آشنائی با مولدین SPF و SPR در میگوهای پرورشی

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پژوهشکده میگوی کشور
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Table 1
Major diseases of Indo-Pacific and east Asian penaeid shrimp.

VIRAL DISEASES	BACTERIAL & FUNGAL	OTHER DISEASES
White Spot Syndrome Virus	Vibriosis:	Epicommensals:
Yellow Head Virus group	- septic HP necrosis	- *Leucothrix mucor*
MBV group	- hatchery vibriosis	- peritrich protozoans
IHHNV	- luminescent vibrio	Gregarines
HPV group	Rickettsia	Microsporidians
REO group	Larval Mycosis	Nutritional imbalances
	Fusariosis	Toxic syndromes
		Environmental syndromes

Table 2
Major diseases of the American Penaeids

VIRAL DISEASES	BACTERIAL & FUNGAL	OTHER DISEASES
White Spot Syndrome Virus	Vibriosis:	Epicommensals:
Taura Syndrome Virus	- "Sindrome Gaviota"	- *Leucothrix mucor*
IHHNV	- hatchery vibriosis	- peritrich protozoans
BP group	- luminescent vibrio	Gregarines
HPV	- shell disease	Microsporidians
REO III?	NHP bacterium	Nutritional imbalances
LOVV?	Larval Mycosis	Toxic syndrome
RPS?	Fusariosis	
Yellow Head Virus?		Zoea II syndrome

WSSV

IHHNV

TSV

PvNV

IMNV

NHP

Table 1. Estimated economic losses since the emergence of certain diseases in penaeid shrimp aquaculture.

Virus	Year of emergence to 2001	Product loss (US dollars)
White Spot Syndrome Virus-Asia	1992	$4-6 billion
White Spot Syndrome Virus-Americas	1999	>$1 billion
Taura Syndrome Virus	1991-1992	$1-2 billion
Yellow Head Virus	1991	$0.1-0.5 billion
Infectious Hypodermal and Hematopoietic Necrosis Virus	1981	$0.5-1.0 billion (includes Gulf of California fishery losses for 1989-1994)

Source: Lightner (2003, p. 85)

Two major ways for restore the industry's levels of production to the "pre-virus"years

- Biosecuruty
- (Good Management practice) GMP

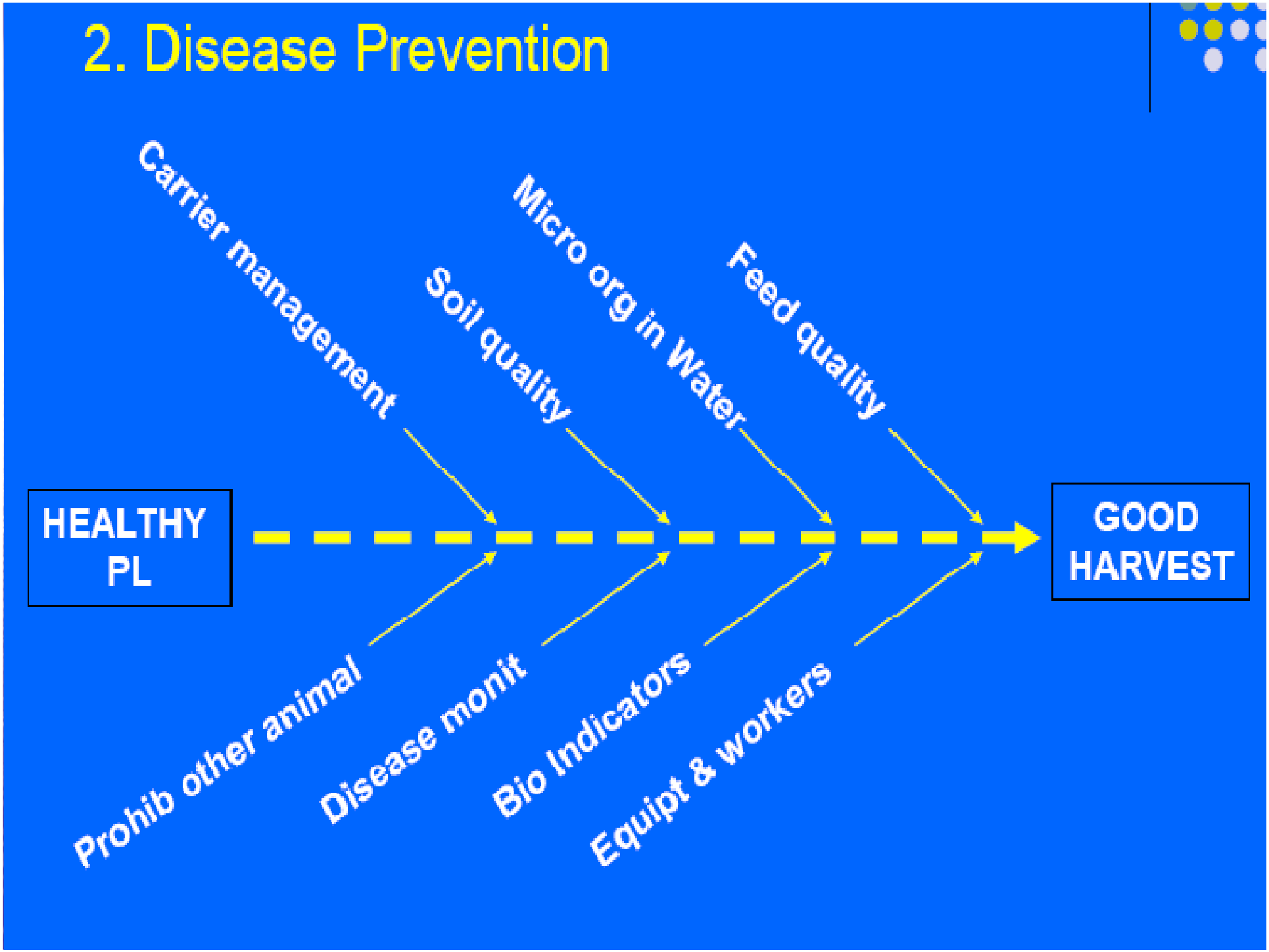
Biosecurity

A series of measures designed primarily to prevent a disease from reaching the farm. Biosecurity can also be considered as measures used to decrease or prevent the spread of existing disease within a farm or a region

Biosecurity program for a shrimp farming facility would incorporate

- disease monitoring
- disease prevention
- effectively managing disease outbreaks
- cleaning and disinfection between production cycles
- general security precautions

2. Disease Prevention



History of shrimp production based on SPF/SPF stocks

- **Pre-SPF Era for the Shrimp farming Industry (1980's – 1991)**
- **Establishment and Benefits of SPF Shrimp (1991 – 1994)**
- **Breeding of SPR Shrimp (1998 – present)**

U.S. Marine Shrimp Farming Program(UMSFP)

- an integrated multi-state research program that continues to develop and transfer technologies, products and services necessary for domestic shrimp farming to become competitive in the world market .
- six Consortium institutions :1-The Oceanic Institute2- Tufts University3- The University of Arizona (UAZ) 4- The University of Southern Mississippi Gulf Coast Research Laboratory (USM-GCRL) 5- Waddell Mariculture Center (WMC)6- Texas Agricultural Experiment Station (TAES)
- formed in 1984

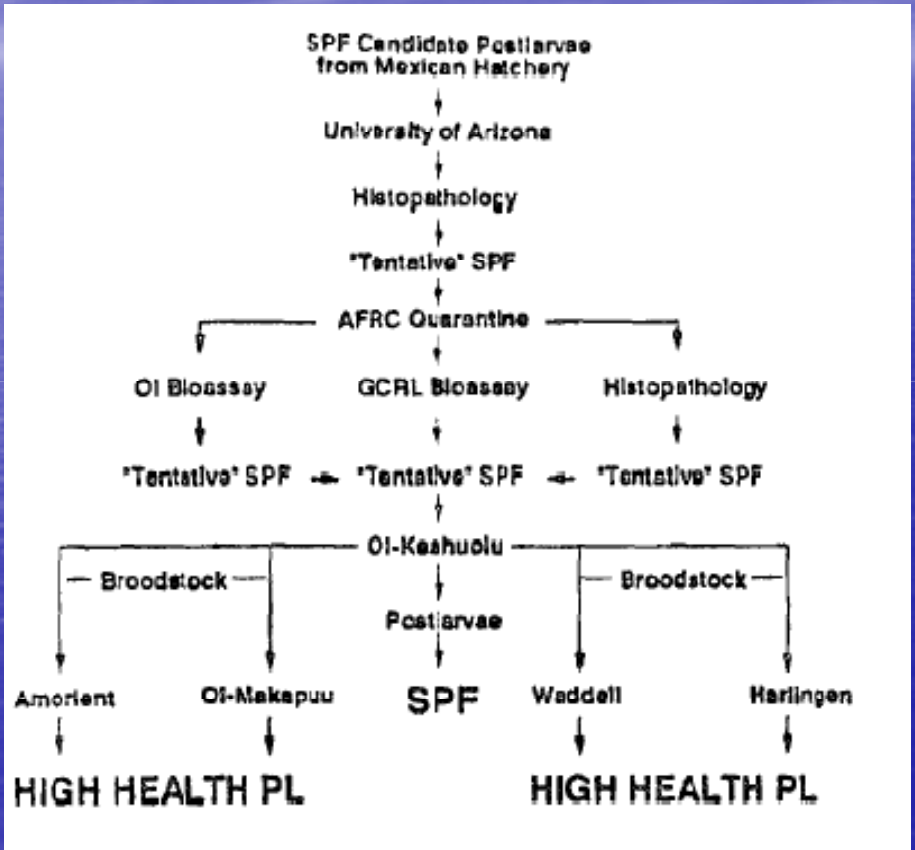
History of shrimp SPF broodstock

- The need for SPF Penaeus vanamei was mostly motivated by the increasing incidence of runt deformity syndrome (RDS) in commercial culture throghout the Western Hemisphere
- The world's first population of SPF shrimp was founded by the US Marine Shrimp Farming Program (USMSFP) in 1989
- guidelines developed by the Intemational Council for the Exploration of the Sea(ICES. 1988)
- In June, 1989, Dr. Donald Lighmer's group at the University of Arizona imported to Tucson approximately **15000** postlaval P. vanamei from a new commercial hatchery in Sidoa, Mexico
- about 10000 of these" tenatative spf "shrimp were shipped to Hawaii
- They were maintained in quarntine at Anuenue Fisheries Research center (AFRC) in Honolulu under the supervision of Dr.james Brock (Hawaian aquatic veterinarian)

History of shrimp SPF broodstock

- In December 1989, the "tentative SPF" shrimp were shipped to OI's SPFshrimp quarantine (OI-Kahuolu) on the Big Island and were stocked into two earthen ponds.
- Postlarvae (PL10)produced from these "tentative" SPF broodstock were subjected to histopathology which confirmed the stock's SPF status
- In December 1990 and January 1991,1310 broodstock were shipped to three hatcheries in Hawaii, Texas and South Carolina
- In 1993, Wyban et al. differentiated between high-health and specific pathogen-free broodstock and seed .It was explained that reference to high-health stock, rather than SPF, reflects a loss of control over the health status of the stock.

History of shrimp SPF broodstock



First results with use SPF stocks in 1992 In Texas & Hawaii

- produced a greater yield
- higher survival
- more uniform size distribution
- lower feed conversion ratio

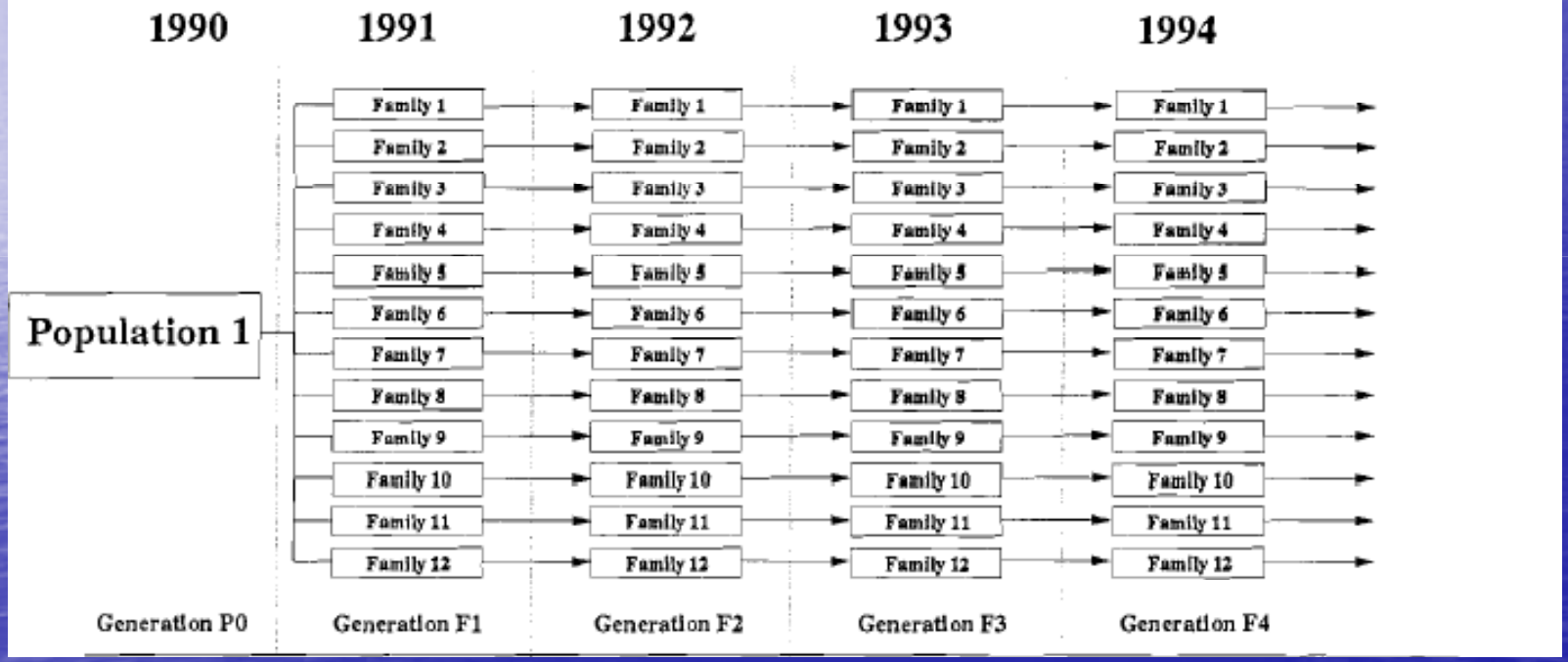
Start of SPF breeding program

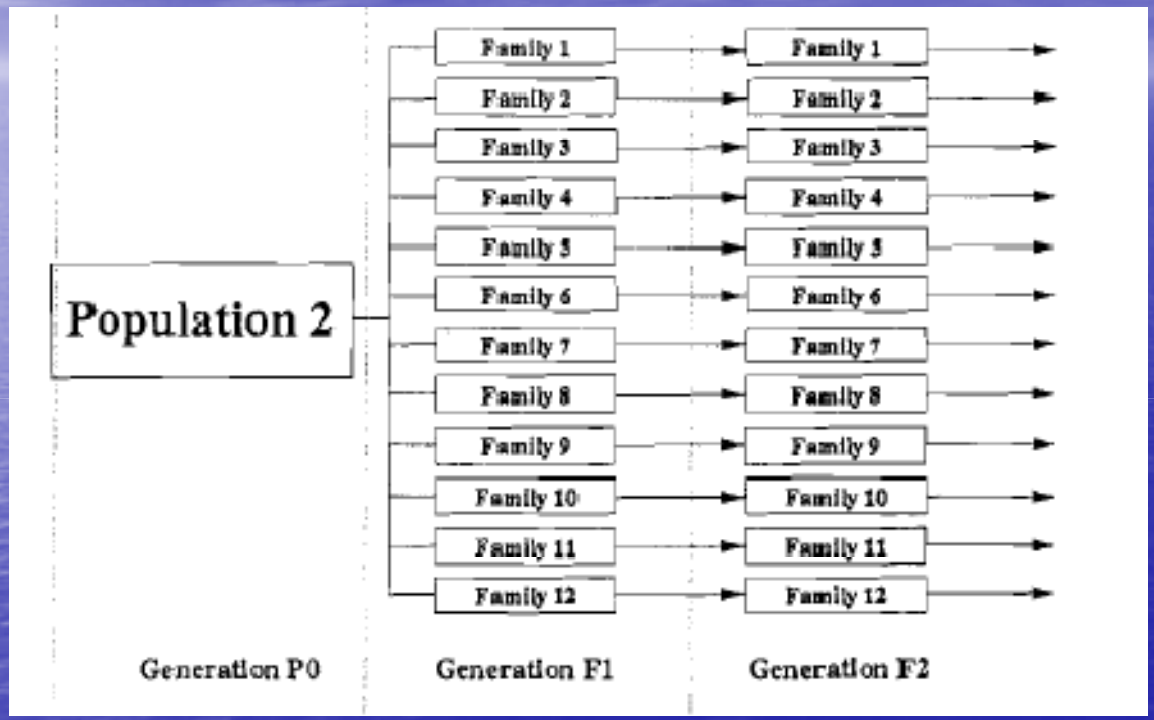
- The original population of SPF shrimp probably represents a narrow genetic sampling of the species
- To avoid of inbreeding
- to expand the gene pool of the SPF stock

The specific objectives of the SPF breeding program :

- To maintain the SPF status of stocks
- To avoid inbreeding
- To improve shrimp growth and survival to market size (20 g)

SPF Shrimp Breeding Scheme




Population 2
Family 1
Family 2
Family 3
Family 4
Family 5
Family 6
Family 7
Family 8
Family 9
Family 10
Family 11
Family 12
Family 1
Family 2
Family 3
Family 4
Family 5
Family 6
Family 7
Family 8
Family 9
Family 10
Family 11
Family 12
Generation P0
Generation F1
Generation F2

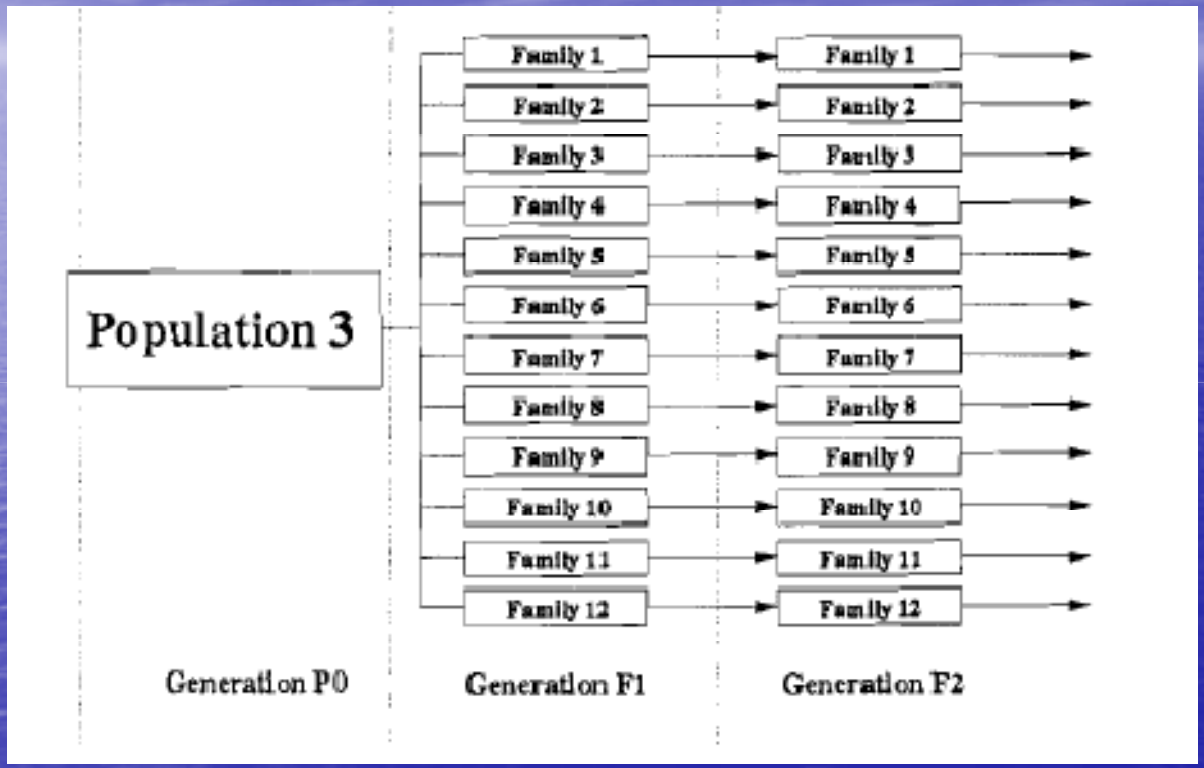

Population 3
Family 1
Family 2
Family 3
Family 4
Family 5
Family 6
Family 7
Family 8
Family 9
Family 10
Family 11
Family 12
Family 1
Family 2
Family 3
Family 4
Family 5
Family 6
Family 7
Family 8
Family 9
Family 10
Family 11
Family 12
Generation P0
Generation F1
Generation F2

Table 2. Growth performance data recorded for each family in SPF breeding program.

Stage	Performance Data
Z2	Survival (%)
PL10	Survival (%)
PL30	Mean individual weight (g)
PL45	Mean individual weight (g)
PL45	Coefficient of variation (CV) in size (%)
PL45	Survival (%)
PL45	FCR
PL60	Mean weight (g)
PL60	CV (%)
PL60	Survival (%)
PL60	FCR
PL60 to 20 weeks	Biweekly individual weight (g)
20 weeks	Mean weight (g)
20 weeks	CV (%)
20 weeks	Survival (%)
20 weeks	FCR

DEVELOPMENT OF SPF SHRIMP

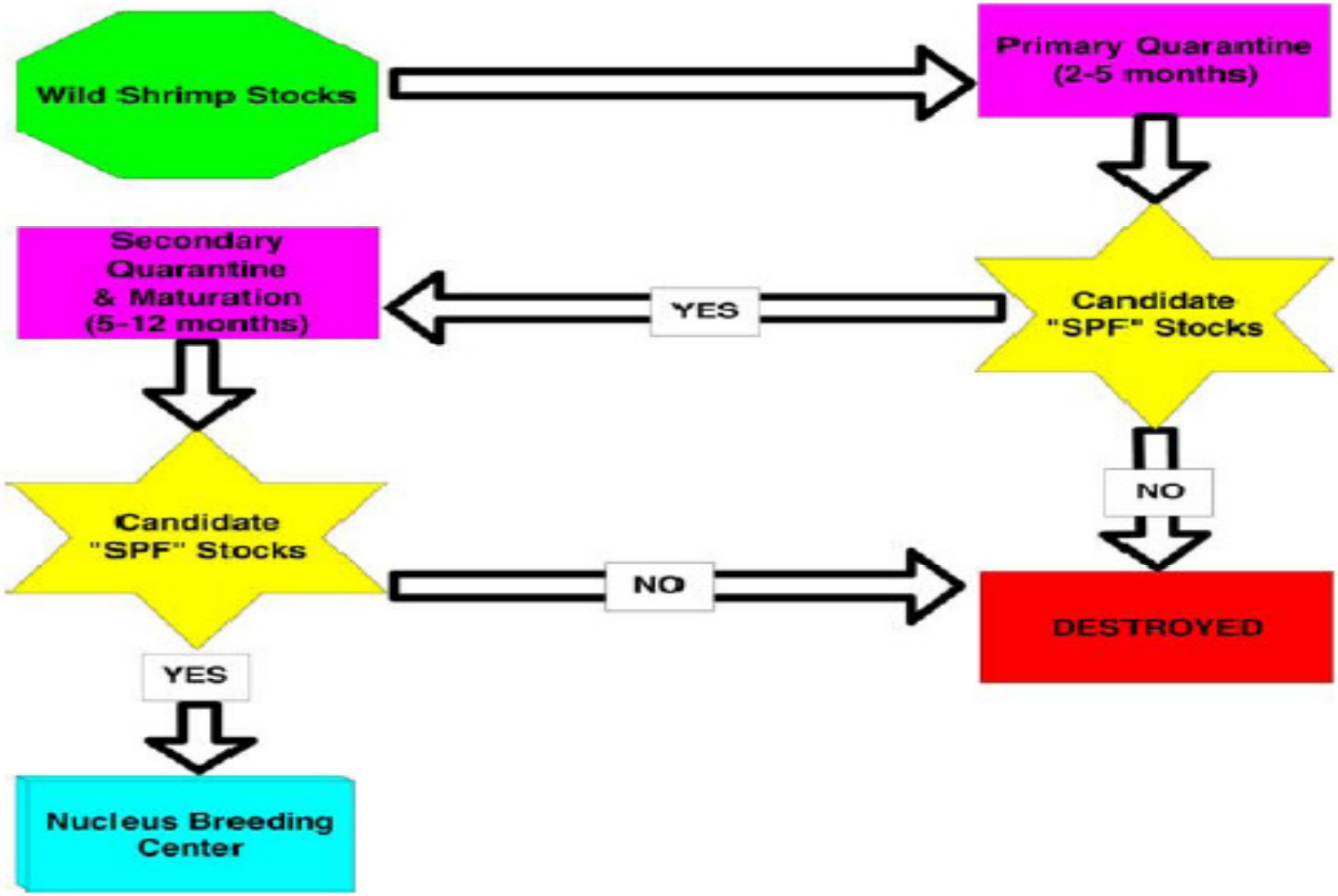
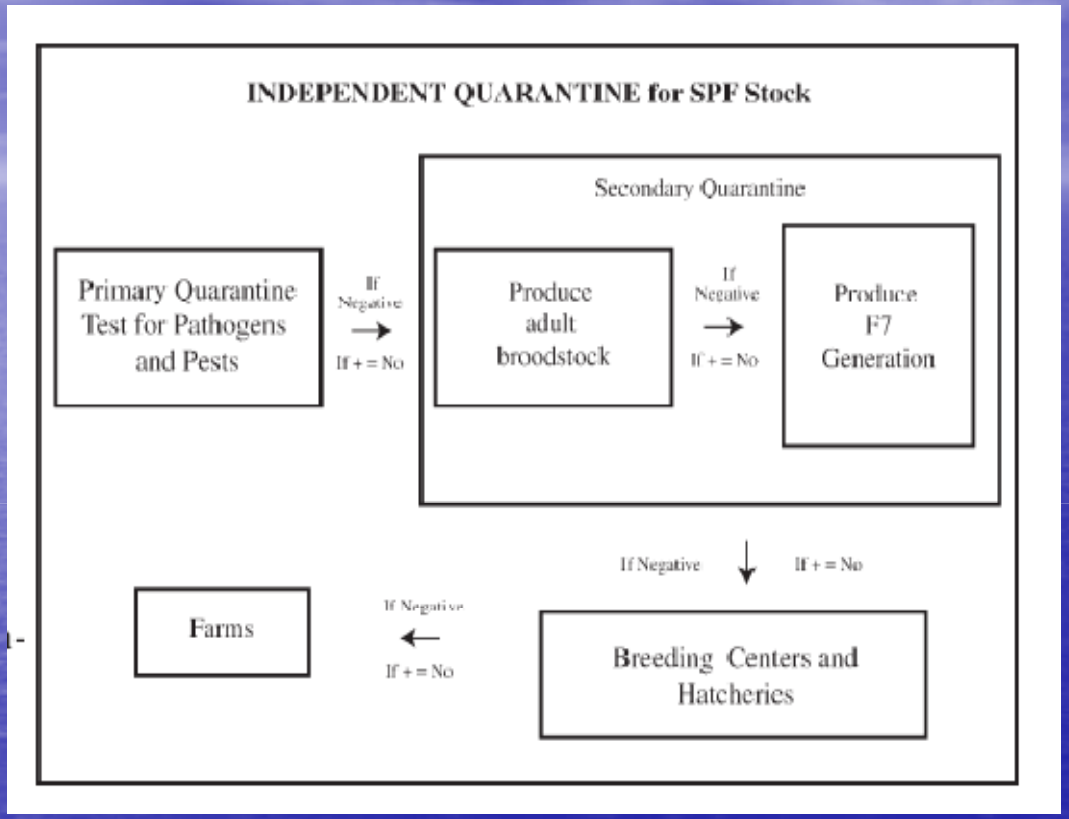


Fig. 1. Development of SPF shrimp.


INDEPENDENT QUARANTINE for SPF Stock
Secondary Quarantine
Primary Quarantine Test for Pathogens and Pests
If Negative
If + = No
Produce adult broodstock
If Negative
If + = No
Produce F7 Generation
If Negative
If + = No
Farms
If Negative
If + = No
Breeding Centers and Hatcheries

The pathogen To be included on an SPF list MUST be:

- ☐ reliably diagnosed
- ☐ physically excluded from a facility
- ☐ a significant threat to the industry

Table 1. A working list of excludable pathogens of *Penaeus vannamei*.

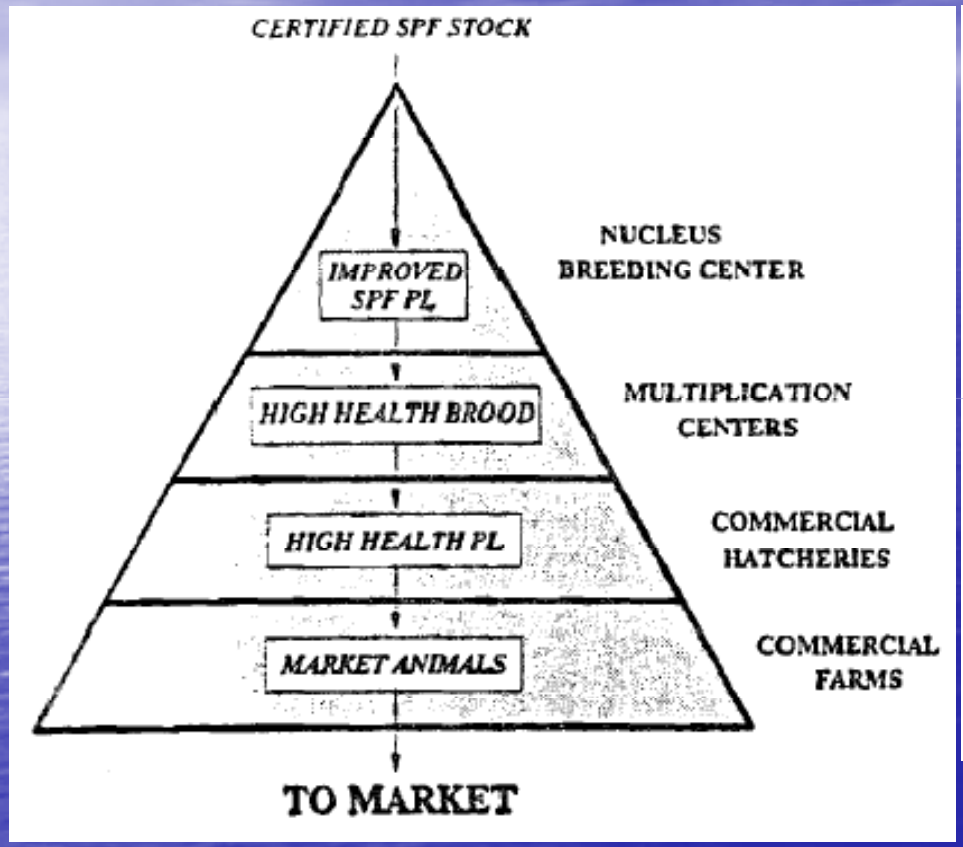
Group	Pathogen
Virus	Infectious hypodermal and hematopoietic necrosis virus (IHHNV)
Virus	*Baculovirus penaei* type-A baculovirus (BP)
Virus	Hepatopancreatic parvo-like virus (HPV)
Protozoan	Microsporidians
Protozoan	Gregarines
Protozoan	Haplosporidians
Metazoan parasites	Nematodes and cestodes

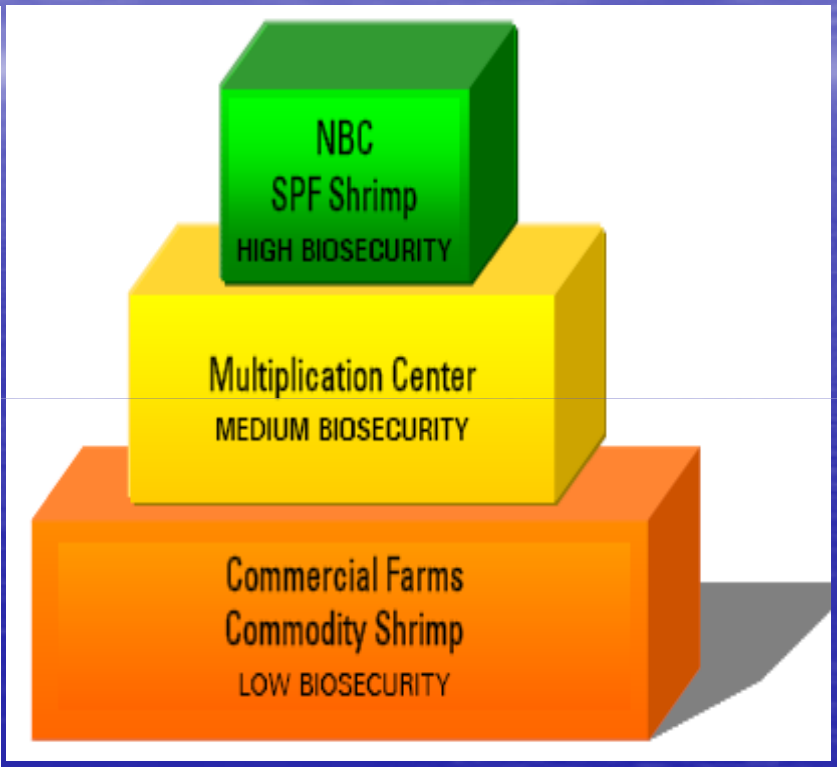
Table 1
Working list of specific pathogens for SPF shrimp

Pathogen type	Pathogen/pathogen group	Pathogen category
Viruses		
	TSV–picornavirus	C-1
	WSSV–nimavirus (new family)	C-1
	YHV/GAV/LOV[3]–roniviruses (new family)	C-1
	IHHNV–systemic parvovirus	C-2
	BP–occluded enteric baculovirus	C-2
	MBV–occluded enteric baculovirus	C-2
	BMN–nonoccluded enteric baculovirus	C-2
	HPV–enteric parvoviruses	C-2
Procaryote		
	NHP–alpha proteobacteria	C-2
Protozoa		
	Microsporidians	C-2
	Haplosporidians	C-2
	Gregarines	C-3

Pathogen category with C-1 pathogens defined as excludable pathogens that can potentially cause catastrophic losses in one or more American penaeid species; C-2 pathogens cause economically significant disease and are excludable; and C-3 pathogens cause less serious disease, but should be excluded from breeding centers, hatcheries, and some types of farms.

SPF shrimp production pyramid





Some commercial brand of shrimp SPF in the world

- **HHA SPF Kona**
- **HHA SPF TVR™**
- **HHA SPF GxTVR™**
- **HHA SPF Stylirostris**
- **HHA SPF Monodon**
- **HHA SPF Japonicus**

Table 1. Comparison of production parameters and profits between typical *P. monodon* and *P. vannamei* production systems in Thailand (in USD).

Parameter	*P. monodon*	*P. vannamei*	% Difference
Density (PL/m²)	40-50	120-200	300%
Crop duration (days)	110-140	105-120	27%
Harvest size (g) (#/kg)	22-28 (40/kg)	21-25 (42/kg)	5%
Yield tonnes/ha/crop	8	24	300%
Crop value (USD/ha)	45,000	96,000	220%
Crop costs (USD/ha)	32,000	60,000	
Production profit (USD/ha)	13,000	36,000	280%

SPF : An SPF shrimp is free of specified pathogens
SPR: An SPR shrimp is resistant to Specific pathogen

- SPF shrimp are **NOT** innately resistant to disease or infection
- SPF ≠ SPR (Specific Pathogen Resistant)
- SPF shrimp can be bred for specific pathogen resistance to produce an SPF/SPR shrimp
- SPF status in NOT a heritable trait
- SPF status can not be passed on from parent to offspring
- SPF status changes with the pathogen condition of the shrimp and the level of biosecurity where the shrimp are cultured.

SPR

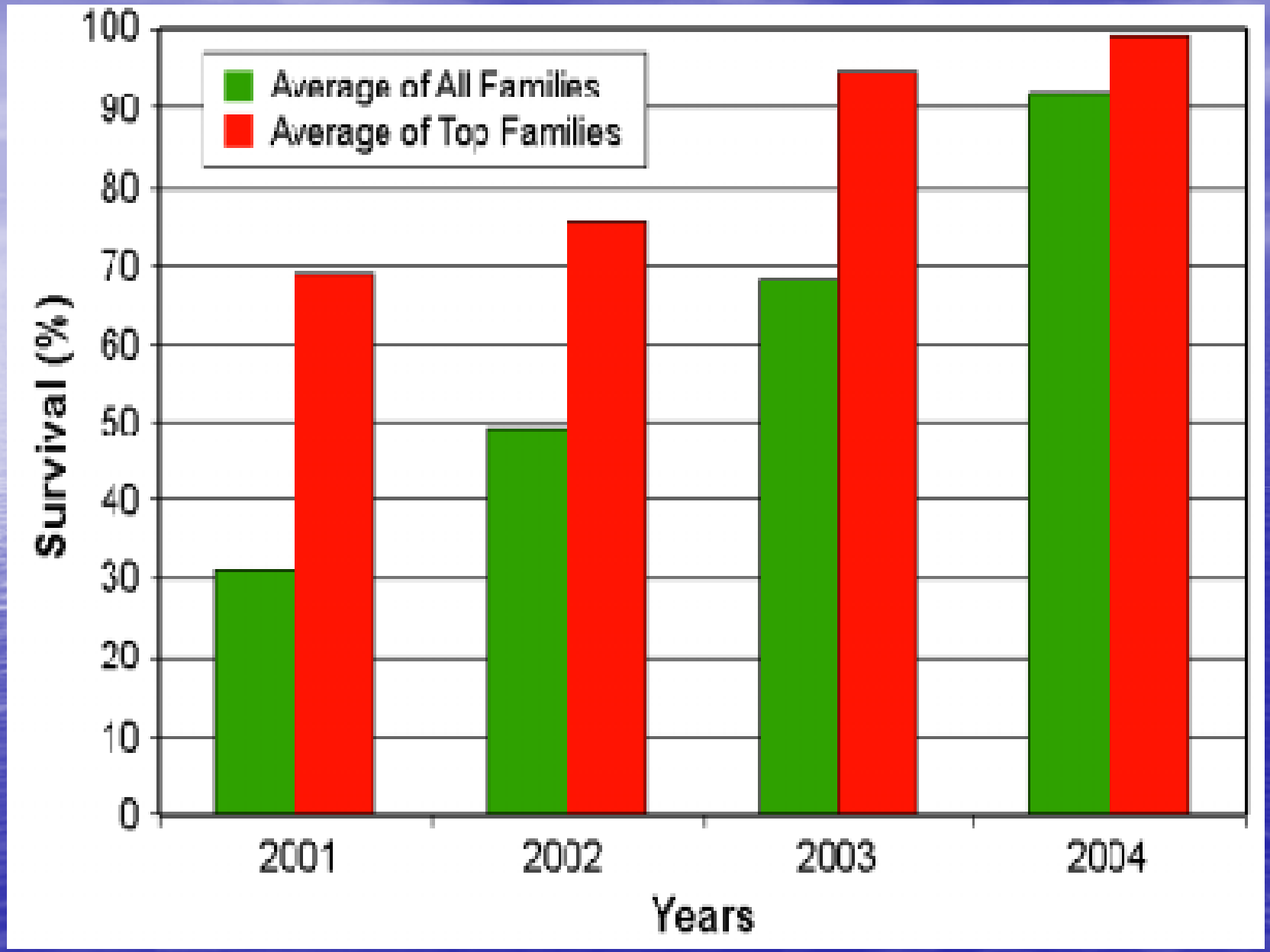
- In 1993, HH shrimp were cultured with wild-caught seed at a commercial shrimp farm near Rio Guayas in Ecuador. HH shrimp exhibited poor survival (7-43%) compared to wild seed (36-42%), and heavy mortalities were attributed to TSV infection.
- In mid-1995, TSV was identified in south Texas and the presence of this virus resulted in a significant decline in U.S. farmed shrimp production
- USMSFP researchers initiated a selective breeding program to develop a TSV-resistant strain of *L. vannamei*

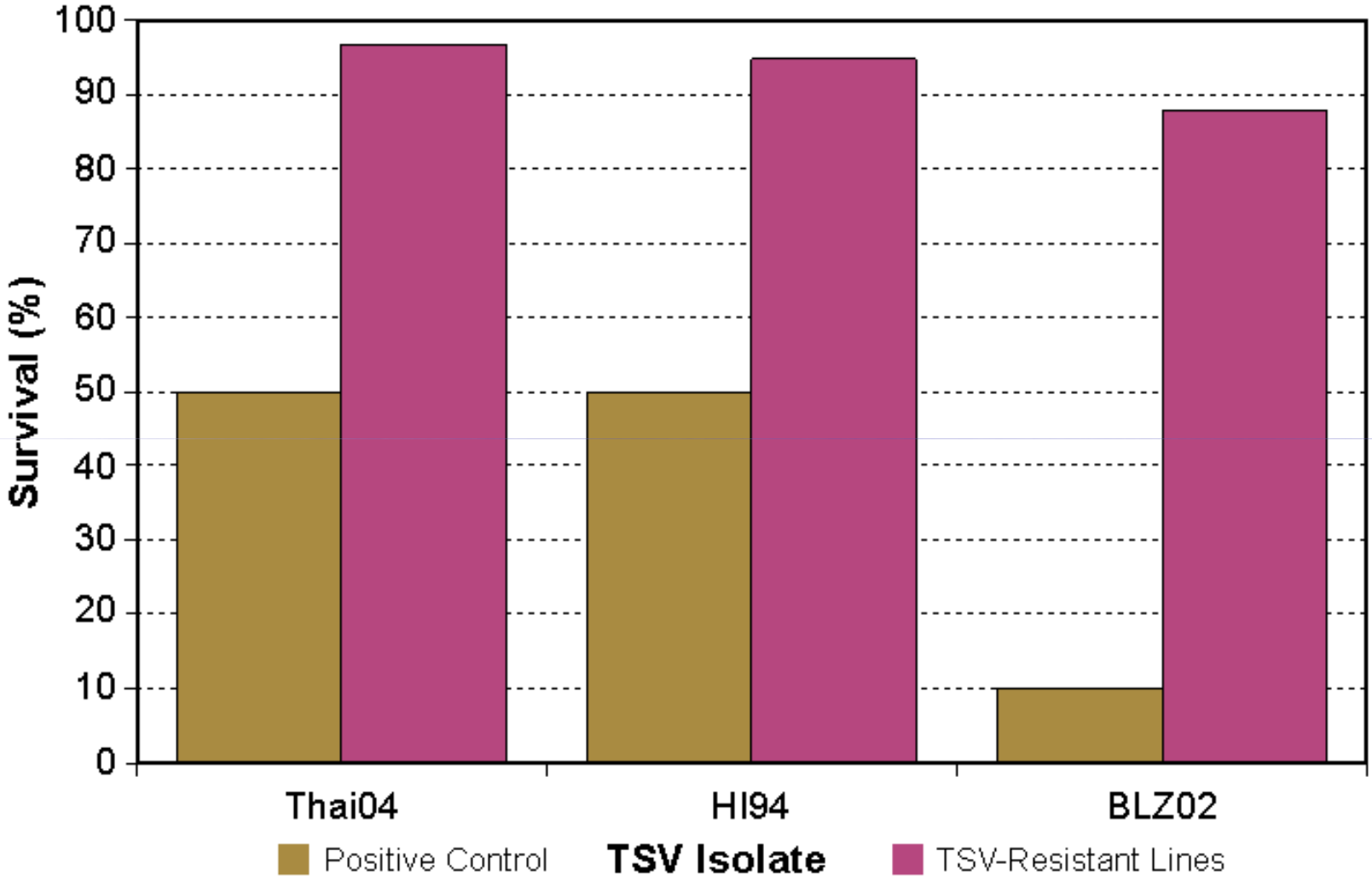
SPR

- In a research trial at OI, shrimp selected for TSV resistance exhibited a mean survival that was 18.4% higher than unselected control shrimp after a TSV-challenge test
- Similar challenge tests conducted at UAZ from 1998-2000 revealed that mean survival of all TSV-challenged families increased from 24% to 39% during this period
- mean survival of the best performing families increased from 65% in 1998 to 100% in 2000
- In 2001, significant mortalities of *L. vannamei* occurred at shrimp farms in Belize resulting from TSV epizootics

SPR

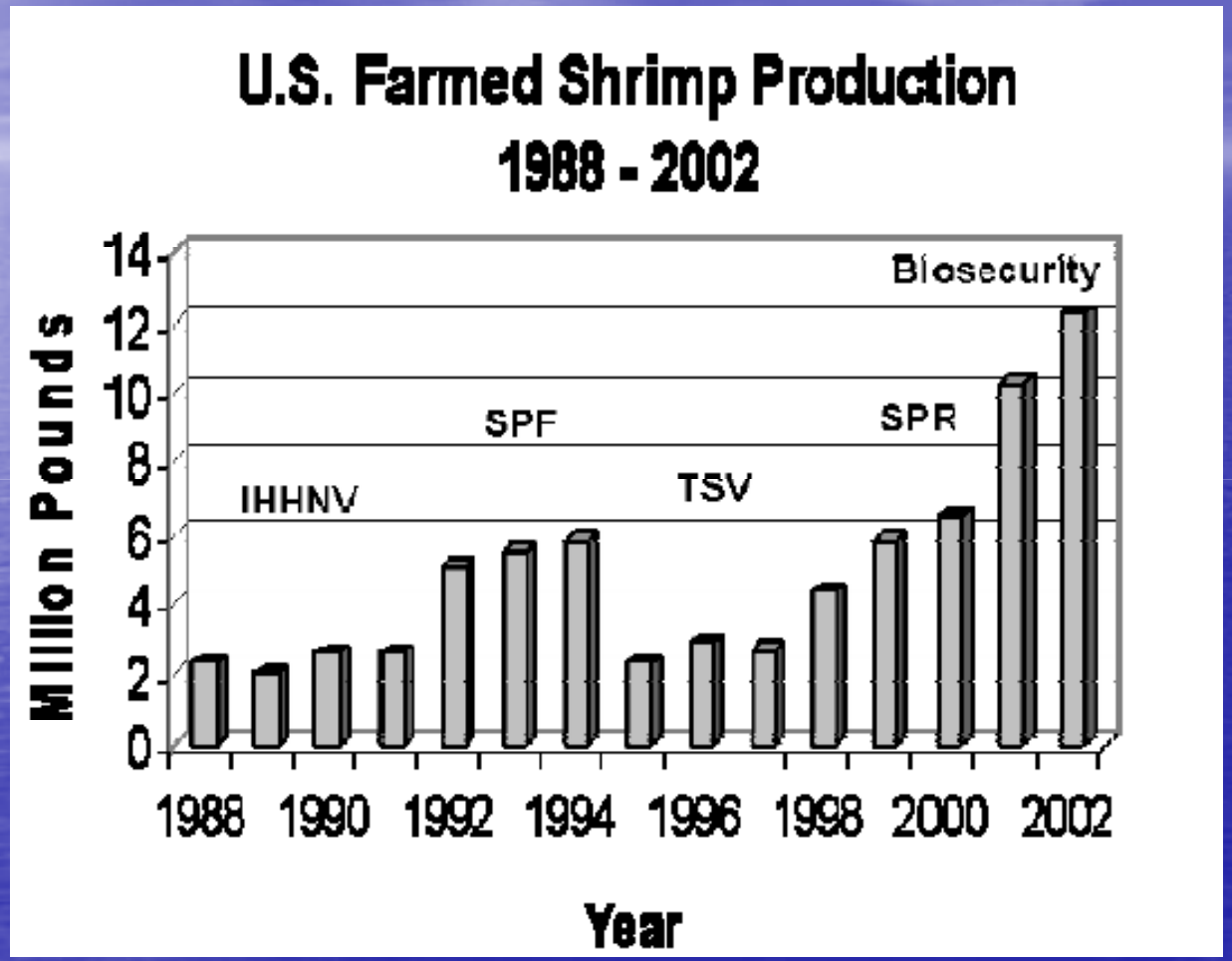
- researchers from OI and UAZ explored the possibility of developing selectively bred families of *L. vannamei* that exhibited resistance both to the Hawaii and Belize TSV strains.
- Selectively bred shrimp exhibited 95% survival after exposure to the Hawaii TSV , 63% survival after exposure to the Belize TSV
- In 2003 new isolation from Thailand
- In 2005 new isolation from Venezuela

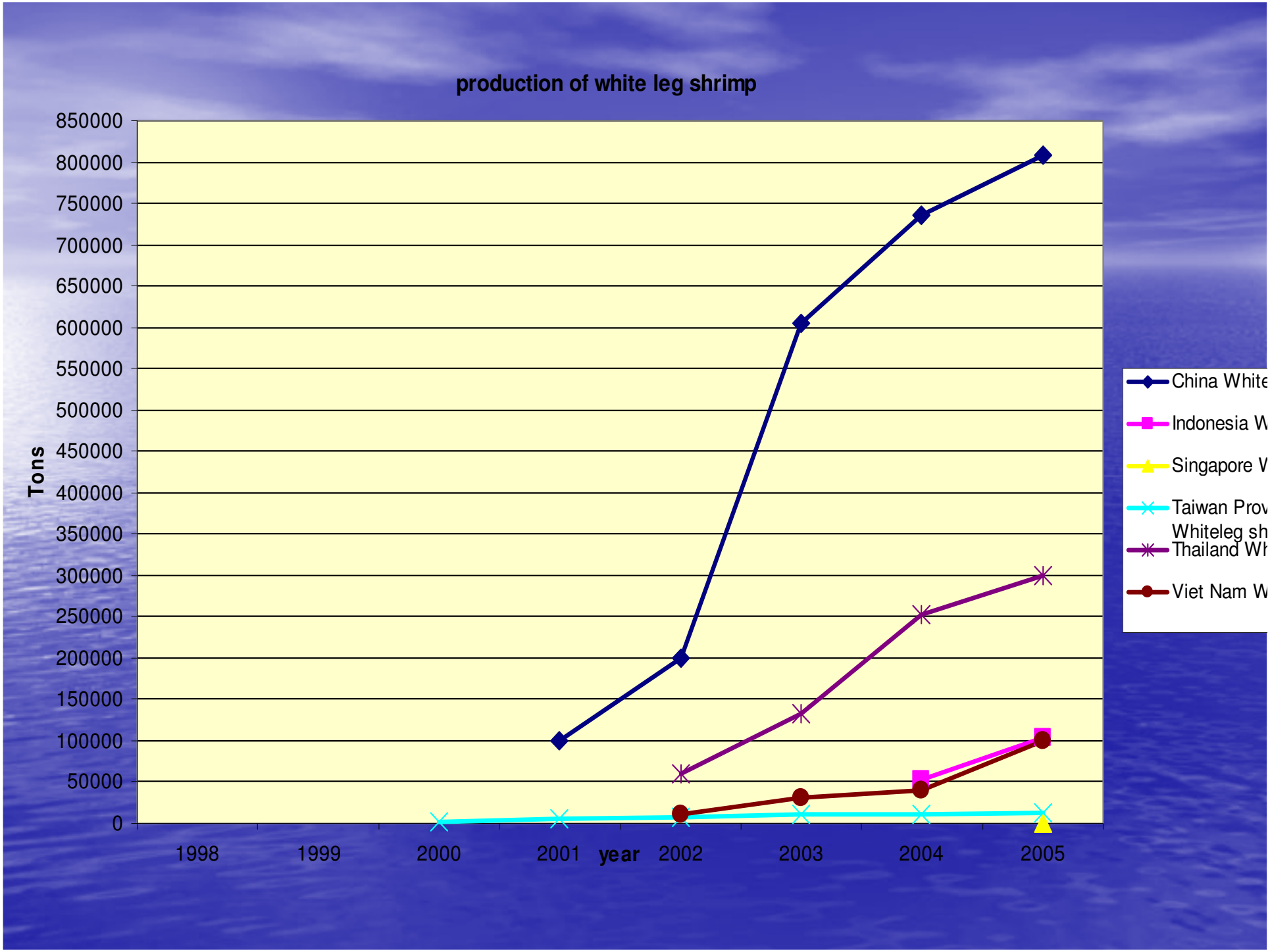

Average of All Families
Average of Top Families
Survival (%)
100
90
80
70
60
50
40
30
20
10
0
2001
2002
2003
2004
Years


100
90
80
70
60
50
40
30
20
10
0
Survival (%)
Thai04
HI94
BLZ02
Positive Control
TSV Isolate
TSV-Resistant Lines

New generation of TSV- Resistance shrimp in OI

- Broodstock that will be used to produce the postlarvae represent the top families selected for resistance to Taura Syndrome Virus (TSV). TSV resistance as determined by a *per os* laboratory challenge test conducted at the Gulf Coast Research Laboratory (GCRL). Shrimp were exposed to TSV reference isolates from Texas (USTX95), Belize (BH01), Thailand (TH04) and Venezuela (VE05). Mean survival of the selected families was 92% for USTX95, 91% for BH01, 99% for TH04, and 99% for VE05


U.S. Farmed Shrimp Production
1988 - 2002
Million Pounds
0
2
4
6
8
10
12
14
1988
1990
1992
1994
1996
1998
2000
2002
Year
IHHNV
SPF
TSV
SPR
Biosecurity


production of white leg shrimp
Tons
850000
800000
750000
700000
650000
600000
550000
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
1998
1999
2000
2001
year
2002
2003
2004
2005
China White
Indonesia W
Singapore W
Taiwan Prov
Whiteleg sh
Thailand Wh
Viet Nam W

2001 ANNUAL REPORT
Oceanic Institute

Father of SPF:**Dr. James 'Jim' Wyban**