Dynamic changes of malaria epidemiology in Southeast Asia and South Pacific area and researches for next steps of control

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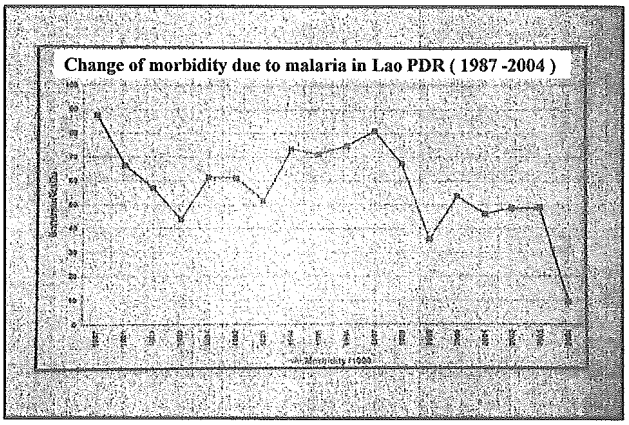
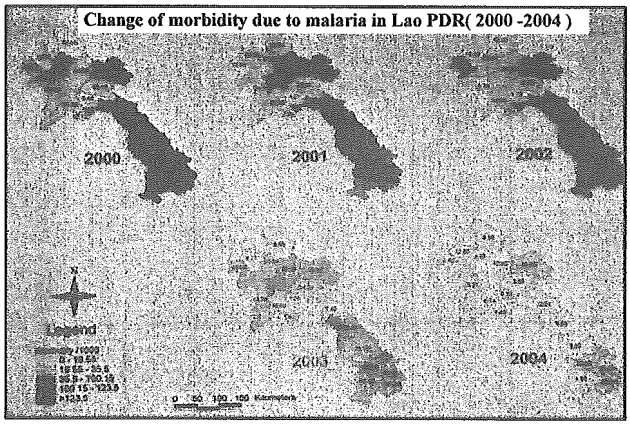
Project title: Construction of net work on epidemiology and control of malaria in Asia and South Pacific area

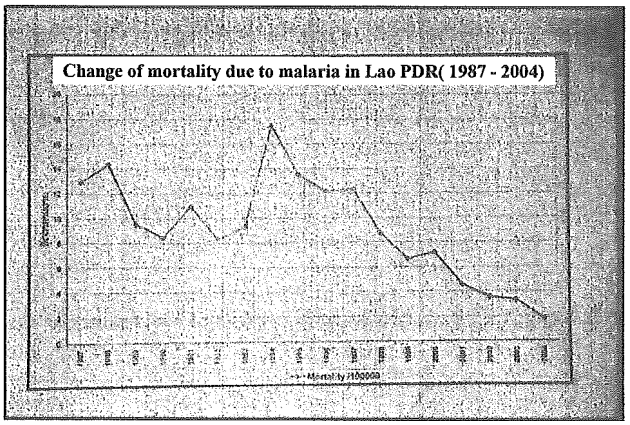
Introduction: Because of the recent progress of malaria control, mortality and morbidity due to *Plasmodium* infection have dramatically decreased in Asia and South Pacific area. This change in epidemiology has resulted in inadequacy of the indicators and systems that had been used for many years. Drug resistant malaria still poses a significant public health threat to the world. The design and incorporation of chemotherapeutic intervention may be essential for the next step of malaria control. In order to promote communication and exchange of the information of malaria, network of institutes among Asian countries and South pacific areas should be constructed and strengthened.

Dynamic changes in epidemiology of malaria in Southeast Asia

Because of the success of big malaria control program such as Mekong malaria control, morbidity and mortality due to *Plasmodium* infection have dramatically improved in Southeast Asia. Before the beginning of Mekong malaria control program, successful cases of malaria control had been reported in Vietnam and Thailand. Decrease of morbidity and mortality has been recently reported in Cambodia, Lao PDR and Mynmer.



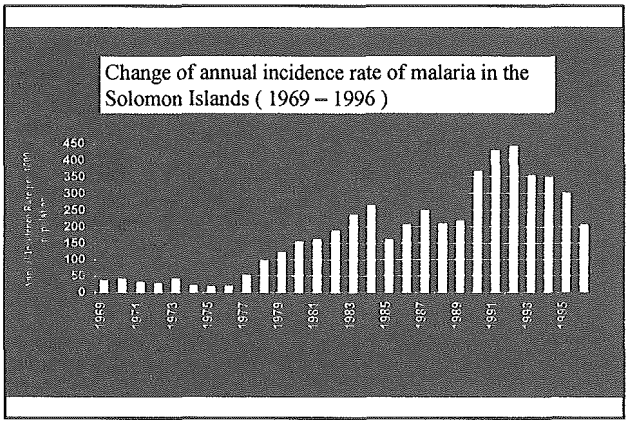


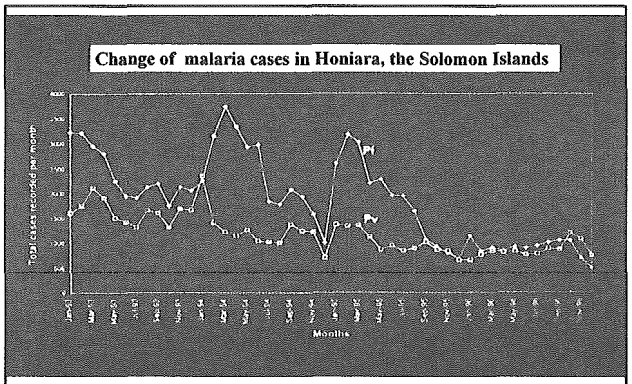


Dynamic changes in epidemiology of malaria in South Pacific islands

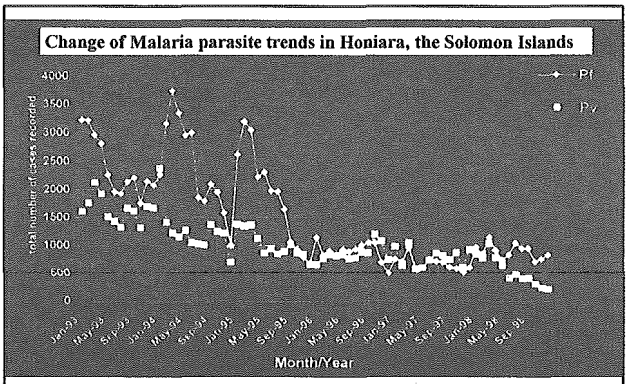
Some south pacific countries such as Papua New Guinea and Solomon Islands have been known as heavy endemic areas of malaria. But symptoms of *P. falciparum* infection are moderate in this area, and this situation has been reported as Pacific enigma(Holo- or hyper endemic area but low mortality and low morbidity, Maitland K . et al., 1997, 1998. Sanual A. et al., 1998).

Because of intensive malaria control program in the 1990s, annual incidence of malaria has decreased in Solomon Islands. Prior to distribution of insecticide treated bed net in 1994 and 1995, chemotherapeutic intervention has used since 1996.

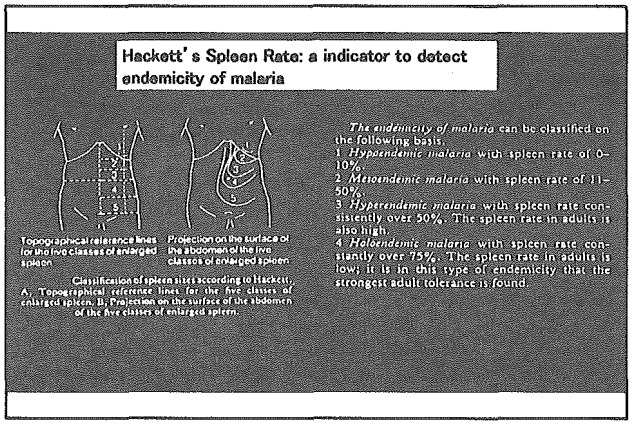


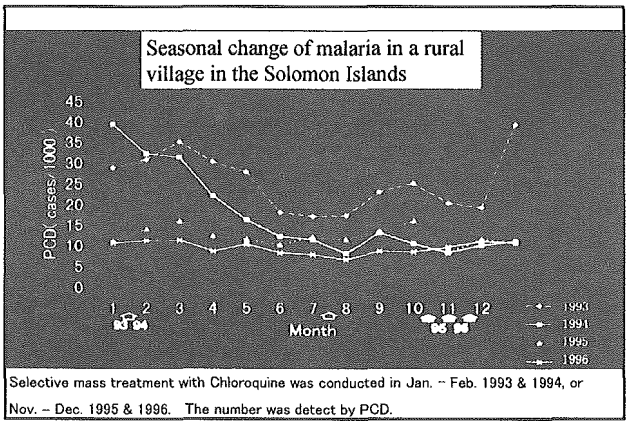


Selective mass treatment with chloroquine was introduced in the beginning of rainy season (January and February) of 1996. The number was detected by passive case detection(PCD).



Selective mass treatment with chloroquine and primaquine was introduced in the beginning of rainy season of 1998. The number was detected by PCD.





Selective mass treatment with Chloroquine was conducted in Jan. – Feb. 1993 & 1994, or Nov. – Dec. 1995 & 1996. The number was detect by PCD.

Progress of malaria control program and changes of indicators to detect the endemicity in a rural village of Solomon Islands

	Aug. 93	Jan. 94	Jan. 95	Jan. 96	Dec. 96	Jan. 98
Parasite rate						
2 – 9	70.6	71.8	62.3	44.3	42.3	32.3
2 - 14	64.3	65.8	57.7	41.3	36.8	28.9
Accuracy of clinical diagnosis						
Sensitivity	36.7	32.5	18.9	15.4	11.1	10.2
Specificity	59.1	73.0	83.5	90.0	93.3	94.2
Spleen rate						
Hackett	76.1	23.6	19.0	12.0	10.3	9.7
Detection by US	77.5	64.2	52.3	40.5	34.2	25.5

%

Malaria control program and its success in the Solomon islands.

- The first step (1994, 1995) Use of insecticide treated bed net
  Effect: Decrease of symptomatic malaria patients
  No change of seasonal trends in the number of malaria patients
- The second step (1996-1998) Use of insecticide treated bed net +
  Selective mass treatment in the beginning of rainy season
  Effect: Decrease of symptomatic malaria patients
  No dynamic decrease of parasite rates
  No seasonal trends in the number of malaria patients

Because of ethnic tension, they had no national control program of malaria since 1999 to 2002. They have recently had no big re-emerging of *P. falciparum* infection.

Chemotherapeutic control program and dynamic change in malaria epidemiology

- After the introduction of selective mass treatment with Chloroquine, the number of *P. falciparum* infection has dramatically decreased. But the number of *P. vivax* infection has not decreased.
- After the intensive chemotherapeutic intervention with Chloroquine, parasite rate has not decreased dramatically. Passive case detection(PCD) by reportin from clinics and hospitals was not enough to detect the endemicity of malaria.
- And some indicators such as Hackett' s spleen rates and febrile or shivering episodes among village people have become insufficient to detect the endemicity of malaria.
- After the introduction of selective mass treatment with chloroquine and Primaquine, the number of *P. vivax* infections has decreased.

Change in the trends of imported cases of malaria in Japan (1984 – 1998)

	Pf				Pv				Po	Pm
year	Arfica	Southeast Asia	South Asia	South America	Arfica	Southeast Asia	South Asia	South America	total country	total country
1984	5	0	0	0	2	0	6	0		
1985	3	2	1	0	1	2	2	0		
1986	4	2	0	0	1	5	5	0	2	2
1987	2	2	1	0	2	0	3	0		
1988	8	1	1	0	1	3	3	0		
1989	5	3	0	0	1	2	3	0		
1990	3	1	1	0	3	4	6	2		
1991	6	4	0	1	0	5	3	0		
1992	3	1	1	0	0	0	5	0		
1993	7	0	1	0	1	6	1	0		
1994	8	2	3	0	2	1	3	1		
1995	6	1	0	0	0	1	1	0		
1996	8	2	0	0	1	1	3	1		
1997	15	1	1	0	5	6	5	3		
1998	23	4	0	0	3	3	3	0		
total	106	31	10	1	23	39	62	7	2	2

The patients with >0.1% parasitemia are listed.

Imported cases of *P.falciparum* infection from Southeast Asian and South Pacific countries

Pf	Myanmar	Lao	Thailand	Philippines	Indonesia	PNG	Africa
1984							5
1985				2			3
1986					1	1	4
1987						2	2
1988						1	8
1989			1		2	1	5
1990				1			3
1991			2	1	1		6
1992				1			3
1993							7
1994		1			1		8
1995					1	1	6
1996				1		2	8
1997	1						15
1998		3	1	1	1	3	23
Total	1	4	4	7	7	11	106

The patients with >0.1% parasitemia are listed.

Imported cases of *P.vivax* infection from Southeast Asian and South Pacific countries

	Myanmar	Laos	Thailand	Singapore	China	Taiwan	Philippines	Indonesia	PNG	Africa
1984			1							2
1985							1	1		1
1986			2		1	1(?)	1		2	1
1987										2
1988			1		1		1			1
1989								1	1	1
1990								2	2	3
1991	4		1							
1992										
1993			1					1	3	1
1994				1(?)						2
1995									1	
1996		1	1							1
1997	1		1	1(?)				4	1	5
1998								2	1	3
Total	5	1	8	2(?)	2	1(?)	3	11	11	23

The patients with >0.1% parasitemia are listed.

The trend in imported cases of P. vivax infection from South Asian countries

	India	Sri Lanka	Nepal	Pakistan
1984	3(gh)	1(h)	2(h)	1
1985	1			1
1986	3(j)		1(j)	2
1987	1	1		1
1988	3			
1989	2			1
1990	4	1	1	
1991	2			1
1992	4(k)	1	1(k)	
1993	1			
1994	3	1(l)		
1995	1			
1996	3			
1997	5			
1998	3			
total	39	5	5	7

The case with >0.1% parasitemia was listed

Change in the trends of imported cases of malaria in Japan

- The number of imported cases of *P. falciparum* from Africa has recently shown rapid increase. Most of the imported cases of *P. falciparum* infection are from Africa.
- In spite of rapid increase of the number of people going South Asian countries, the number of imported cases of malaria from this area has not increased.
- We have had some imported cases of *P. vivax* infection from South Asian countries, especially from India.

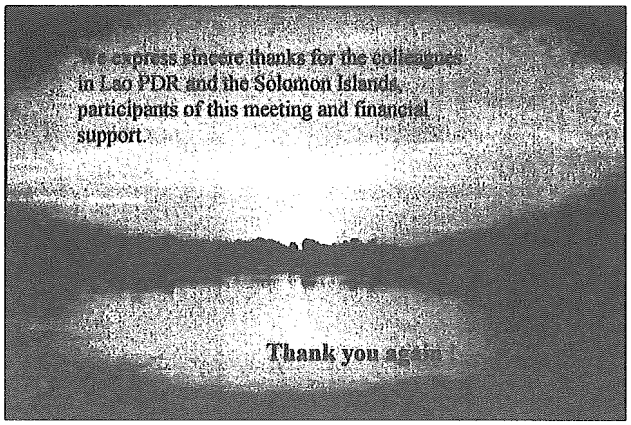
Useful information for network system on malaria and next step of control

- Dynamic change of epidemiology
  - Seasonal or local trends of malaria infection
  - Change of morbidity
    - The shift from symptomatic severe cases to asymptomatic moderate cases.
    - The shift from *P. falciaparum* Infection to *P. vivax* infection
    - Morecular basis for difference of morbidity and drug resistance
    - Necessity of new indicators and investigation on morecular and pathological basis of new investigators

PCD and some present indicators are not enough to detect dynamic change of epidemiology. Further investigation are necessary on new indicators to detect the endemicity of malaria and good combination of PCD and ACD. Adequate monitoring system is expected for low malaria endemicity.

Useful information for network system on malaria and next step of control

- The role of chemotherapeutic intervention
  - Targeting population, Best season, Duration, Frequency,
  - Choice of anti-malarial agents
- Standardization of system for treatment
  - Detection of drug resistance
  - Detection of G6PD deficiency
- Mathematical modeling
  - Good control plan from the socioeconomic aspects
  - Prevention of re-emerging



Mathematical model of Malaria transmission and control
Re-emerging of vivax in Korea

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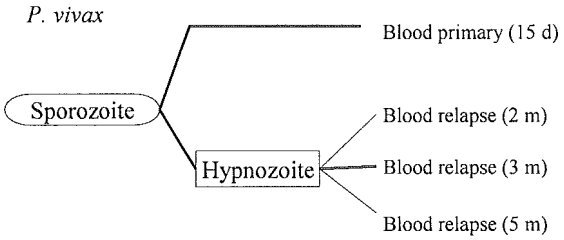
Graduate School of Environmental science, Okayama Univ.
Jan 31-Feb 1, 2006, at NIID

Mathematical model of *P. vivax*

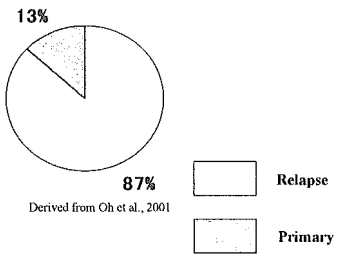
Plasmodium vivax Malaria

- Transmission Process
  - *Indirect Transmission*
  - Influenced by Mosquito Density & Seasons
- Relapse
  - Hypnozoites

Exoerythrocytic development



Ratio of Primary infection to Relapse

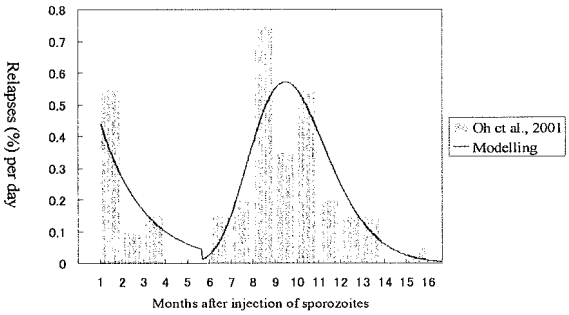


Derived from Oh et al., 2001

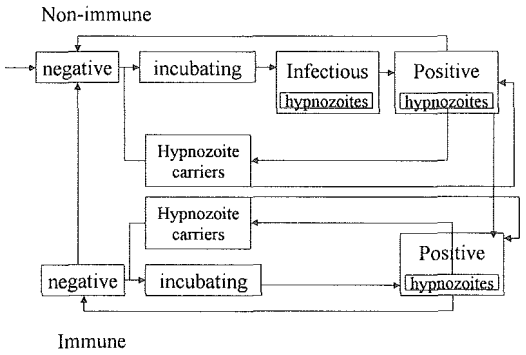
Derived from Park et al., 2003

Derived from Kim, 2001

The distribution of the latent period of relapses in South Korea



Basic Model Scheme (*P. vivax*)



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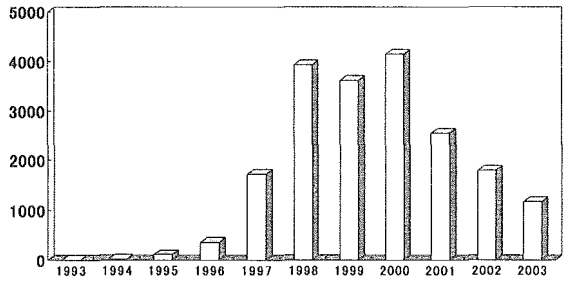
Re-emerging *Plasmodium vivax* malaria in Demilitarized Zone, Korea

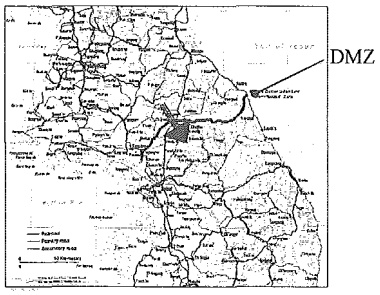
Presumption

Malaria cases in the Republic of Korea, 1993-2003



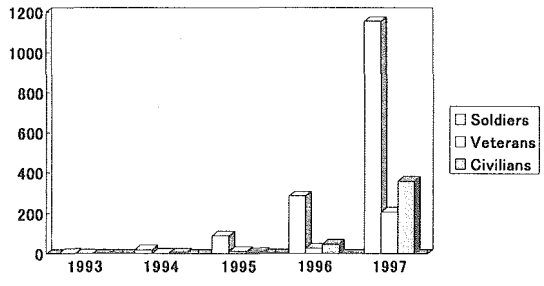
Derived from Park et al., 2003; Yeom et al., 2005 9

Re-emerging vivax malaria in South Korea



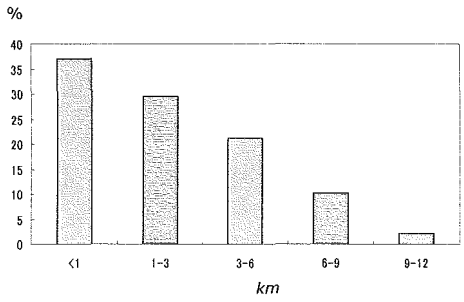
By Perry-Castañeda Library Map Collection University of Texas 10

Re-emerging vivax malaria in South Korea



Derived from Park et al., 2003 11

Flight of *An. sinensis*



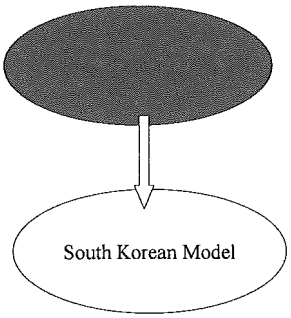
Derived from Cho et al., 2002 12

Korean Model

Construction of North Korean Model & South Korean Model

N. K. Model operates on S. K. Model one-sidedly

Malaria Models for DMZ



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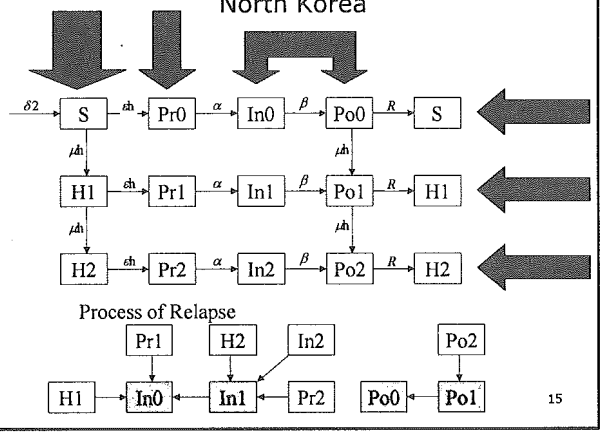
Scheme of malaria model for North Korea



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Features of South Korean model

- State of medical treatment for malaria in South Korea
  - All patients are dosed with chloroquine and treated radical cure, then they are cured and have no hypnozoites.
- Influence of the prevalence in North Korea
  - The influence depends on the distance from DMZ to the target region.

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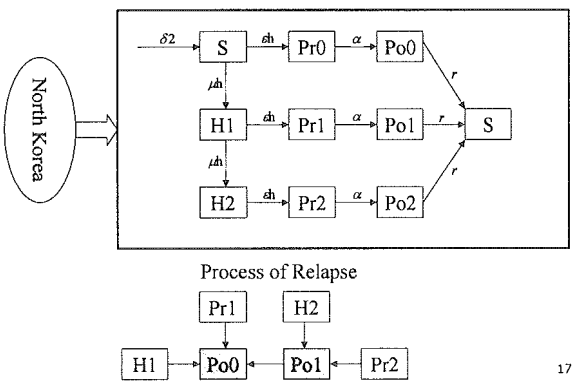
Scheme of malaria model for South Korea



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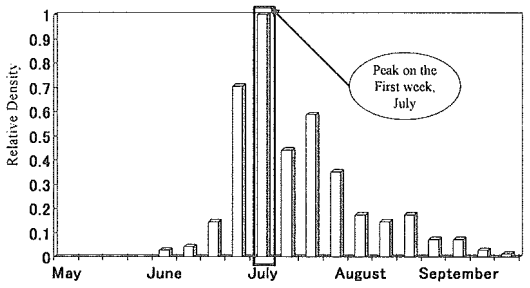
Seasonal variation in malaria incidence

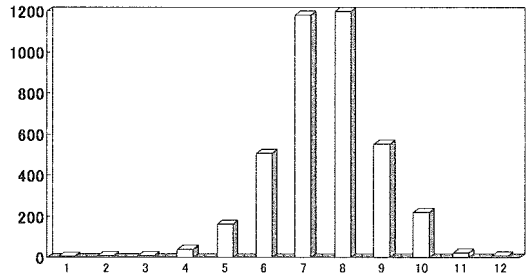
Seasonal variation in the density of An. sinensis



Derived from Lee et al., 2002

19

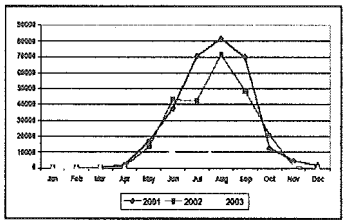
Number of reported cases of malaria in South Korea, by month, in 1998



Derived from NIH Korea, 2003

20

Number of reported cases of malaria in DPR Korea, by month, in 2001-2003



Derived from Vason Pinyowiwat
Medical Officer, CDS/CSR WR Office, DPR Korea

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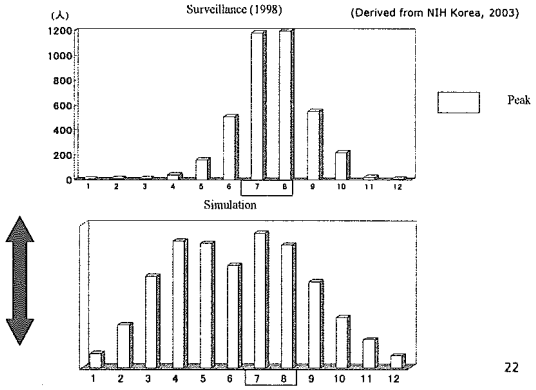
Variation of Incidences by month



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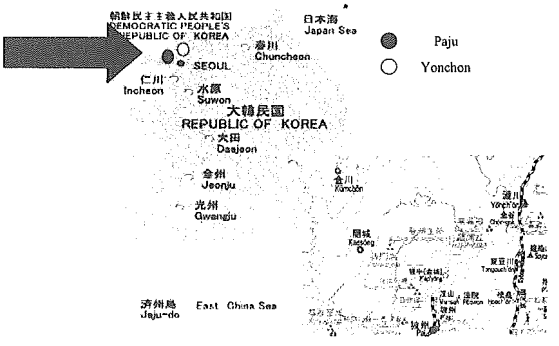
Simulation

Yonchon, Paju
near DMZ in South Korea

Study Areas



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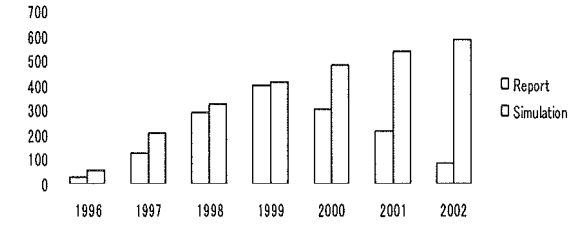
Yonchon in South Korea

Number of civilian cases per 10^5 (dis=14)

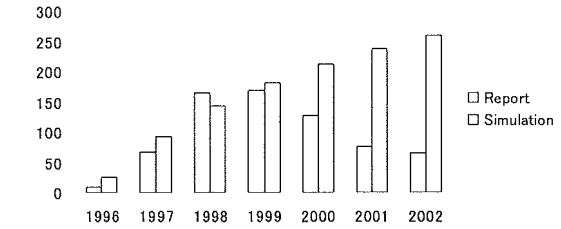


Derived from CDMR 2003; Moon 2001; Lee 1998; Park 2003

25

Paju in South Korea

Number of civilian cases per 10^5 (dis=21)



Derived from CDMR 2003; Moon 2001; Lee 1998; Park 2003

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Reduction Factors of malaria cases

Reduction factor ①

- Shortening the Diagnosis period

Year	1995	1997	1999	2000
Diagnosis period (days)	23.6	13.6	11	5

Derived from Lee et al., 1998; Lee et al., 2001

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Reduction factor ②

- Reduction of mosquito density in 2001

  ➢The persistence of dry weather caused a drastic retrenchment of mosquito density in 2001 in Korea

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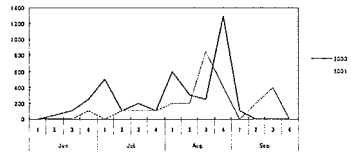
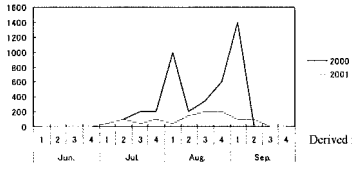
Reduction of mosquito density

Yonchon



Cheolwon



Derived from Yeom et al., 2005

30

Reduction factor ③

- Reduction in prevalence of malaria in DPR Korea
  - National malaria control activities started in DPR Korea in 1999 based on Roll Back Malaria Program (WHO).
  - R Korea gave assistance $500,000 in 2000.

Derived from Chol et al., 2005

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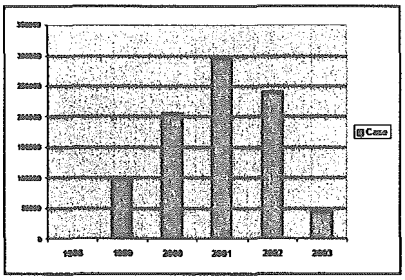
Number of reported cases of Malaria in DPR Korea, by year, 1998-2003



Derived from Vason Pinyowiwat
Medical Officer, CDS/CSR WR Office, DPR Korea

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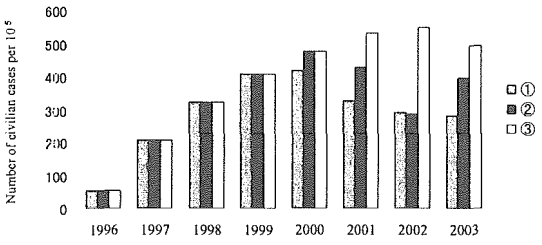
Comparison among reduction factors



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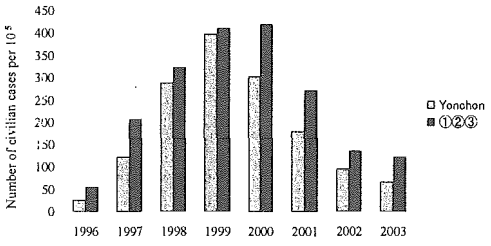
Simulation under 3 reduction factors



Derived from CDMR 2003; Moon 2001; Lee 1998; Park 2003

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Conclusion

- Construction of mathematical models for transmission of vivax malaria near DMZ regions
- Simulating the process of re-emerging malaria in several regions (Paju, Yonchon)
- Estimating the control factors on the prevalence of malaria

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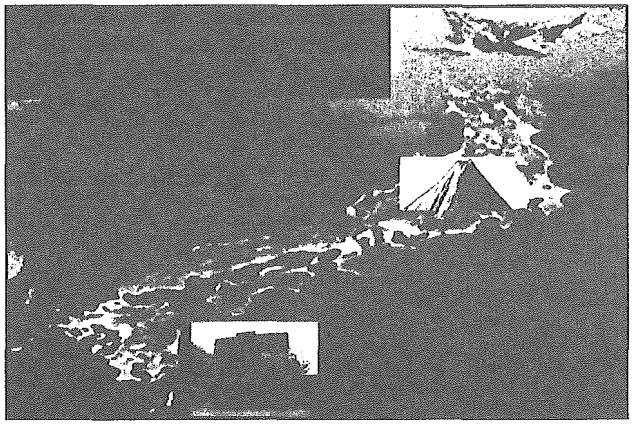
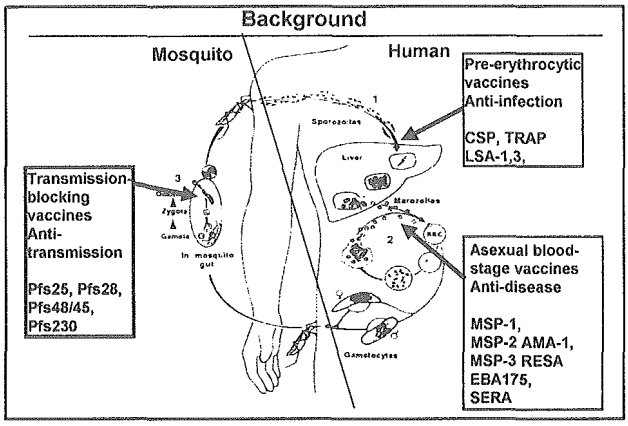
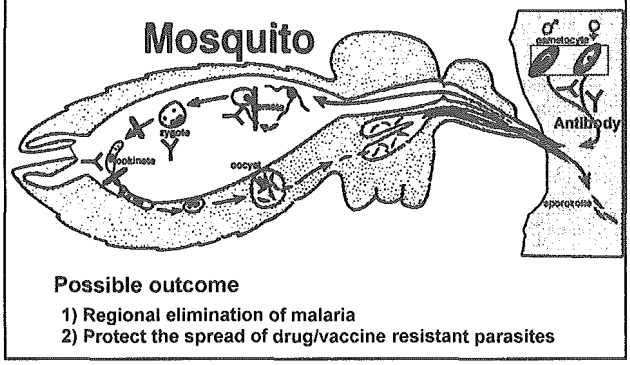


Background



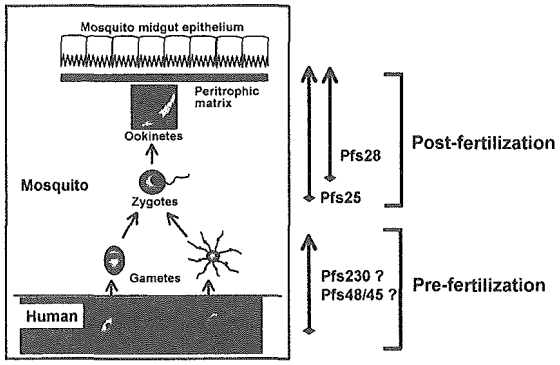
Mechanism of malaria TBV



Possible outcome

1) Regional elimination of malaria
2) Protect the spread of drug/vaccine resistant parasites

Current TBV candidates are limited

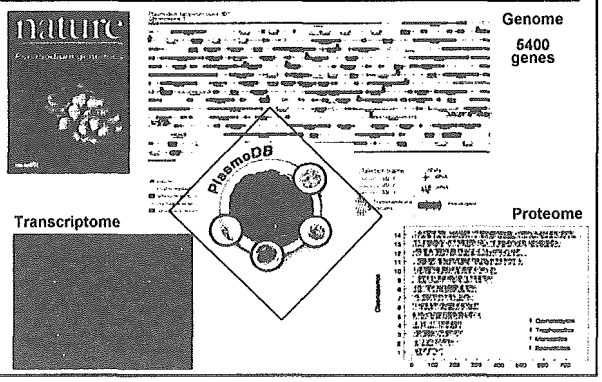


Aim

Novel antigen discovery for Transmission-blocking vaccines:

Post-genome approach

Target selection: stage specifically expressed molecules

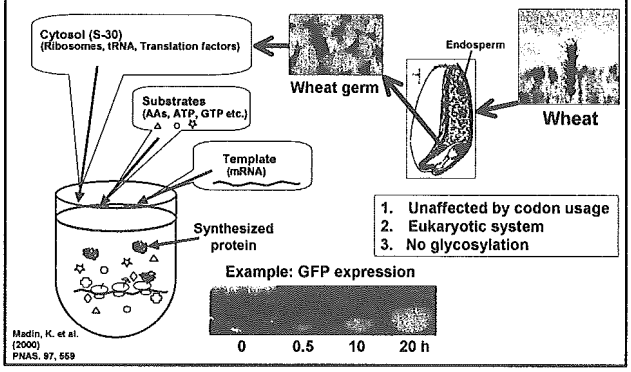


Methods

- How to do?
  - Recombinant protein expression
- Requirement for the protein expression method
  - Not affected by codon usage
  - Proper folding is necessary
  - No glycosylation
- Traditional methods are contradictory
  - *E. coli*, Yeast, Insect cell, virus, etc.
- Selection of protein expression system
  - *TRY NEW METHOD!*
    Wheat germ cell-free system

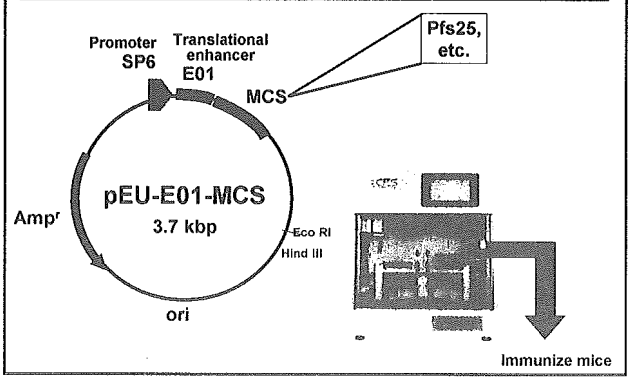
- What is wheat germ cell-free expression system?
- Proof-of-principle : Pfs25 expression
- Genome wide expression of falciparum proteins
- Screening strategy of novel TBV candidates

Wheat Germ Cell-free Protein Expression System

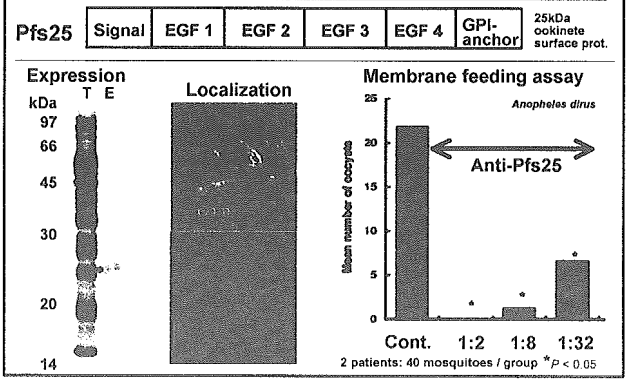


- What is wheat germ cell-free expression system?
- Proof-of-principle : Pfs25 expression
- Genome wide expression of falciparum proteins
- Screening strategy of novel TBV candidates

Large scale wheat germ cell-free expression

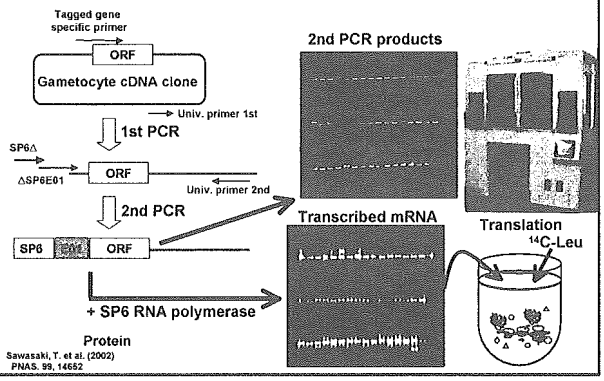


Anti-Pfs25 sera completely block transmission of *P. falciparum*

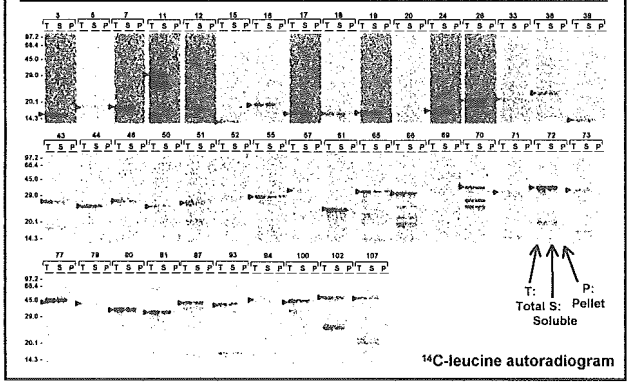


- What is wheat germ cell-free expression system?
- Proof-of-principle : Pfs25 expression
- Genome wide expression of falciparum proteins
- Screening strategy of novel TBV candidates

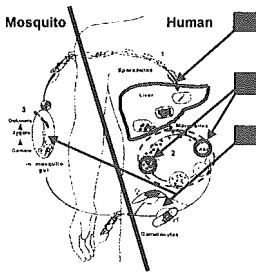
High-throughput cell-free methods



Most of the expressed proteins were soluble



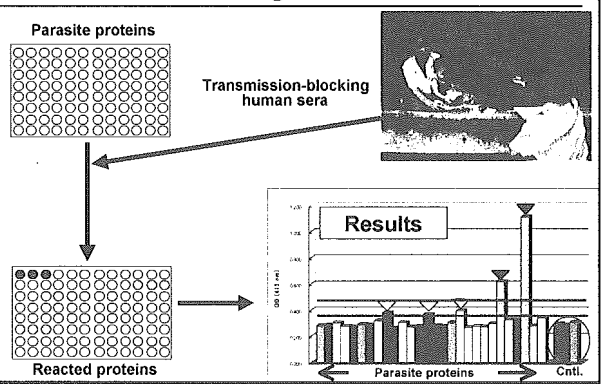
Highly efficient recombinant protein expression of *Plasmodium falciparum*



Protein expression system	Expression efficiency
Wheat germ cell-free	86%

- What is wheat germ cell-free expression system?
- Proof-of-principle : Pfs25 expression
- Genome wide expression of falciparum proteins
- Screening strategy of novel TBV candidates

Immunoscreening of TBV candidates

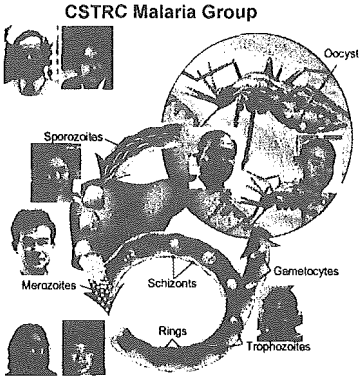


Summary and Perspectives

1. Wheat germ cell-free system is an efficient tool for the genome-wide recombinant protein expression of falciparum molecules.
2. High-throughput screening of novel malaria transmission-blocking vaccine candidates is feasible.
3. This high-throughput method is also applicable to novel antigen discovery from all the stages.

Acknowledgments

CSTRC Malaria Group



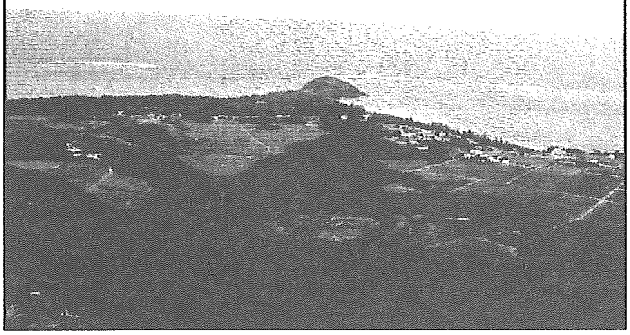
MVDB, NIAID, NIH
Sanjay Singh, David Keister, Carole Long, Allan Saul

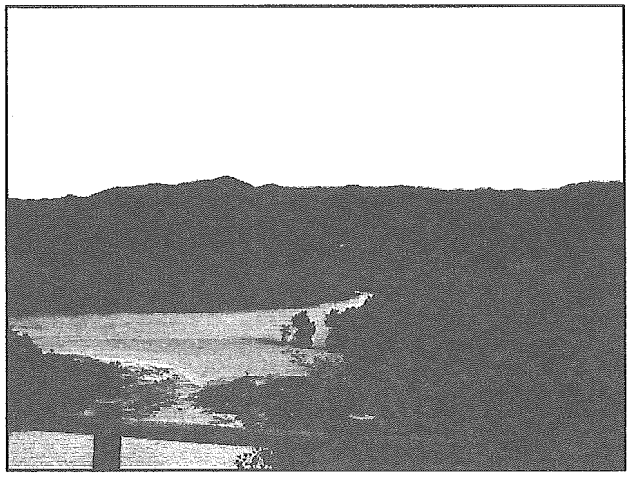
AFRIMS, Thailand
Jetsumon Sattabongkot

Facul. Sci. Mahidol Univ., Thailand
Rachanee Udomsangpetch

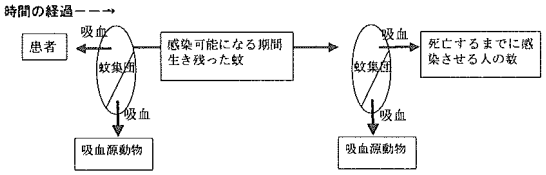
Financial support
Ministry of Health, Labour and Welfare, Japan

我が国におけるマラリア媒介蚊の生息状況





2次患者が発生するプロセス



各プロセスで媒介蚊に関連した重要な生態的形質

人吸血嗜好性 生息密度 吸血飛翔範囲	生存率	人吸血嗜好性 生息密度 吸血飛翔範囲	期待余命

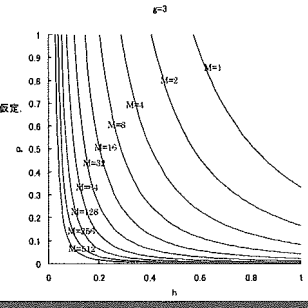
媒介蚊の生態的形質の相互関係に関する理論的推測

蚊の生息密度, M
人嗜好性, h
感染可能になるまで生き残る割合, P
感染蚊が死亡するまでに行う吸血の回数, g
簡単のために, 患者から吸血した蚊は必ず感染すると仮定.

1人の患者によって感染した蚊が死亡するまでに行う人への吸血回数(≒2次患者の発生数)＝$M \cdot h^2 \cdot P \cdot g$

マラリアが流行するためには, 1人の患者から1人以上の2次患者が発生することが条件.

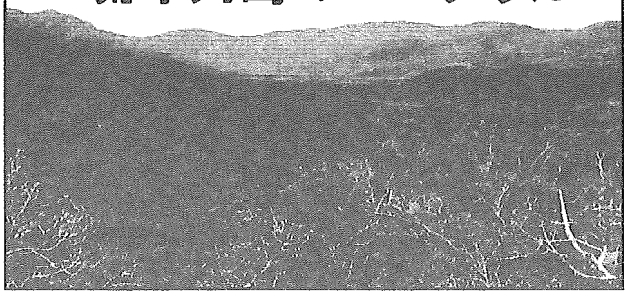
$$M \cdot h^2 \cdot P \cdot g > 1$$



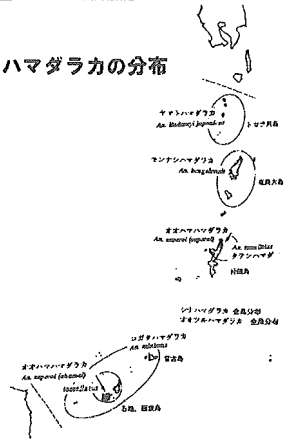
人嗜好性やマラリア原虫媒介能を考慮すると, 我国産12種のハマダラカでその分布や生息密度を問題とすべき種類は5種類である.

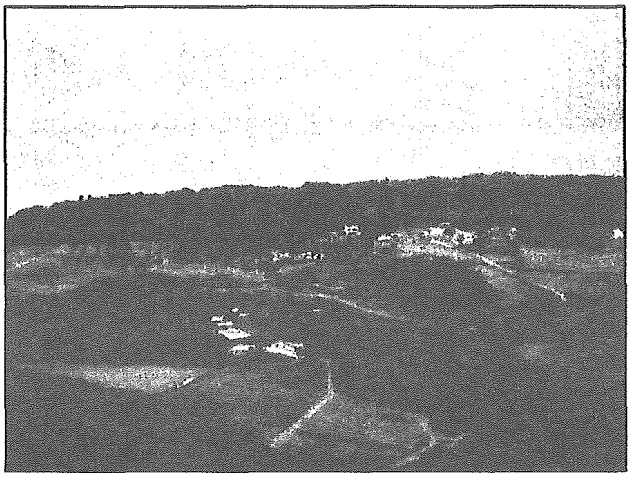
コガタハマダラカ	*Anopheles (Cel.) minimus*	琉球列島（宮古，八重山群島）
オオハマハマダラカ	*An. (Ano.) saperoi*	琉球列島（沖縄，八重山群島）
シナハマダラカ	*An. (Ano.) sinensis*	北海道，本州，四国，九州，対馬，屋久島，琉球列島，大東諸島，
オオツルハマダラカ	*An. (Ano.) lesteri*	北海道，本州，九州，琉球列島（奄美，沖縄，八重山群島）
チョウセンハマダラカ	*An. (Ano.) coreicus*	北海道，本州，四国，九州

琉球列島のハマダラカ

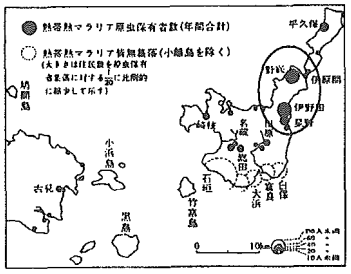


南日本におけるハマダラカの分布



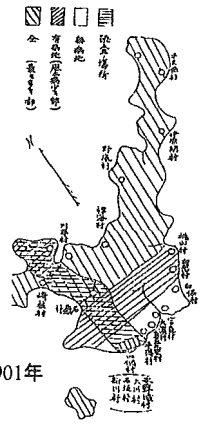


マラリア患者の分布



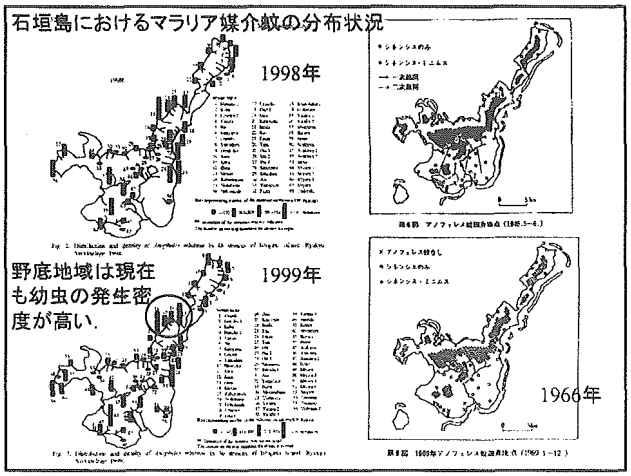
第8図 1955年八重山諸島マラリア原虫保有者分布概況

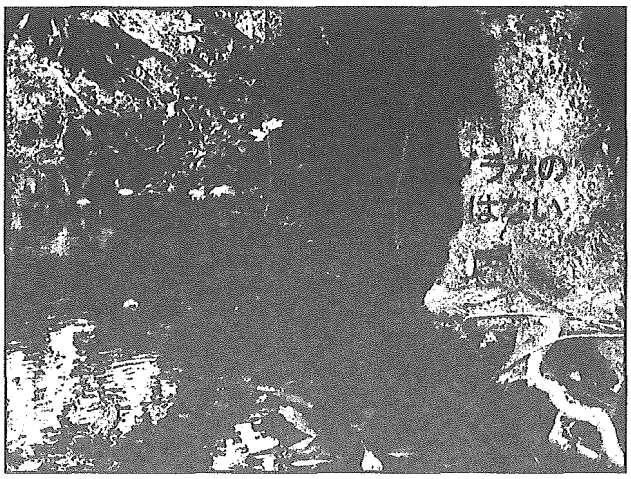
1955年



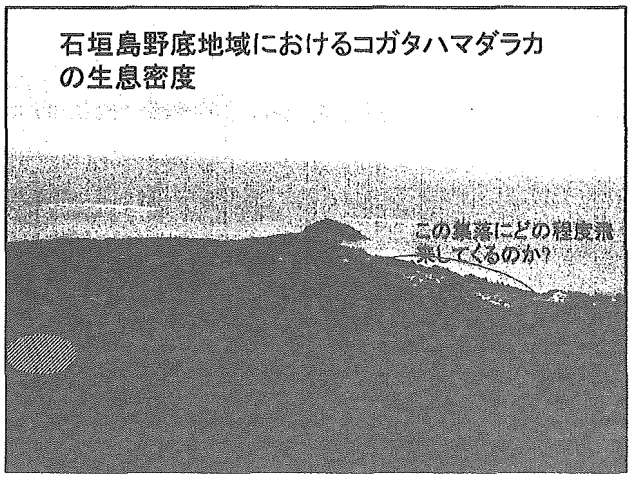
1901年

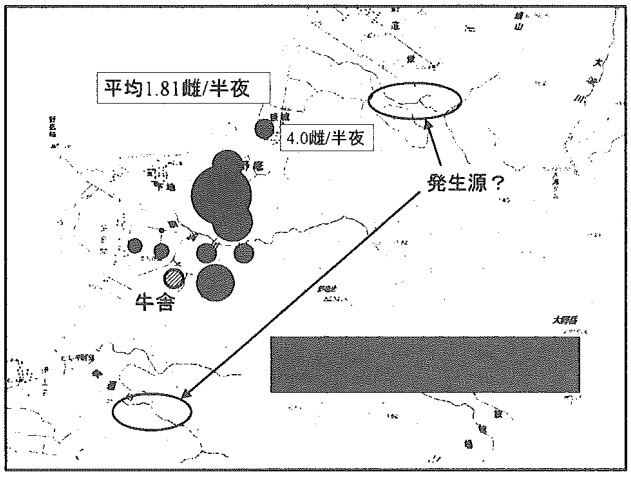
石垣島におけるマラリア媒介蚊の分布状況

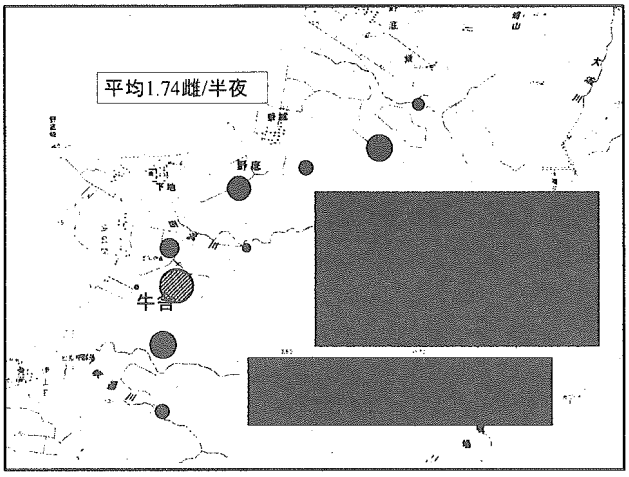




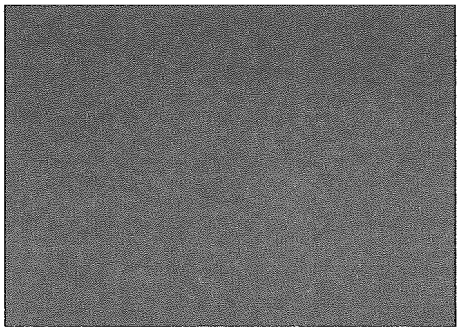
石垣島野底地域におけるコガタハマダラカの生息密度



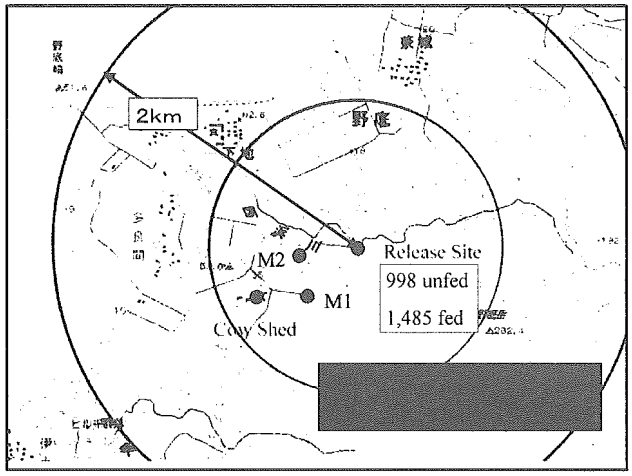




マラリア媒介蚊の飛翔範囲：既存の報告



石垣島野底地域におけるコガタハマダラカの吸血飛翔範囲



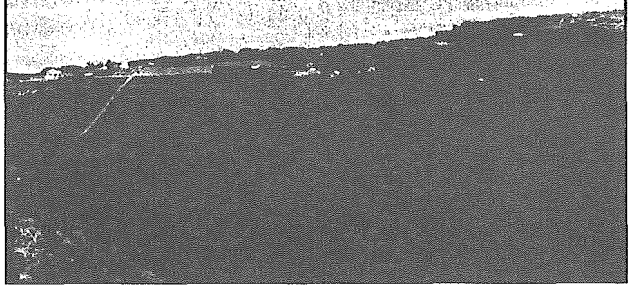
September 1999 TSUDA ET AL.: MARK-RELEASE-RECAPTURE OF *An. minimus* IN JAPAN 603

Table 1. Number of marked and unmarked *An. minimus* collected at 4 sites in March 1993 on Ishigaki Island, Japan

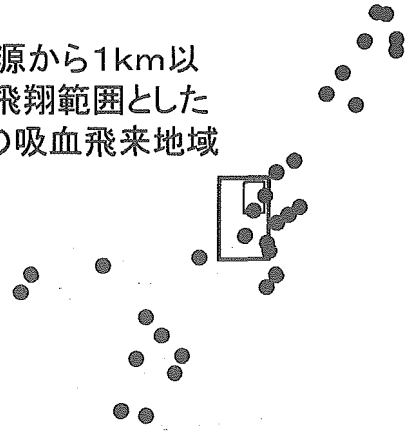
Cohort	Collection site	Collection method*	Days after release					Total
			0	1	2	3	4	
Fed	Release	Human bait	4	10	2	1	0	17
	Middle 1	Human bait	0	5	0	4	1	13
	Middle 2	Human bait	1	1	0	0	1	3
	Cowshed	Human bait	0	2	0	0	0	2
		Sweeping	0	0	0	2	0	2
		Light trap	0	5	0	0	0	5
	Total		5	26	2	7	2	42
								2.82%
Unfed	Release	Human bait	6	0	1	0	0	7
	Middle 1	Human bait	0	1	0	0	1	2
	Middle 2	Human bait	0	0	0	0	1	1
	Cowshed	Human bait	0	0	0	0	0	0
		Sweeping	0	1	0	0	0	1
		Light trap	0	2	0	0	0	2
	Total		6	4	1	0	2	13
								1.30%
Unmarked	Release	Human bait	1	0	0	0	1	2
	Middle 1	Human bait	0	1	2	7	2	12
	Middle 2	Human bait	0	0	0	0	0	0
	Cowshed	Human bait	0	0	0	0	0	0
		Sweeping	1	2	0	2	1	6
		Light trap	0	0	0	0	0	0
	Total		2	3	2	9	4	20

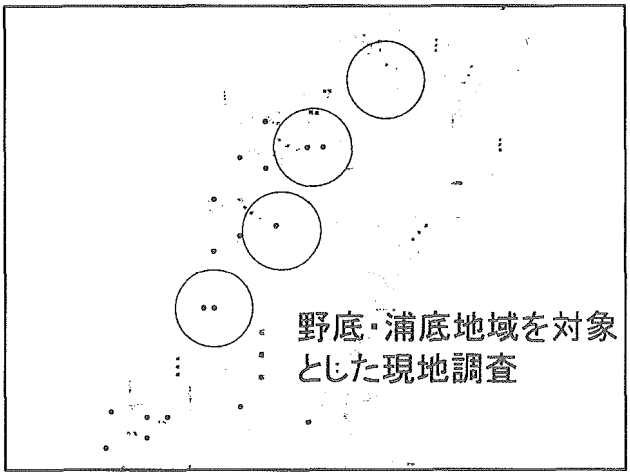
* Sweeping and light trap collections were conducted only at the cowshed.

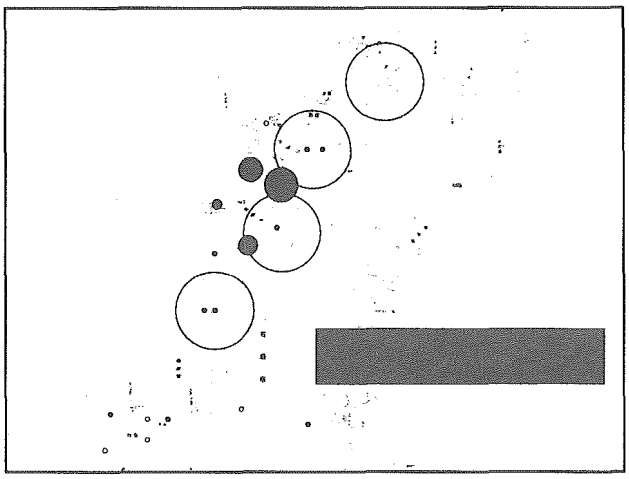
石垣島全体でコガタハマダラカが
吸血飛来するのはどの範囲か？

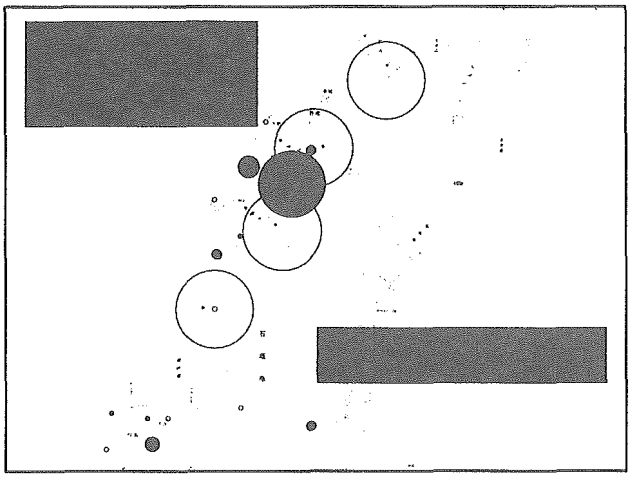


発生源から1km以
内を飛翔範囲とした
ときの吸血飛来地域

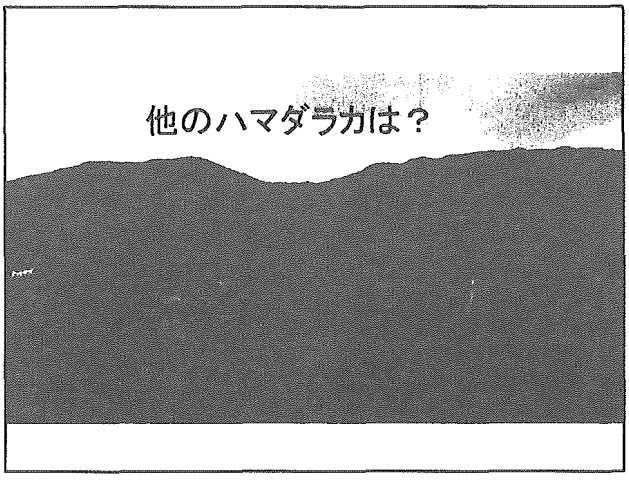








他のハマダラカは？



1998-2005年

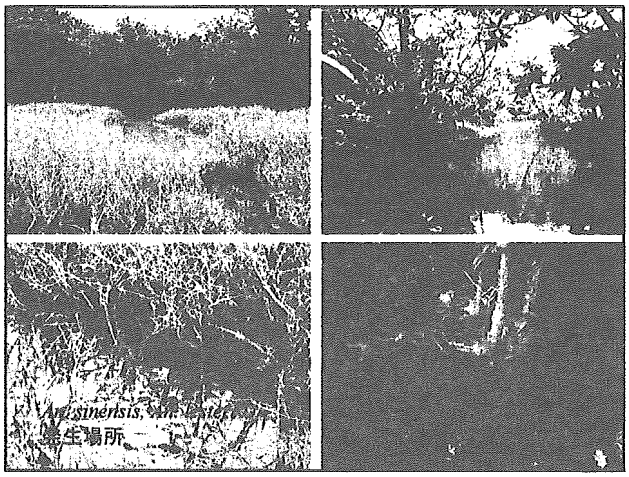
野底・浦底地域での調査結果

人囮採集

An. minimus	310
Cx. sitiens	142
Ma. uniformis	89
Ae. vexans	82
An. sinensis	30
An. lesteri	24
Ar. subalbatus	23
Cx. pseudovishnui	15
Ae. albopictus	9
Cx. bitaeniorhynchus	8
Ae. riversi	6
Cq. crasipes	4
Cx. vishnui	4
Cx. tritaeniorhynchus	3
Cx. hayashii ryukyuanus	1
Cx. quinquefasciatus	1
Oc. japonicus	1

ドライアイストラップ採集

Cx. sitiens	865
Cq. crassipes	449
Ae. albopictus	153
An. minimus	153
Ae. riversi	94
Cx. pseudovishnui	92
Cx. tritaeniorhynchus	86
Cx. nigropunctatus	56
Cx. (Culiciomyia) nigropunctatus	52
Cx. bitaeniorhynchus	49
Ur. annandalei	45
Ur. macfarlanei	31
Ur. ohamai	29
Or. anopheloides	24
Ma. uniformis	23
Ar. subalbatus	20
Ur. yaeyamana	19
Mi. elegans	11
Cx. okinawae	6
Cx. (Culiciomyia) ryukyensis	4
Mi. luzonensis	4
Ur. lateralis	4
An. sinensis	3
Cx. quinquefasciatus	2
Cx. ryukyuensis	2
Ur. jacksoni	2
Ur. novobscula	2
Ae. flavopictus	1
Tr. Bambusa	1



今後に向けて

ハマダラカが生息できる場所がどのような生態的条件を満足しているのかを明らかにする.

特に生息場所の[illegible]

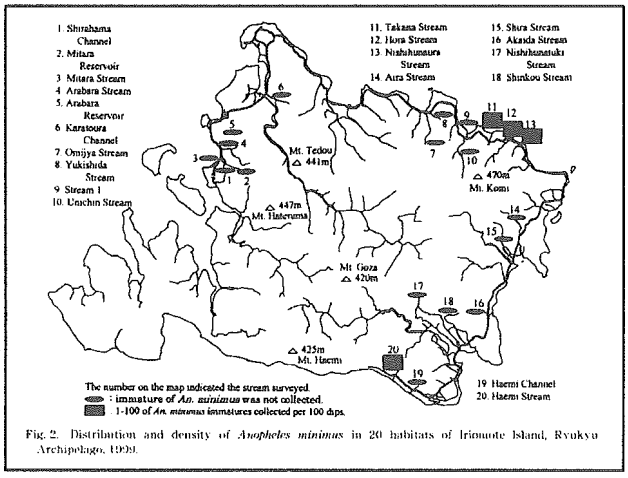


Fig. 2. Distribution and density of *Anopheles minimus* in 20 habitats of Iriomote Island, Ryukyu Archipelago, 1999.

成田国際空港におけるマラリア等の昆虫媒介性感染症の監視状況

アジアで流行している感染症のわが国への
侵入監視の強化に関する研究
Tokyo, January 31–February 1, 2006

Michio Haseyama

Assistant director for Sanitation Division
Narita Airport Quarantine Station
Ministry of Health, Labor and Welfare

検疫感染症と法律

検疫法 No.145 (2003)
この法律は，国内に常在しない感染症の病原体が船舶又は航空機を介して国内に侵入することを防止するとともに，船舶又は航空機に関してその他の感染症の予防に必要な措置を講ずることを目的とする。

この法律において「検疫感染症」とは，次に掲げる感染症をいう。

1 エボラ出血熱,クリミア・コンゴ出血熱,SARS,痘そう,ペスト,マールブルグ病,ラッサ熱

2 コレラ 3 黄熱

政令で定めるもの
マラリア，デング熱，ウエストナイル熱，腎症候性出血熱，日本脳炎，ハンタウイルス肺症候群

2

ベクターサーベイランスと法律

検疫法第二十七条
（検疫所長の行う調査及び衛生措置）

検疫所長は，検疫感染症・・・の病原体を媒介する虫類の有無その他・・・当該・・飛行場の衛生状態を明らかにするため・・・**政令で定める区域内に限り・・・航空機・・・当該区域内・・・施設，建築物その他の場所について・・・虫類の調査**を行い，又は検疫官をしてこれを行わせることができる。

2 検疫所長は，前項に規定する感染症が流行し，・・・おそれがあると認めるときは，・・・虫類の駆除を行い，又は検疫官その他適当と認める者をしてこれを行わせることができる。

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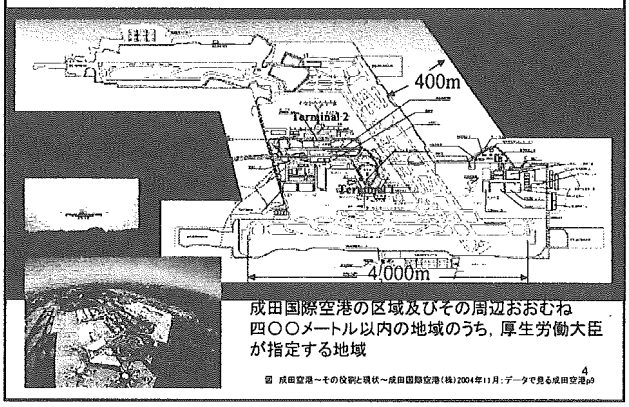
成田国際空港の調査対象区域（政令区域）



成田国際空港の区域及びその周辺おおむね四〇〇メートル以内の地域のうち，厚生労働大臣が指定する地域

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出典 成田空港～その役割と現状～成田国際空港(株)2004年11月：データで見る成田空港p9

ガイドラインによるサーベイランス

食安検発第0803001号 平成17年8月3日
「港湾区域等衛生管理業務の手引きについて」

港湾衛生管理ガイドライン

○港湾衛生対策
Ⅰ ねずみ族調査マニュアル
（ペスト，ラッサ熱，腎症候性出血熱，ハンタウイルス肺症候群） Ⅱ ねずみ族寄生虫調査マニュアル（ペスト）
Ⅲ **蚊族調査マニュアル**
（黄熱,**マラリア，デング熱**，ウエストナイル熱，日本脳炎）

○環境衛生対策（コレラ対策）
Ⅳ 海水調査マニュアル
Ⅴ 飲料水調査マニュアル
Ⅵ 機内食調査マニュアル
Ⅶ 汚水汚物調査マニュアル

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リスクアセスメントに基づくベクターサーベイランス

リスクファクター
- ① 疾病ごとの危害度評価
- ② 流行状況検疫感染症等の患者発生数
- ③ 入港数
- ④ ベクターの生息状況

数値化 ⇩

港ことに感染症が侵入するリスクを評価 ⇩

リスクの分類化

- Ⅳ 高い
- Ⅲ 中等度
- Ⅱ 低い
- Ⅰ かなり低い

⇒ リスクに応じた調査

- ① 航空機調査
- ② 港湾区域等調査（成虫）
- ③ 港湾区域等調査（幼虫）
- ④ 病原体保有調査

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