

Surveillance of ticks as SFTS vectors in RO Korea

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VECTOR BORNE DISEASES

Group	Disease	Vectors
2(1)	- Japanese encephalitis	- <i>Culex tritaeniorhynchus</i>
3(6)	- Malaria	- <i>Anopheles</i> spp.
	- Scrub Typhus	- Chigger mites
	- Leptospirosis/Hemorrhagic fever with renal syndrome	- Rodents
	- Epidemic typhus	- Body louse
	- Murine typhus	- Mouse flea, rodents
4(12)	- Dengue fever	- <i>Aedes</i> spp.
	- Yellow fever/Chikungunya fever/Zika	
	- West Nile fever	- <i>Culex</i> spp.
	- Tularemia/Q fever/Lyme borreliosis/ - Tick-borne encephalitis/Severe fever with thrombocytopenia syndrome	- Ticks
	- Plague/Melioidosis	- Rodents, Flea
Designed(1)	- Foreign imported parasitic diseases	- <i>Aedes</i> spp. tsetse fly

DOMESTIC TICKS

- **Classification**

- Kingdom Animal / Phylum Arthropoda
- Class Arachnida / Order Acari
- Suborder Metastigmata
- Family Ixodidae, Argasidae

- **2 families, 7 genus, 31 species**

- **Pathogens**

- **Severe Fever with Trombocytopenia Syndrome Virus**
- *Borrelia burgdorferi*
- Tick Borne Encephalitis Virus

- **Major species**

- *Haemaphysalis longicornis* – asian tick
- *Haemaphysalis flava*
- *Ixodes nipponensis*
- *Amblyomma testudinarium*
- *Ixodes persulcatus*



Korean ticks and vector borne diseases

Tick borne encephalitis



H. longicornis



H. flava



I. nipponensis

Lyme borreliosis



I. persulcatus



I. granulatus



A. testudinarium

SFTS

Anaplasmosis

Spotted fever

Q fever

Ehrlichiosis

Babesiosis

GENERAL CHARACTERISTICS 1

- Distribution and size
 - Family Ixodidae
 - Distributed world widely
 - 850 species (including Argasidae)
 - Unfed tick: 1-9 mm
 - Blood fed female tick: approx. **2~3 cm**



GENERAL CHARACTERISTICS 2

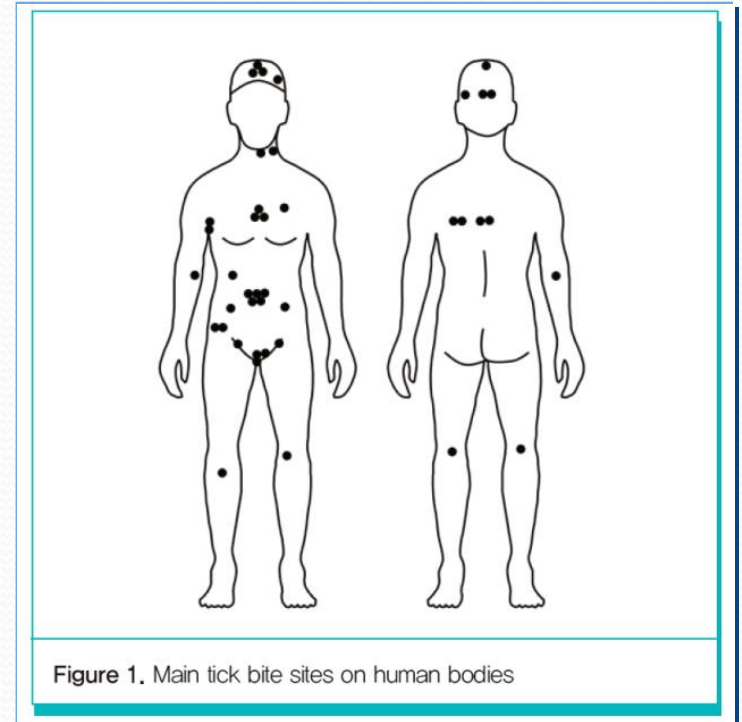
- Searching host

- Host: many animals from small to large mammals and birds. rodents, cattle, horses, pigs, dogs, cats, birds, humans.
- Searching activity: waiting on soils and leafs and attaching host animals
- **Sensing: CO₂, scent, movement, body temperature, intensity of lights**



GENERAL CHARACTERISTICS 3

- Blood feeding
 - Feeding part: all parts of body mainly back, head, chest, groin, axilla
 - Feeding period:
 - larva 3~7 days,
 - nymph 7~10 days,
 - adult **1~4 weeks**
 - Lyme borreliosis:
 - to transfer pathogen,
 - nymph should feed for **36~48 hr**



LIFE CYCLE OF SFTS VECTORS

- Three host ticks

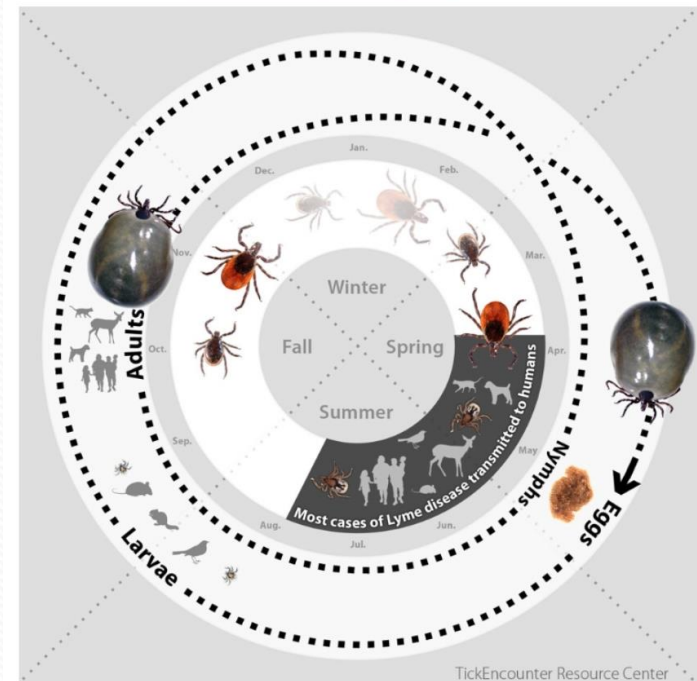
- Larva, nymph, adult all stage feed blood from hosts
- Almost ticks except Genus *Boophilus spp.* (single host tick)
- One life cycle: **2~3 yrs in the temperate regions**

- *Ixodes scapularis*

- 1st yr
 - adult -> egg -> larva -> hibernation
- 2nd yr
 - larva -> nymph -> adult -> hibernation

Life-cycle of *Ixodes scapularis* (a.k.a. blacklegged or deer tick)

Life-cycle of *Ixodes scapularis* (a.k.a. blacklegged or deer tick) in the northeast/mid-Atlantic/upper mid-western United States. **Larval deer ticks** are active in August and September but these ticks are pathogen-free. Ticks become infected with pathogens when larvae (or nymphs) take a blood meal from infectious animal hosts. Engorged larvae molt over winter and emerge in May as poppy-seed sized **nymphal deer ticks**. Please note that **most cases of Lyme disease are transmitted from May through July**, when nymphal-stage ticks are active. **Adult-stage deer ticks** become active in October and remain active throughout the winter whenever the ground is not frozen. Blood-engorged females survive the winter in the forest leaf litter and begin laying their 1,500 or more eggs around Memorial Day (late May). These eggs hatch in July, and the life-cycle starts again when **larvae** become active in August. [Download the print version of Life-cycle of Ixodes scapularis - 2.2 MB](#)



TickEncounter Resource Center

DEVELOPMENTAL STAGES

- Developmental stages
 - Fed female tick: 2,000~8,000 egg laying
 - Larva: 3 paired legs, blood feeding
 - Nymph: 4 paired legs, blood feeding
 - Adult: 4 paired legs, blood feeding

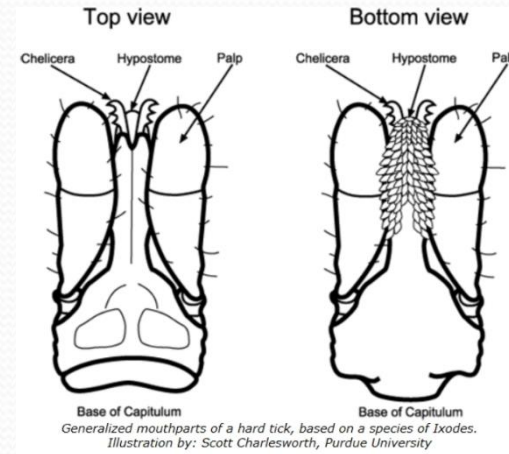


[*H. longicornis*, female adult, male adult, nymph, larva]

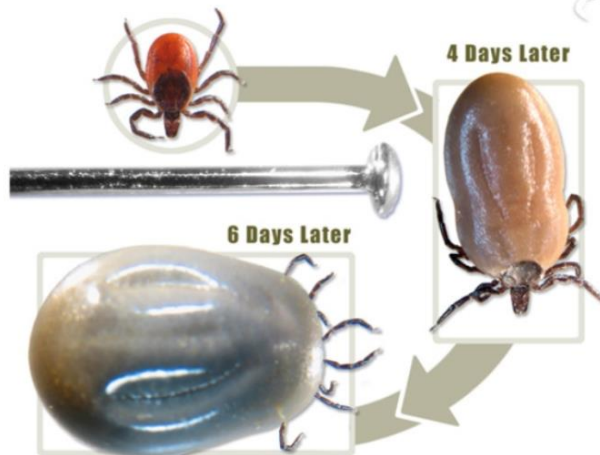


Blood feeding

- Mouth part (Capitulum)
 - Chelicera
 - Hypostome
 - Palp
- After blood feeding
 - Size 10-fold, weight 100-fold

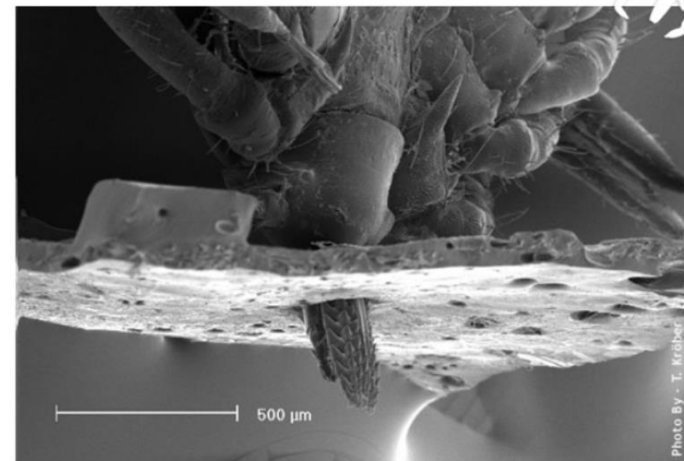


Tick **Bite**-ology



Ticks grow as they blood feed, increasing more than 10X in size and 100X in weight. That same tiny tick that first bit you transforms into a bloated monster!

Tick **Bite**-ology



Ticks cut a hole in the skin and insert their mouthpart (hypostome). This is the extent to how far they can penetrate.

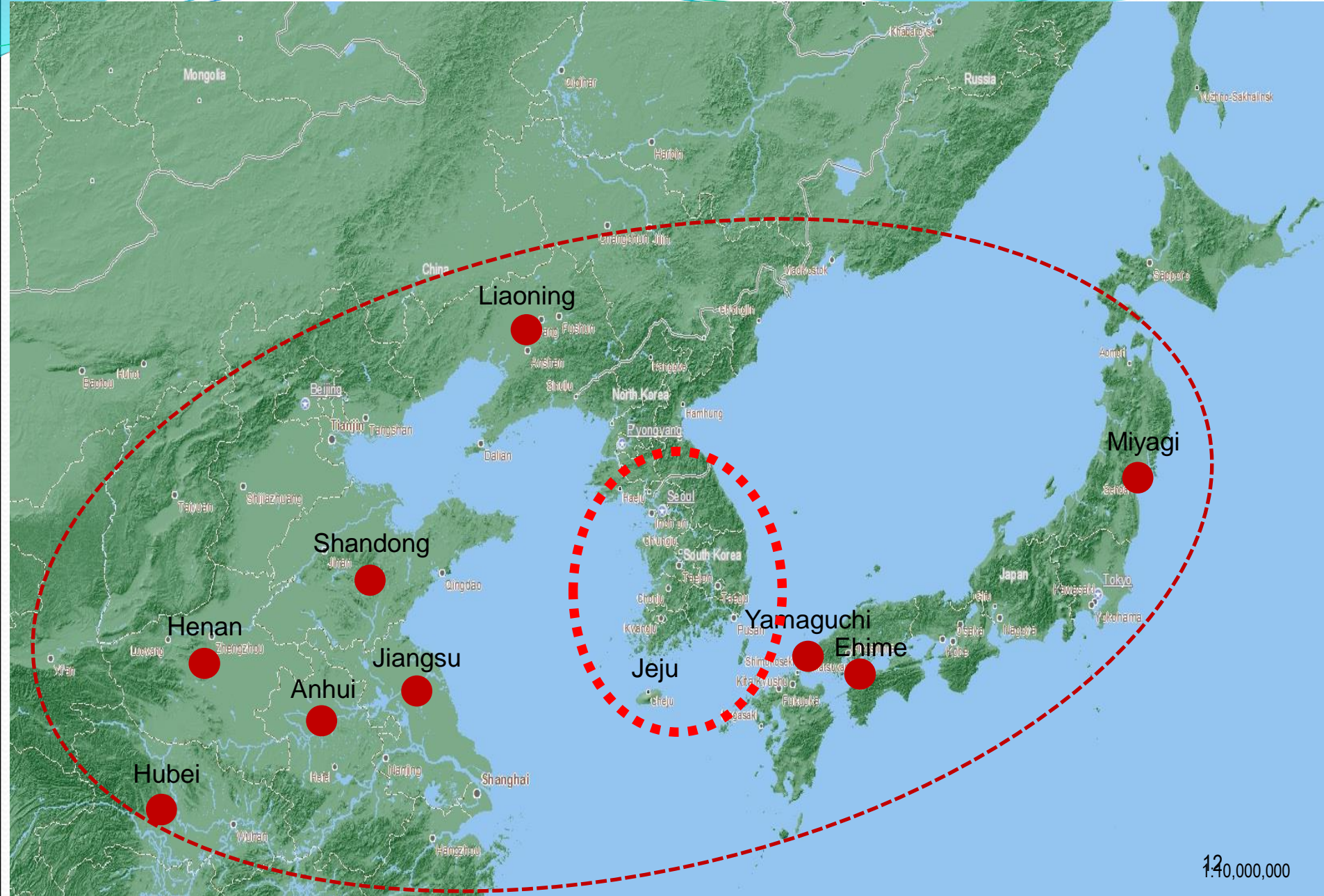


SFTS (Severe fever with thrombocytopenia syndrome)

- Group 4
- Vector: ticks

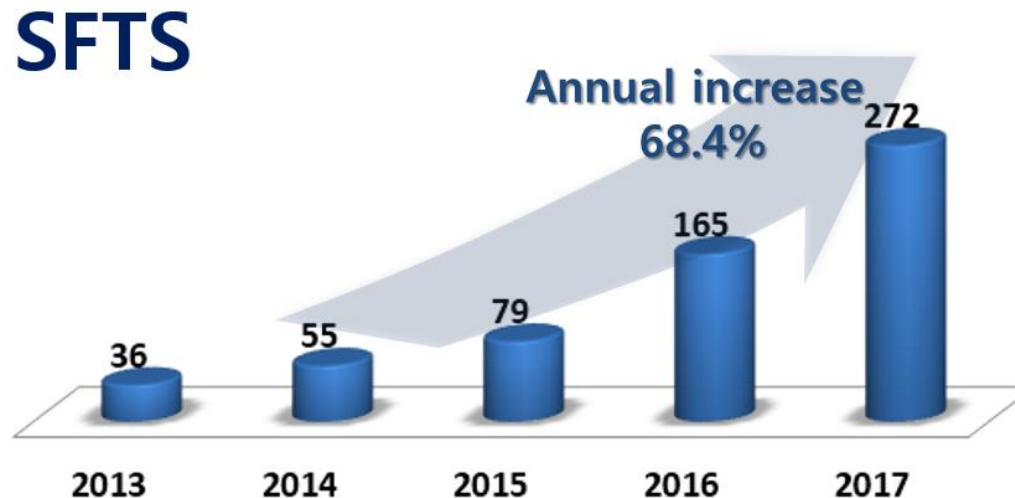


Asia regions of SFTS cases (deaths)



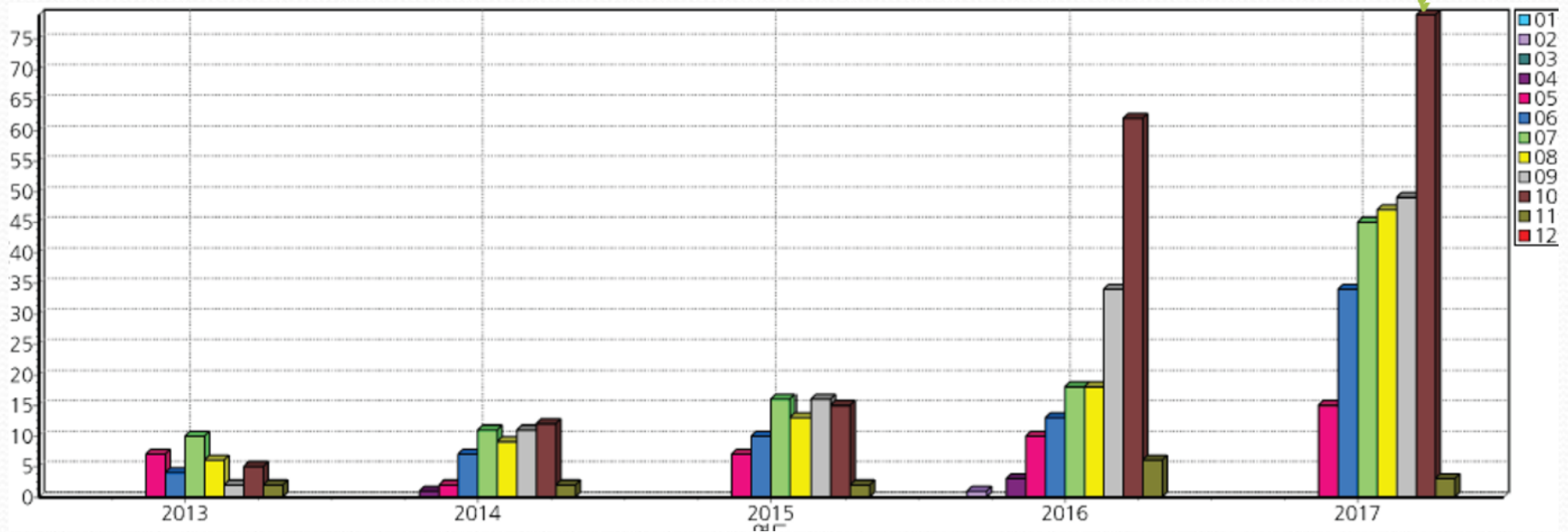
STATUS OF SFTS IN RO KOREA

- 1st report: May 2013, 36 patients in 2013 (death 17 cases)
- Categorized as national notifiable disease Group 4
- In 2017, 272 patients (death 54)
- **Fatality: 20.9%**



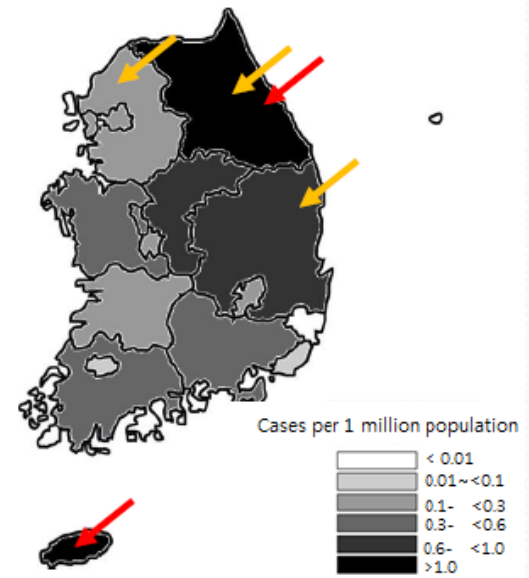
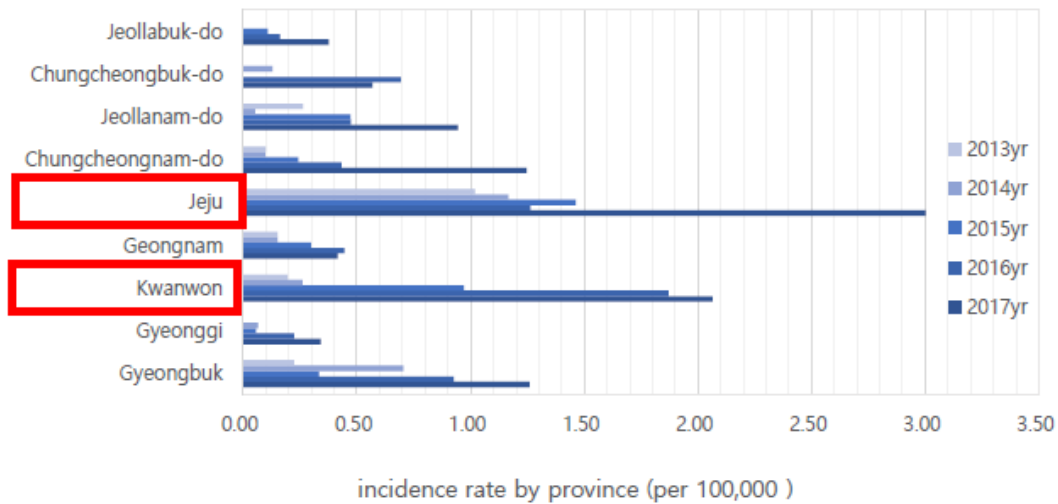
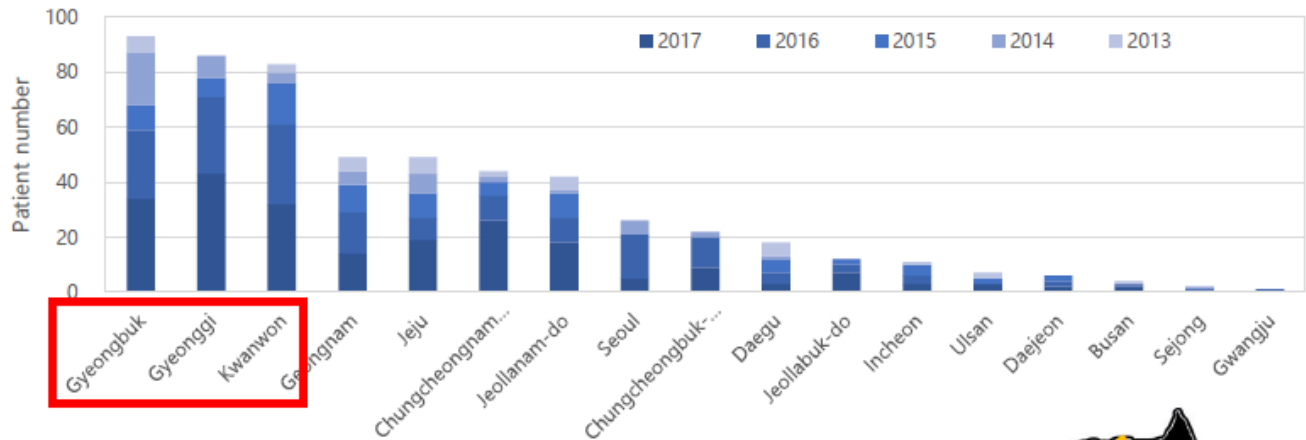
MONTHLY INCIDENCE OF SFTS

- ⊕ Patients: Mainly from April (4) to November (11)
- ⊕ Active season of ticks: from April (4) to November (11)



[KCDC]

REGIONAL INCIDENCE



SFTS MURDER TICKS?

Vectors for SFTSV Transmission

- Free ticks from the grassland
- The parasitic ticks from the host skin



H. longicornis: 2873



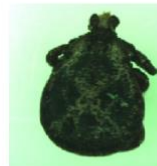
R. sanguineus: 140



Boophilus microplus
114



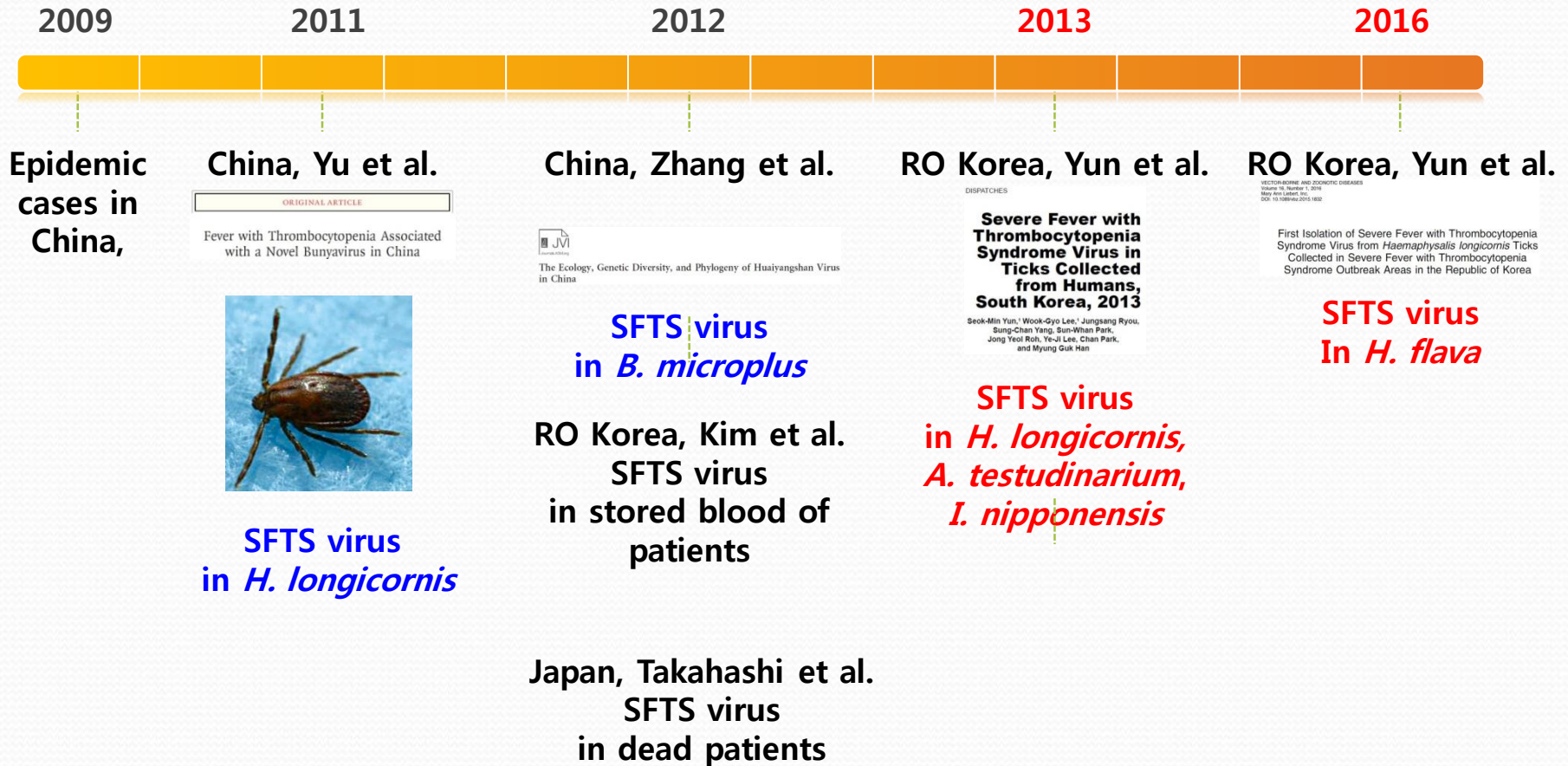
H. campanulata: 9



D. sinicus: 5

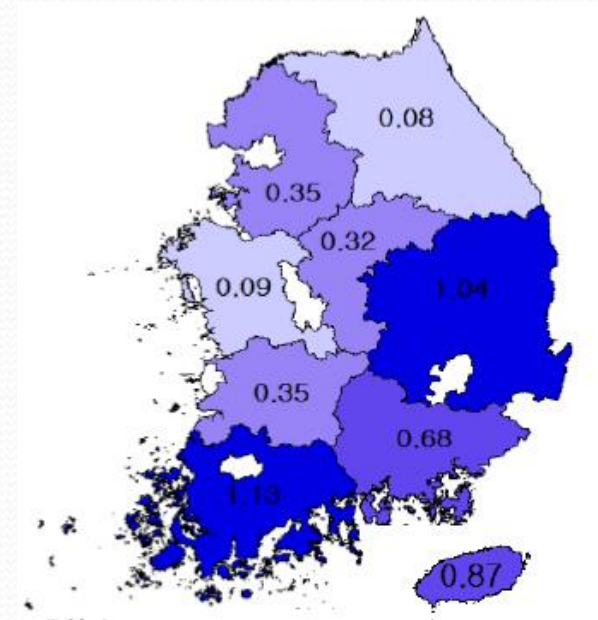
- 2012.10. China CDC
- Dexin Li & Mifang Liang
- Main vectors in China
 - *H. longicornis*
 - *R. sanguineus*
 - *B. microplus*
 - *H. campanulata*
 - *D. sinicus*

SFTS TICK RESEARCH



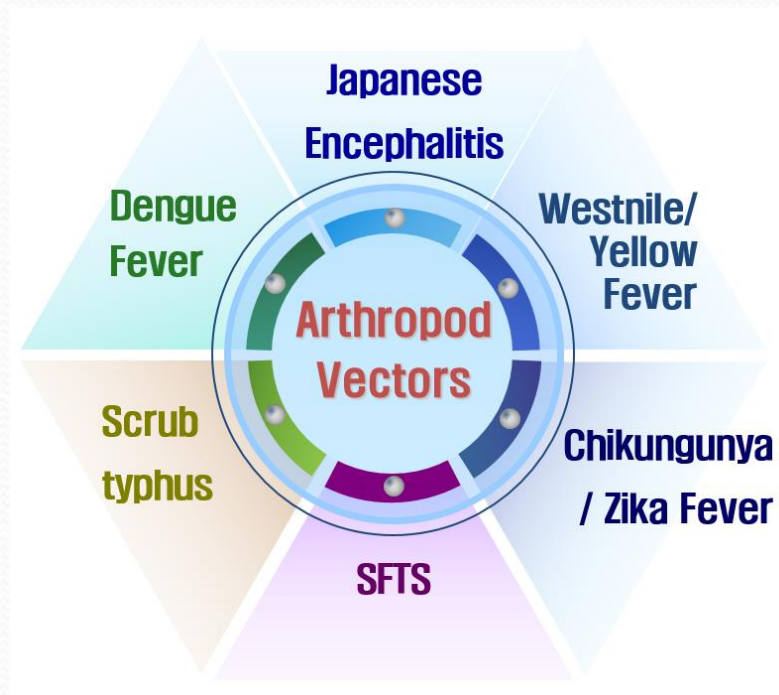
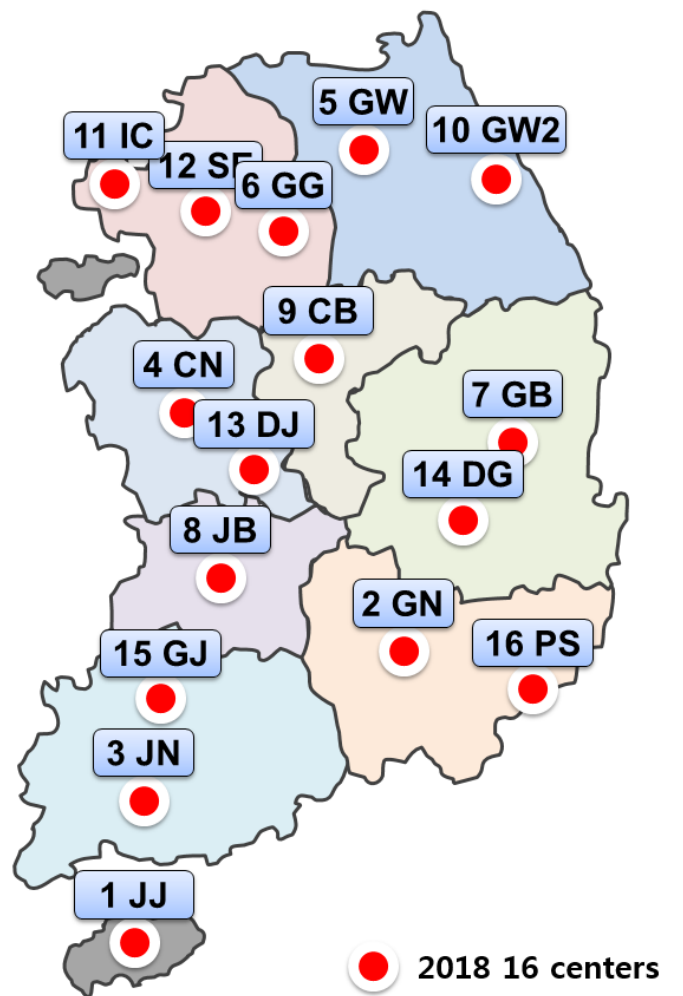
TICK SURVEILLANCE OF TICKS IN RO KOREA

- 2011~2012 (13,053 individuals)
- Composition of species
 - ***Haemaphysalis longicornis*: 90.8%**
 - *H. flava*: 8.8%
 - *Ixodes nipponensis*: 0.3%
 - *I. persulcatus*: 0.05%
- Detection of SFTS virus
 - ***H. longicornis* 11,856 individuals, MIR 0.46%**
 - Regional: Jeollanam-do 1.13% > Gyeongsanbuk-do 1.04%
 - Developmental: Female adult **1.53%** > male adult 0.90%
> nymph 0.36% > larva 0.57%



Minimum infection rates of SFTSV

Climate Change Preparedness Regional Vector Surveillance Centers



Introduction of surveillance

1. Surveillance of distribution

- Flagging (5 environments)
- July, August / monthly
- SFTSV detection (Pooling)

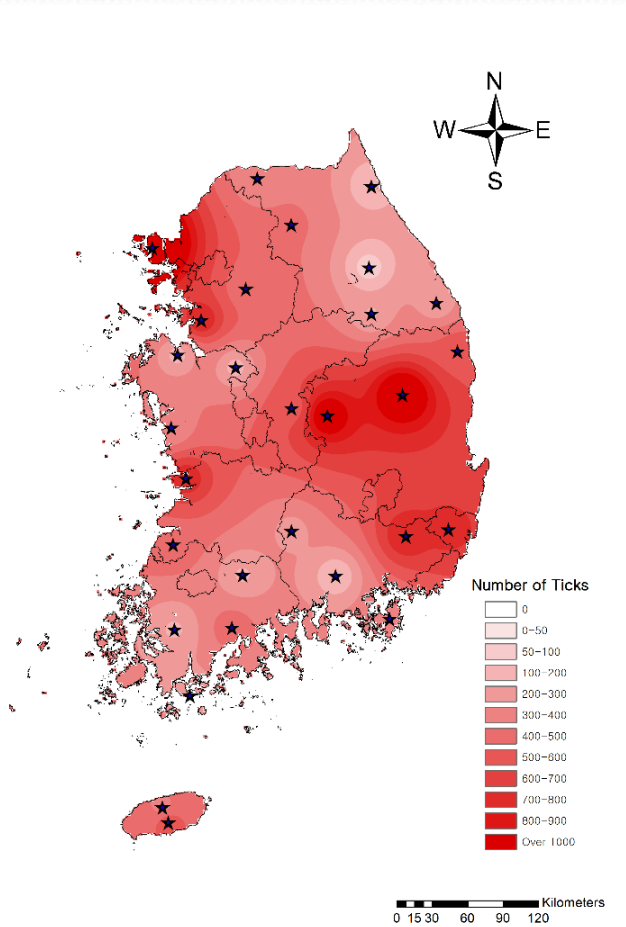


2. Surveillance of annual incidence

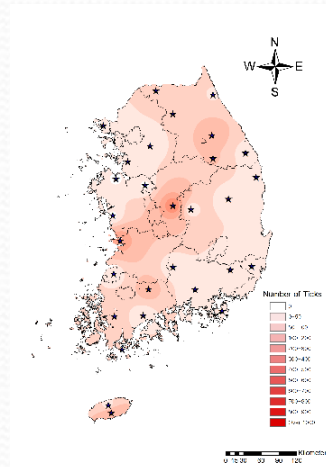
- Tick collection trap (12, 4 environments)
- April - November / monthly



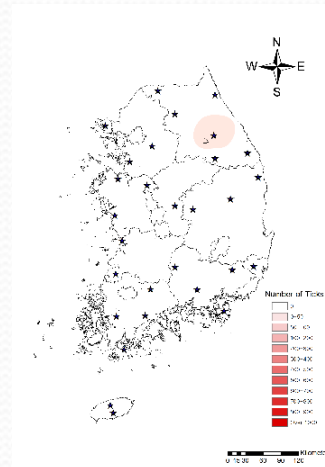
Distribution of Major ticks (2015)



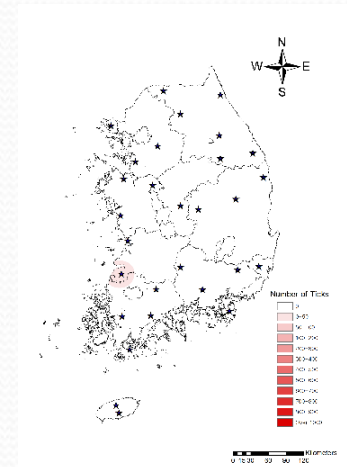
1. *Haemaphysalis longicornis*



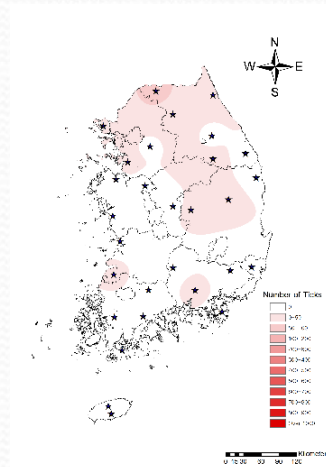
2. *H. flava*



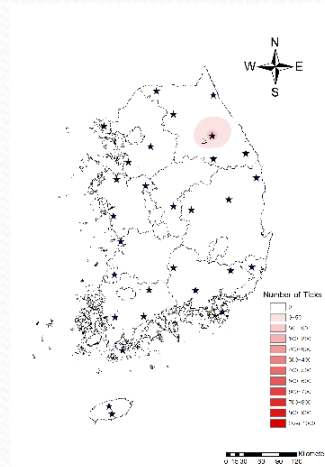
5. *H. japonica*



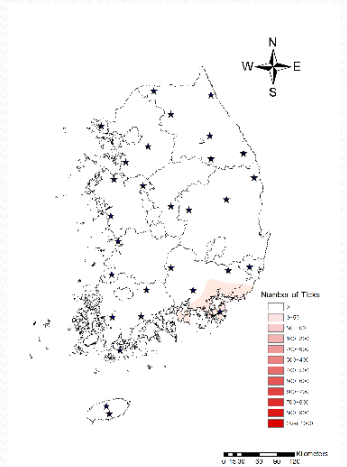
6. *Amblyomma testudinarium*



3. *Ixodes nipponensis*

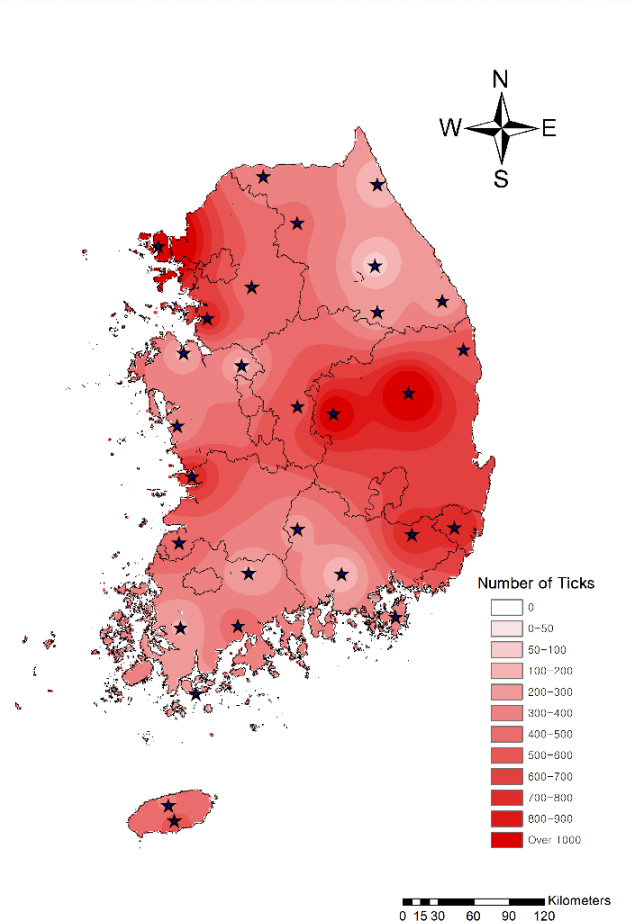


4. *Ixodes persulcatus*

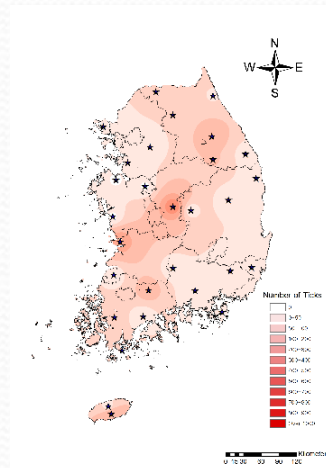


7. *Ixodes granulatus*

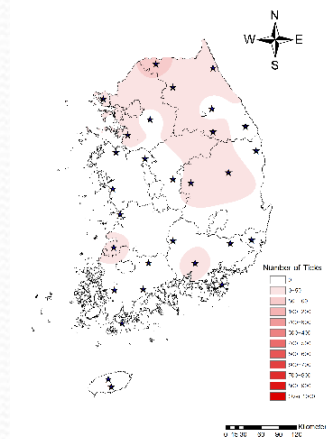
Distribution of Major ticks (2015)



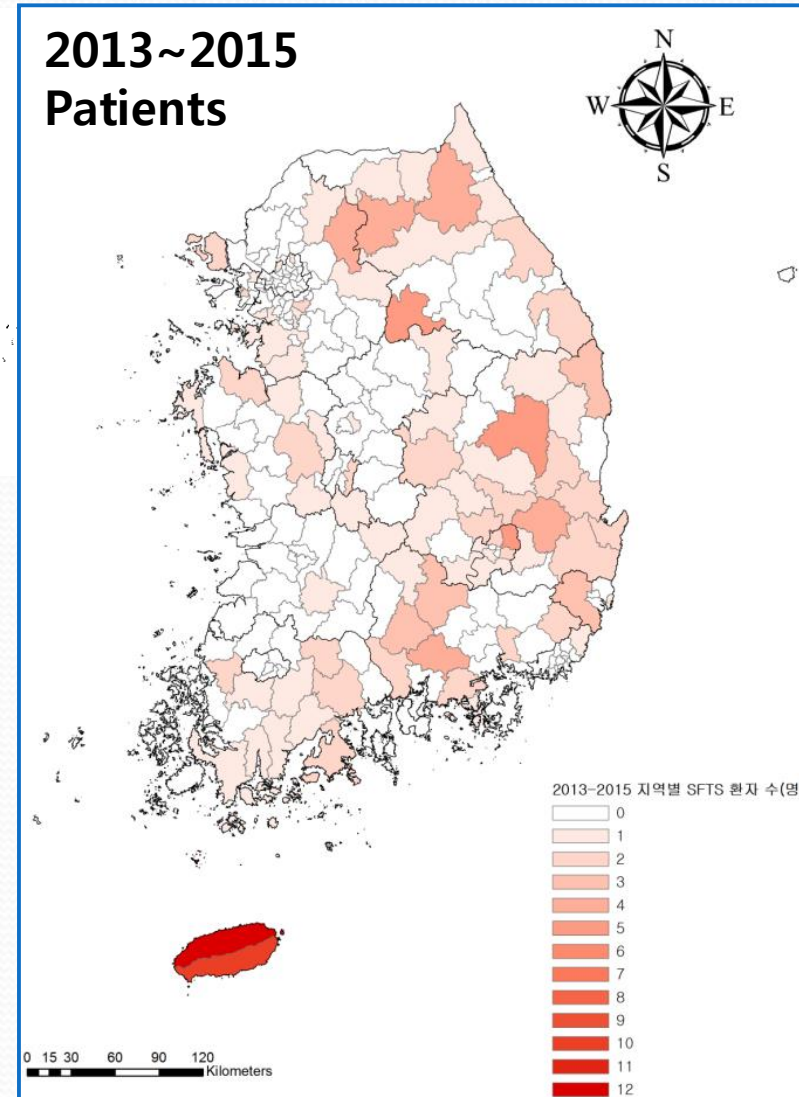
1. *Haemaphysalis longicornis*



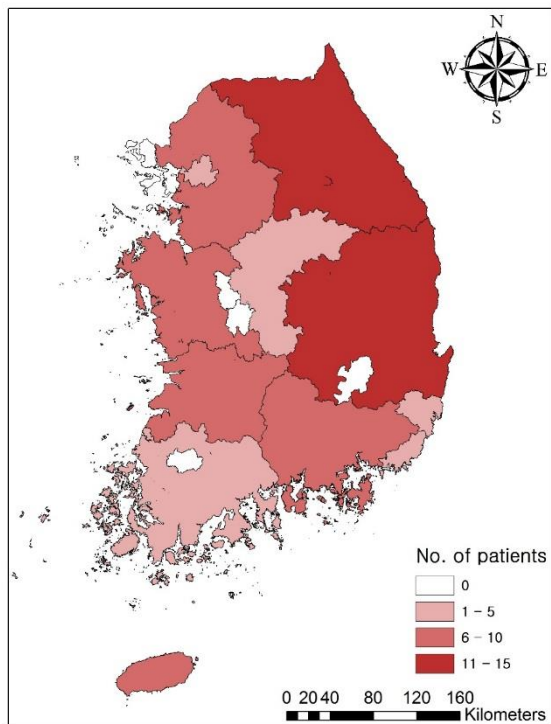
2. *H. flava*



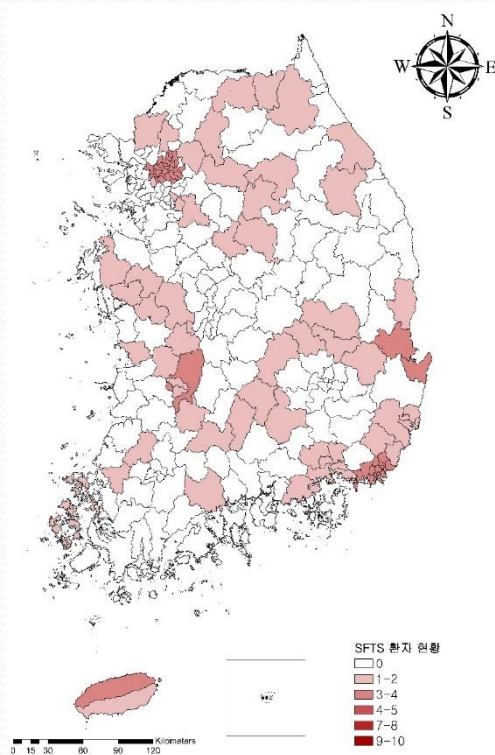
3. *Ixodes nipponensis*



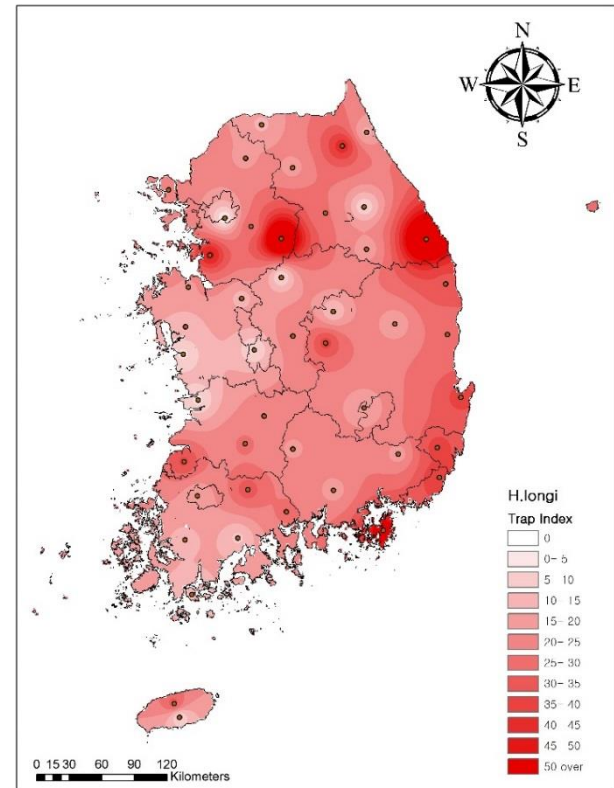
Distribution of *H. longicornis* (2018)



‘18 patients (provincial)



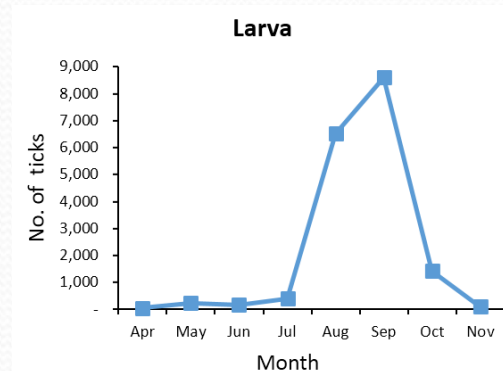
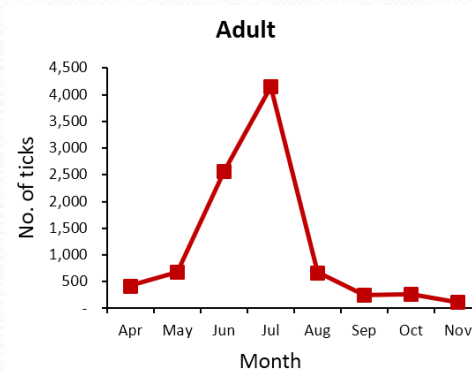
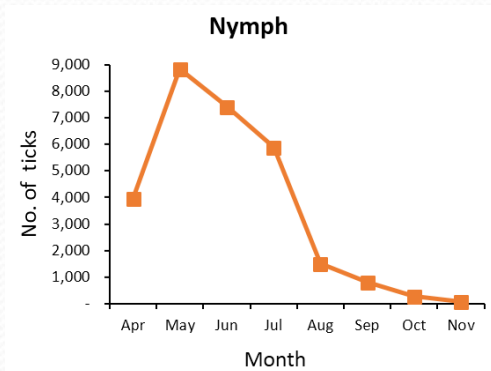
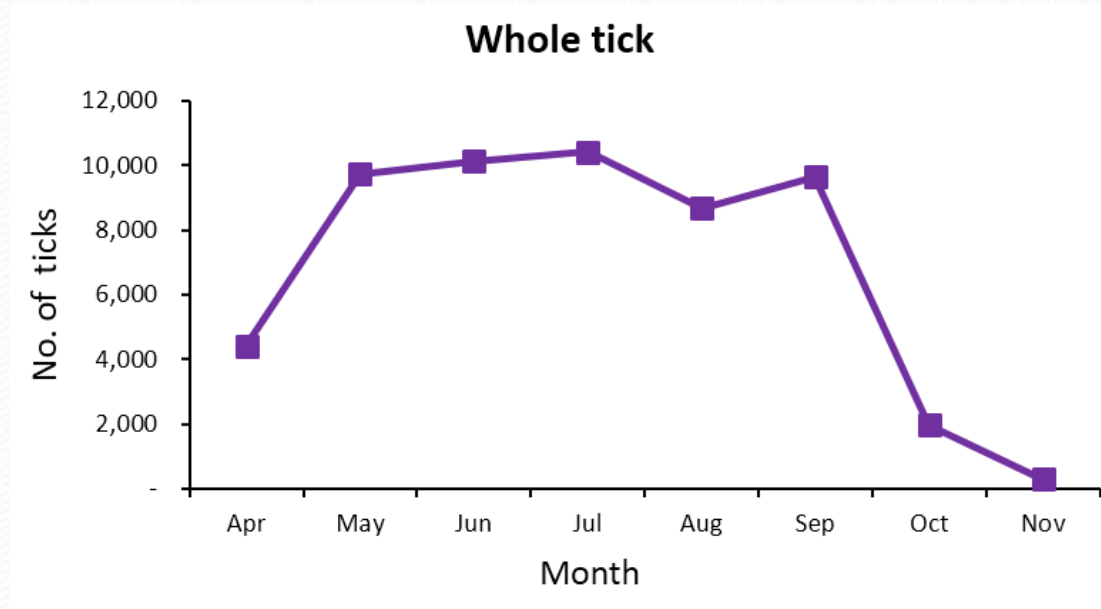
‘18 patients (districts)



H. longicornis

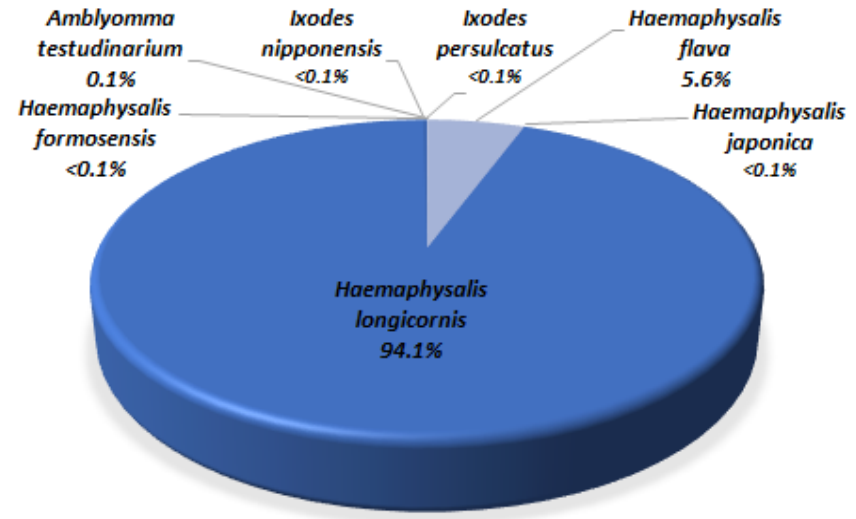
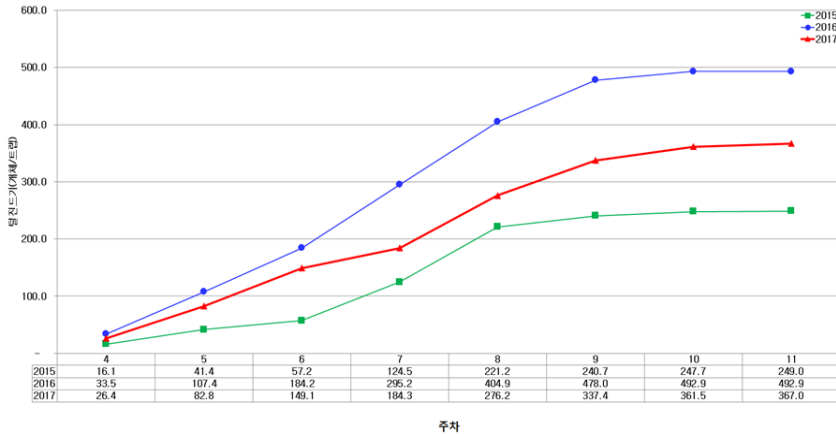
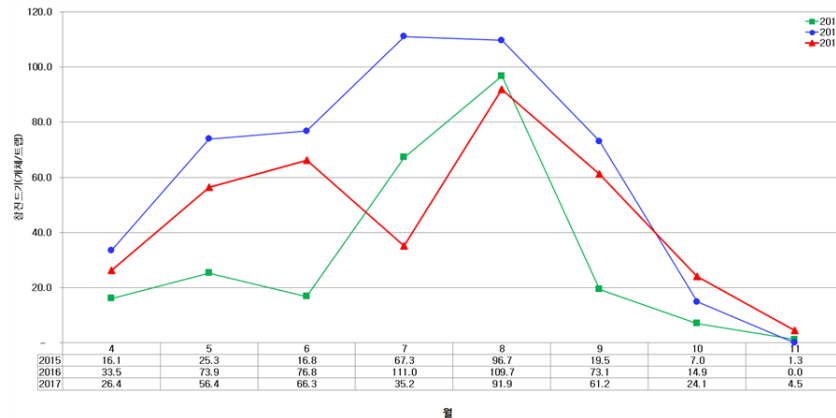
※ 환자: ‘18년 6월 30일 73명 기준

Monthly incidence of ticks – developmental stages



Annual incidence of ticks

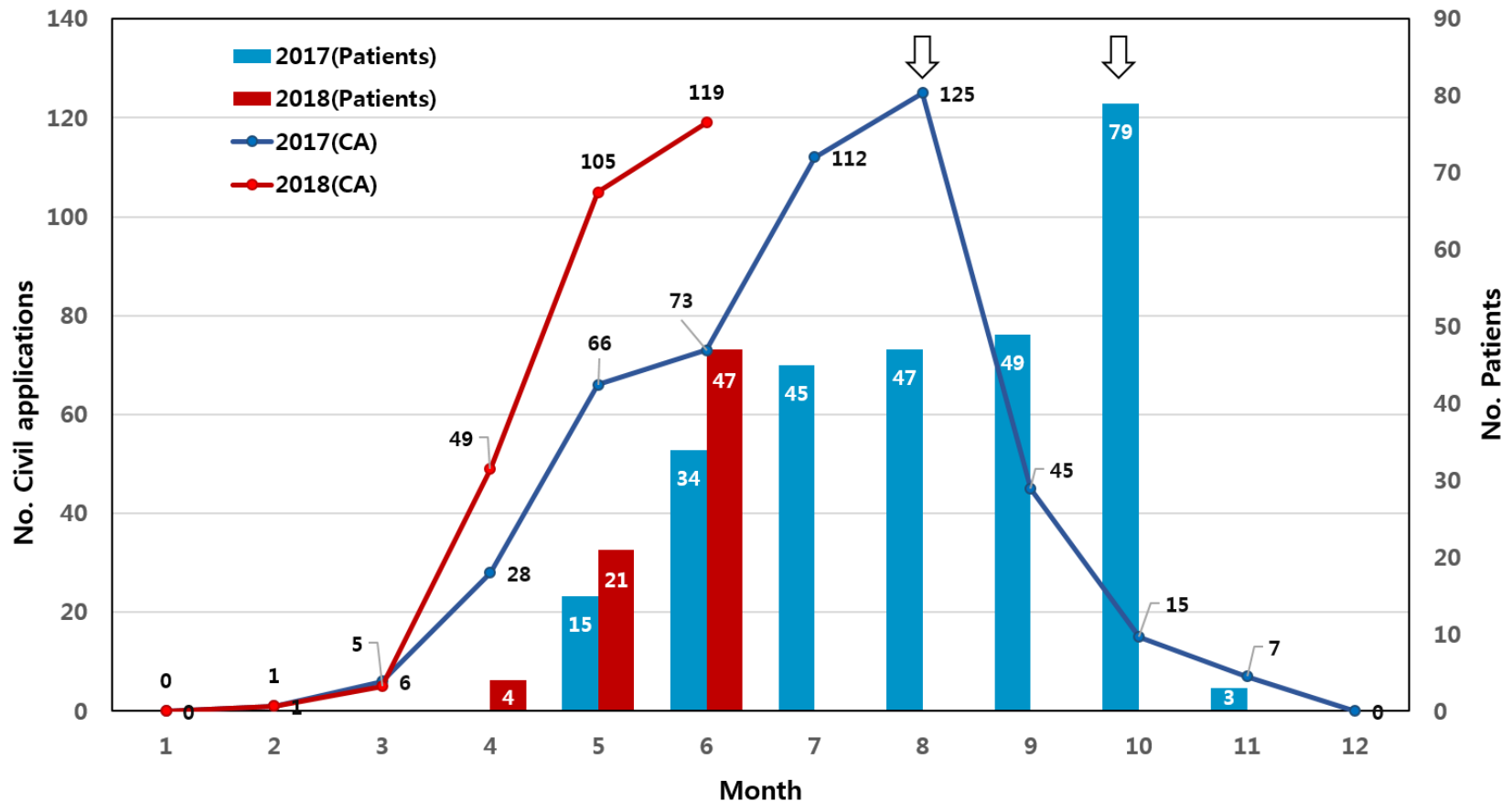
- 2017: increase compared to 2015, decrease to 2016
- *H. longicornis* 94.1% > *H. flava* 5.6% > *A. testudinarium* 0.1%



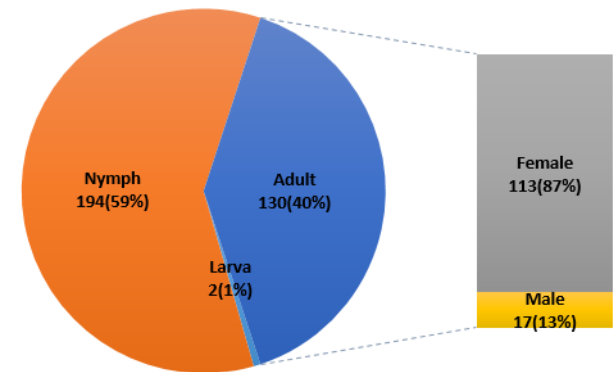
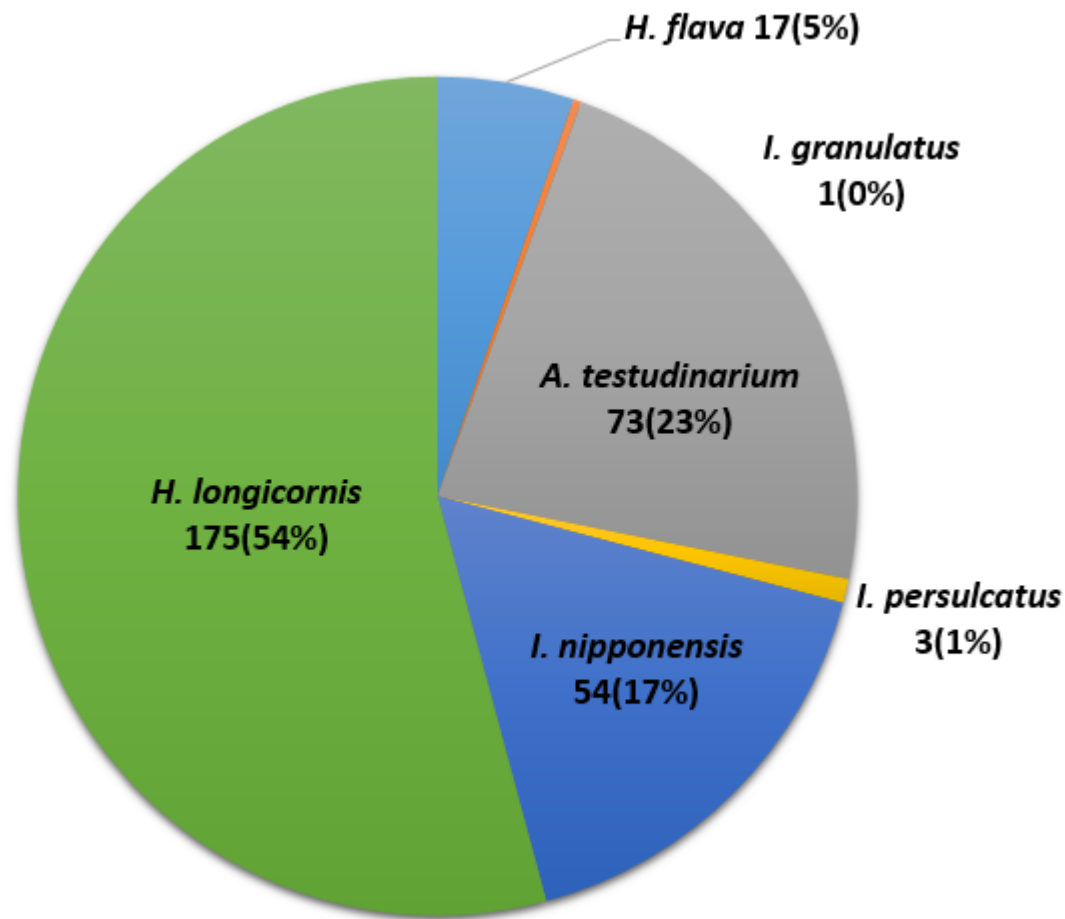
Civil application of SFTS

- Civil application: tick identification and its SFTSV detection
- Results: total **478 applicants**, **positive 9 cases**, **MIR 1.9% (2017)**

* June, 2018. 60.3% increase to 2017 (174→279)



Civil application of SFTS – Species



Civil application of SFTS – Positive

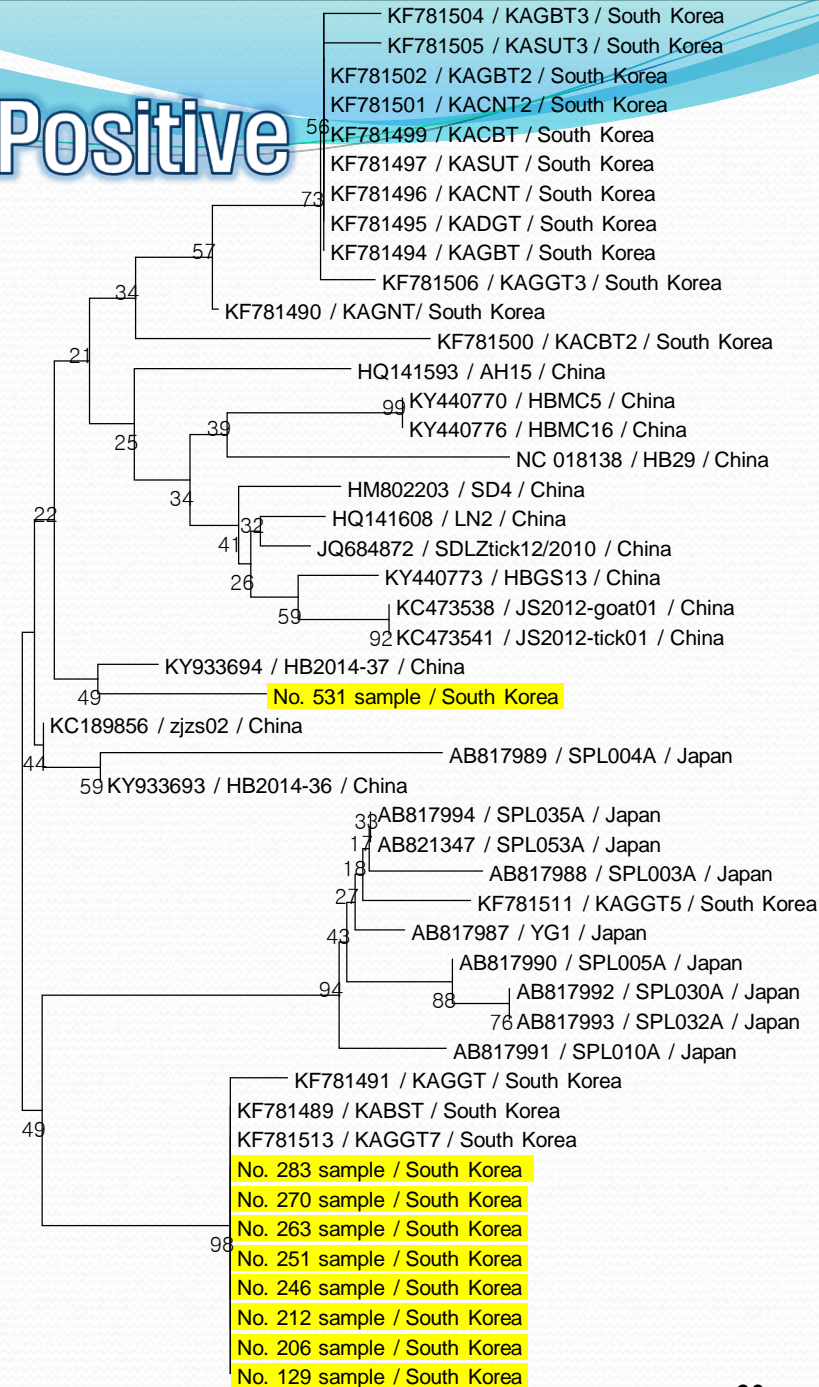
No	Region	Tick	F	M	N	L
129	GW	<i>H. longicornis</i>			1	
206	GB	<i>I. nipponensis</i>			1	
212	JN	<i>A. testudinarium</i>			1	
246	GB	<i>H. longicornis</i>	1			
251	CN	<i>H. longicornis</i>	1			
263	GW	<i>H. longicornis</i>			1	
270	GG	<i>H. longicornis</i>	1			
283	CN	<i>A. testudinarium</i>			1	
531	GG	<i>H. longicornis</i>				6

KF781513(KAGGT7), KF781489(KABST)
KF781491(KAGGT)

host= *Haemaphysalis longicornis*
country= South Korea
collection_date= 2013

KY933694(HB2014-37)

host= *Homo sapiens*
isolation_source= serum
country= China: Hubei, Chongyang
collection_date= 23-Jun-2014



Transovarial transmission of SFTSV in ticks

- Jeju island in 2016: collection of blood fed female adults
- Host: horse, dog, wild boar, roe deer, water deer
- After laying: detection in eggs & larvae



Transovarial transmission of SFTSV in ticks

- SFTSV transovarial and transstadial transmission in ticks
 - **Transovarial transmission**
 - Female Adult to egg and larvae
 - **Transstadial transmission**
 - Larvae to nymphs

Table. Transovarial and transstadial transmission of SFTSV in *H. longicornis*

No.	Species	Developmental stage	No of tested pools	No of positive pools	Ration of positive pools(%)
168	<i>H. longicornis</i>	larvae	10	1	10.0
		Subtotal	10	1	10.0
		egg	30	1	3.3
214	<i>H. longicornis</i>	larvae	60	14	23.3
		nymph	60	7	11.7
		Subtotal	150	22	14.7
246	<i>H. longicornis</i>	larvae	60	18	30.0
		nymph	60	8	13.3
		Subtotal	120	26	21.7
		Total	310	49	15.8

PREVENTION OF TICK-BORNE DISEASES

- No vaccine
- Difficult to control
 - Various environment
 - Wide chemical control: environment pollution
 - **Control: Small and restricted area**
- Personal Protection
 - **Advertisement and education**
 - Protection cloth and laundry
 - **Repellents**
 - Quick shower and body wash after outdoor works and activities



Protect Yourself Against Lyme Disease in Spring, Summer, and Fall



Survey of SFTS cases



Near dog house of front yard in rural houses



Mountain side field



Mt Jiri (2017)



Thank you for your attention~^^

