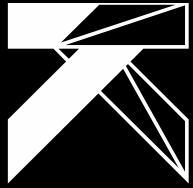




Genética
Spring

GENÉTICA SPRING'S (GS) BREEDING PROGRAM





Benchmark
Holdings plc



Benchmark's aquaculture business

INTRODUCTION





SUMMARY

- 2000:
 - Benchmark Holdings plc
- 2004:
 - Fish Vet Group
- 2014:
 - SalmoBreed
 - Stofnfiskur
- 2015:
 - Akvaforsk Genetics
 - Spring Genetics
- 2015:
 - INVE
- 2016:
 - Genética Spring - CENIACUA

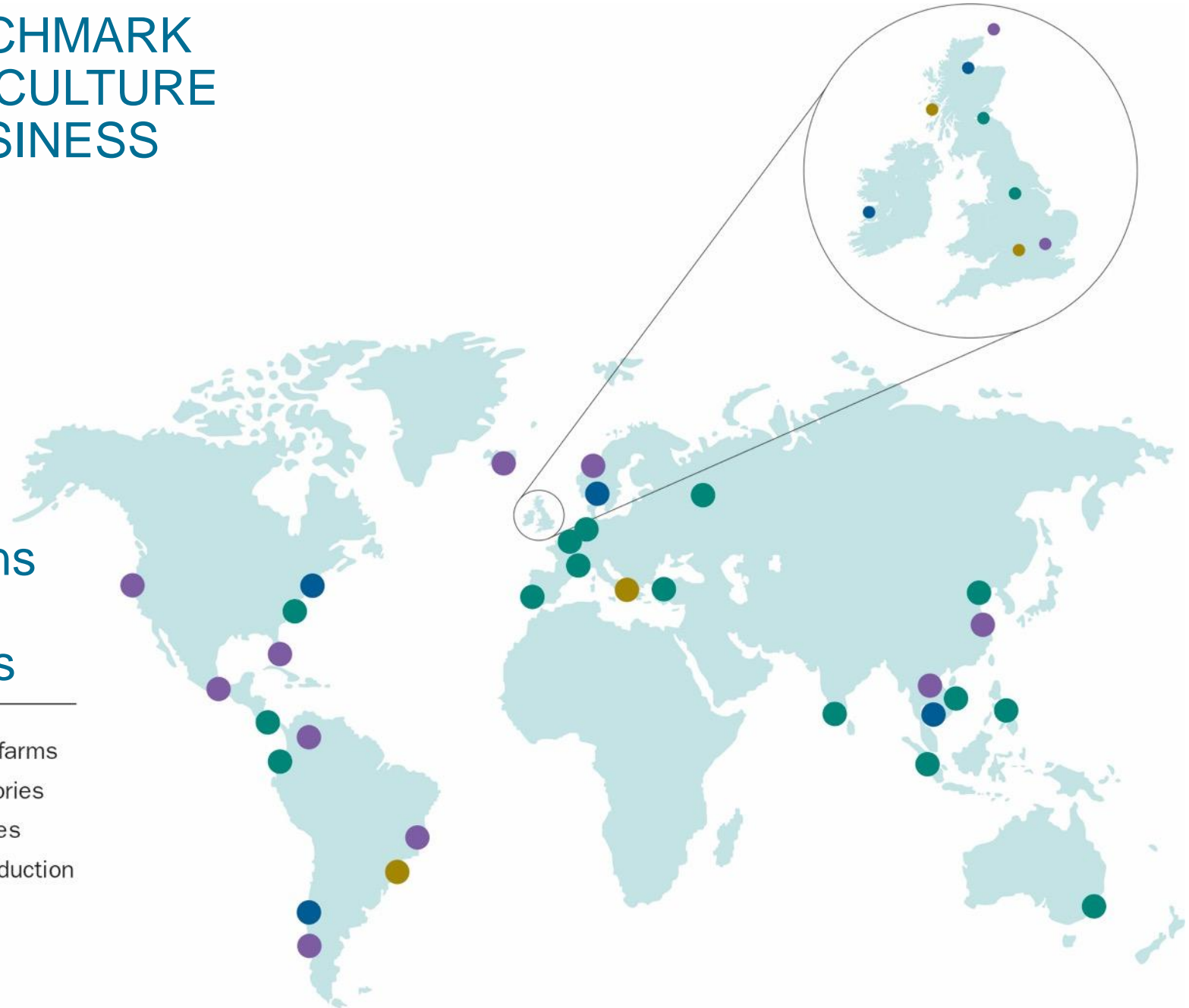




BENCHMARK AQUACULTURE BUSINESS

Operations
in 27
countries

- R&D facilities and farms
- Diagnostic laboratories
- Commercial services
- Manufacturing/production





BENCHMARK'S AQUACULTURE PLATFORM



GENETICS

Selecting for Sustainable Results



Akvaforsk Genetics

Advanced design and technical breeding program services



SalmoBreed

Salmon, shrimp and tilapia genetics plus major farmed species



StofnFiskur

PRODUCTS INCL.

- OVA 52
- SB QTL
- SB Exclusive



Spring Genetics



Genética Spring



NUTRITION

Stimulating Healthy Growth & Performance



Specialist advanced animal nutrition

PRODUCTS INCL.

- GSL Artemia
- Frippak
- Sep-Art



HEALTH

Advancing Animal Health & Welfare



FishVet Group

Aquaculture vaccines & medicines and holistic approach for disease prevention



Benchmark Vaccines Ltd

PRODUCTS INCL.

- Diagnostic and veterinary care
- Salmosan®
- MarieShield N
- Sanolife
- Sanocare
- Sanoguard



Benchmark Animal Health



KNOWLEDGE & RESEARCH

Shaping Sustainable Aquaculture



The Fish Site

SERVICES INCL.

R&D & trials facilities

Sustainable aquaculture courses

Knowledge transfer & training

Aquaculture conferences



BENCHMARK GENETICS

Atlantic Salmon



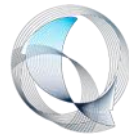
StofnFiskur



SalmoBreed



Tilapia



Spring Genetics



Shrimp



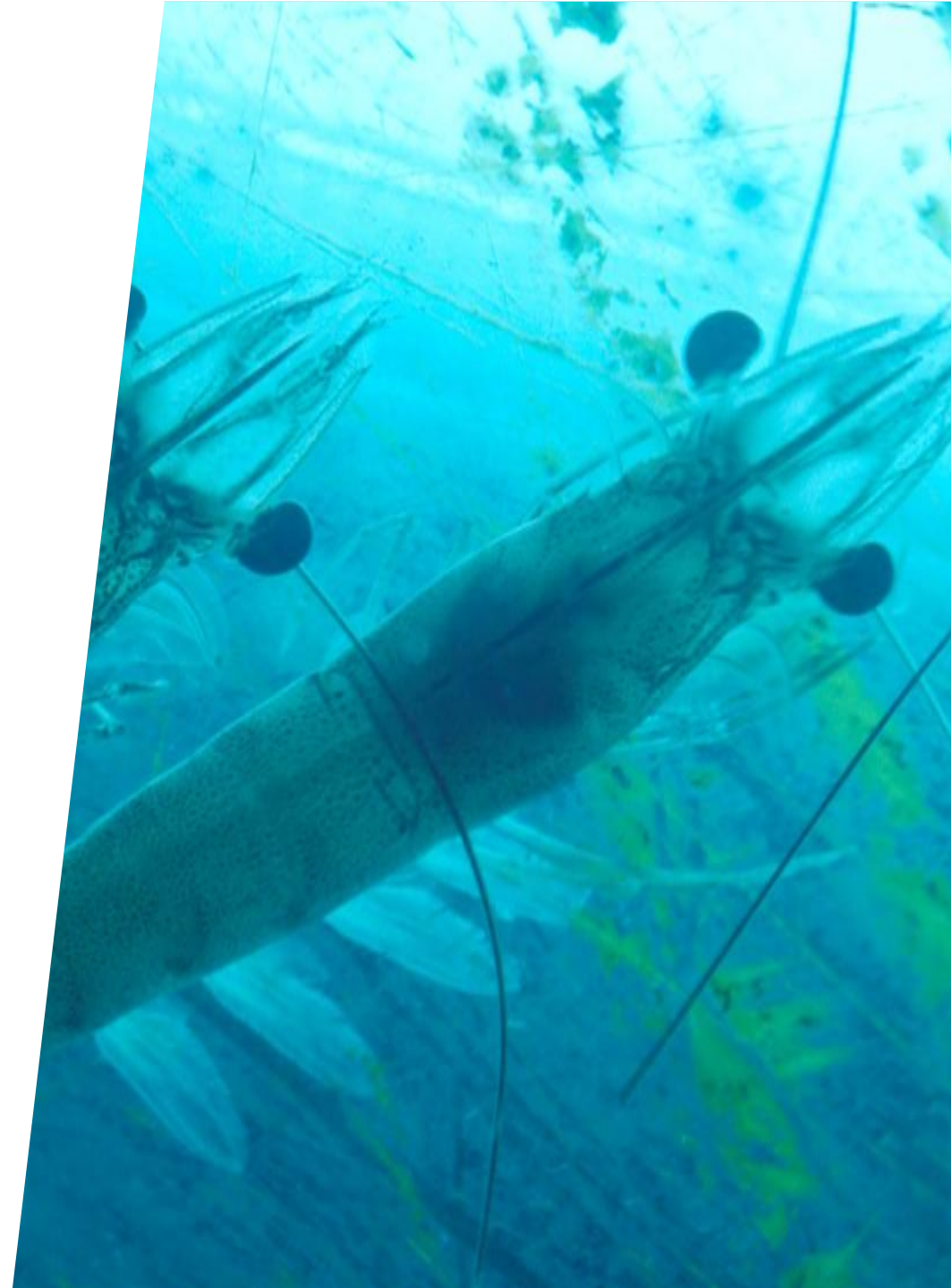
Genética Spring





- CENIACUA
 - *P. vannamei* breeding program
 - Established in 1997
 - For the Colombia farming industry

- BENCHMARK
 - Acquired the shrimp breeding programs from CENIACUA in 2016
 - Genética Spring is formed
 - Developing breeding lines for the global shrimp industry







P. vannamei diseases today!

- ▀ **WSSV**
 - ▀ The most significant viral pathogen
- ▀ **AHPND (“EMS”)**
 - ▀ The most significant bacterial disease
- ▀ **EHP**
 - ▀ “New kid on the block”



SOME COSTS OF SHRIMP DISEASES ACROSS ASIA





WSSV, AHPND (“EMS”) AND EHP

LOST OF PRODUCTIO ALONE*

- Thailand
 - AHPND
 - US\$ 7 billion from 2011 to 2016
 - EHP
 - US\$180 million in 2016
- Vietnam - 2015
 - WSSV
 - US\$ 11 million
 - AHPND
 - US\$ 26 million

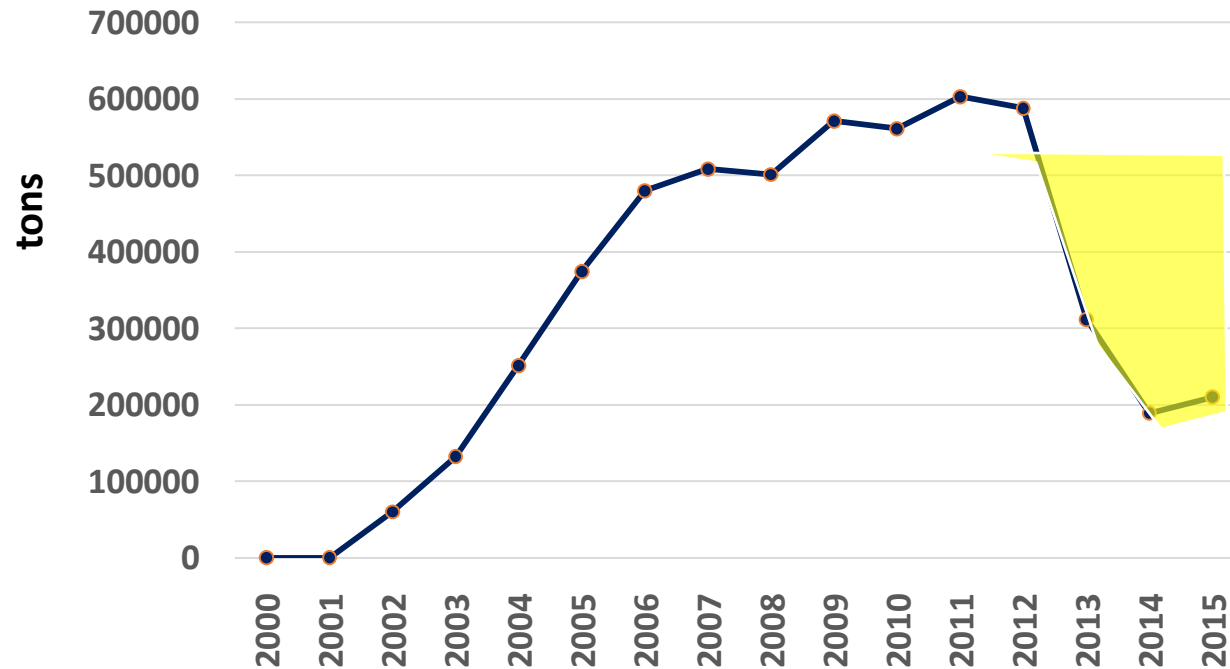
* Feed sales losses are estimated to be 30% of production losses!





AHPND IN THAILAND

P. vannamei



In the absence of AHPND and assuming that the peak production of 2011 would have been maintained, then the AHPND outbreak has cost Thailand an estimated US\$7 billion to date.



Genética
Spring

GENÉTICA SPRING'S (GS) BREEDING PROGRAM

A TALE OF TWO BREEDING LINES



A TALE OF TWO BREEDING LINES

Atlantic breeding program

- 1997: Between and within-family selection
- Selected for:
 - Resistance to TSV, NHP and Vibriosis
 - General pond survival and growth
- Base Line**

Pacific breeding program

- 2008: Mass selection
- Selected for:
 - WSSV resistance and general pond survival
- WSSV R Line**





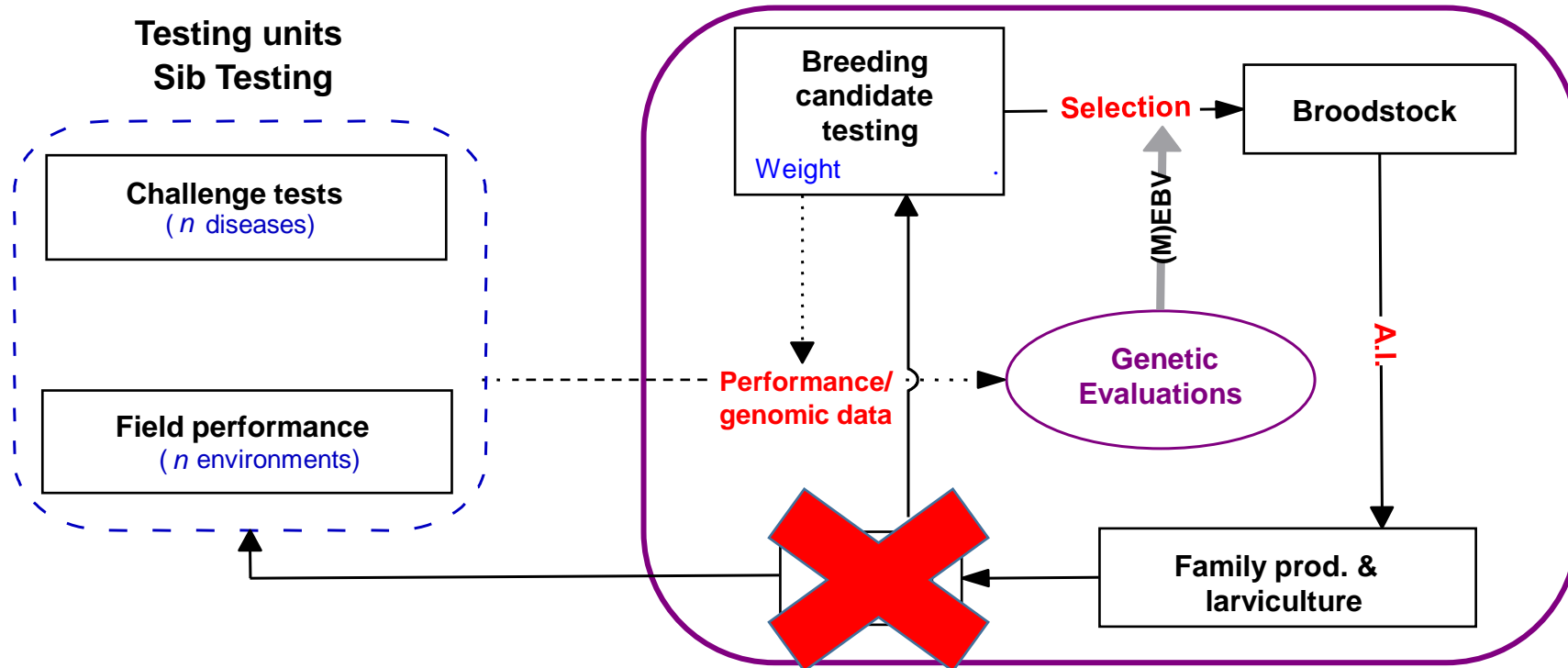
Atlantic line – Base line.

- Complete pedigree information
- Origin from eight (8) different countries, both wild & farmed
- Actual inbreeding around 9-10%
- Between and within family selection
- 100 families per batch (full and half sib scheme)
- Two batches for year
- Current preparing the 14th generation



BASE LINE DESIGN

BREEDING NUCLEUS





PACIFIC LINE – WSSV R LINE

- Mass selection
- Origin from:
 - Base Line + four (4) lines from Ecuador + one (1) wild population
- High selection pressure
 - <0.001% (1 in 10,000)
- One batch per year
- Selected for WSSV resistance and pond survival
- Current preparing the 9th generation



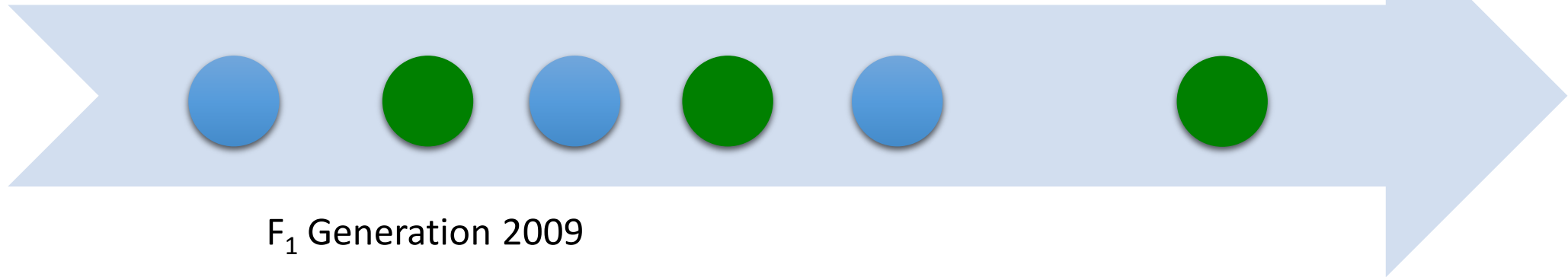
WSSV R LINE DESIGN

F₀ Generation 2008

- Challenge test PL40
- Broodstock raising
- Reproduction

F₈ Generation 2016

- Challenge test PL40
- Challenge test - lab
- Farm stocking
- Broodstock raising
- Reproduction



F₁ Generation 2009

- Challenge test PL40
- Challenge test - lab
- Farm stocking
- Broodstock raising
- Reproduction



SHRIMP FIT FOR THEIR ENVIRONMENT

- The Shrimp sector will continue to be repeatedly exposed to new epidemics while depending on broodstock poorly adapted to local conditions.
- To break this vicious cycle:

SAFE

Use of clean animals

ROBUST

Use of SPR robust animals

ADAPTED

Select breeders adapted to local conditions



Genética
Spring

Safe

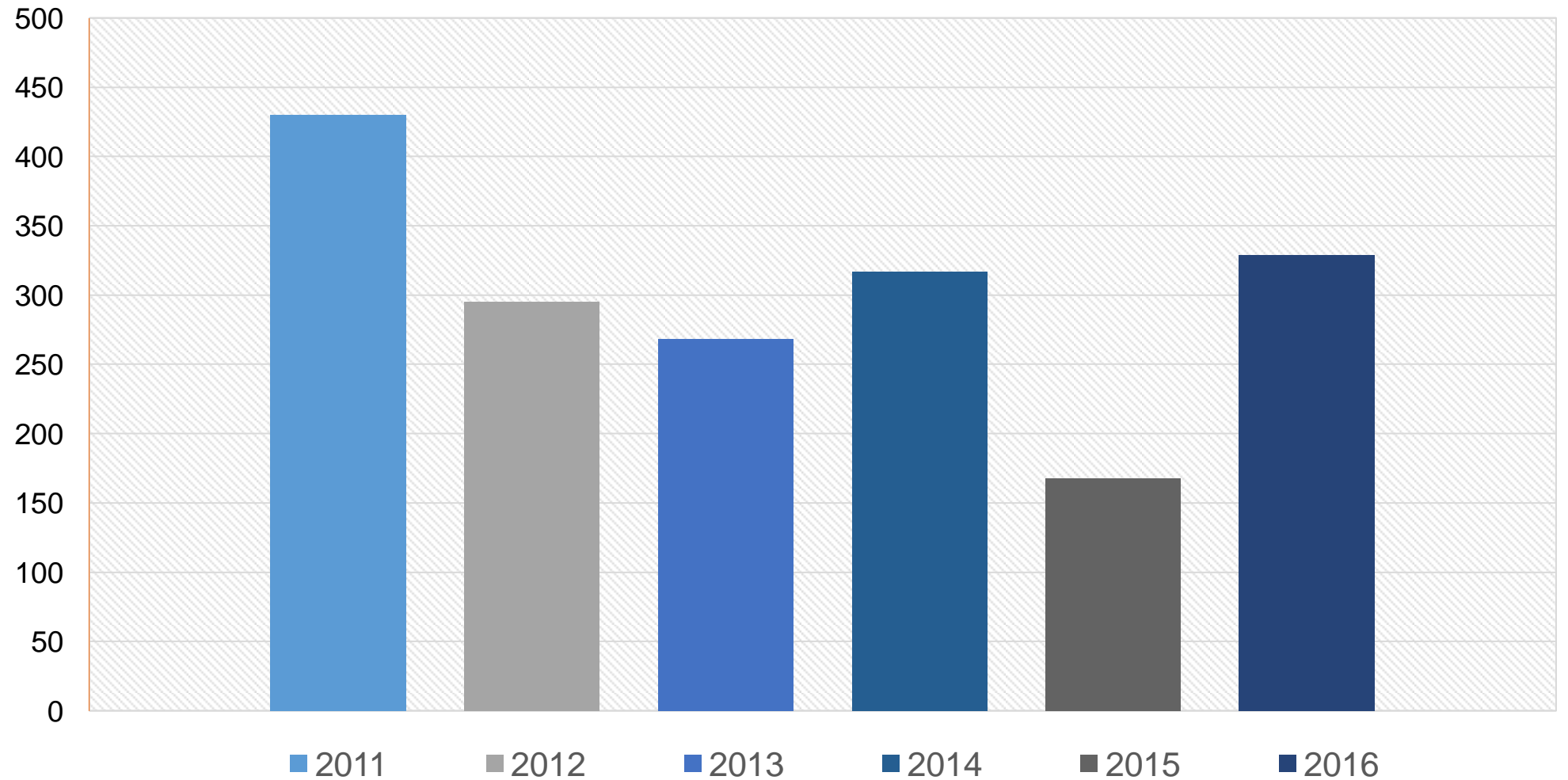




Pathogen/test	PCR	RT-PCR	Histopathology
White Spot Syndrome Virus (WSSV)	✓		✓
Taura Syndrome Virus (TSV)		✓	✓
Yellow-Head Virus (YHV)		✓	✓
Infectious Myonecrosis Virus (IMNV)		✓	✓
<i>Nodavirus de P vannamei</i>		✓	✓
IHHNV			✓
AHPND	✓		✓
Necrotizing Hepatopancreatitis (NHP)	✓		✓
BP – MBV - HPV			✓
EHP	✓		✓
Gregarines – Nematodes - Haplosporidians			✓
Bacterial infections	✓		✓



SURVEILLANCE ANALYSIS (# of samples tested)





THE UNIVERSITY OF
ARIZONA.
TUCSON ARIZONA

AQUACULTURE PATHOLOGY LABORATORY
School of Animal & Comparative Biomedical Sciences Bldg. #90, Room 102
1117 E. Lowell Street, Tucson, Arizona 85721-0090
Phone: 520-621-4438; Email: aquapath@ag.arizona.edu



April 6, 2017

Genetica Spring SAS
Andres Suarez
Calle 32 # 8-33 Oficina 215
Cartagena Bolivar, Colombia

Case: 17-163

E-mail: asuarez@ceniacua.org

Dear Mr. Suarez:

The PCR and RT-PCR tests you requested for the detection of WSSV, IHNV, TSV, YHV, IMNV, AHPND, NHP-B and EHP have been completed. The 57 vials of *P. vannamei* arrived on March 28th, 2017 in good condition. The samples were collected from Punta Canoas Breeding Facility in 2015, 2016, and 2017. Representative samples from the vials (approx. 30mg) were collected for DNA and RNA extractions. WSSV, IHNV, TSV, YHV, IMNV, AHPND, NHP-B and EHP were not detected in the samples tested. The testing was completed on April 5th, 2017. A summary of the tests and results is provided on the following page.

We hope that this information will be helpful to you. A hard copy of this report will be mailed to you. If there are any questions regarding this case, please feel free to contact us.

UAZ Policy on certification: This report provides our findings on the samples submitted to our laboratory for examination, health status evaluation, disease diagnosis, or pathogen detection. It is our policy and intent to perform the most appropriate assay(s) for the determination of the health/pathogen status of all specimens submitted to our laboratory. However, this report in no way constitutes a stock or facility "certification" or a "certificate" of health/pathogen status for the sample(s) tested or for the stocks, or facility, from which the sample(s) were derived.

PCR: disclaimer: This report provides our findings on the samples submitted to our laboratory for pathogen detection. The PCR assay used by this laboratory for the detection of shrimp pathogens is a research tool. The results should be considered as experimental and tentative. Whenever possible, PCR results should be confirmed by alternative assay. This report in no way constitutes a stock or facility "certification" or a "certificate" of health/pathogen status for the sample(s) tested or for the stocks, or facility, from which the sample(s) were derived.

The UAZ Aquaculture Pathology Lab is a OIE (Office International des Epizooties or the Organization or World Animal Health Organization) Reference Laboratory for White Spot Disease, Taura Syndrome, Infectious Hypodermal and Hematopoietic Necrosis, Spherical Baculovirus, Tetrahedral Baculovirus, Necrotizing Hepatopancreatitis Bacterium, and Infectious Myonecrosis, and a U.S.D.A. A.P.H.I.S. Approved Laboratory for export testing for White Spot Disease, Taura Syndrome, Infectious Hypodermal and Hematopoietic Necrosis, Spherical Baculovirus, Tetrahedral Baculovirus, Infectious Myonecrosis, and Yellowhead Disease.

Sincerely yours,

Irina Maskaykina
Research Specialist

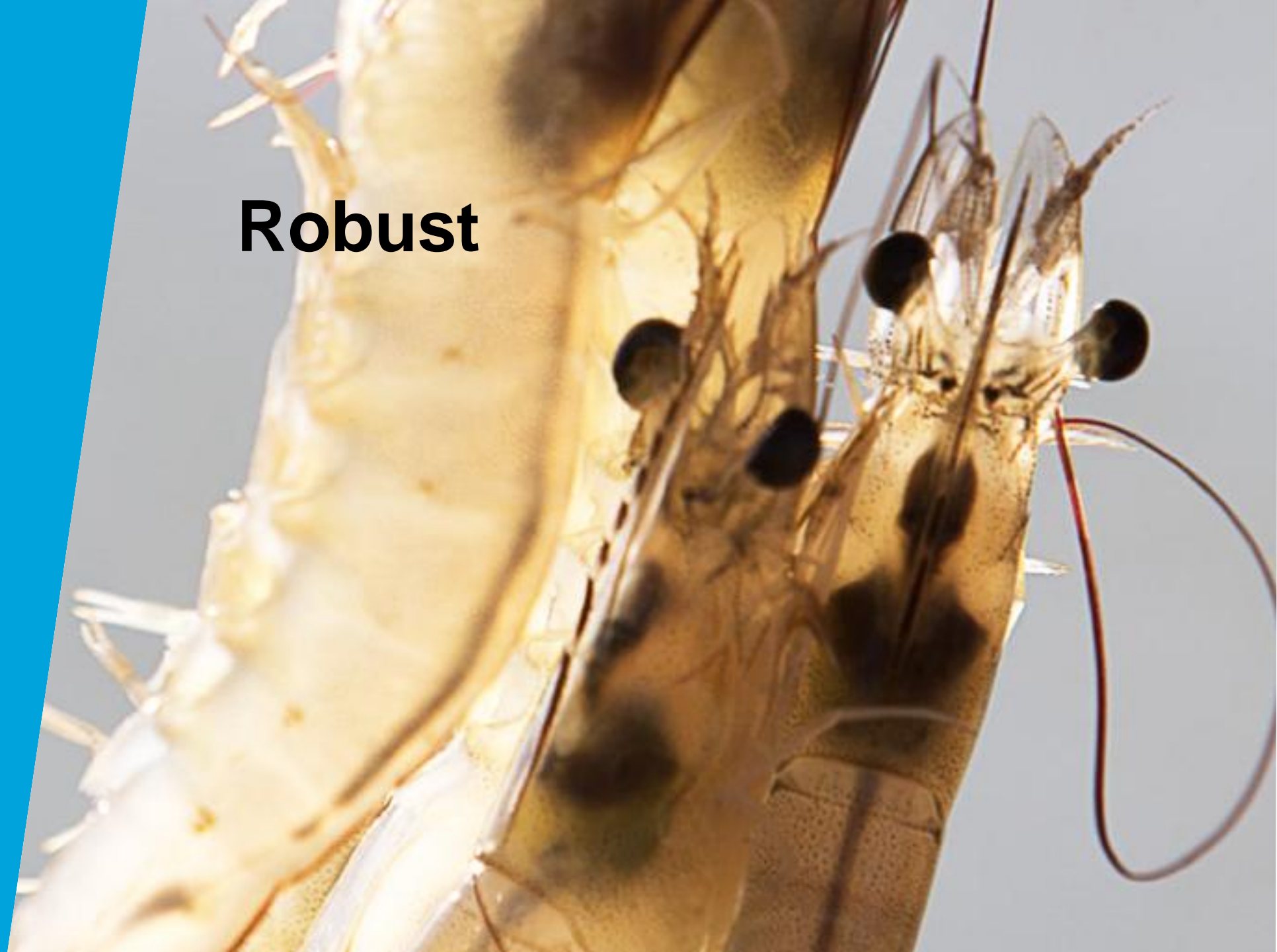
Arun K. Dhar, Ph.D.
Associate Professor
Aquaculture Pathology Laboratory Director





Genética
Spring

Robust





GENÉTICA SPRING POPULATIONS ARE SPR FOR:

TSV

NHP

WSSV

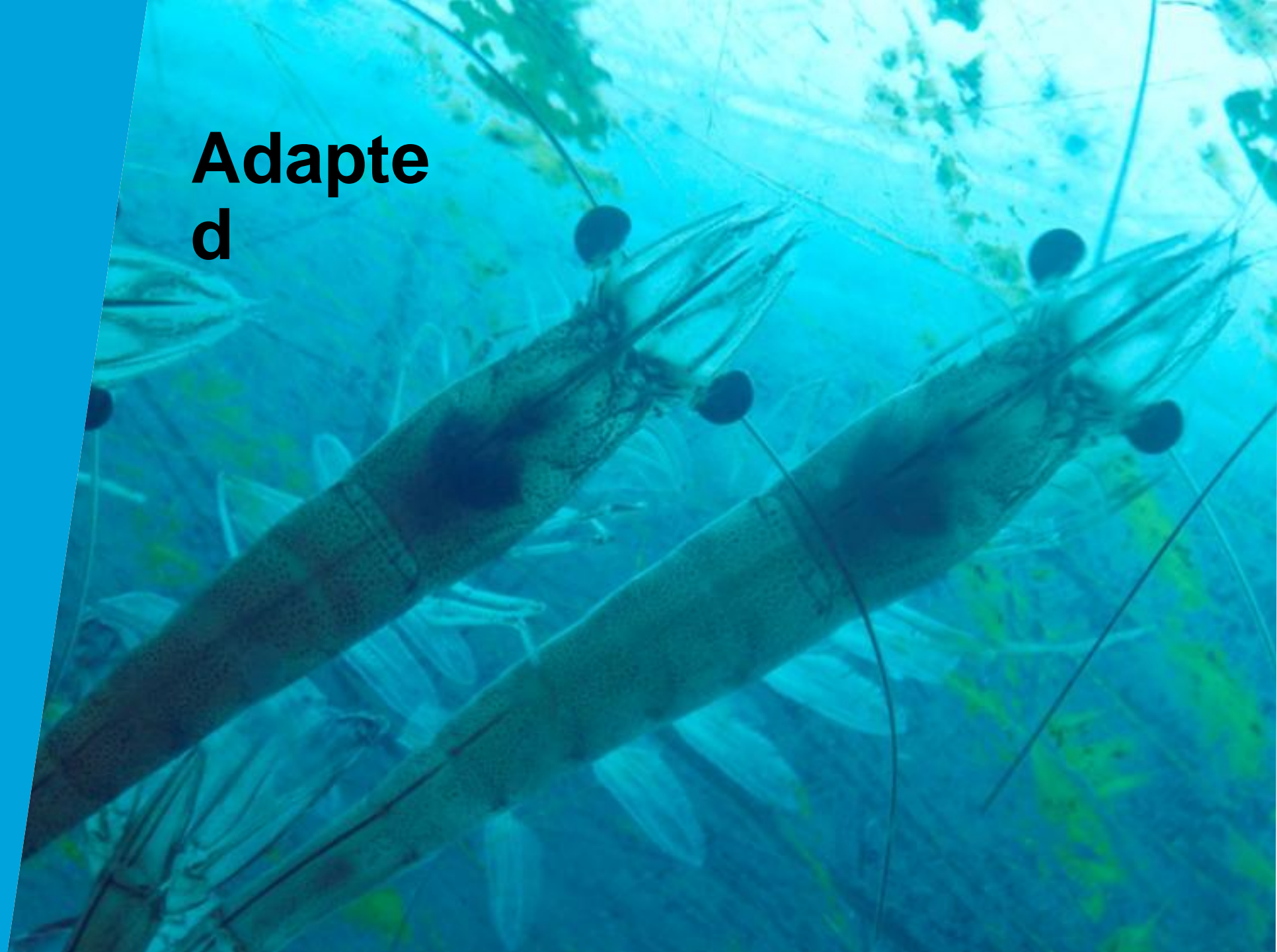
IHHNV

Mild
vibriosis



Genética
Spring

**Adapte
d**





ADAPTED

- ▣ Distinct lines:
 - ▣ Selected for superior performance under specific conditions.
- ▣ Our dissemination protocols:
 - ▣ Select lines best suited to our clients conditions.
 - ▣ Local adaptation in the multiplication phase.





DIVERSE GENETIC BASE

“GENE SUPERMARKET”

- ▣ Countries – Original Gene Pool:
 - ▣ Colombia¹
 - ▣ Costa Rica²
 - ▣ Ecuador²
 - ▣ Hawaii¹
 - ▣ Panama²
 - ▣ Peru²
 - ▣ El Salvador²
 - ▣ Venezuela¹

¹Domestic stocks; ²Wild stocks





GENOTYPE BY ENVIRONMENT INTERACTION

- ▀ GxE interactions are relevant in *P.vannamei* culture

DOES ONE SIZE FIT ALL?





LINES UNDER DEVELOPMENT

- Resistant Lines:
 - WSSV – Genomic Selection
 - AHPND – Genomic Selection
 - General survival
- Maturation:
 - No ablation
 - Dry feed 100%





LINES UNDER DEVELOPMENT

- Growth Lines:
 - Early growth (60 DOC)
 - Late growth (100 DOC)
 - Lined outdoor ponds (100 PL/m²)
 - Low salinity (<5ppt)





GENÉTICA SPRING FACILITIES

■ Punta Canoas: SPF & SPR

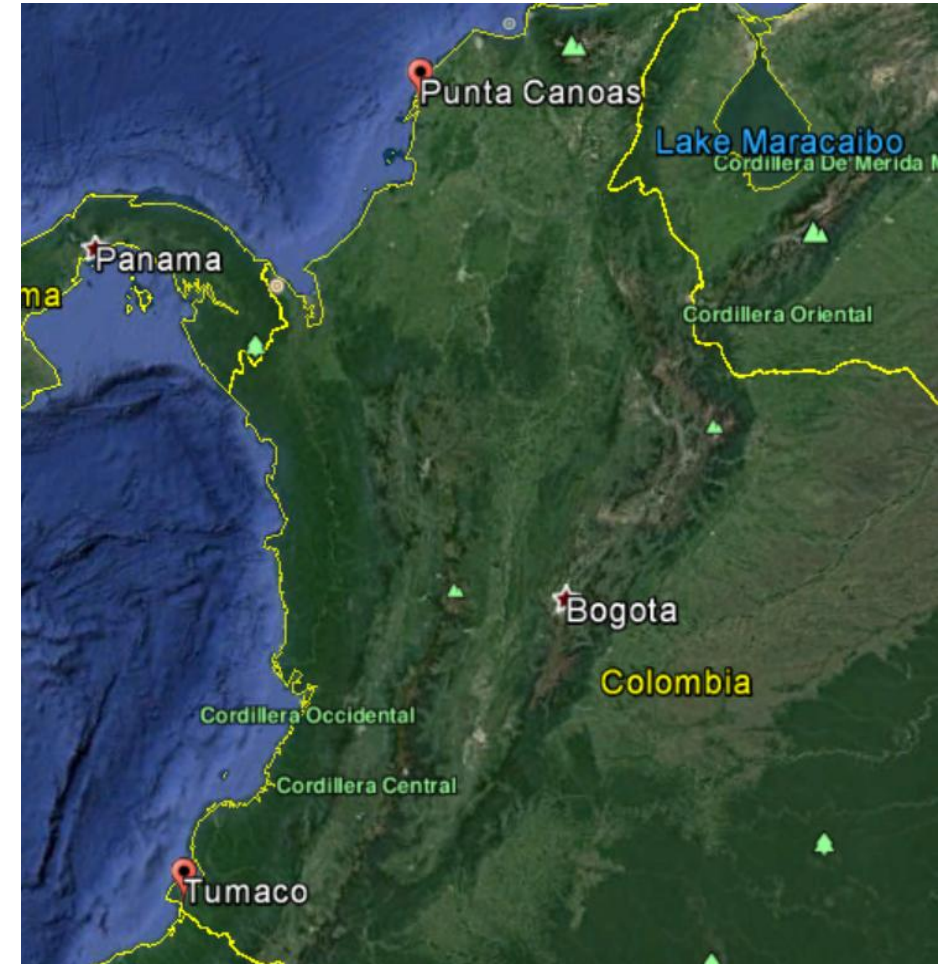
- NBC
 - Family selection
- MC
 - Commercial breeders

■ Pacific Coast: SPR

- NBC
- Testing facility

■ Bogotá:

- Single pathogen challenge testing



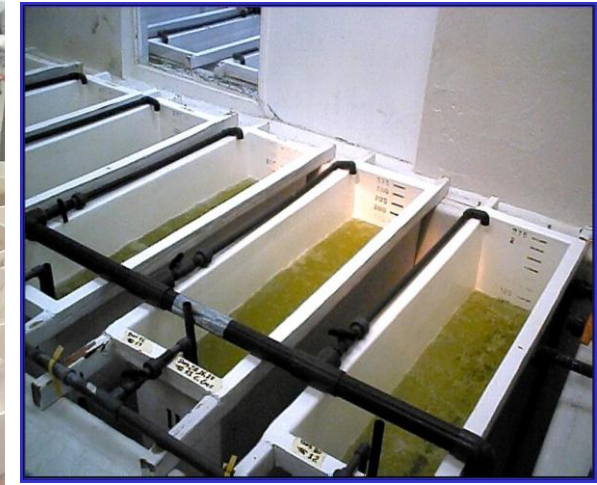


GENÉTICA SPRING INFRASTRUCTURE

■ Punta Canoas – Biosecure Facility

- Physically isolated from commercial farms
- Indoor NBC
- Covered MC
- Fenced perimeter
- No visitors
- Testing infrastructure
 - Earth ponds
 - Lined intensive ponds
 - Indoor/outdoor tanks
- Lab infrastructure
 - PCR; Histology; Bacteriology







BASE LINE x WSSV R LINE



LINE AND FAMILY CONCEPT

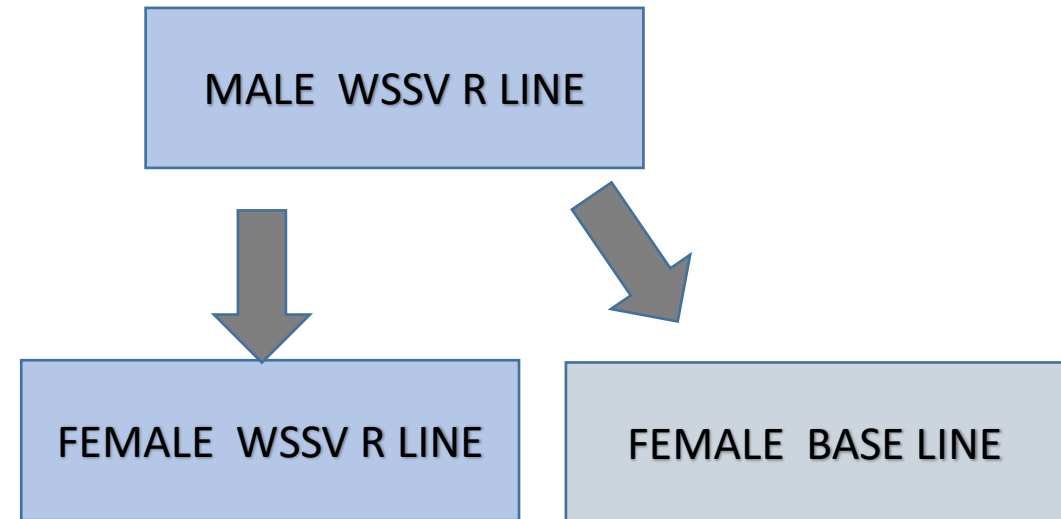
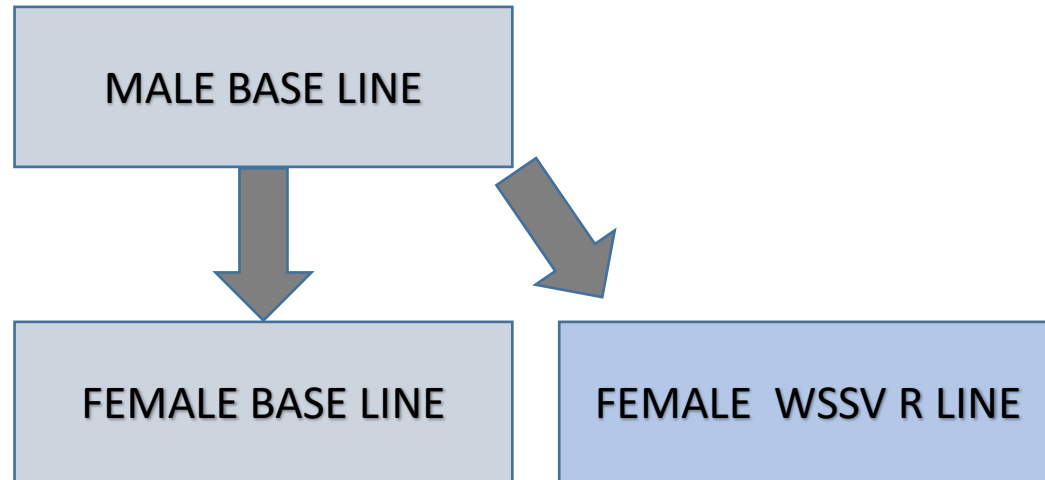
- Line (or strain):
 - Group of families with one or more common characteristic such as:
 - WSSV resistant
 - Fast growing

- Family:
 - Shrimps originated from one individual spawn
 - One male crossed with one female





MATINGS DESIGN



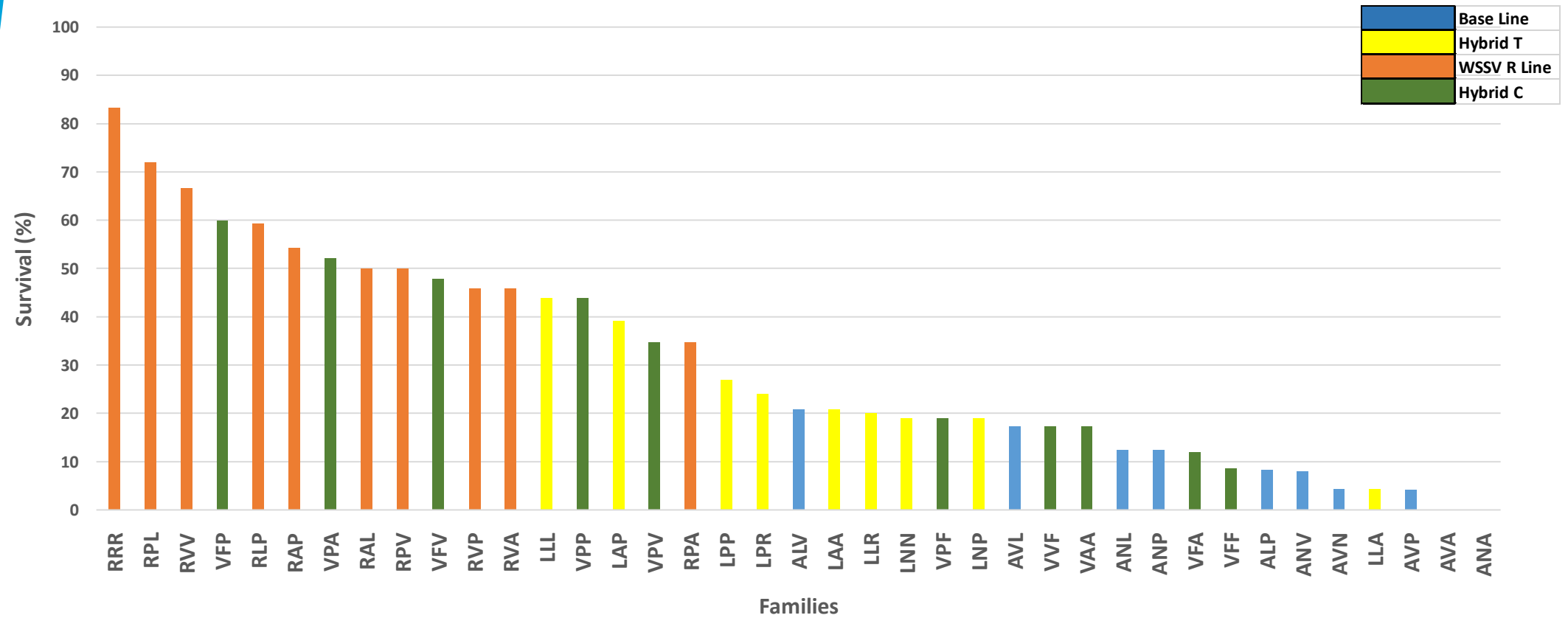
- 40 families total
 - 10 families from each line
 - Two pure lines
 - Two hybrids lines

- Full sib and half sib families.
 - The same male inseminated one female from each line.



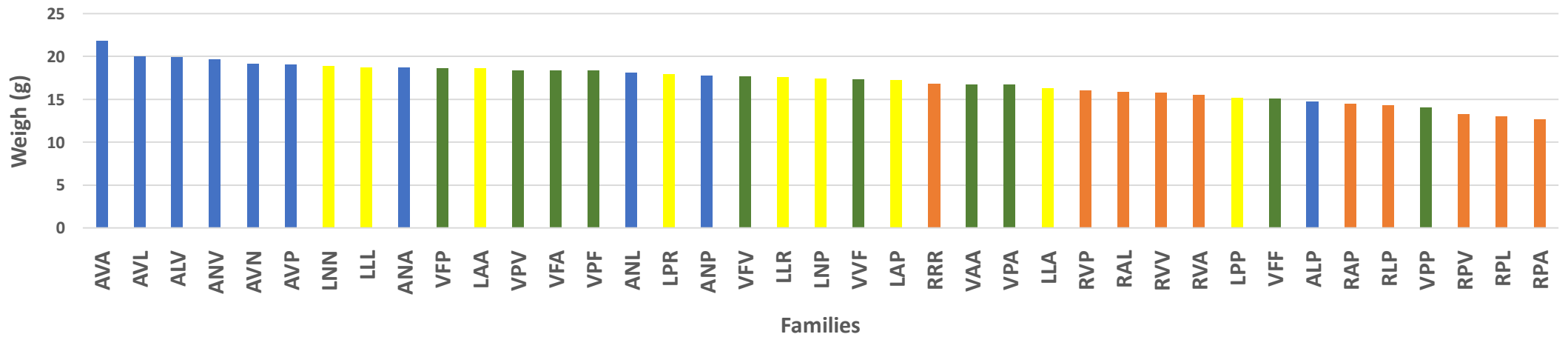
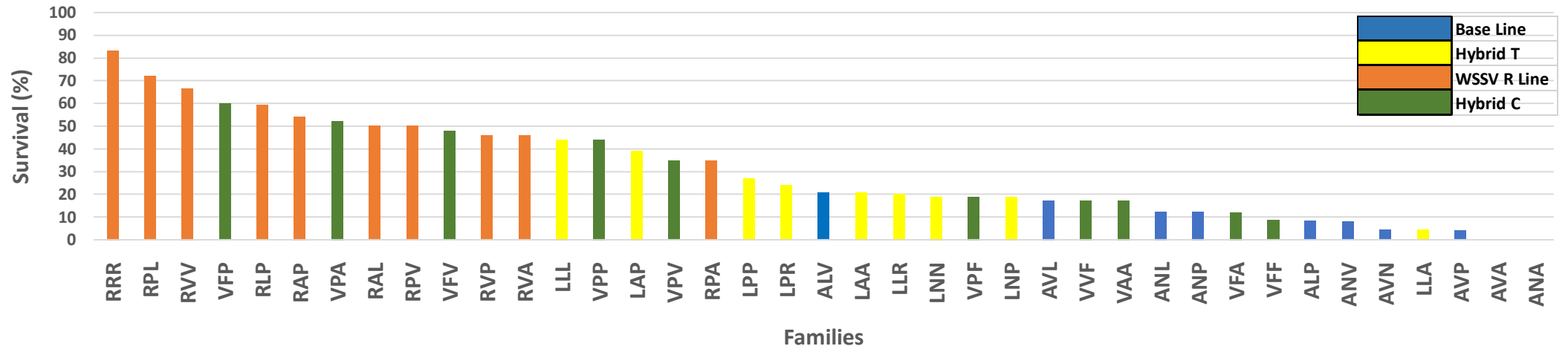
RESULTS

FAMILY SURVIVAL FOR A 30 DAYS WSSV CHALLENGE TEST MAY 2017





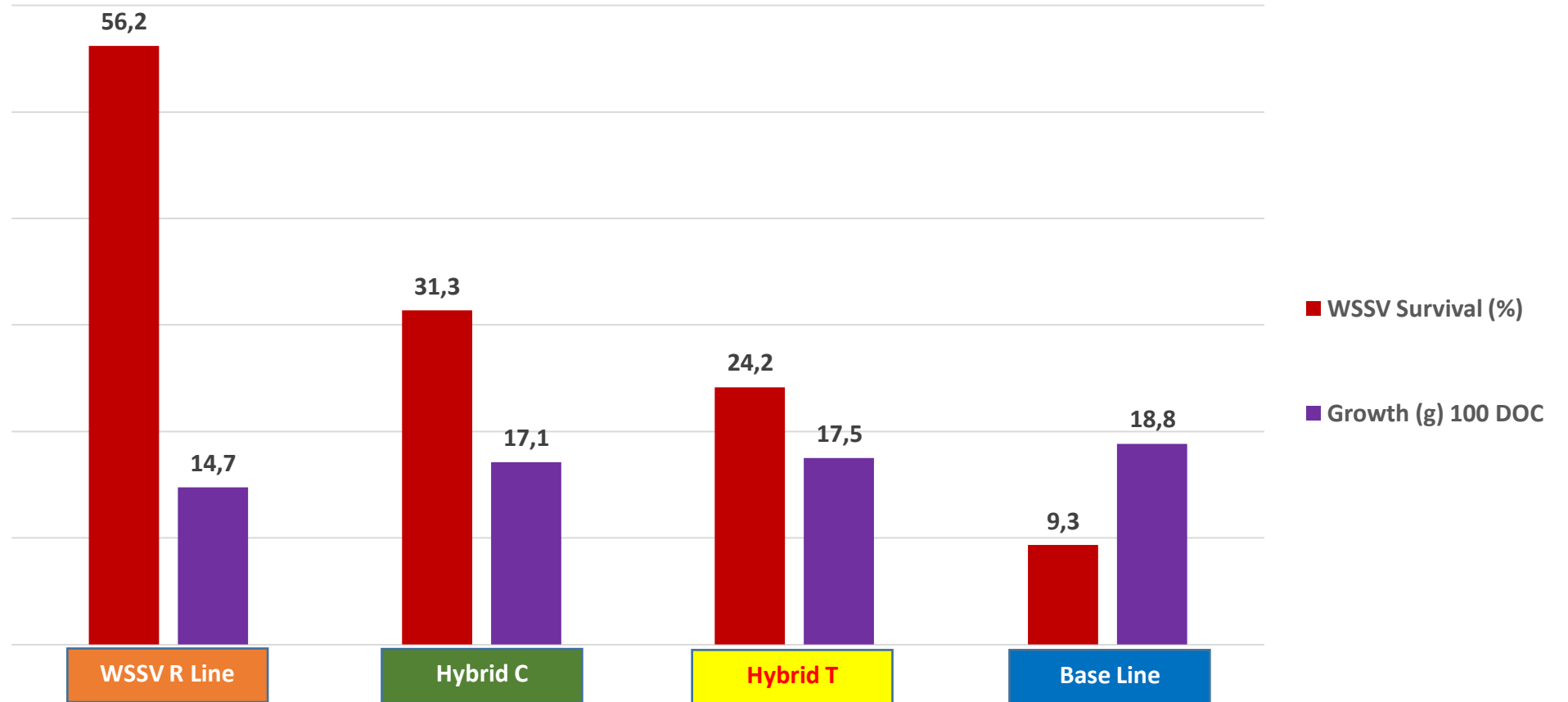
FAMILY SURVIVAL FOR A 30 DAYS WSSV CHALLENGE TEST



FAMILY GROWTH AT 100 DOC



AVERAGE WITHIN EACH LINE FOR: SURVIVAL FOR WSSV CHALLENGE TEST GROWTH FOR 100 DOC (PL-10)





CUTTING EDGE TECHNOLOGIES

- Pit Tags:
 - Individual monitoring of breeders candidates:
 - From growth selection to maturation
- Parental assignment:
 - 192 SNPs panel
 - Replacing elastomer tagging
 - Common environment
- Genomic Selection
 - Training data: Trial Base line x WSSV R line
 - 2378 SNPs: different in the two lines



Salmon

Taking the learning
from Salmon



Shrimp



Tilapia

Deploying
Technologies



Other major
farmed species



Acknowledgments

- ▀ **Mr. Itamar Rocha – ABCC**
 - ▀ **For the invitation**
- ▀ **Genética Spring Staff**
 - ▀ **For the hard work**
- ▀ **Dr. Andy Shinn – FVG**
 - ▀ **For the scary disease data**
- ▀ **Morten Rye – AFGC**
 - ▀ **For the genomic data**





Genética
Spring

**Muito
Obrigado!**

Portal Oficial de Turismo do Rio Grande do Norte

