
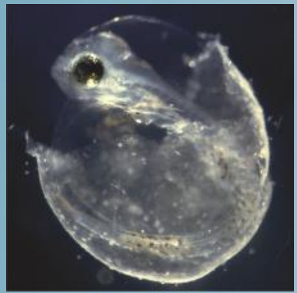


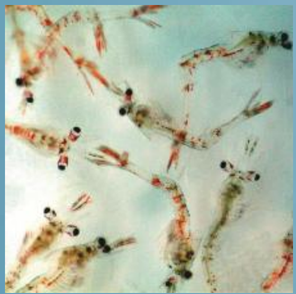
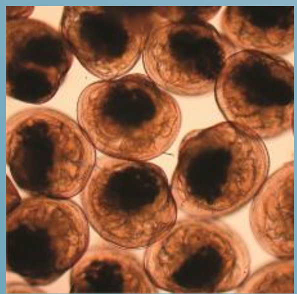
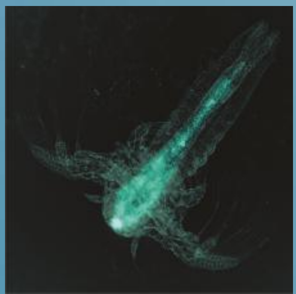

larvi 2013

6th fish & shellfish larviculture symposium

Intensification of *Litopenaeus vannamei* larviculture

Maria de Lourdes Cobo Barcia

ghent university, belgium, 2-5 september 2013

INTENSIFICATION OF WHITE SHRIMP *Litopenaeus vannamei* (Boone) Larviculture

María de Lourdes Cobo Barcia

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&
P. Sorgeloos

Laboratory of Aquaculture
& Artemia Reference Center

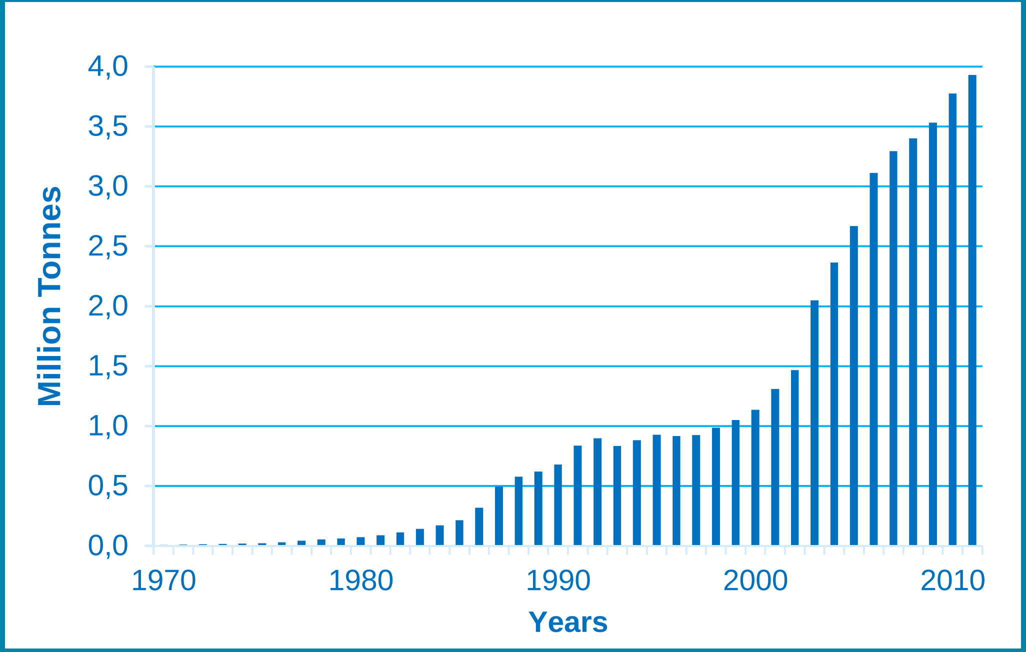
VLIR Vlaamse Interuniversitaire Raad
UOS University Development Co-operation

CENAIM-ESPOL

GENERAL INTRODUCTION

Penaeus monodon

Litopenaeus vannamei



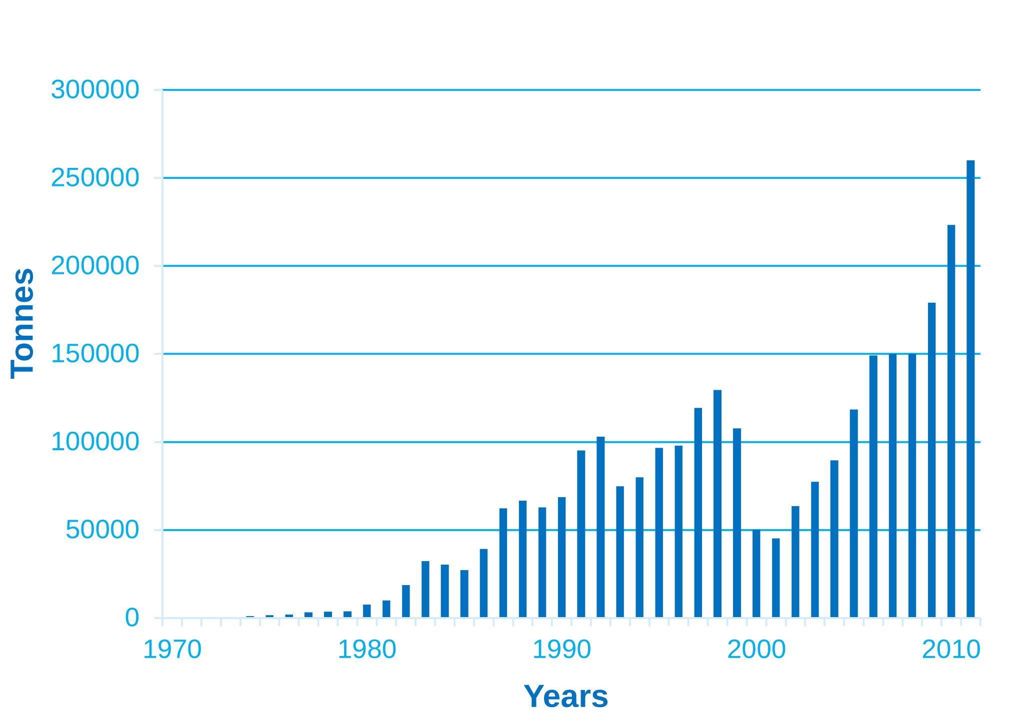
Marine shrimp
4 million tonnes
USD 18 billion

L. vannamei
3 million tonnes
USD 12 billion

FAO, 2013

GENERAL INTRODUCTION

L. vannamei aquaculture production in Ecuador



FAO, 2013

Top ten regional aquaculture producers in America

Country	Tonnes	Percentage
Chile	701 062	27.21
United States of America	495 499	19.23
Brazil	479 399	18.61
Ecuador	271 919	10.55
Canada	160 924	6.25
Mexico	126 240	4.90
Peru	89 021	3.46
Colombia	80 367	3.12
Cuba	31 422	1.22
Honduras	27 509	1.07
Other	113 067	4.39
Total	**2 576 428**	**100**

GENERAL INTRODUCTION

Reliable supply of shrimp larvae:

quantity and quality

> 200 hatcheries

> 60 billion PL year^{-1}

GENERAL INTRODUCTION

Traditional Aquaculture System

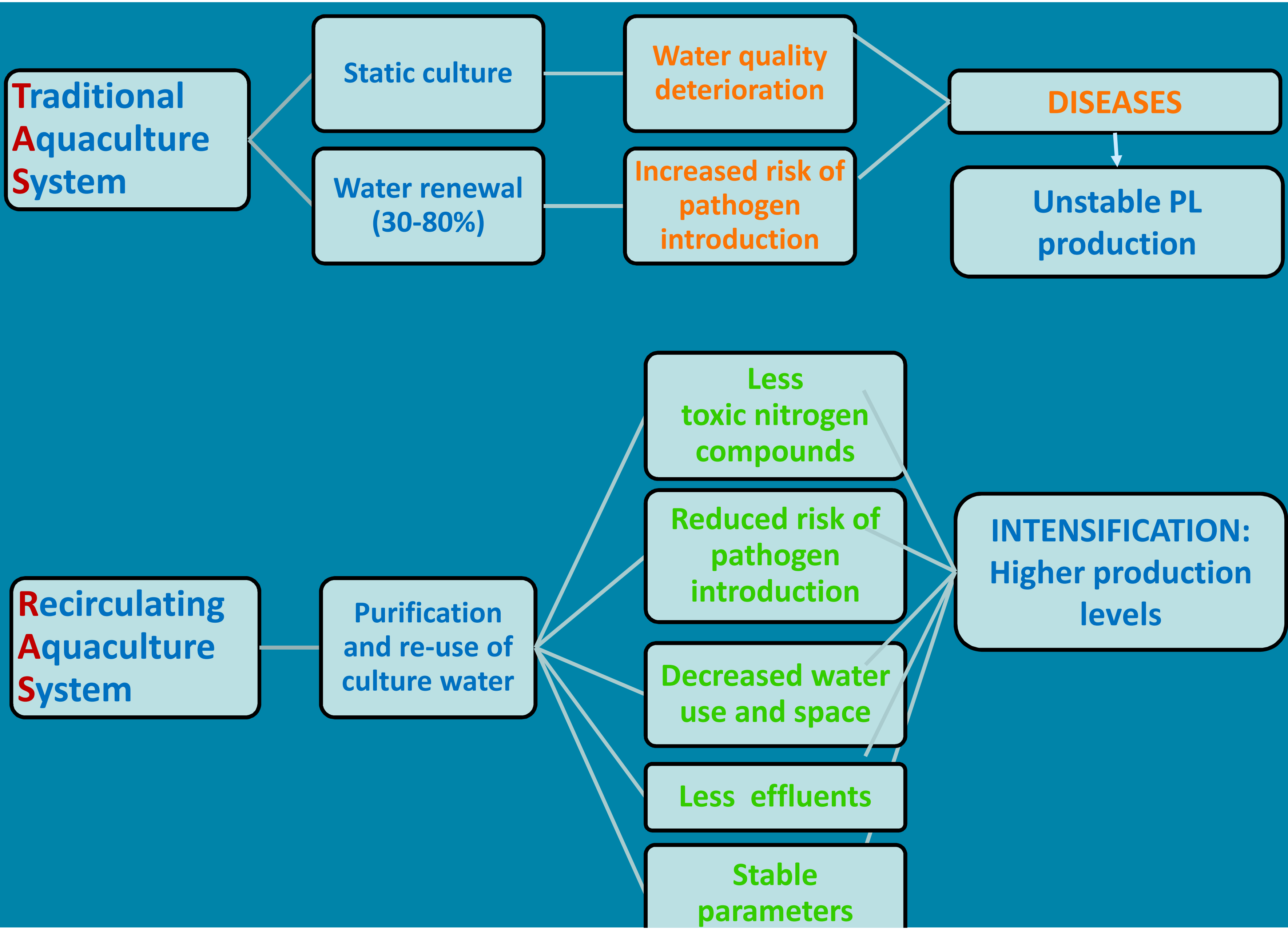
- Static culture — Water quality deterioration
- Water renewal (30-80%) — Increased risk of pathogen introduction

→ DISEASES → Unstable PL production

In fish culture Recirculating Aquaculture System (RAS) are used

Could it be possible to use RAS in shrimp larviculture ?

GENERAL INTRODUCTION



OBJECTIVE OF THIS STUDY

To develop a new technique for the intensive culture of *Litopenaeus vannamei* larvae through the use of a RAS

- Intensification of *L. vannamei* larviculture in an EXPERIMENTAL-SCALE RAS
- Intensification of *L. vannamei* larviculture in a PILOT-SCALE RAS
  - Improvement of Intensification through feeding regime in a PILOT-SCALE RAS

EXPERIMENTAL-SCALE RAS

To develop a new technique for the intensive culture of *Litopenaeus vannamei* larvae through the use of a RAS

Intensification of *L. vannamei* larviculture in an EXPERIMENTAL-SCALE RAS

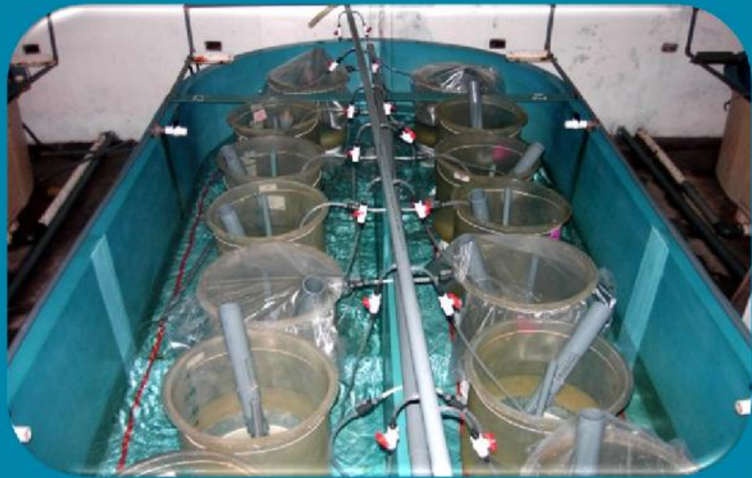
Evaluate the effect of super-high stocking densities, water recirculation and feeding strategies on larviculture performance

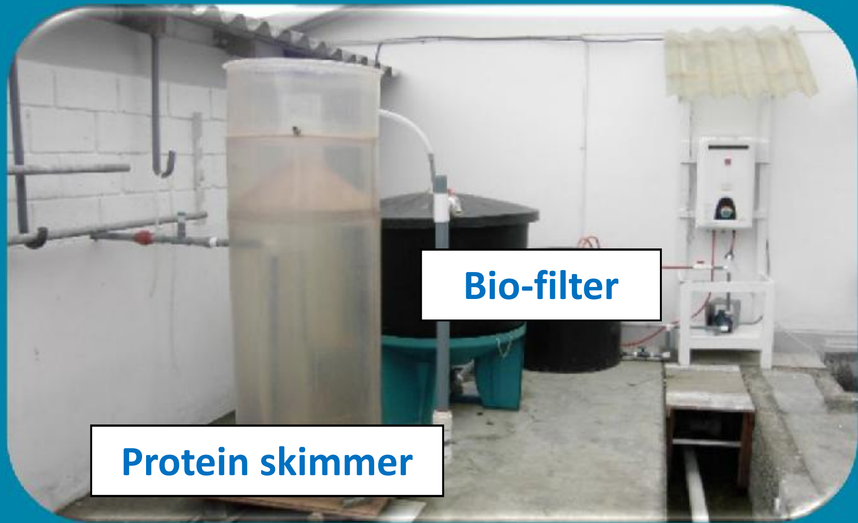
MATERIALS AND METHODS

N5 – Z3 STATIC PHASE

T (°C)	32 ± 1
Salinity (g L^{-1})	34
Oxygen (mg L^{-1})	> 4

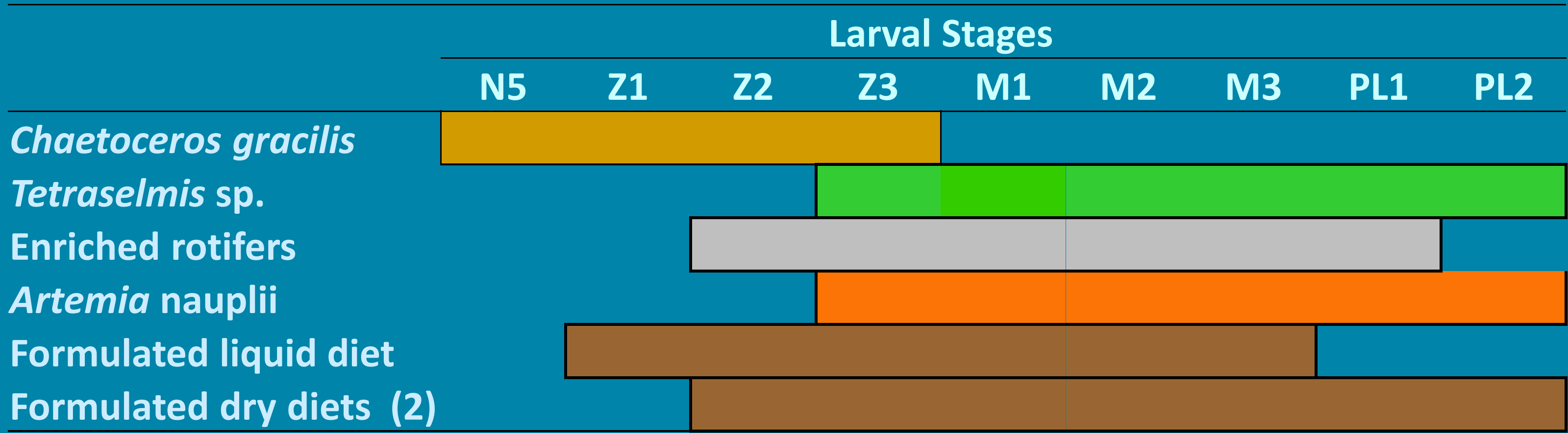
Z3 – PL1 RECIRCULATION (RAS)



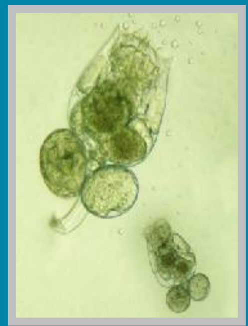


MATERIALS AND METHODS

ESPOL – CENAIM feeding protocol (100 larvae L^{-1})



Concentrates



Probiotic *Vibrio alginolyticus*

MATERIALS AND METHODS

Static phase

	Stocking Density (larvae L^{-1})	Feeding strategy
Experiment 1	750 1000 1500 2000	ESPOL - CENAIM 's protocol
Experiment 2	750 1000 1500 2000	Continuous supply of algae Same concentration of algae irrespective of stocking densities
Experiment 3	1000 2000	Continuous supply of algae either at low or high concentrations

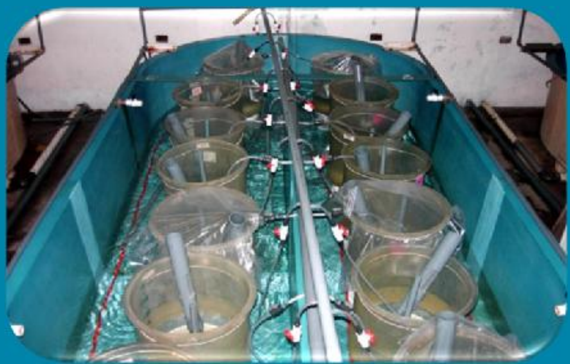
RESULTS: Performance in Static phase

Stocking density (larvae L^{-1})	Microalgae concentration (10^3 cells mL^{-1})	Survival (%)	Dry weight (mg larvae L^{-1})	Larval Stage Index
EXPERIMENT 1				
750	60 - 160	61 ± 2^{ab}	0.034 ± 0.004^{a}	3.09 ± 0.00^{a}
1000	60 - 160	67 ± 7^{a}	0.028 ± 0.001^{a}	3.17 ± 0.03^{a}
1500	60 - 160	53 ± 8^{ab}	0.027 ± 0.002^{a}	3.03 ± 0.05^{a}
2000	60 - 160	51 ± 3^{b}	0.025 ± 0.006^{a}	3.09± 0.04^{a}
EXPERIMENT 2				
750	100	50 ± 6^{b}	0.060 ± 0.010^{a}	2.71 ± 0.05^{a}
1000	100	89 ± 10^{a}	0.041 ± 0.004^{a}	2.90 ± 0.02^{a}
1500	100	52 ± 6^{b}	0.041 ± 0.003^{a}	2.70 ± 0.06^{a}
2000	100	78 ± 5^{a}	0.032 ± 0.002^{a}	2.80 ± 0.05^{a}
EXPERIMENT 3				
1000	100	88 ± 3^{a}	0.031 ± 0.002^{b}	3.42 ± 0.15^{ab}
1000	200	84 ± 8^{a}	0.045 ± 0.001^{a}	3.84 ± 0.06^{a}
2000	400	61 ± 8^{b}	0.031 ± 0.001^{b}	2.99 ± 0.01^{b}
2000	700	82 ± 10^{a}	0.037 ± 0.001^{b}	3.58 ± 0.17^{a}

MATERIALS AND METHODS

RAS

Experiment	Density (larvae L^{-1})	Water Recirculation Rate (% day^{-1})	Feeding strategy
Experiment 1	750	250	Live food ration increased with different factors to account for increasing stocking densities
	1000	500	
	1500	750	
	2000	1000	
Experiment 2	750	250	Formulated feed increased with different factors to account for increasing water recirculation rate
	1000	500	
	1500	750	
	2000	1000	
Experiment 3	1000	500	Same as in experiment 2
	2000	1000	

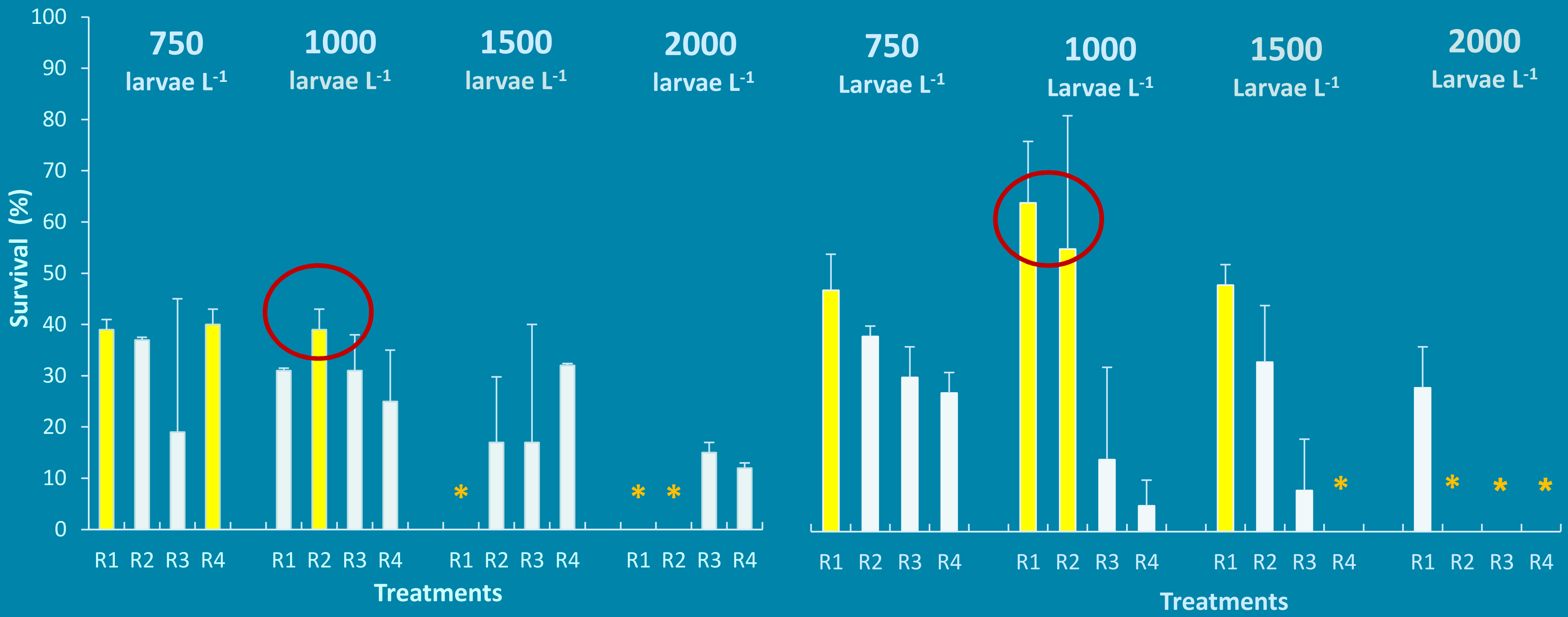


RESULTS: SURVIVAL RAS

EXP 1

Water Recirculation Rate (% day $^{-1}$)	R1	R2	R3	R4
	(250)	(500)	(750)	(1000)

EXP 2



Density: $p<0.05$; Water recirculation rate: NS; D x WRR: NS

Density: NS ; Water recirculation rate: $p<0.05$; D x WRR: NS

CONCLUSIONS

STATIC CULTURE

- Continuous feeding and higher concentrations of microalgae increased:
  - Survival for 1000 larvae L^{-1} and 2000 larvae L^{-1}
- High survival for density 1000 larvae L^{-1} in all experiments

EXPERIMENTAL RAS

- Increasing stocking densities affected negatively survival and growth
- Water recirculation rates higher than 500% day^{-1} does not improve survival or growth
- High survival for combination 1000 larvae L^{-1} and 500% day^{-1} in all experiments

OBJECTIVE OF THIS STUDY

To develop a new technique for the intensive culture of *Litopenaeus vannamei* larvae through the use of a RAS

Intensification of *L. vannamei* larviculture in an EXPERIMENTAL-SCALE RAS

Intensification of *L. vannamei* larviculture in a PILOT-SCALE RAS

Improvement of Intensification through feeding regime in a PILOT-SCALE RAS

To evaluate the effects of intensification on larval performance with different feeding regimes in a PILOT-SCALE RAS

MATERIALS AND METHODS

PILOT- SCALE RAS

Automatic feeder

UV

Macrolite

Mechanical Filter

Greenhouse

MATERIALS AND METHODS

Traditional (TAS)

Stocking density: 100 N5 L^{-1}

Water exchange starts at Z3 with a rate of 30% day^{-1}

RAS

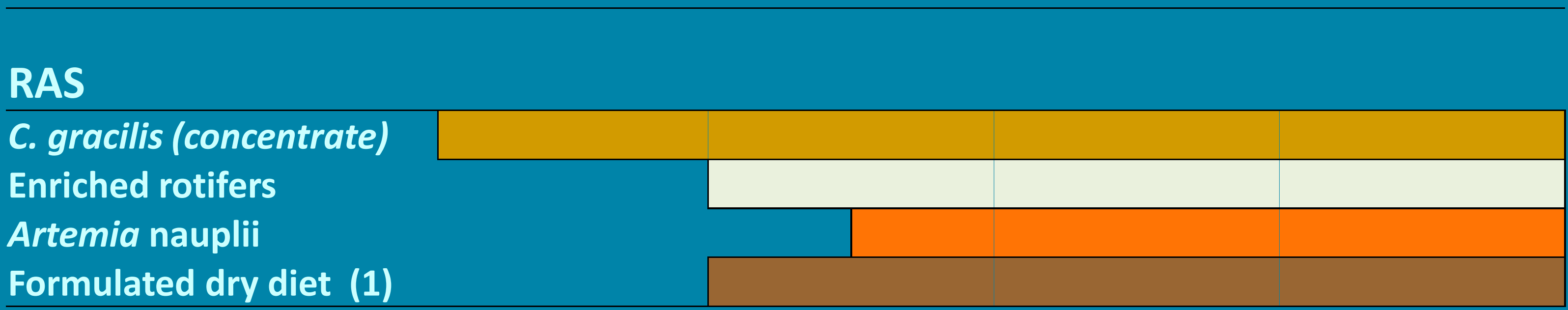
Stocking density: 1000 N5 L^{-1}

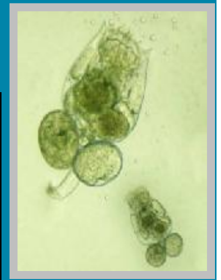
Recirculation starts at Z3 with a rate of 500% day^{-1}

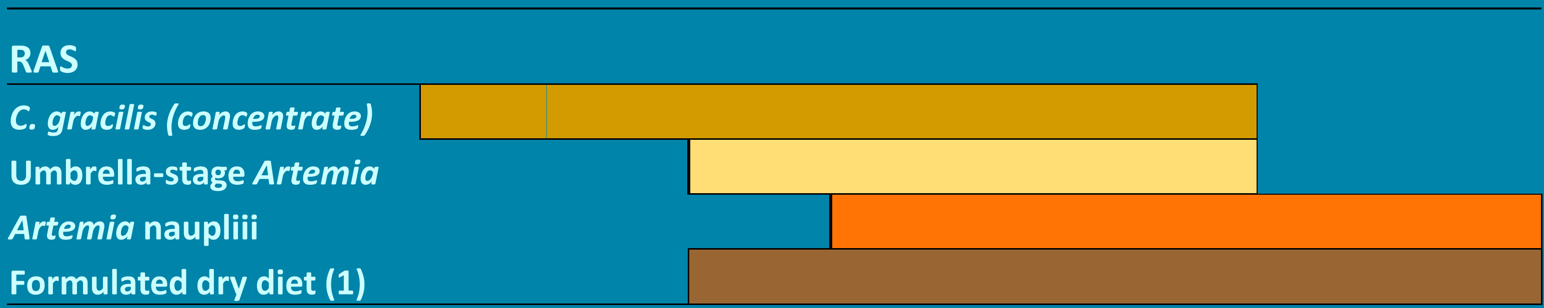
T (°C)	32 ± 1
Salinity (g L^{-1})	34
Oxygen (mg L^{-1})	> 4

MATERIALS AND METHODS

Feeding regimes for Pilot-scale RAS

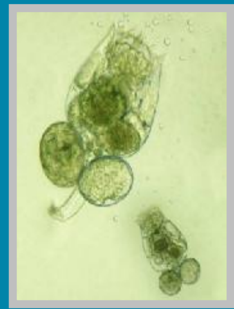






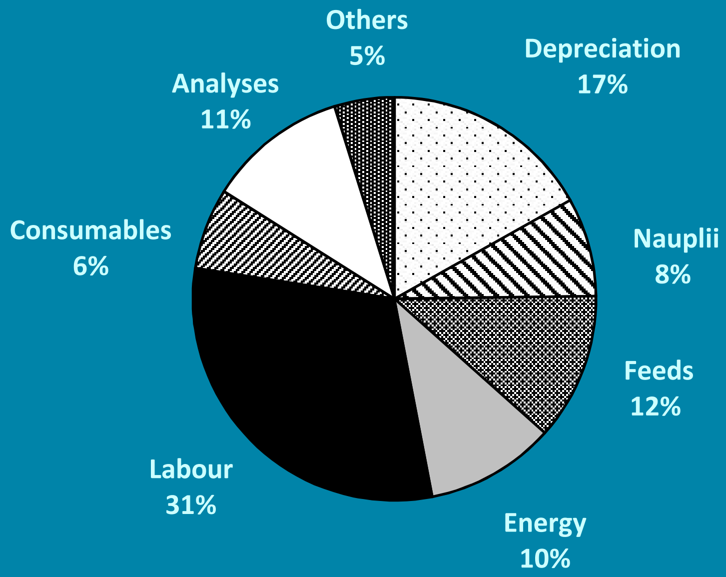
RESULTS: LARVAL PERFORMANCE

Culture system	Survival (%)	Dry weight (mg larvae $^{-1}$)	Larval Stage Index	Biomass (g)
TAS	62 ± 8^{a}	0.170 ± 0.020^{a}	7.50 ± 0.20^{a}	55.0 ± 4.0^{b}
RAS	50 ± 7^{a}	0.090 ± 0.010^{b}	6.70 ± 0.20^{b}	304.0 ± 5.0^{a}
TAS	71 ± 5^{a}	0.130 ± 0.020^{a}	6.92 ± 0.03^{a}	55.7 ± 12.1^{b}
RAS	74 ± 6^{a}	0.110 ± 0.010^{a}	6.82 ± 0.02^{a}	411.0 ± 12.0^{a}

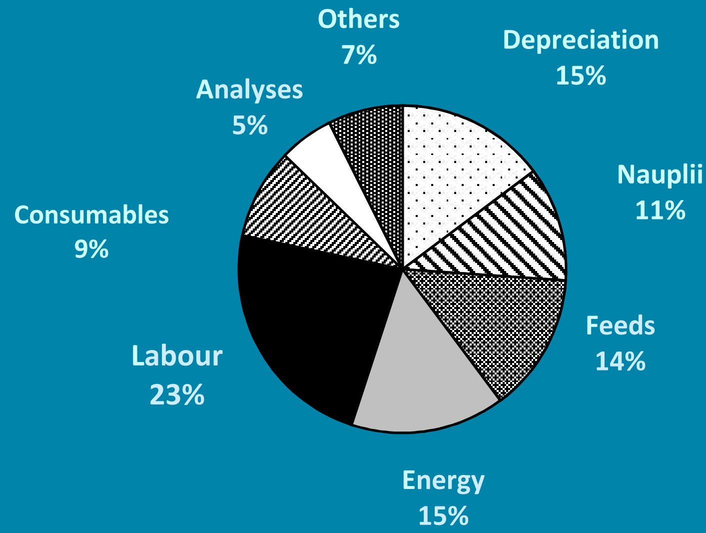


RESULTS: COST ANALYSIS

Traditional (TAS)



RAS



Total Running cost 30% lower for RAS

RESULTS: Postlarvae condition

Nursery culture: 160 PL25 m^{-2}

Parameters	Culture System TAS	RAS
Survival (%)	89 ± 7[a]	83 ± 3[a]
Dry weight (g $larvae^{-1}$)	0.026 ± 0.010[a]	0.024 ± 0.010[a]
Lenght (mm)	18.46 ± 2.52[a]	19.03 ± 2.11[a]
Biomass (g)	18.81 ± 2.83[a]	17.19 ± 3.24[a]

Grow-out culture:

9 ponds of 0.25ha, 12 PL25 m^{-2}

	Weight (g)	Survival (%)	Yield (kg ha^{-1})
Mean	9.15	59.61	657.77
StDev	0.55	6.34	90.26

CONCLUSIONS

- Umbrella stage-*Artemia* in RAS increased:
  - survival
  - dry weight
  - biomass

- Running cost 30 % lower in RAS compared to TAS

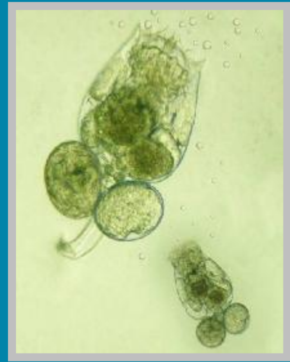
- Postlarvae produced in RAS performed similarly than those produced in TAS during subsequent nursery culture

- Postlarvae produced in RAS performed well in grow-out ponds with 60% survival and a yield of 658 kg ha^{-1}


THANK YOU
BEDANKT
GRACIAS

RESULTS: WATER QUALITY

Culture system	Culture period	TAN (mg L^{-1})	N-NO_2 (mg L^{-1})	N-NO_3 (mg L^{-1})
TAS	Initial	0.03 ± 0.02	0.001 ± 0.001	0.540 ± 0.030
	Final	1.30 ± 0.04^{a}	0.070 ± 0.010^{b}	3.250 ± 0.200^{a}
RAS	Initial	0.07 ± 0.02	0.001 ± 0.001	0.140 ± 0.020
	Final	0.34 ± 0.21^{b}	0.420 ± 0.220^{a}	1.900 ± 0.700^{b}



Culture system	Culture period	TAN (mg L^{-1})	N-NO_2 (mg L^{-1})	N-NO_3 (mg L^{-1})
TAS	Initial	0.02 ± 0.02	0.009 ± 0.002	0.651 ± 0.020^{a}
	Final	2.23 ± 0.22^{b}	0.010 ± 0.006^{b}	2.297 ± 0.028^{a}
RAS	Initial	0.0	0.0	0.112 ± 0.010^{b}
	Final	3.39 ± 0.39^{a}	0.191 ± 0.054^{a}	1.950 ± 0.628^{b}