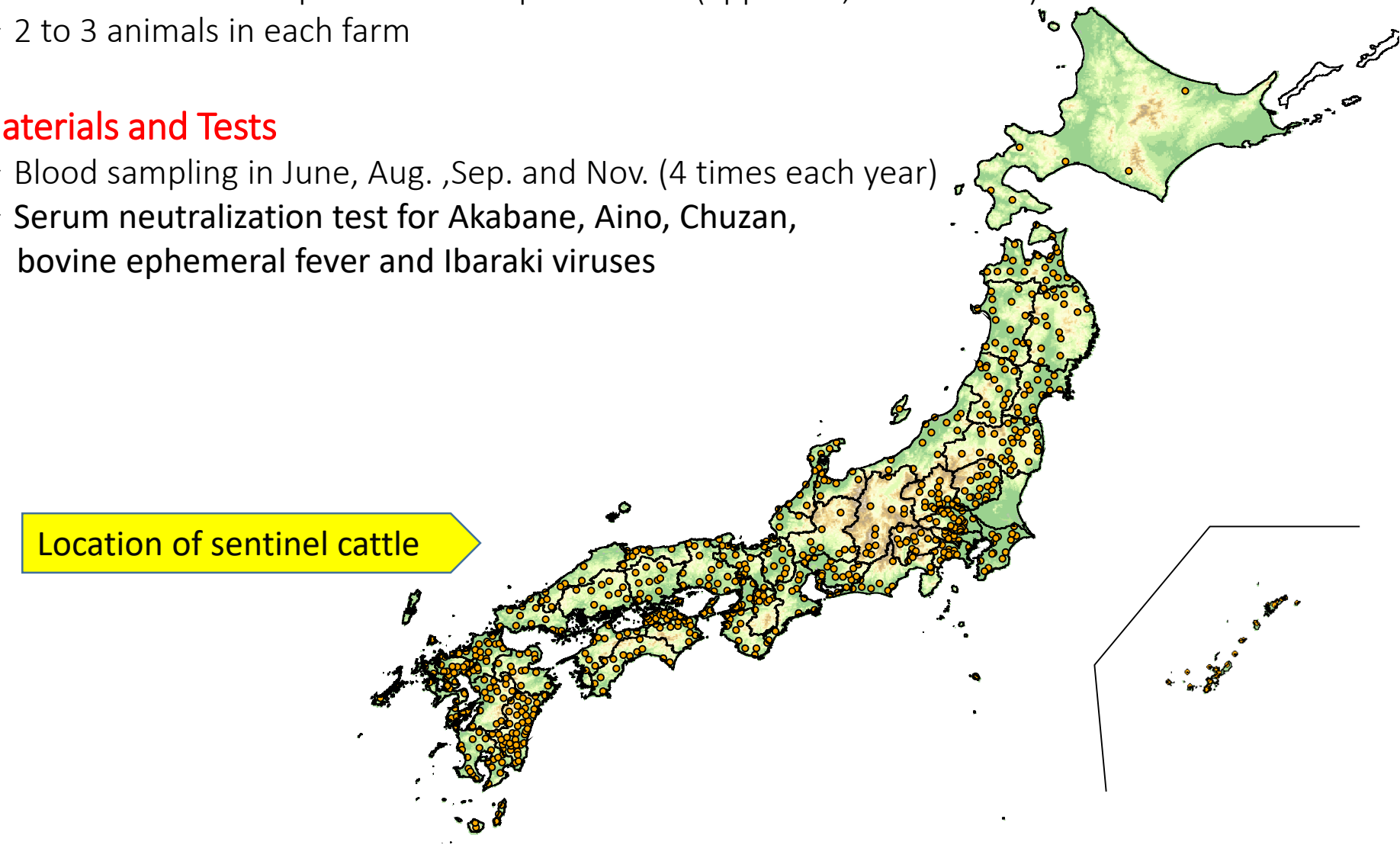
Nationwide sentinel surveillance for arbovirus infections

Sentinel cattle

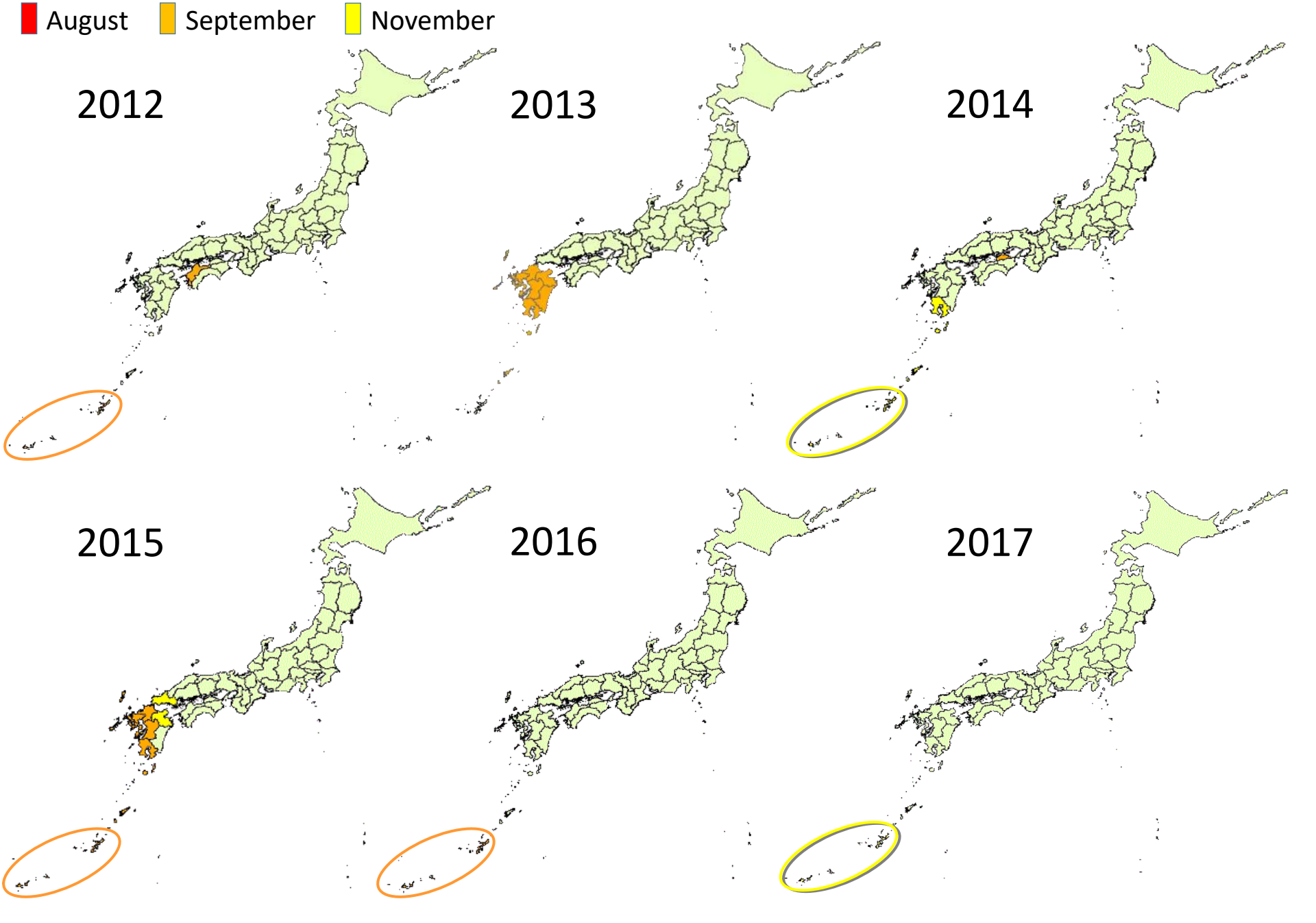
- Calves, not experience previous summer
- At least 50 animals per each of 47 prefectures (approx. 3,000 animals)
- 2 to 3 animals in each farm

Materials and Tests

- Blood sampling in June, Aug. ,Sep. and Nov. (4 times each year)
- Serum neutralization test for Akabane, Aino, Chuzan, bovine ephemeral fever and Ibaraki viruses



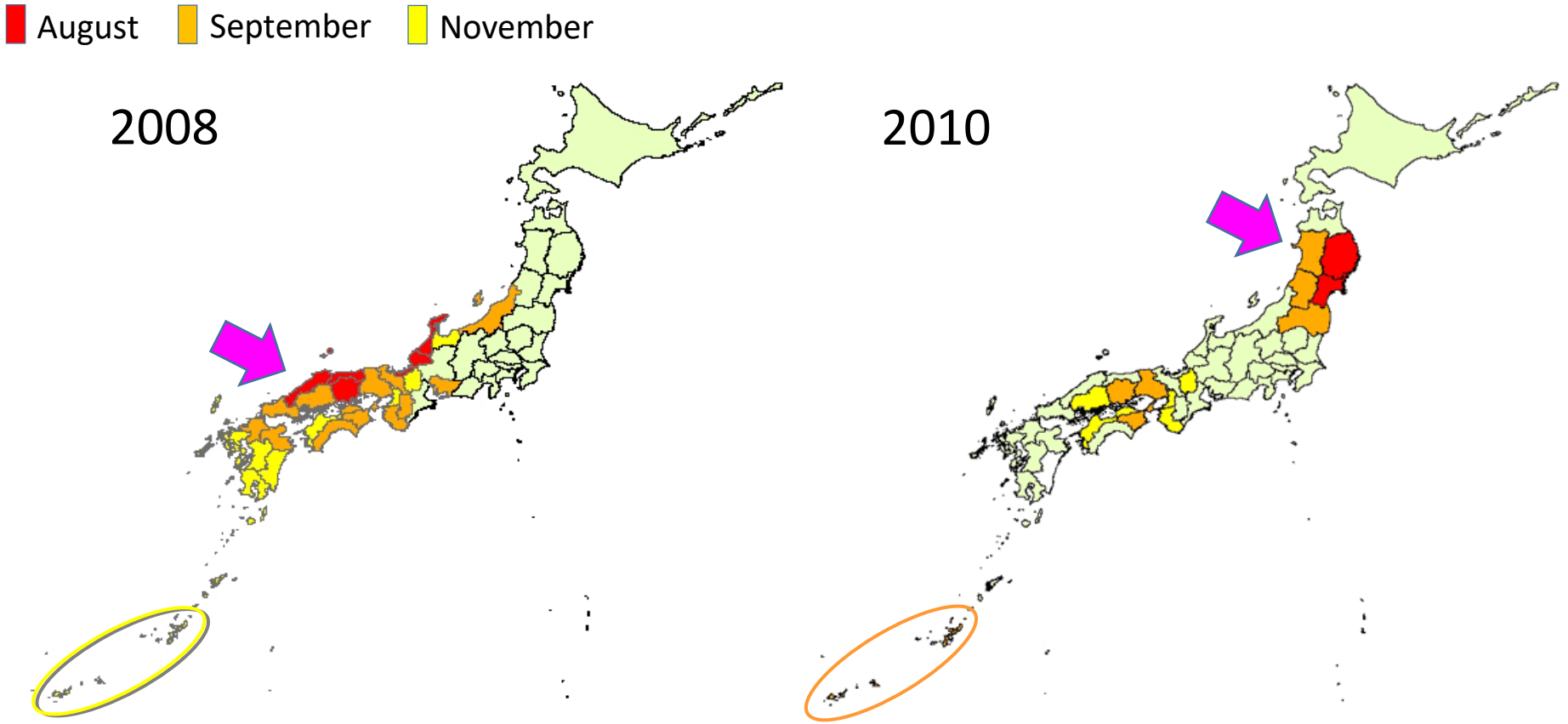
Sero-conversion to Akabane virus in Japan in 2012-17



Sero-conversion to Akabane virus in Japan in 2008 and 2010

- ✓ In 2008, the seroconversion was first detected in the southwest of Honshu.
- ✓ In 2010, the incursion initially occurred in the northeast of Honshu.

Irregular epizootic patterns were sometimes observed in recent years.



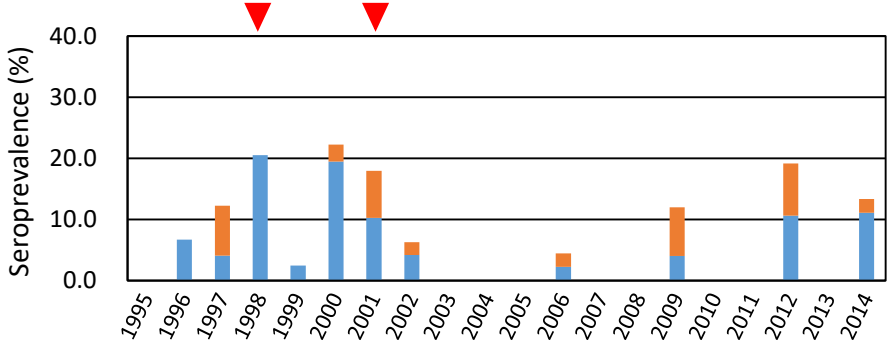
Risk-based surveillance

Virus isolation at Kagoshima from 1980s
Source: *Culicoides* and sentinel cattle
Sampling frequency: twice per week

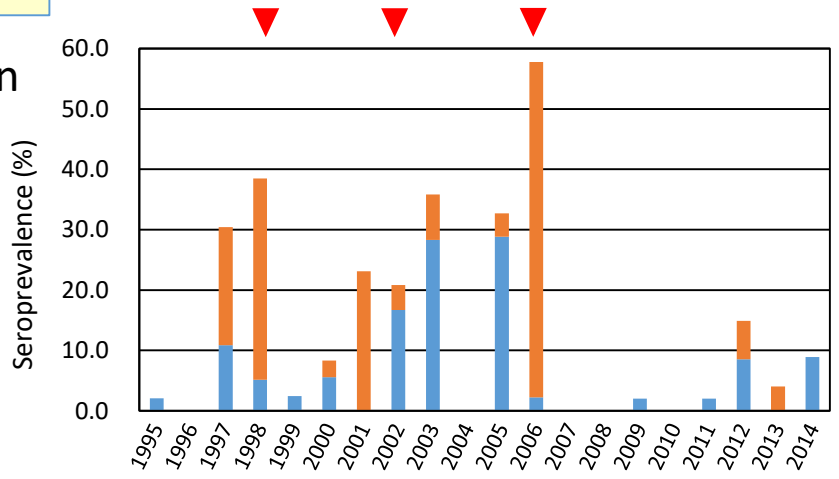
Year	Virus
2000	Akabane
2001	Akabane, D'Aguilar, BTV-16
2002	Aino, Shamonda
2003	Akabane
2004	
2005	
2006	Akabane, Peaton
2007	
2008	Akabane, Sathuperi, BTV-16
2009	Bunyip Creek
2010	Peaton
2011	
2012	
2013	Akabane, D'Aguilar, EHDV-1
2014	
2015	Shamonda
2016	Peaton, EHDV-7

Serological monitoring at Yaeyama Islands from 1990s
Source: Sentinel cattle (approx. 50 animals)
Sampling frequency: once per year

Akabane

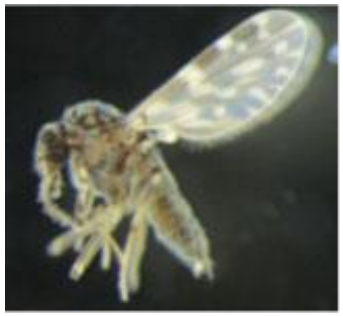


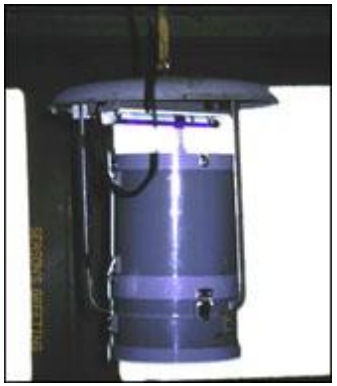
Chuzan



Vector surveillance

- ✓ *Culicoides* collection and virus isolation have been conducted at Kagoshima for over 30 years.
- ✓ Distribution and structure of *Culicoides* have been investigated through Japan.





Isolation of arboviruses from *Culicoides* biting midges between 1985-2016

	C. oxystoma	*C. punctatus*	*C. jacobsoni*	*C. tainanus*	*C. lungchiensis*	*C. sumatrae*
Akabane	19					
Aino	8	2				
Peaton			1			
Sathuperi	1					
Shamonda				1		
Chuzan	2					
D'Aguilar	28					1
Bunyip Creek	4					
EHDV-1		1				
Ibaraki	24	1			2	
EHDV-7	8	2				
BTV 16				1		
Total	94	6	1	2	2	1

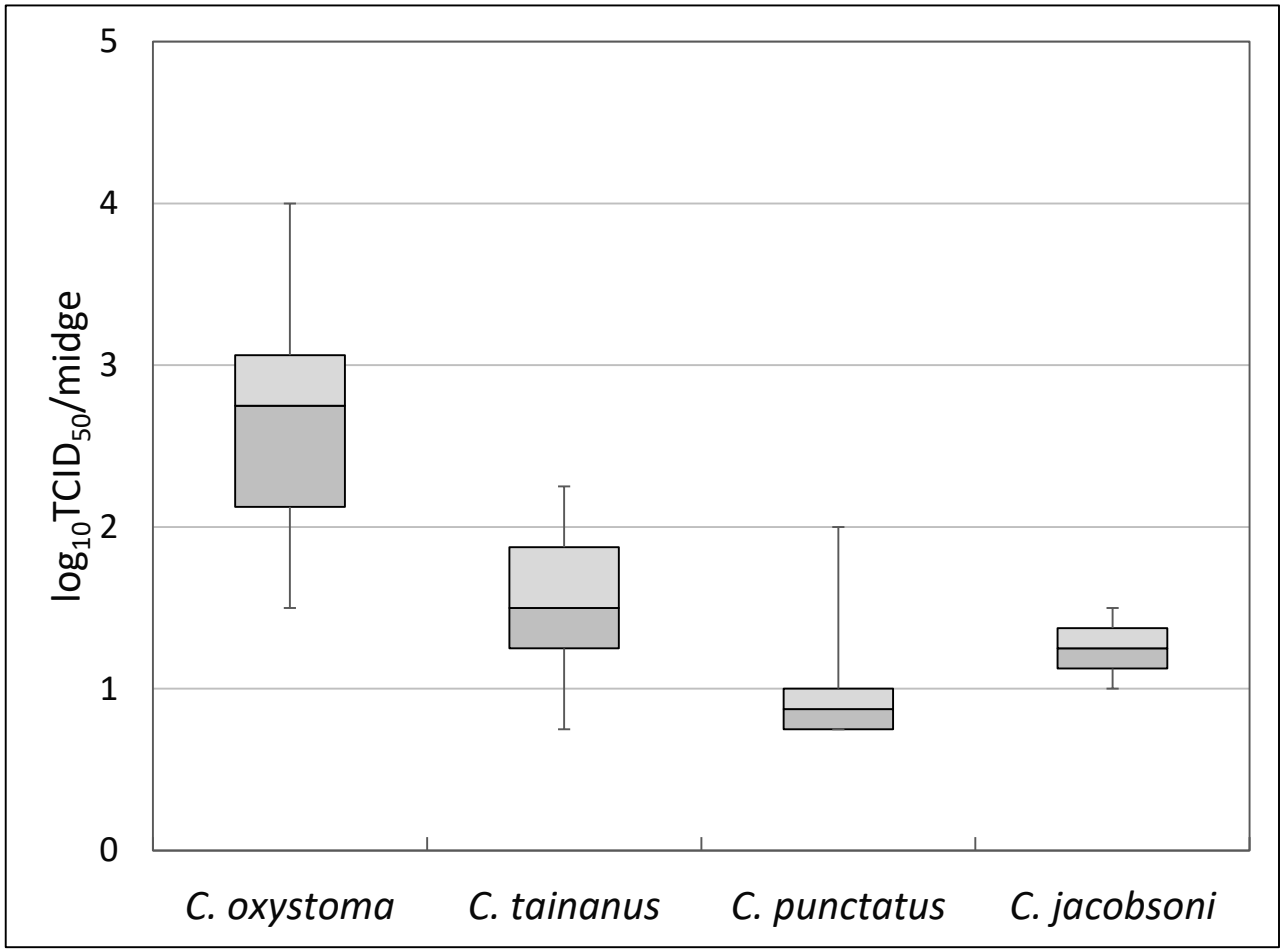
Oral susceptibility of *Culicoides* biting midges to Akabane virus

Culicoides oxystoma

Culicoides tainanus

Culicoides punctatus

Viral titer in experimentally infected midges at the day 9-10 p.i.



- ✓ The high susceptibility of *C. oxystoma*, *C. tainanus* and C. *punctatus* was observed.
- ✓ The viral titers in infected *C. oxystoma* were likely higher than those in other infected midges.

Sero-conversion to Akabane virus in Japan in 2008 and 2010

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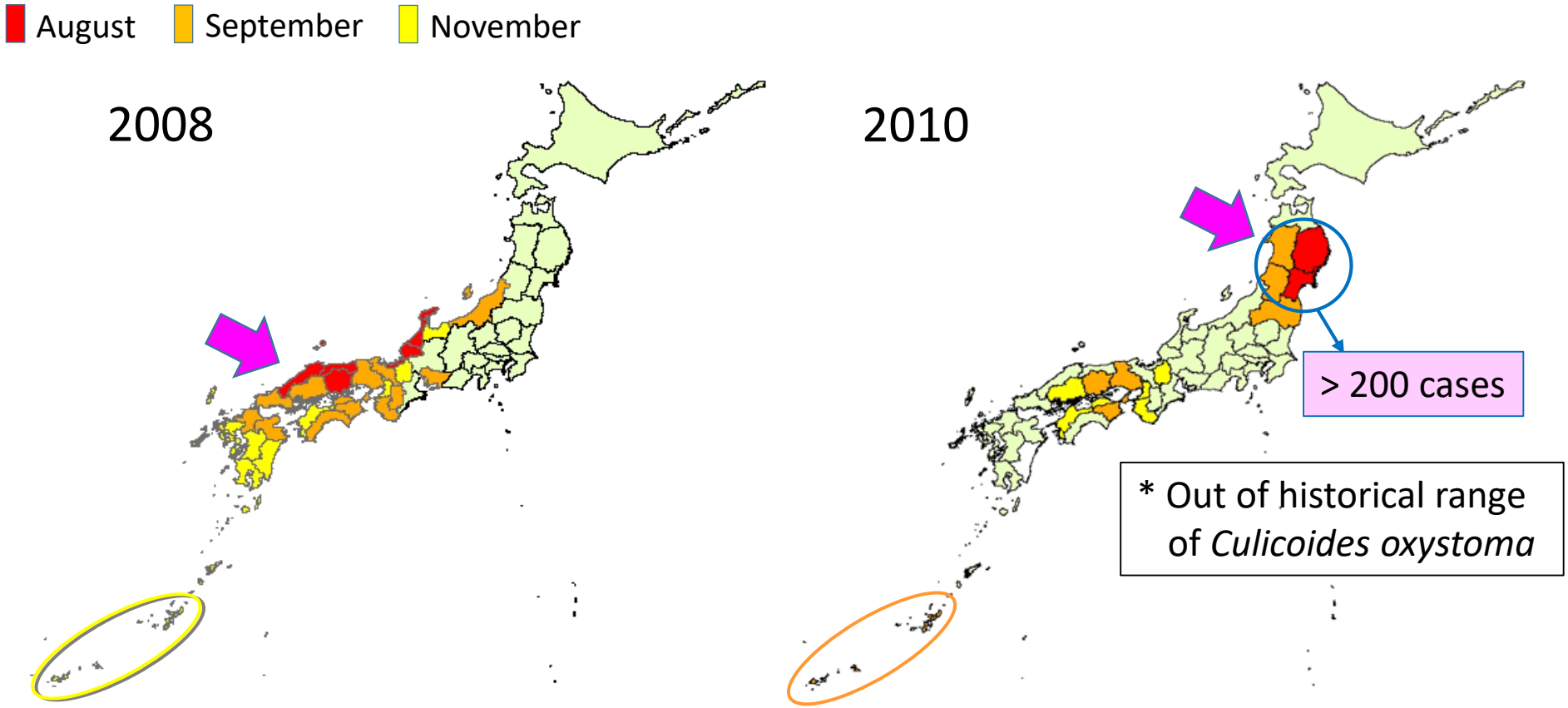
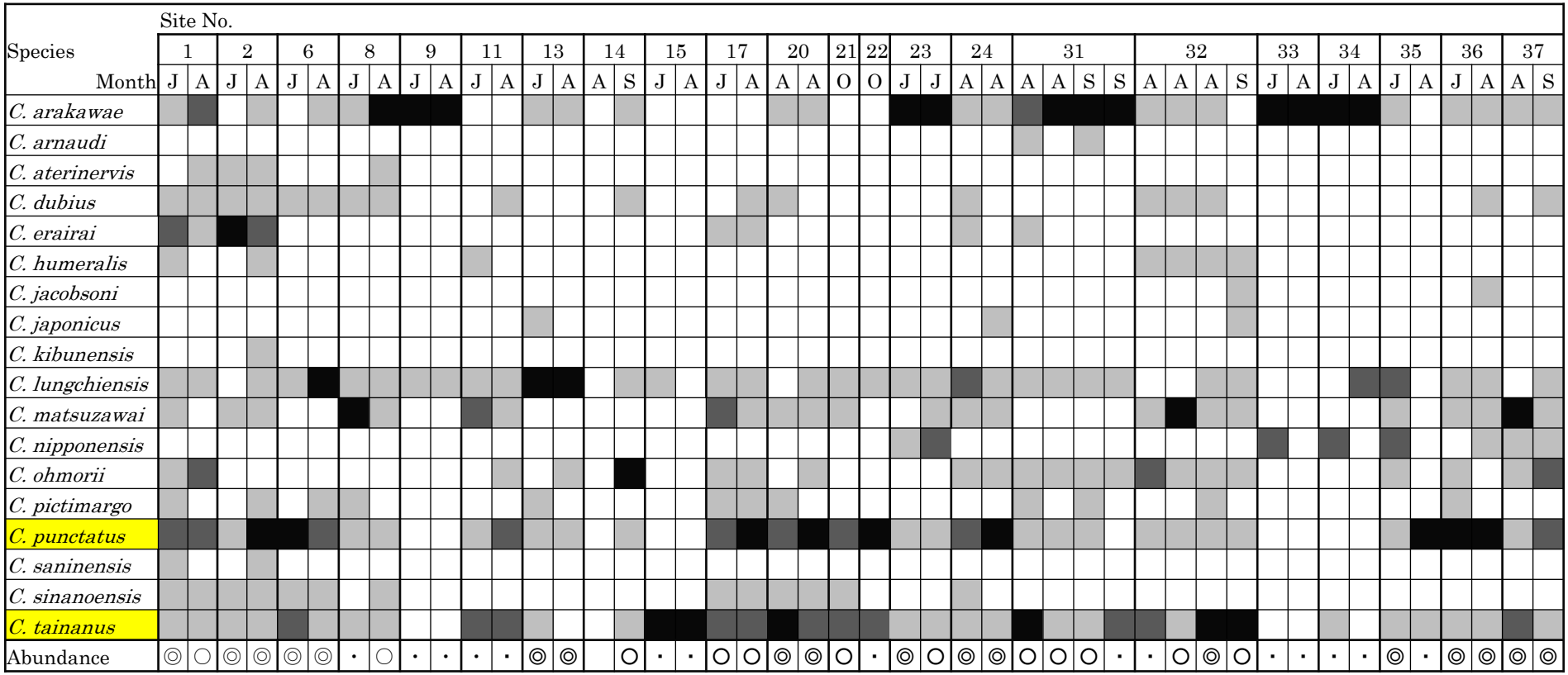
Irregular epizootic patterns were sometimes observed in recent years.



Vector surveillance in northern Japan in 2010 summer and autumn



Proportion of each species: ■ >50% ■ 20-50% ■ <20% □ Not collected

Midge abundance: ◎ > 500 ○ 100-500 ・ 1-100

- **No *Culicoides oxystoma* was collected at 37 trap sites in Tohoku between July and October in 2009 and 2010.**
- ***C. tainanus* and *C. punctatus* were dominant or subdominant at many trap sites.**

Association of other arboviruses with cattle diseases

Congenital malformations of calves

Orthobunyavirus

- ✓ Peaton virus (1–12 cases/year),
- ✓ Shamonda virus (< 50 cases in 2015-16)
- ✓ Sathuperi virus (rare)

Orbivirus

- ✓D'Aguilar virus (Sporadic in 2001-2)

Suspected case of Shamonda virus infection

Cattle diseases suspected to be caused by EHDV

- ✓ EHDV-6: Ibaraki disease like symptom (46 cases in 2015)
- ✓ EHDV-7: abortion and stillbirth (approx. 1,000 cases in 1997)

Little is known about their circulation, pathogenesis and impact on livestock industries.

What is next?

- ✓ Accurate estimation of arbovirus risk in each part of Japan
- ✓ Countermeasure for emerging and reemerging arboviruses
- ✓ Promotion of vector investigation
  competence for arbovirus transmission, ecology, effective control measure……
- ✓ Development of more sensitive and early warning surveillance systems
- ✓ Information sharing through Asia and Oceania

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