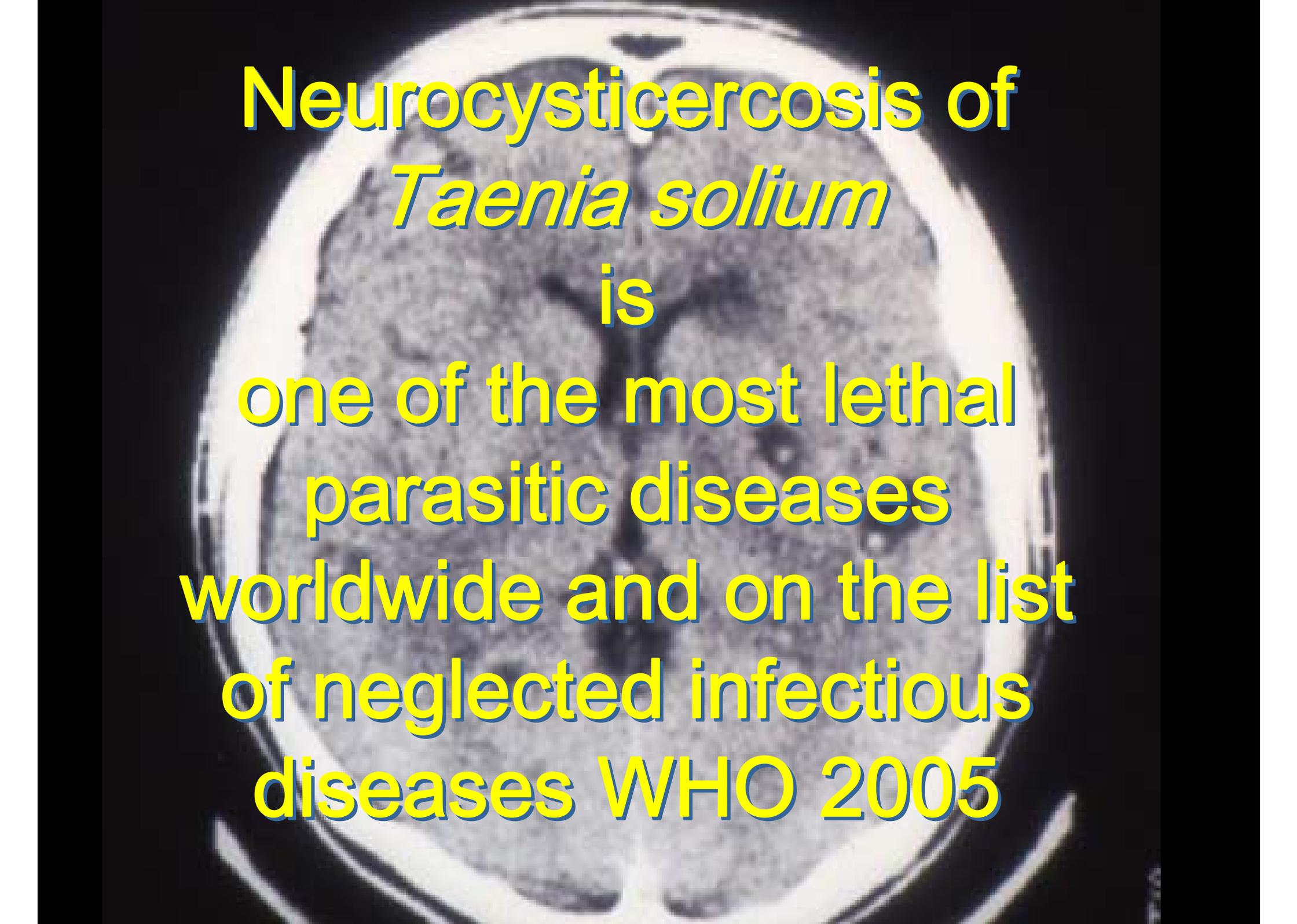




Molecular and serological
diagnosis
of taeniasis and cysticercosis
in Asia and the Pacific

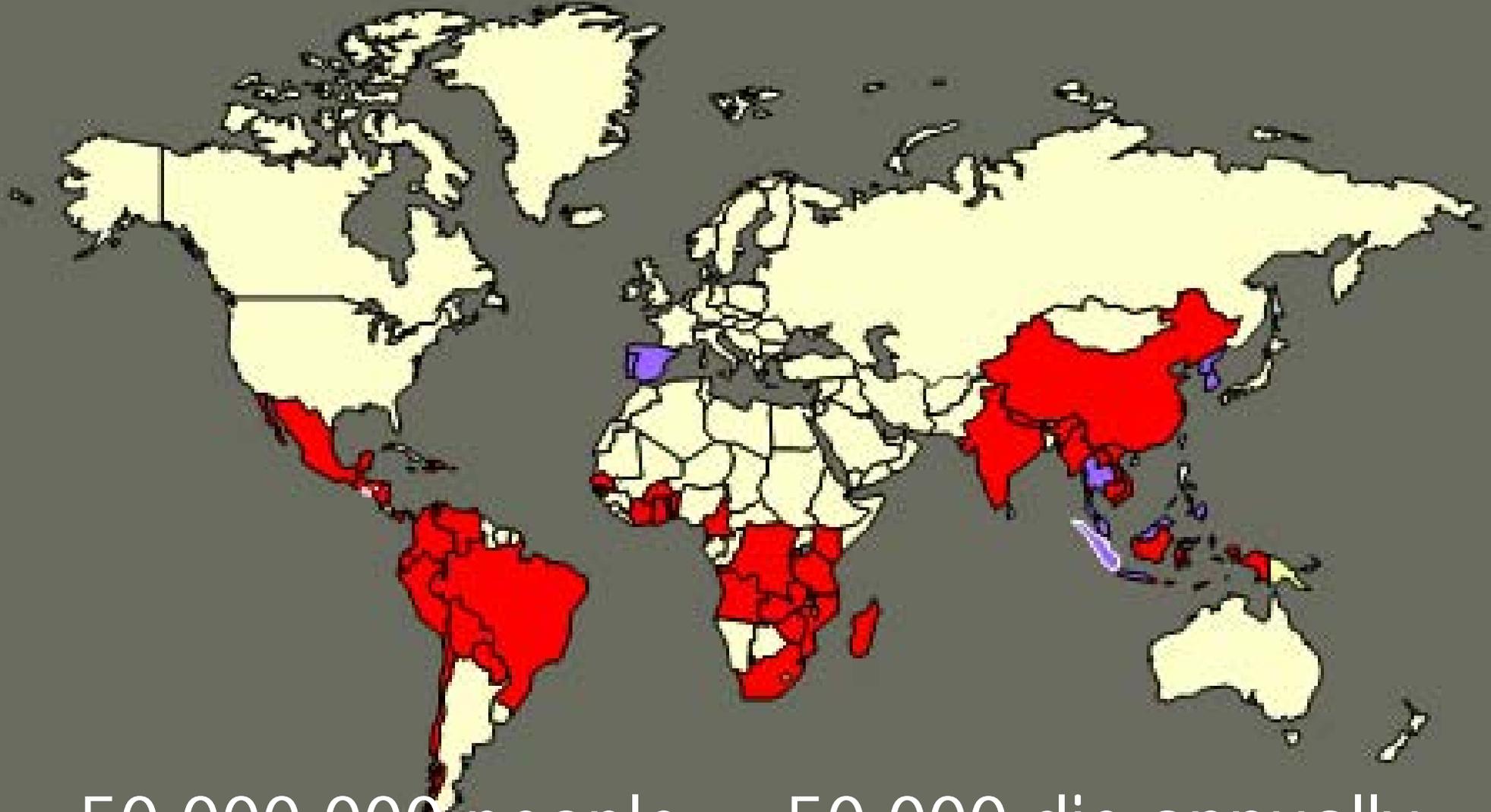
A. Ito and Colleagues

Asahikawa Medical College



Neurocysticercosis of
Taenia solium
is
one of the most lethal
parasitic diseases
worldwide and on the list
of neglected infectious
diseases WHO 2005

Distribution of Taeniasis/Cysticercosis of *T. solium*



50,000,000 people 50,000 die annually
(MMWR 1993, 42: 1-25)

Clinical Manifestations of NCC

No specific symptom

The majority of NCC cases
asymptomatic: no treatment

Clinical Manifestations of NCC of *T. solium*

Clinical pictures	%
Epileptic Seizures	62
Intracr. hypertension	34
Meningitis	29
Mental disorders	11
Vasculitis	2
Spinal	0.5
Combined	37

No symptoms specific to NCC of *T. solium*

Epilepsy due to *T. solium*

Main cause of late-onset epilepsy

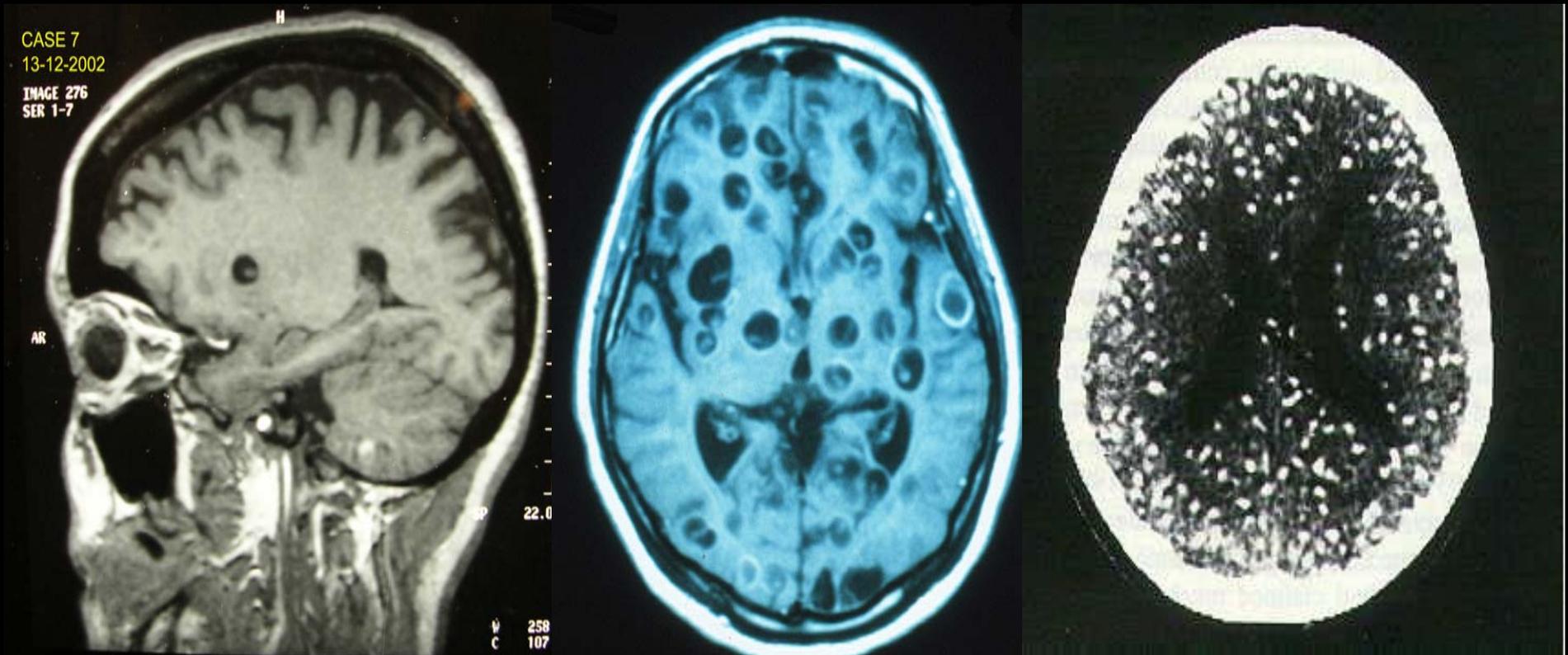
Developing countries

Endemic areas for *Taenia solium*

Epileptic Seizures

Most common symptom of NCC

70% - 90%



By courtesy of Dr.O.M. Takayanagui

Most of the symptoms of NCC become evident when the parasite has just been damaged by the host immune responses or by treatment with metacestocidal drug such as praziquantel through mass screenings

Treatment of NCC patients based on crucial diagnosis

Chemotherapy vs Surgery

No symptoms specific to NCC of *T. solium*

How to suspect NCC?

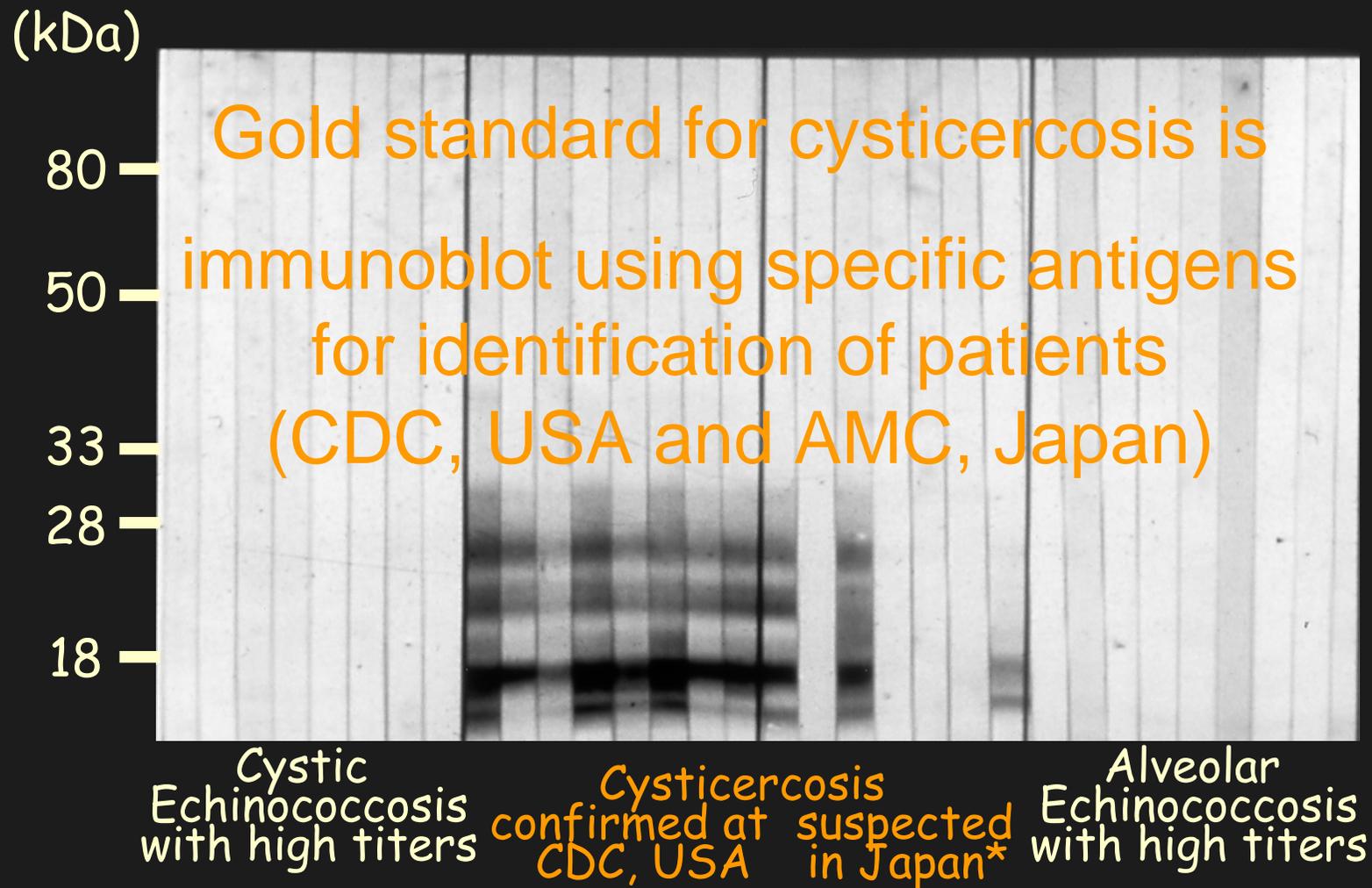
- 1) Neurologic disorders:
no symptoms specific to NCC
- 2) Neuroimaging: not always typical
- 3) History of traveling to and/or
living in *T. solium* endemic areas

Then,

4) Serology!

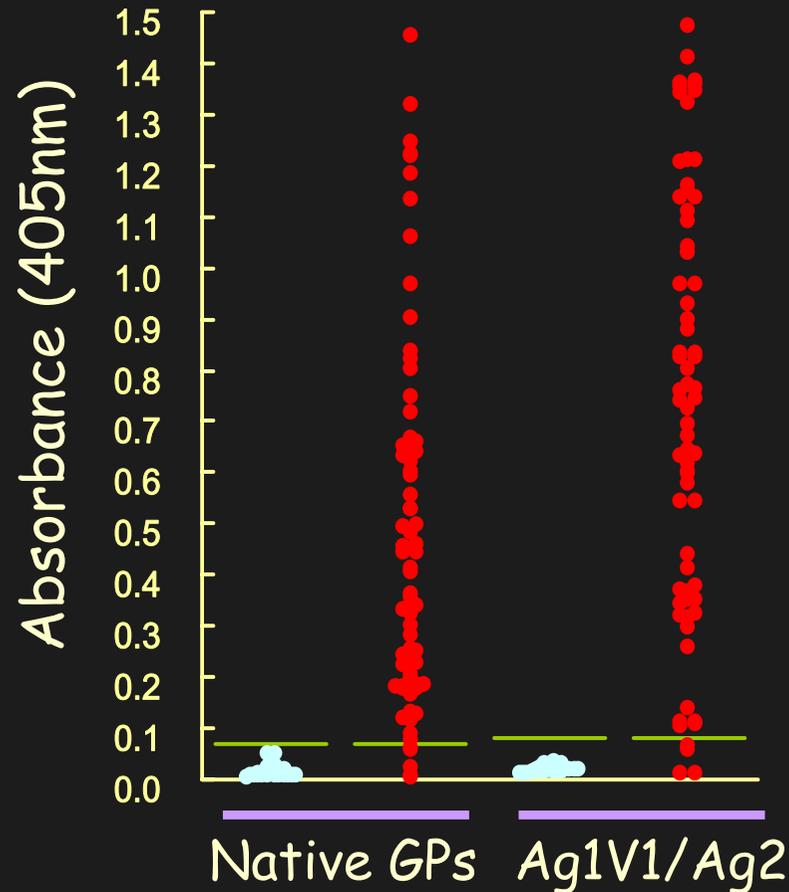
Cysticercosis

* *T. solium*: not indigenous in Japan



Differential Serodiagnosis of Cysticercosis by Immunoblot
(modified from Ito A et al. 1998. Am J Trop Med Hyg 59: 291-294)

Comparison of native GPs and recombinant chimeric antigens (Sako Y et al. 2000. JCM 38)



Native GPs	65/70	92.9%
Ag1V1/Ag2	66/70	94.3

Similar sensitivity in ELISA and IB between these two antigens

- healthy persons
- cysticercosis patients

How to diagnose NCC?

Neuroimaging: not always typical

Serology: sensitivity not always 100%

Surgery suspected brain tumor

Histopathology

Molecular identification

Molecular identification of metacestode in the histopathological specimens

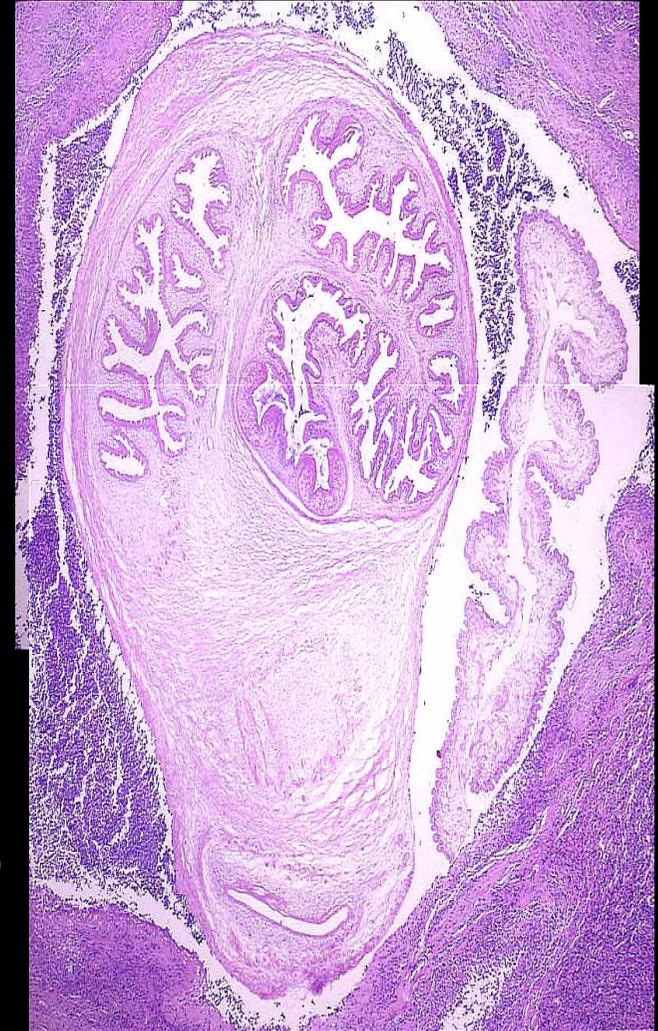
No antibody Response : ID?

Solitary NCC? Calcified NCC?

With or without hooklets?

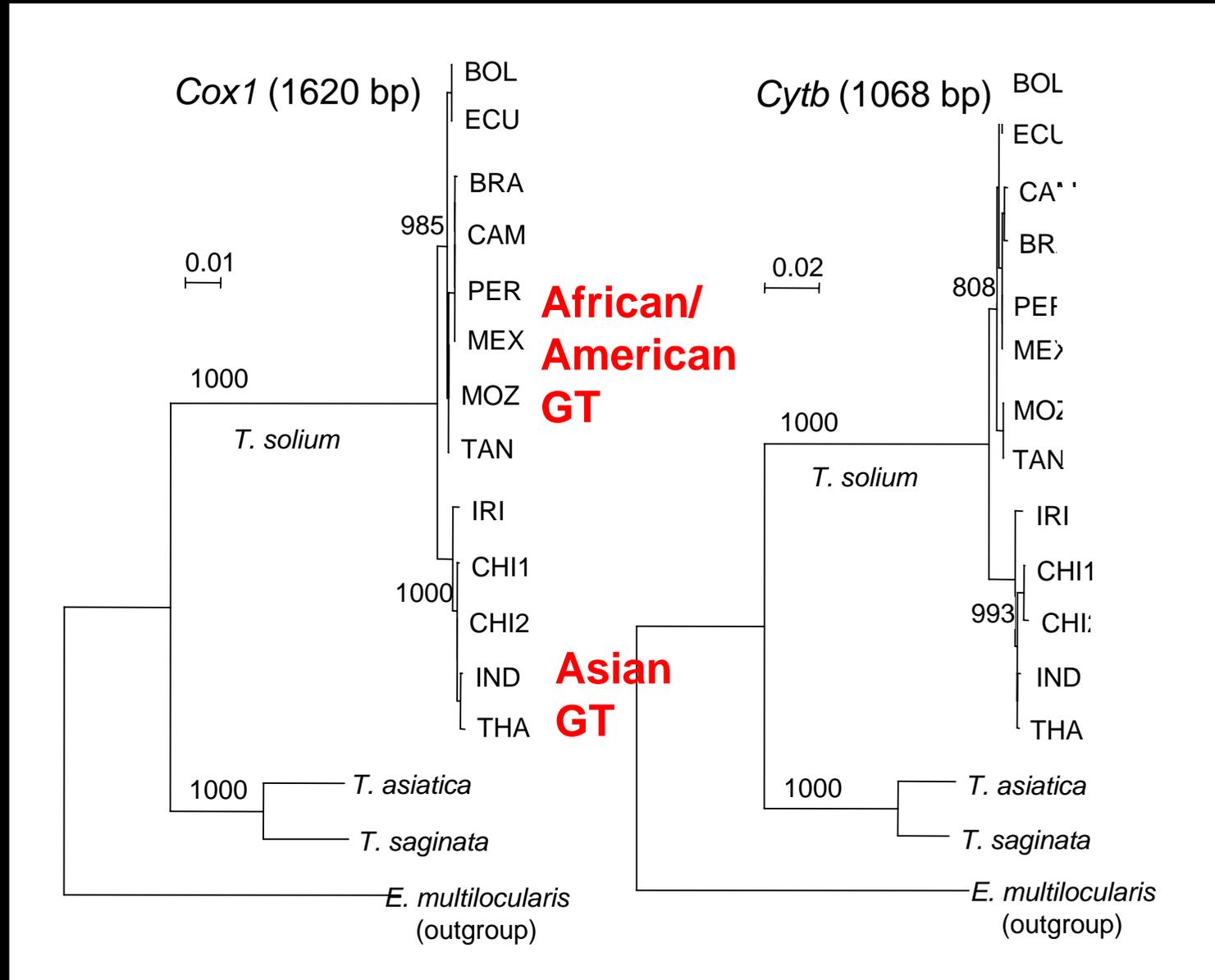
Are the causative agents really
cysticerci of *T. solium*?

Other zoonotic taeniid species?



The majority of such cysts may be expected to be due to *T. solium*.
However, molecular confirmation is essential nowadays.

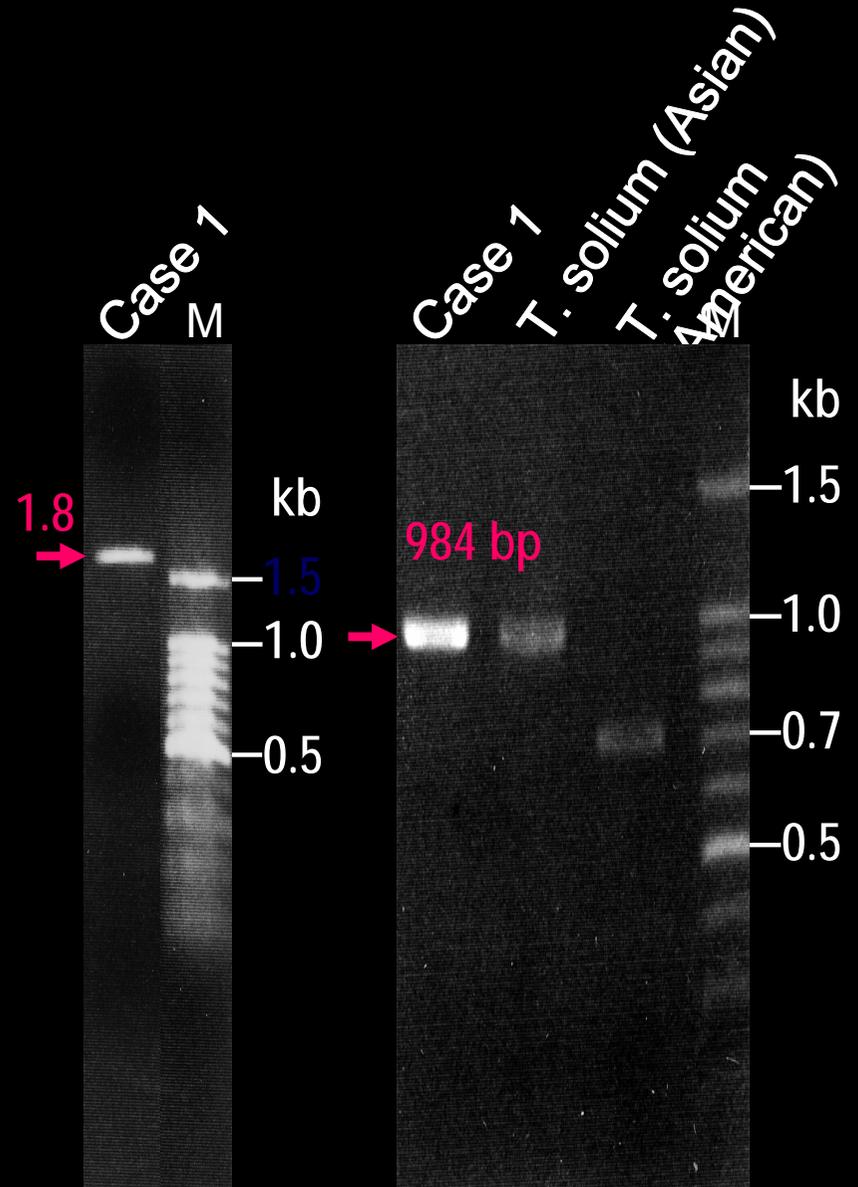
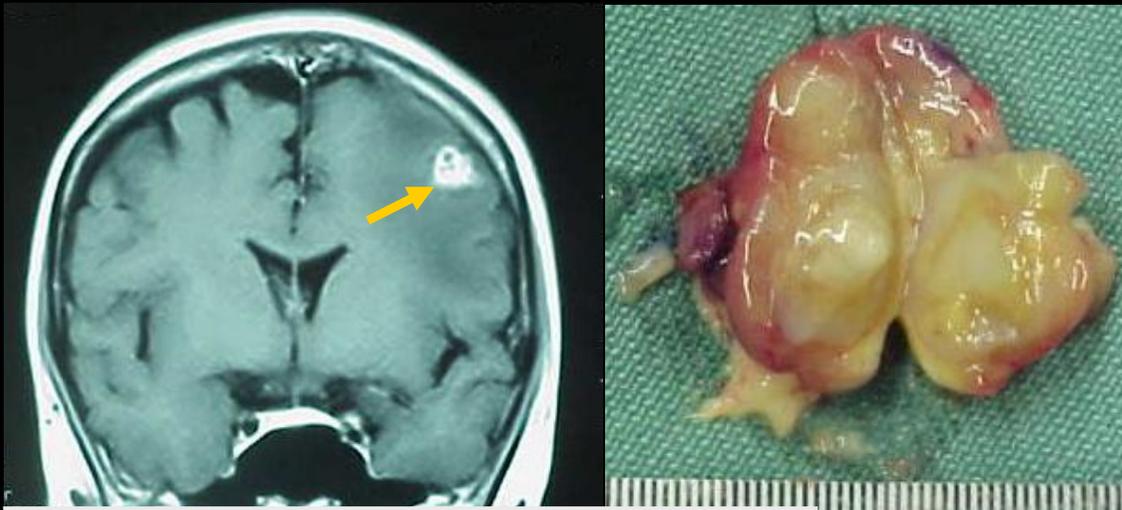
Two genotypes of *T. solium* worldwide



Case 1

53-year-old, Japanese woman;
a solitary cyst in the left frontal
lobe; repeated travel histories
to India and Southeast Asian
countries from 1993 to 2001.

PCR-amplification of *cox1*



Such cases may retrospectively
be analyzed as to where they
were exposed to eggs based on
subtyping of mtDNA.

This case is suspected to have
been exposed to *T. solium* eggs
in Bali, Indonesia.

PCR : 94C, 30sec; 58C, 30sec; 72C, 90sec; 35 cycles

T. saginata vs *T. asiatica*

A long-standing puzzle
has been
that
adult taeniid tapeworms
expelled from people
in Asia-Pacific

seem

to be *T. saginata*, the beef tapeworm,
although
these people eat
pork rather than beef

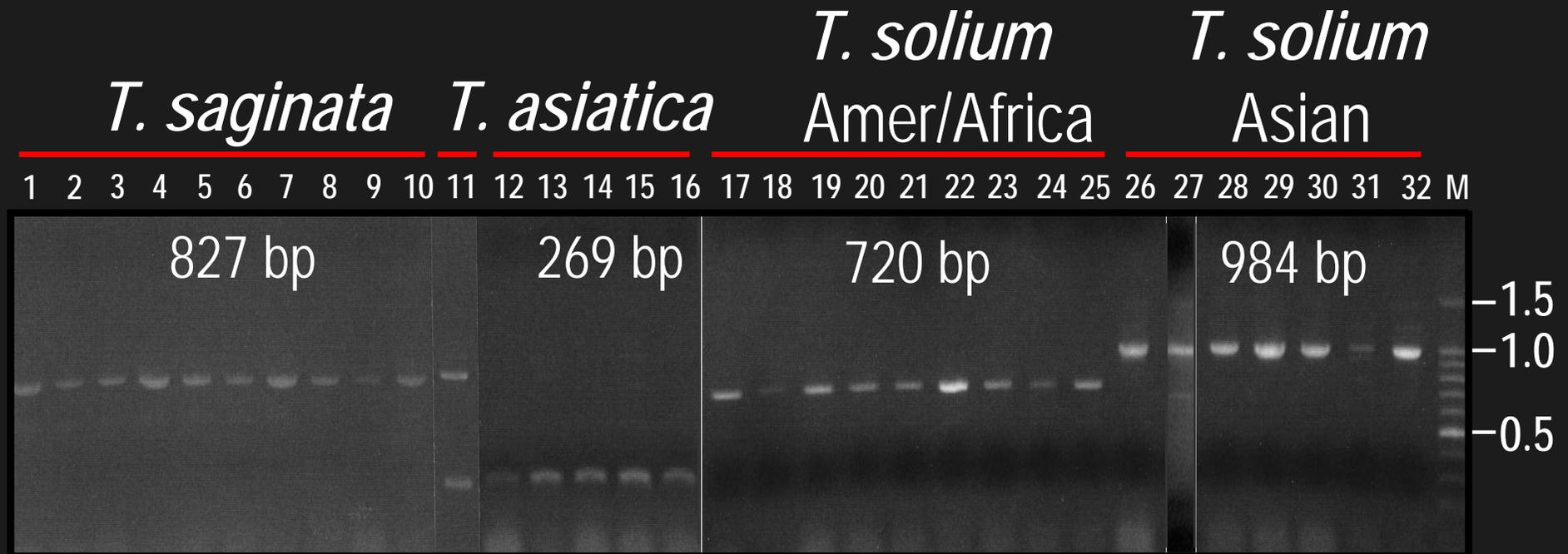
(from Ito et al. 2003. Lancet 362, 1918-1920).

How many human *Taenia* species
are distributed
in Asia-Pacific?

Now we have three in Asia-Pacific
Taenia solium, *Taenia saginata* and *Taenia asiatica*.

Historically we recognized only two in the world
T. solium and *T. saginata*!

Multiplex PCR for differentiation of three human taeniid species



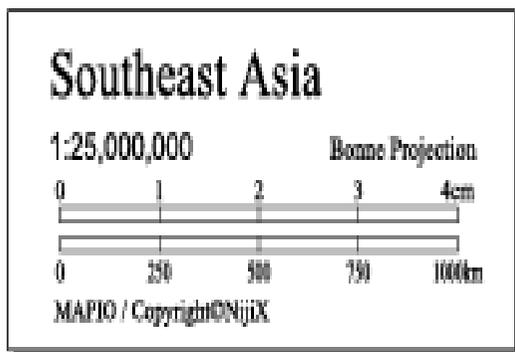
Lane 11 : taeniid egg sample from Yunnan, China

(mixture of *T. saginata* and *T. asiatica*)

(Yamasaki H et al. 2004. J C Microbiol 42, 548-553)

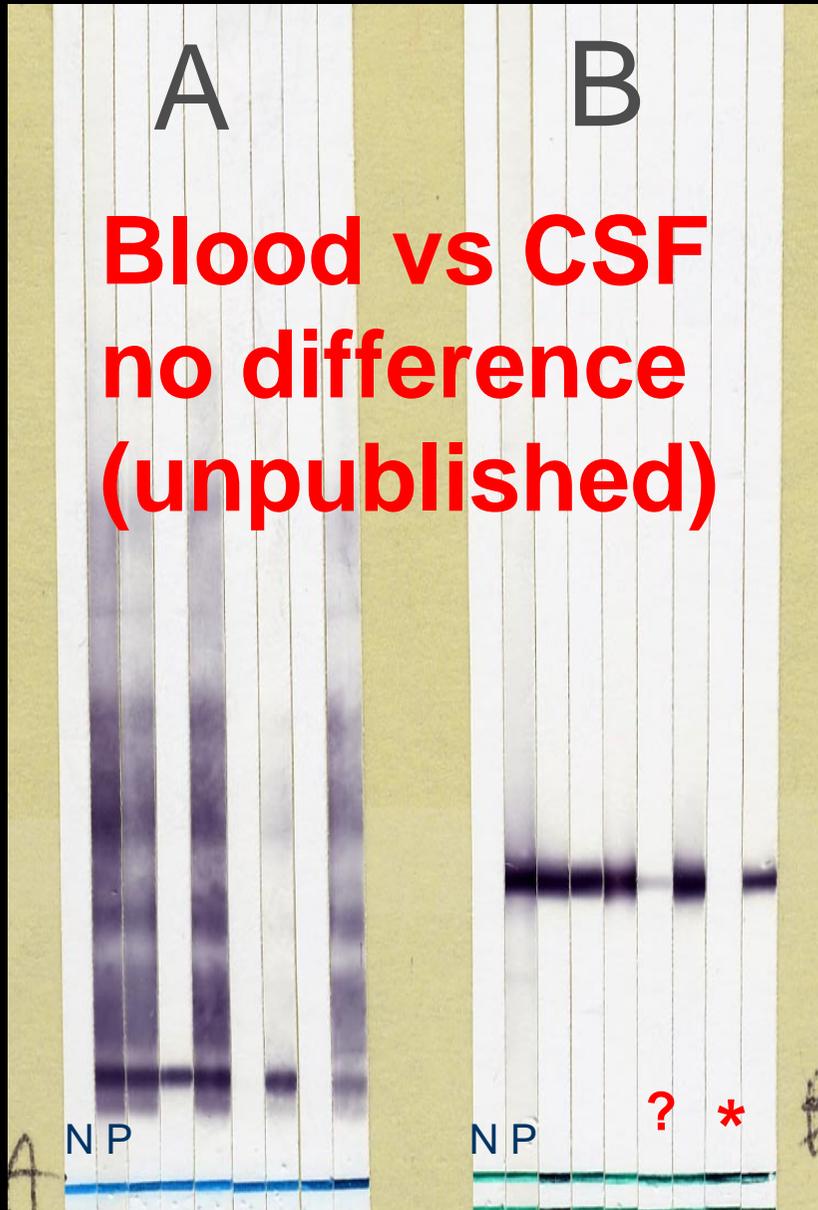
Three countries where we have confirmed three species are briefly introduced.

- 1) Indonesia where three species are distributed basically separately due to the barriers of the religion (Wandra et al. 2006 *Trans R Soc Trop Med Hyg* 100)
- 2) Thailand where three species are sympatrically occurring (Anantaphruti et al. 2007 *Emerg Infect Dis* 13)
- 3) China where three species are sympatrically occurring (Li et al. 2006 *Acta Trop* 100)



Bali
T. saginata
T. solium

International collaborative projects



**Blood vs CSF
no difference
(unpublished)**

Immunoblots of NCC
suspected patients'
sera from Bali 2005

*: not NCC but malignant tumor
(Feb 2006)

A: GPs prepared by
isoelectric focusing

B: recombinant Ag

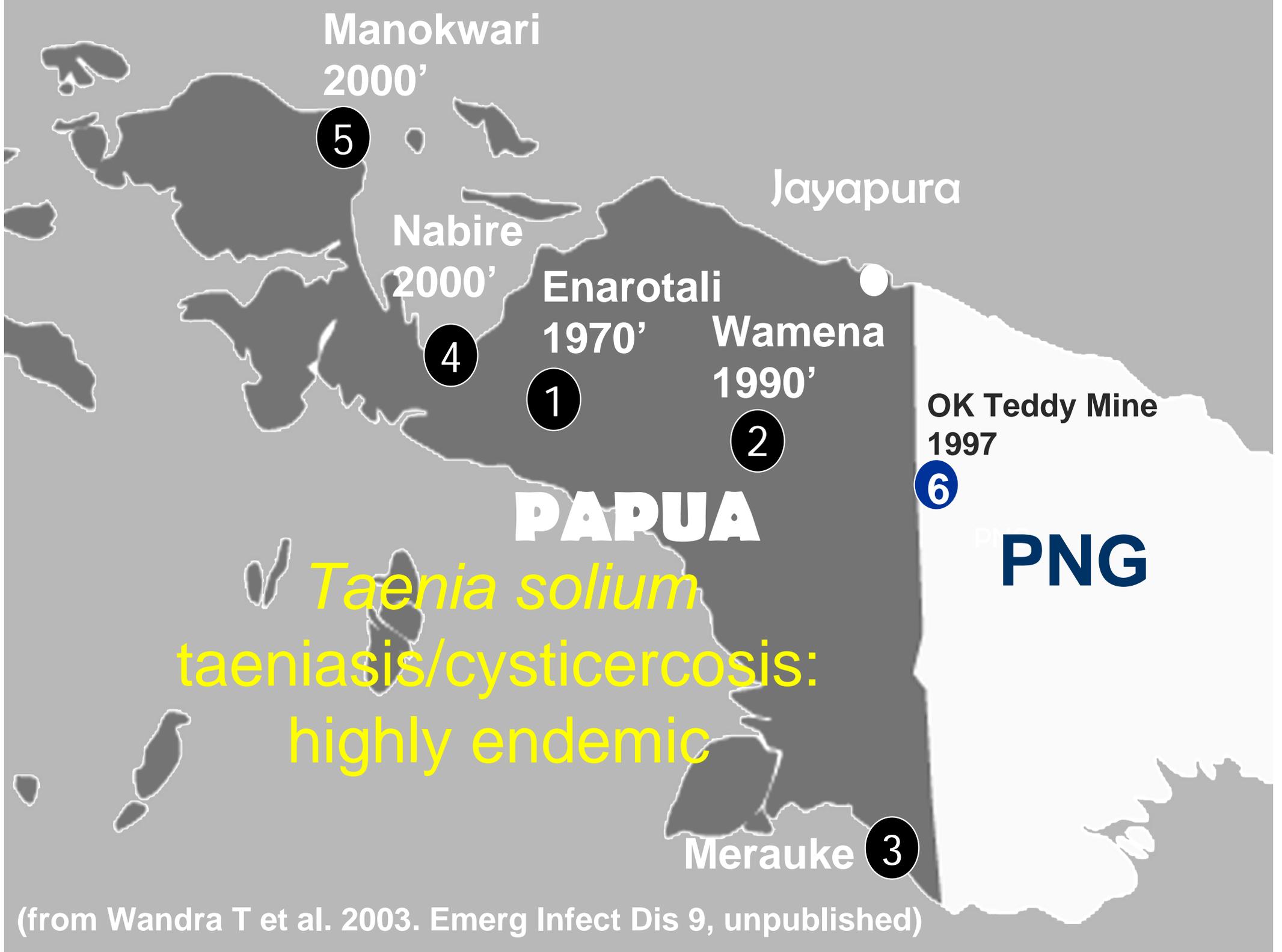
(see Sudewi RAA et al. 2007. Trans R Soc Trop Med Hyg 101: in press)



Taenia saginata in Bali

very common in local residents

(Wandra T et al. 2006. Trans R Soc
Trop Med Hyg 100: 346-353)

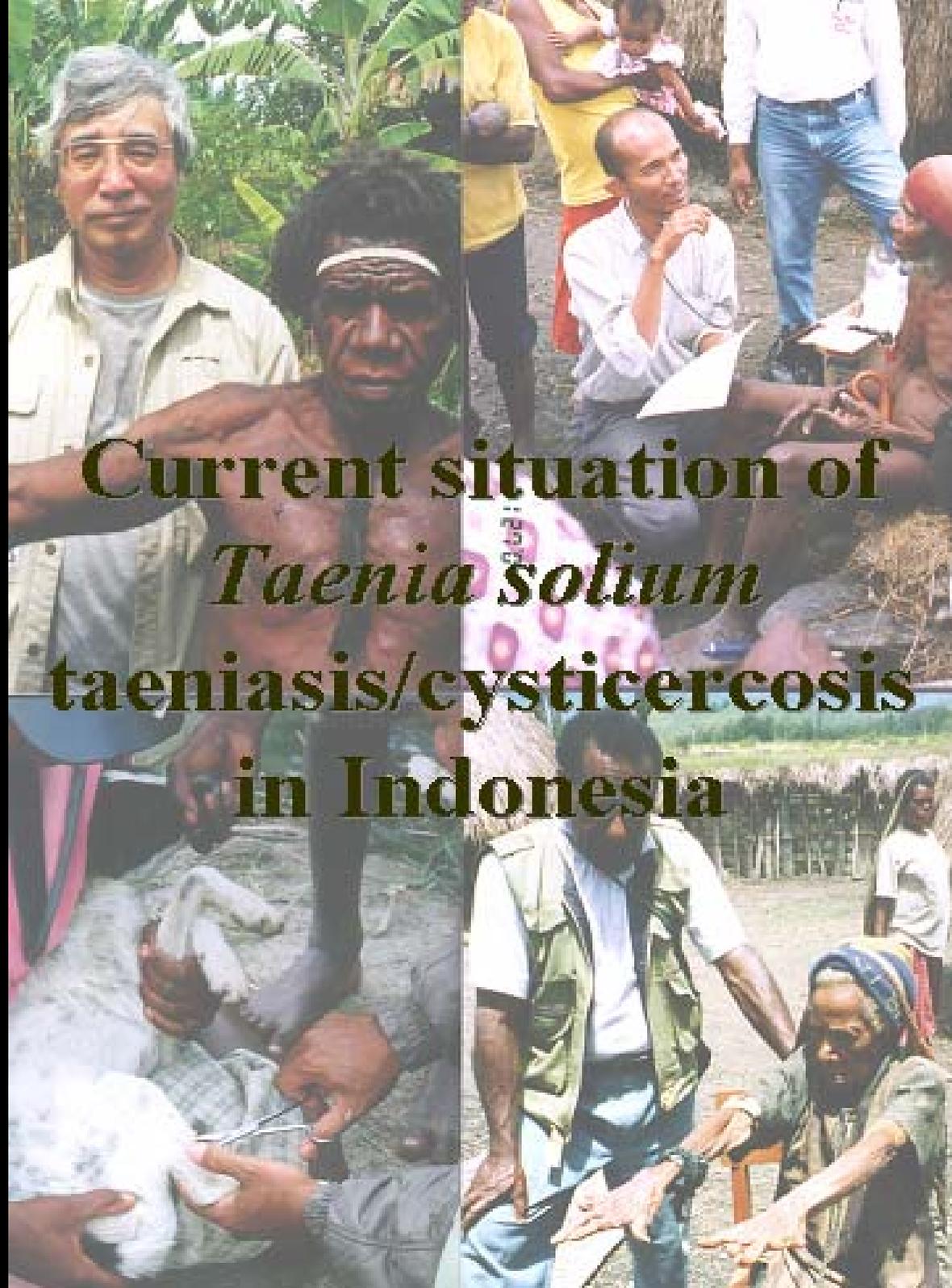


(from Wandra T et al. 2003. Emerg Infect Dis 9, unpublished)

Neuro-cysticercosis (NCC) in Irian Jaya, Indonesia



Pigs and dogs have free access
to human feces



Current situation of
Taenia solium
taeniasis/cysticercosis
in Indonesia



Traditional tongue examination
for porcine cysticercosis



The dog was suspected to be infected with
T. solium cysticerci
by highly specific antibody-ELISA and IB
(Ito A et al. 2002. J Helminthol 76)

Taeniasis of *T. asiatica* is still endemic in Samosir island, north Sumatra!

(Wandra et al. SEAJT MPH 2007: 38,
Trop Med Health in press)



T. asiatica

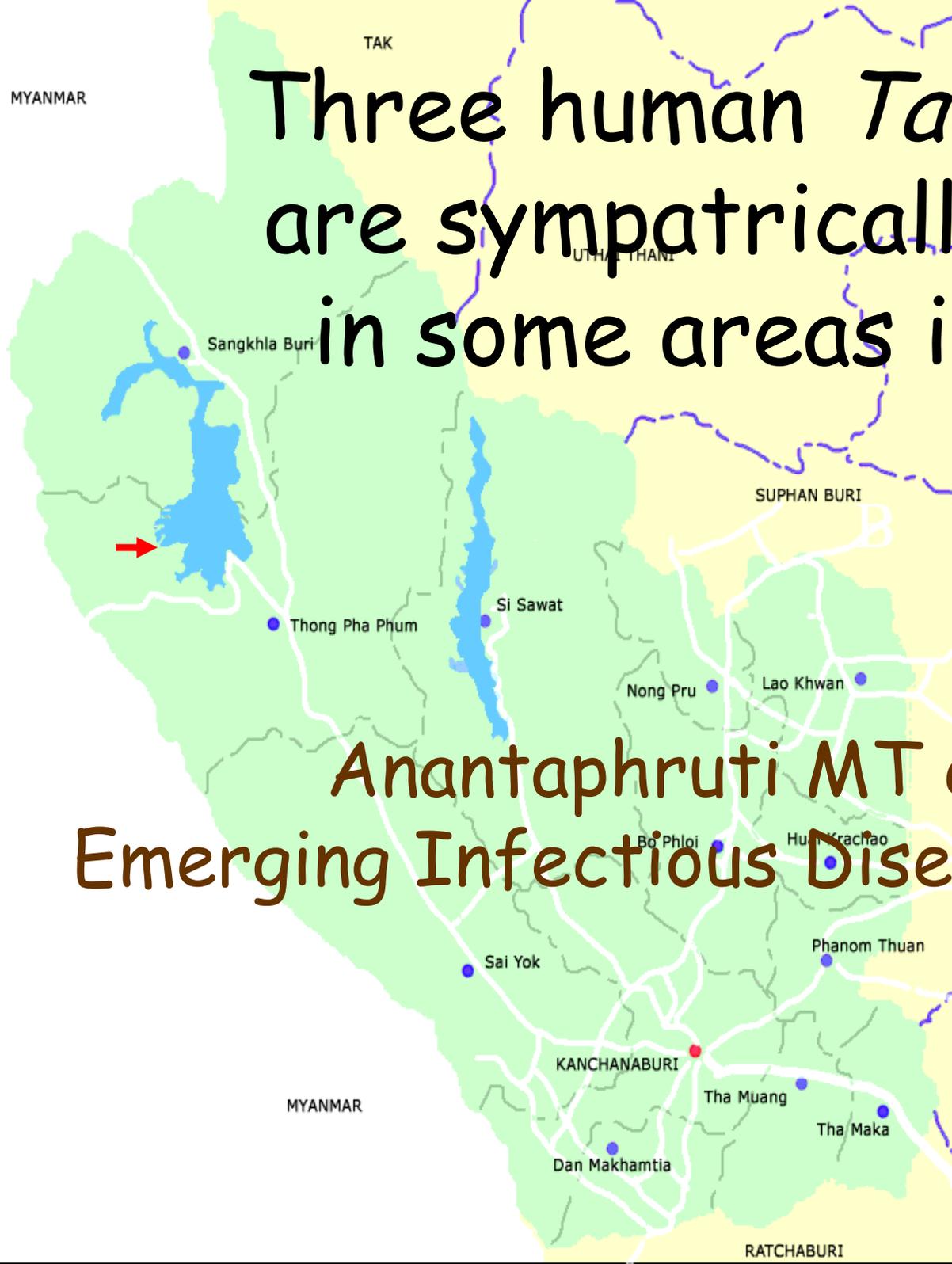


In Indonesia,

there is no area where
three human taeniid species are
sympatrically occurring

(Wandra et al. Parasitol Int 2006:
55 Supplement; SEAJTMPH 2007:
38; Trop Med Health in press).

Three human *Taenia* species
are sympatrically occurring
in some areas in Thailand



Anantaphruti MT et al. 2007.

Emerging Infectious Diseases 13, 1413-1416

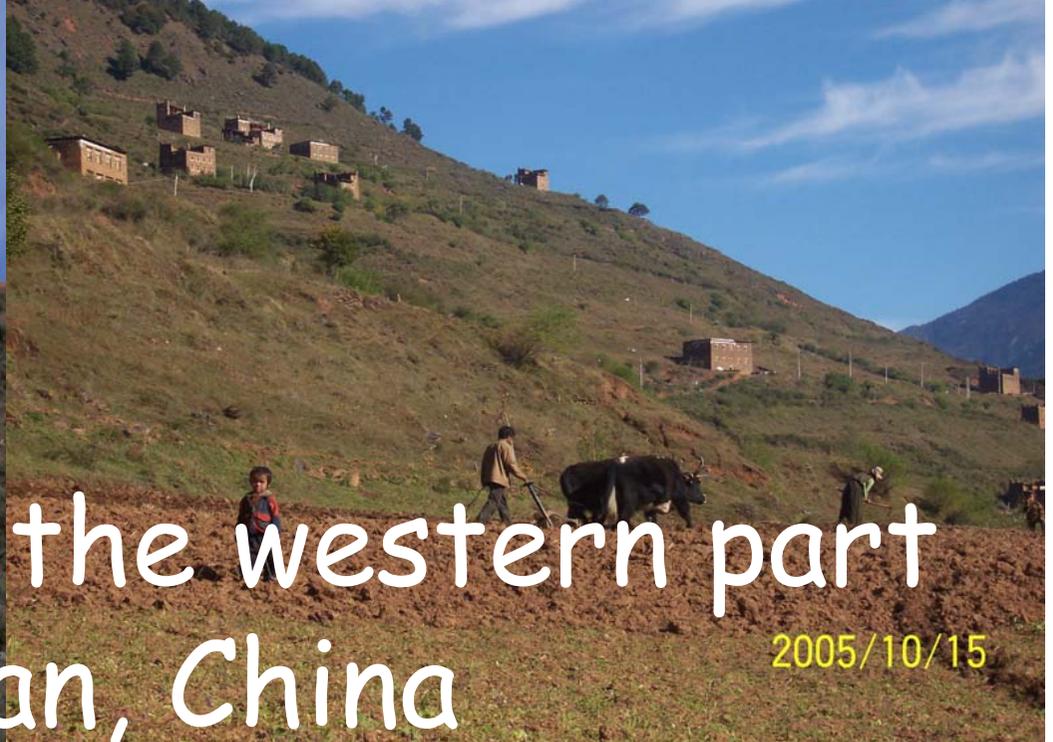
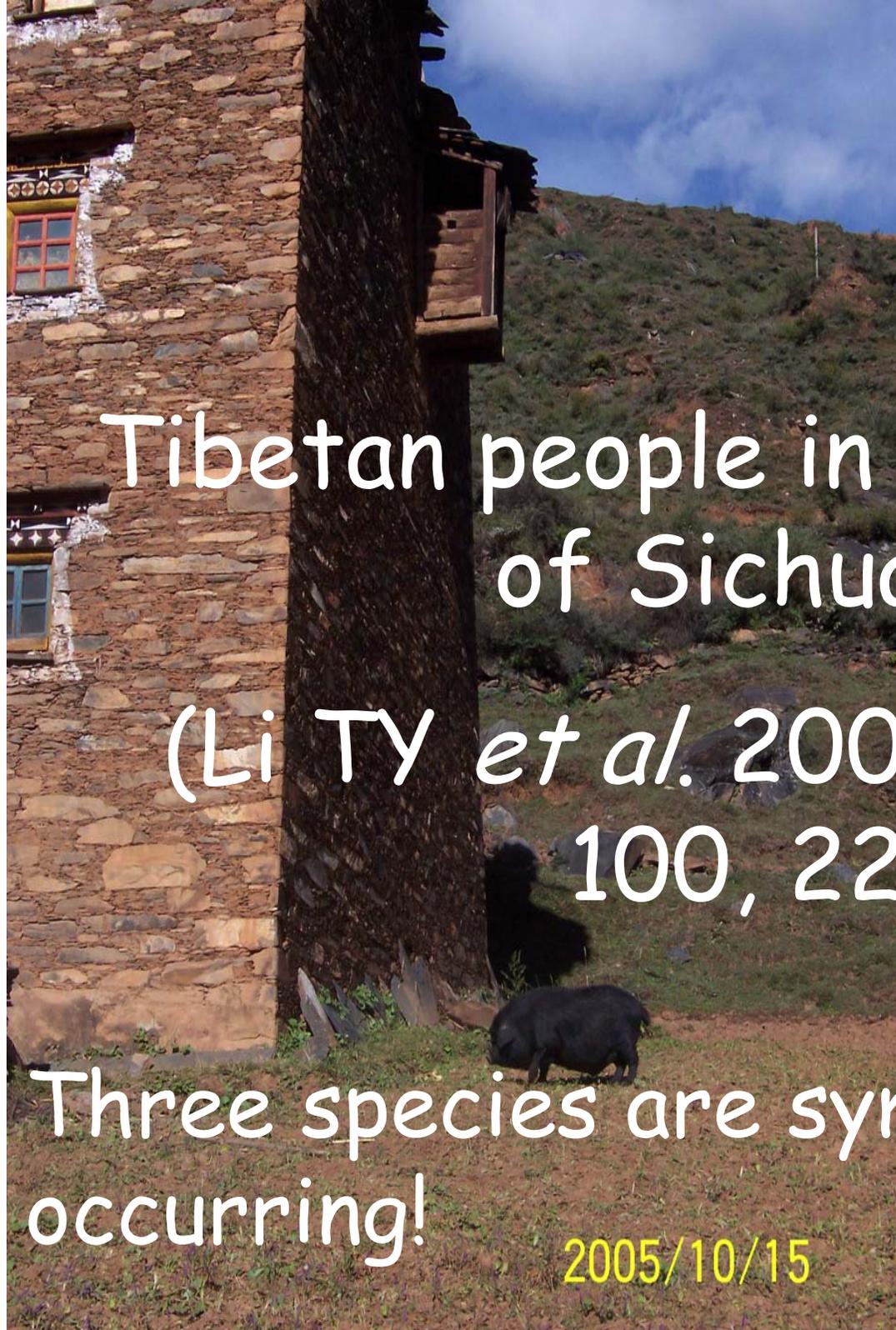
Three worms were expelled from one patient in Thailand 2004 (Anantaphruti MT *et al.* 2007 EID 13, 1413-1416)



2 Taenia solium



Taenia saginata
or
Taenia asiatica



Tibetan people in the western part of Sichuan, China

2005/10/15

(Li TY *et al.* 2006. *Acta Tropica* 100, 223-231)

Three species are sympatrically occurring!

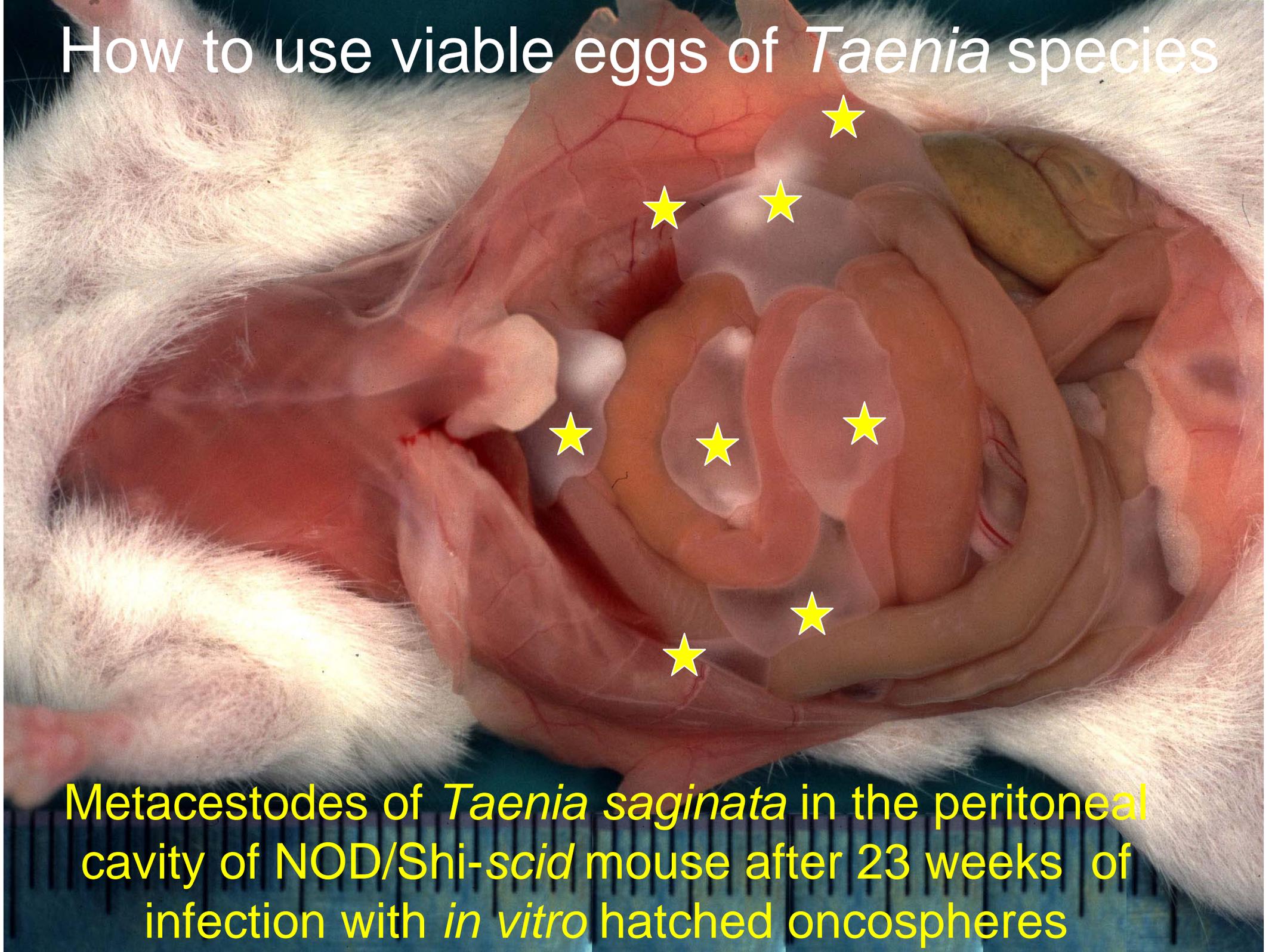
2005/10/15



2005/12/20

T. asiatica has been confirmed
from
Taiwan, China, Korea, Indonesia,
Philippines, Vietnam, Thailand
through our collaboration projects.

How to use viable eggs of *Taenia* species



Metacestodes of *Taenia saginata* in the peritoneal cavity of NOD/Shi-scid mouse after 23 weeks of infection with *in vitro* hatched oncospheres

Huge number of metacestodes of

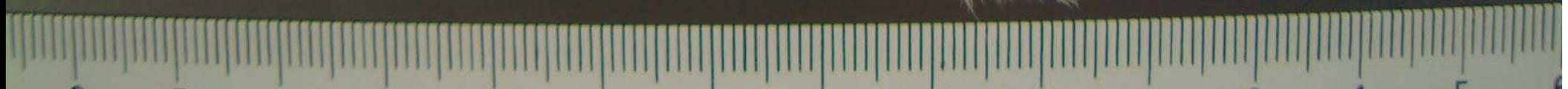
Taenia asiatica

after 19 weeks of inoculation with

in vitro hatched oncospheres

in a NOD/Shi-*scid* mouse

from Nakaya K et al. Parasitol Int 2006; 55Supplement



"A long-standing puzzle that adult taeniid tapeworms expelled from people in Asia-Pacific seem to be *T. saginata*, the beef tapeworm, although these people eat pork rather than beef"

has been resolved

not to be *T. saginata* but to be *T. asiatica*.

We have to re-evaluate all *T. saginata* worms in the world when the patients were from Asia-Pacific or having visiting or living history in Asia-Pacific.

Summary

1. Three human *Taenia* species are occurring in Asia-Pacific. Taeniasis may be detected by several tools.
2. Molecular identification of these human *Taenia* species is feasible.
3. Serology is highly useful for detection of NCC.
4. Confirmation of NCC is based on neuroimaging, serology, histopathology and molecular identification.
5. *T. saginata* in the world as well as in Asia-Pacific should be re-evaluated by molecular tools (Ito et al. 2003. Lancet 362, 1918-20).