Aquaculture genetic breeding in China

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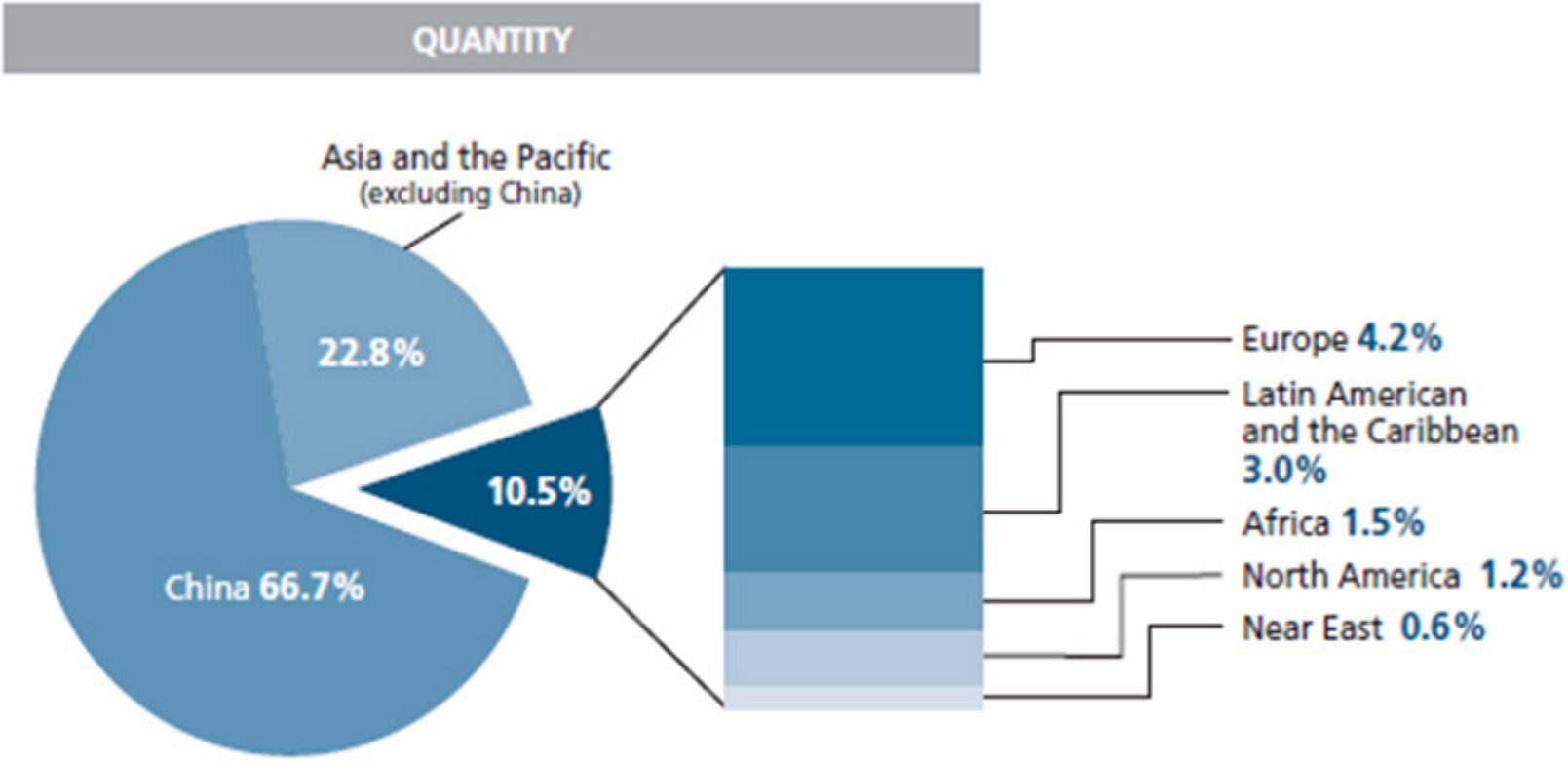
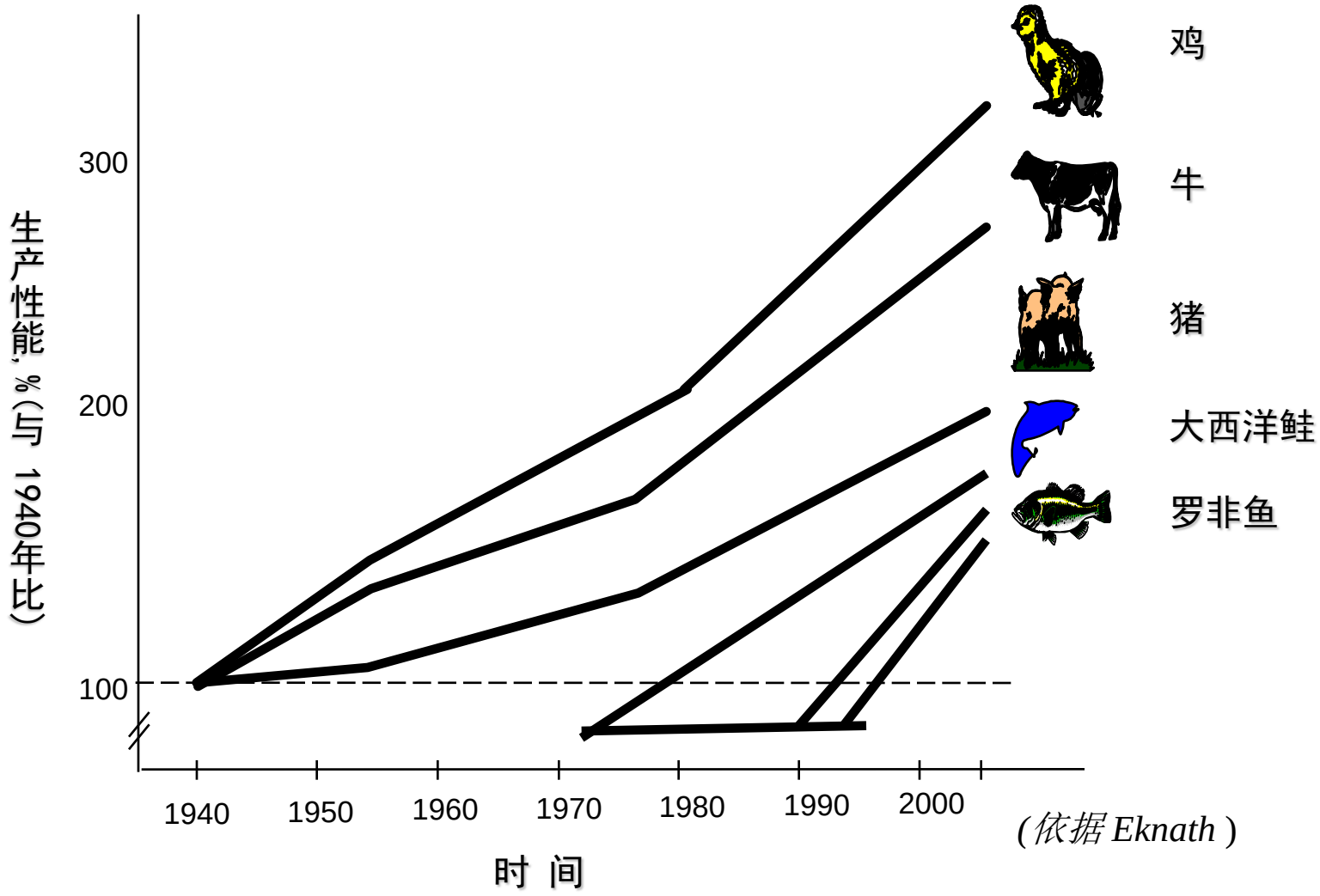
Contribution of China to the world aquaculture production



World production: 52 million tonnes with a value of US$ 78.8 billion

(FAO, 2009)

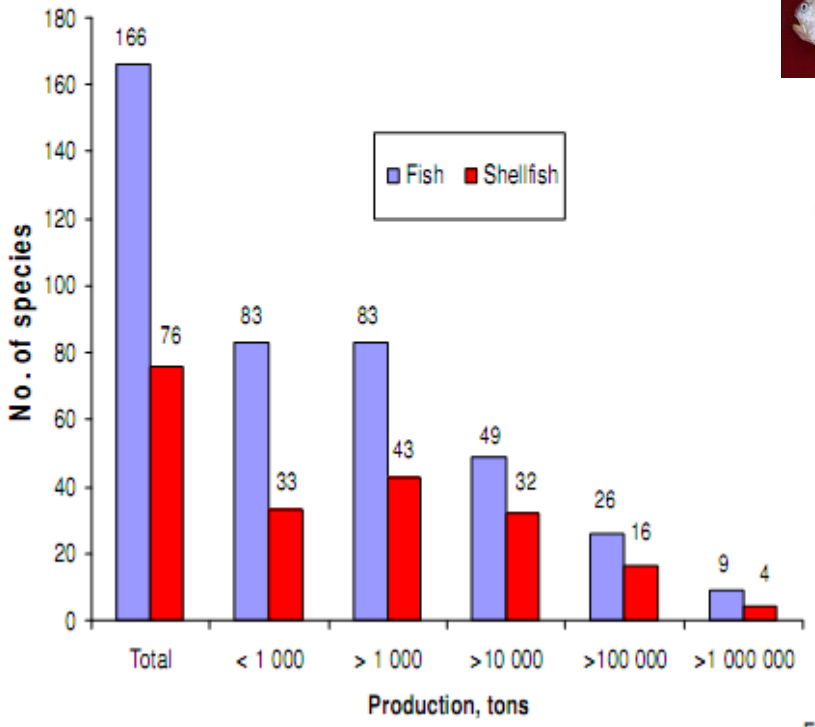
世界育种成就


鸡
牛
猪
大西洋鲑
罗非鱼
300
200
100
生产性能，%（与1940年比）
1940
1950
1960
1970
1980
1990
2000
时 间
(依据 Eknath)

High diversity of aquacultural species

Aquaculture:

- 240 species farmed
- 42 species > 100 000 tons
- 13 species > 1 mill tons



FAO (2005)


大菱鲆"丹法鲆"


牙鲆"鲆优1号"


中国对虾"黄海1号、2号"


斑节对虾"南海1号"


仿刺参"水院1号"

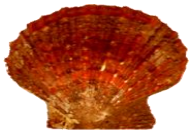

大黄鱼"闽优1号"


中华绒螯蟹"光合1号"

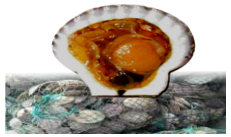

三疣梭子蟹"黄选1号"


南美白对虾"中科1号"、"中兴1号"、"桂海1号"、科海1号


"大连1号"皱纹盘鲍


"蓬莱红"栉孔扇贝


"中科红"海湾扇贝


"海大金贝"虾夷扇贝


"中科红II"海湾扇贝


"海优1号"马氏珠母贝


"东优1号"杂色鲍


坛紫菜"闽丰1号"

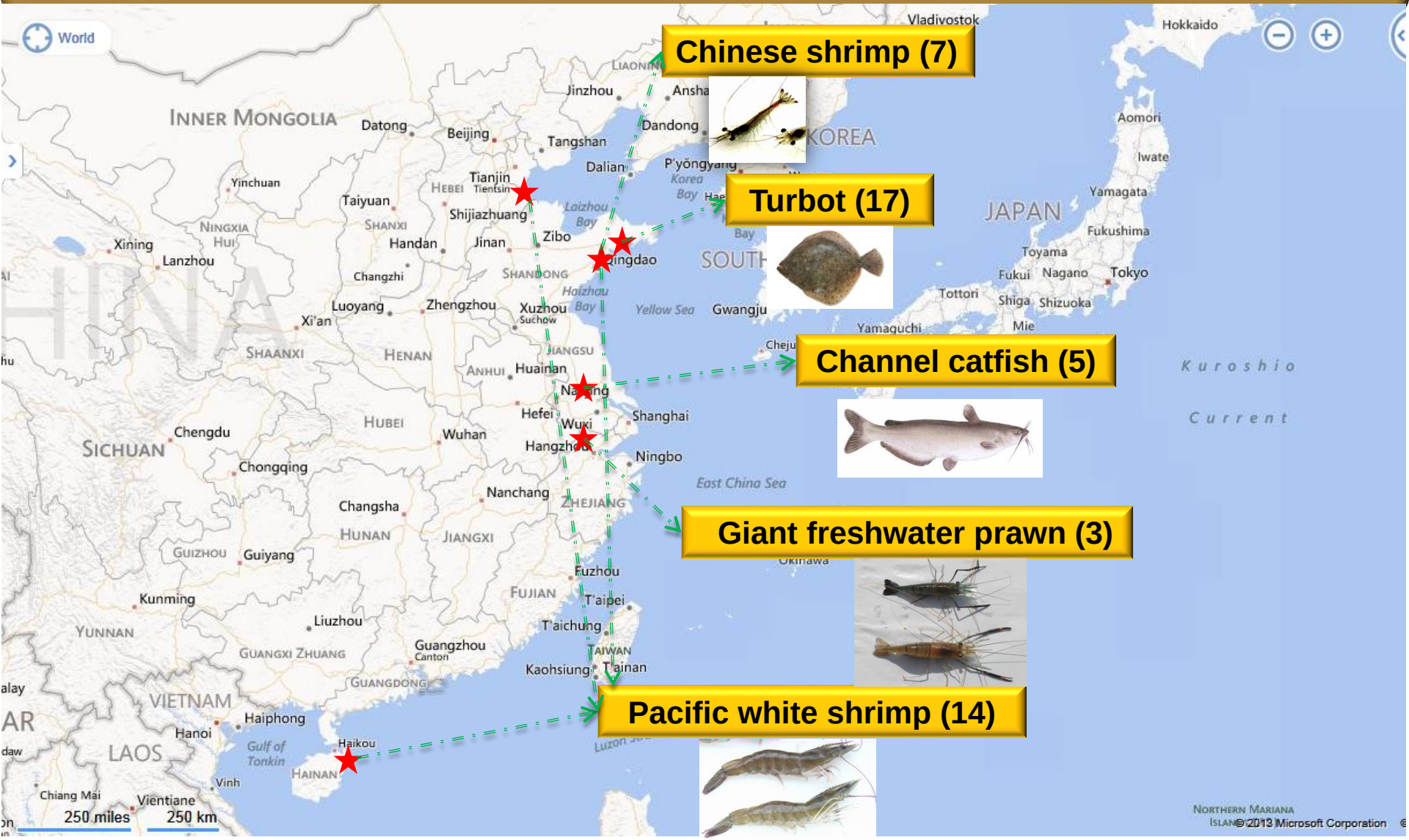

坛紫菜"申福1号"


"东方1号、2号、3号"海带


"981号"龙须菜

Aquacultural varieties bred in China

Five selective breeding projects



Breeding Strategies--shrimp

Composite Base Population:

-high genetic quality

-broad additive genetic diversity

Design and Control Mating

Individual Spawning/Hatching

Marking and Tagging

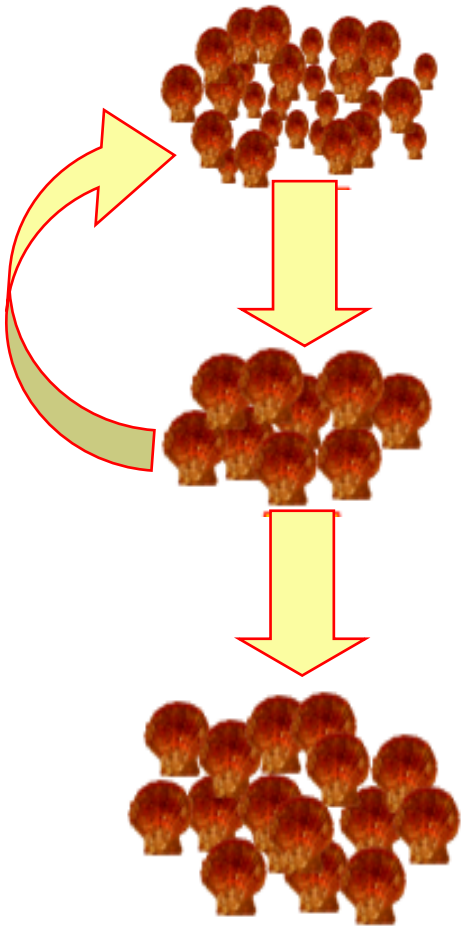
Testing:

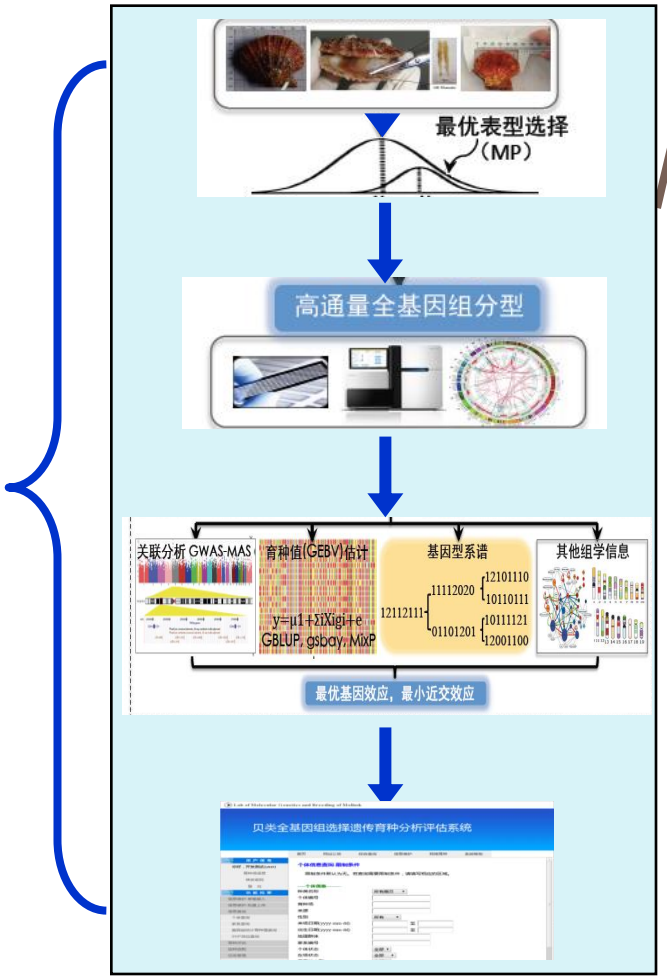
- *Growth/survival in commercial ponds*
- *WSSV-challenge Testing*

Calculate Selection Index

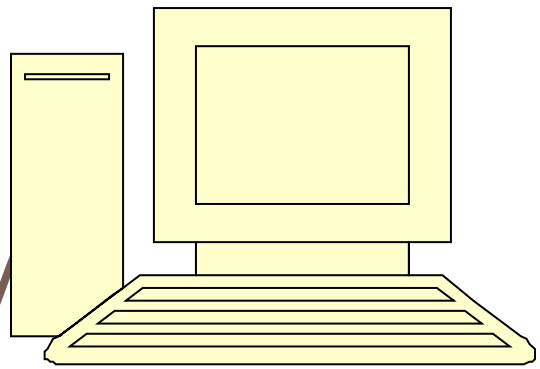
Key procedures of scallop breeding

Novel GS approach applied in scallop





Mass Optimum Effects Genomic Selection, (MOEGS)



Hatching facility for fish

Turbot

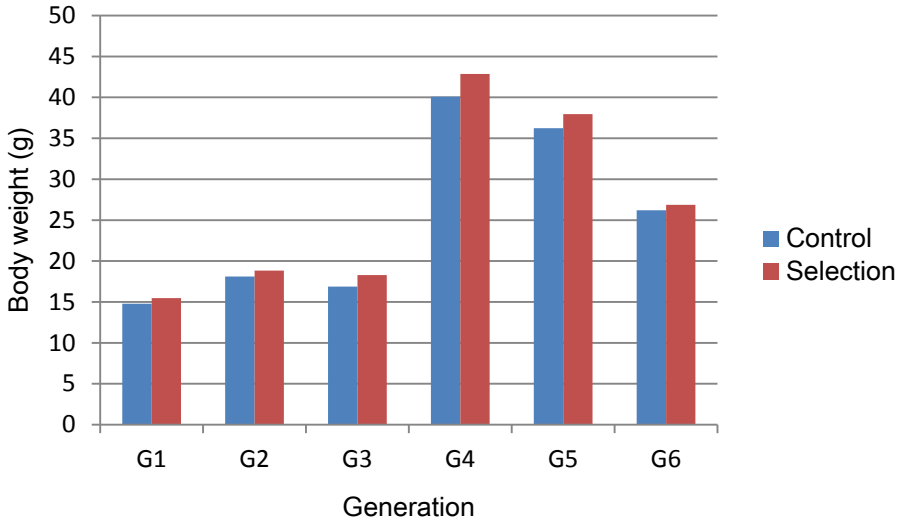
Cat fish

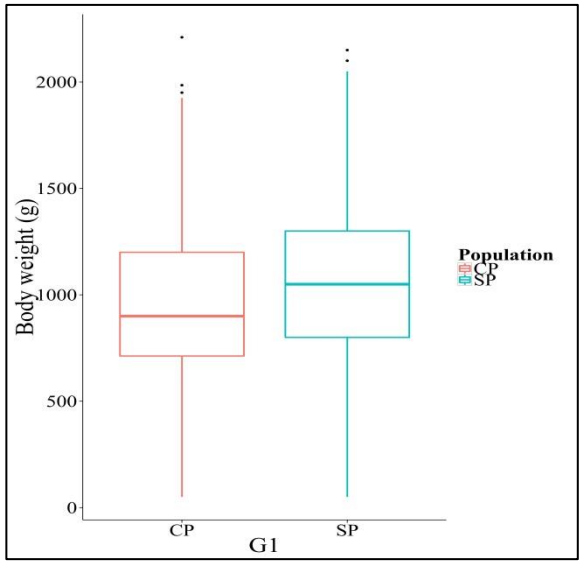

2376

Genetic parameters

Trait	Species	Heritability	Common environment
		$h^2 \pm se$	$c^2 \pm se$
Body weight	Chinese shrimp	0.180±0.050	0.160±0.020
	Pacific white shrimp	0.350±0.080	0.070±0.030
	Giant freshwater prawn	0.056±0.014	0.039±0.005
	Channel catfish	0.225±0.083	0.129±0.036
	Turbot	0.560±0.150	0.042±0.045
Survival	Chinese shrimp	0.030±0.021	0.060±0.032
	Pacific white shrimp	0.051±0.034	0.093±0.018
	Giant freshwater prawn	0.016±0.012	0.092±0.007
	Channel catfish	0.280±0.048	-
	Turbot	0.120±0.030	-
WSSV resistance	Chinese shrimp	0.140±0.120	-
Temperature tolerance	Turbot	0.055±0.035	0.027 ±0.066

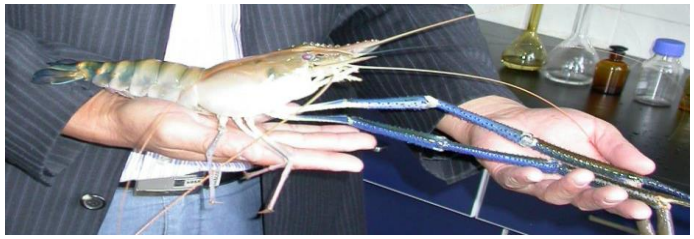
Genetic gain with multiple generations





Accumulated genetic gain: 30.48% for six generations of selection.

Accumulated genetic gain: 11.71% for one generation of selection.



Measuring genetic gain using the wild population

species	Generation	Population	Least square means (g)	Selection response (%)
Chinese shrimp	G_7	Selection	17.10	18.67
		Wild	14.41	
Giant freshwater prawn	G_3	Selection	18.63	39.76
		Wild	13.33	
	G_6	Selection	26.87	39.95
		Wild	19.20	

Data management

- **Data is essential component**
  - **Pedigree records**
  - **Performance records**

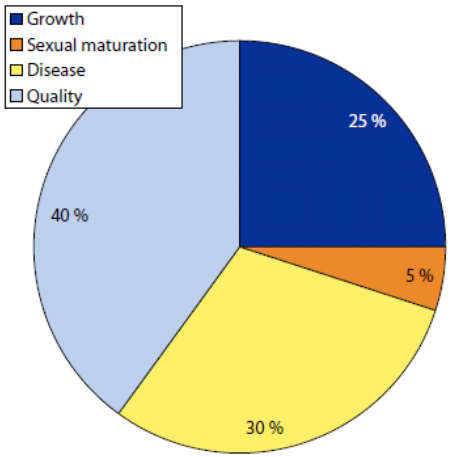
- **Data system is required:**
  - **Purpose-built database**
  - **Standard file imports and exports**
  - **Output for genetic analysis and breeding decisions**

Four programs were written and finished for data acquisition, breeding design and genetic evaluation.

Future developments

1、multi-traits selection technology.

- **Growth rate, feed efficiency, disease resistance, resistance to adverse environments (temperature, salinity, ammonia nitrogen), sexual maturation and quality.**
- **Genotype by environment interaction.**
- **Move towards more balanced breeding objectives.**

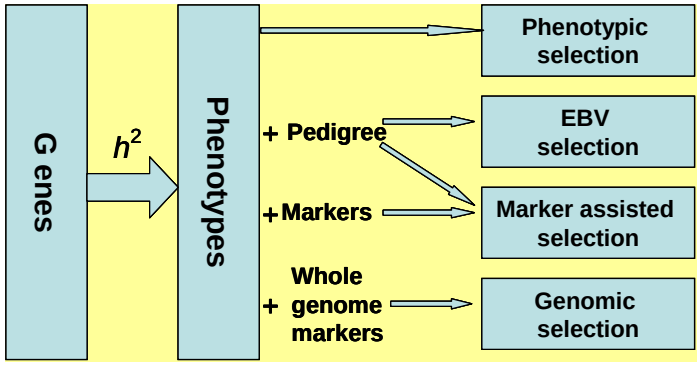


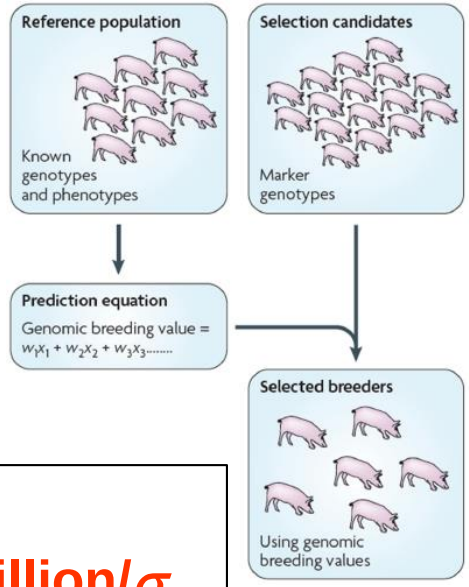
Main-traits	Sub-traits	Main weighting	Partial weighting
Growth		25	
	Smolt weight		5
	Slaughter weight		20
exual maturation		5	5
Disease		30	
	IPN		10
	ISA		15
	Furunculosis		5
Quality		40	
	Filet colour		20
	Body shape		5
	Total fat		10
	Visible fat		5
Total		100	100

Example of increasing number of trait in the AquaGen population

2、The future of a genome-wide association study and the whole genome selection in aquaculture

- Increased genetic gain (increasing accuracy of selection; reducing the generation interval)
- Lower inbreeding rate per generation





Dairy cattle (Schaeffer et al., 2006).

	Genetic gain	Cost
BLUP	$0.215\sigma_g$/year	\$116 million/σ_g
GS	$0.467\sigma_g$/year	\$4.17 million/σ_g

Thank you !