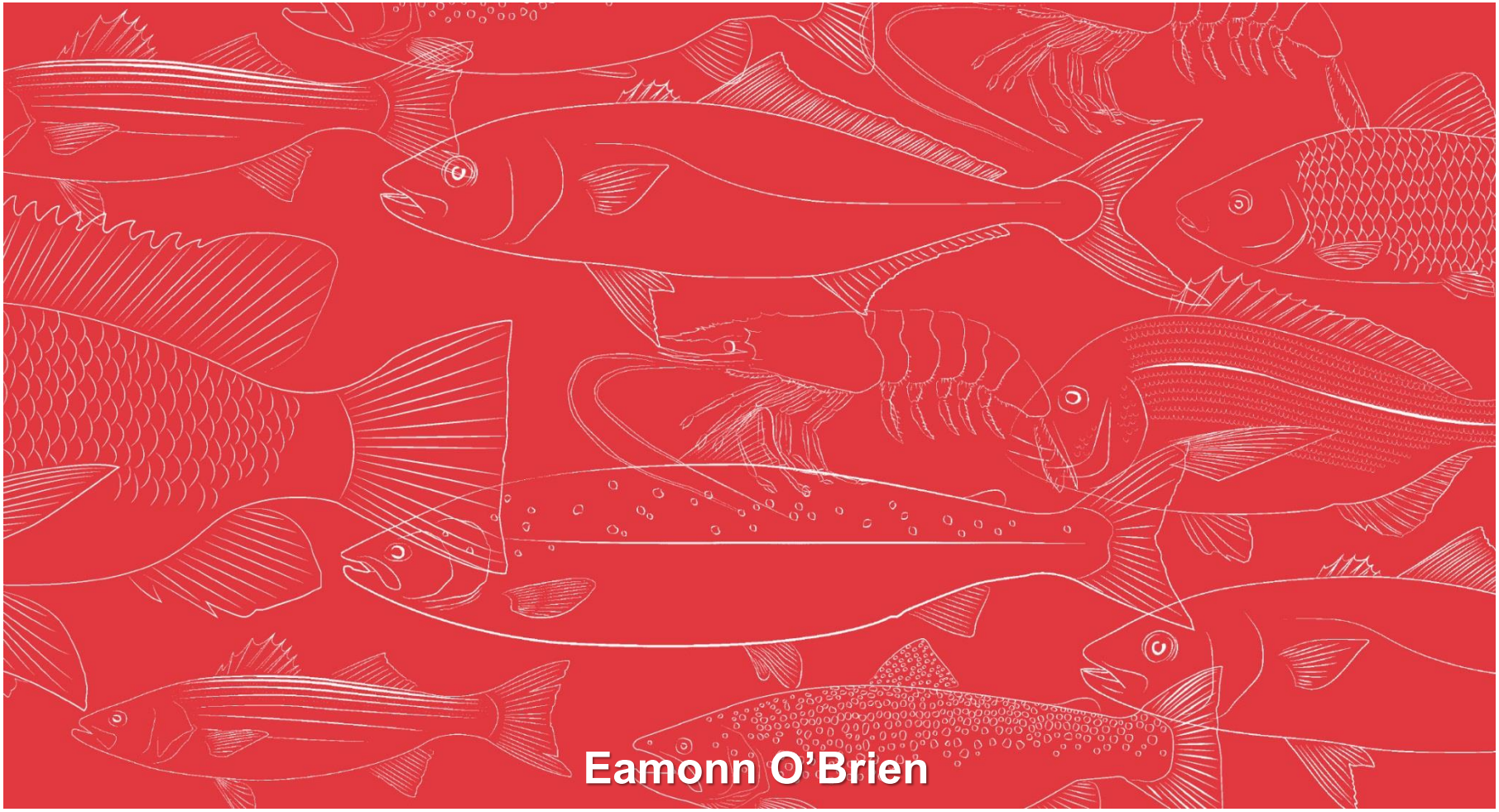

LARVAL HATCHERY MANAGEMENT AND NUTRITIONAL ASPECTS FOR BETTER SURVIVAL

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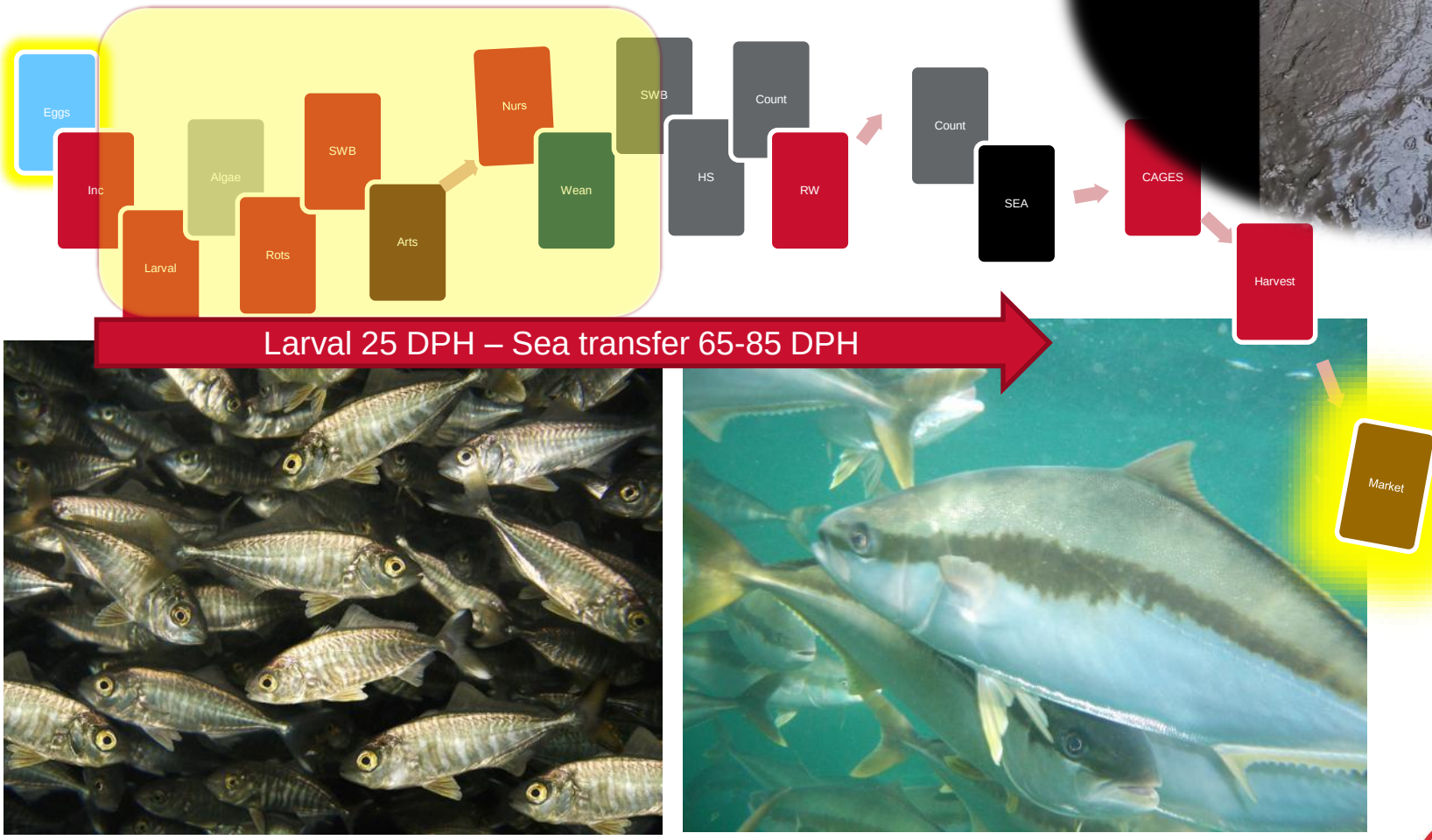
Hatchery – Production Overview



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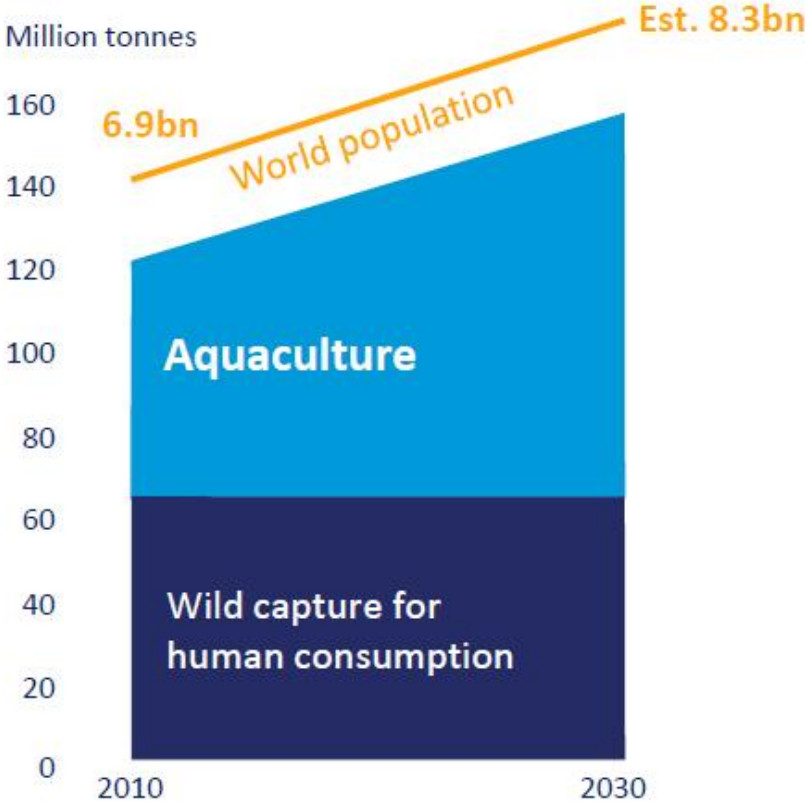
Oceans of opportunities



Source: FAO Fish to 2030
Prospects for Fisheries and Aquaculture, 2013

Aquaculture growth factors

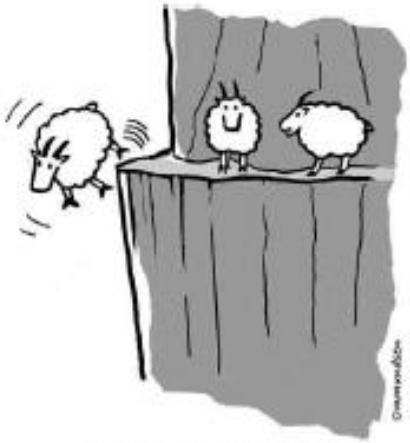
Doubling food production

Halving the pressure on the planet

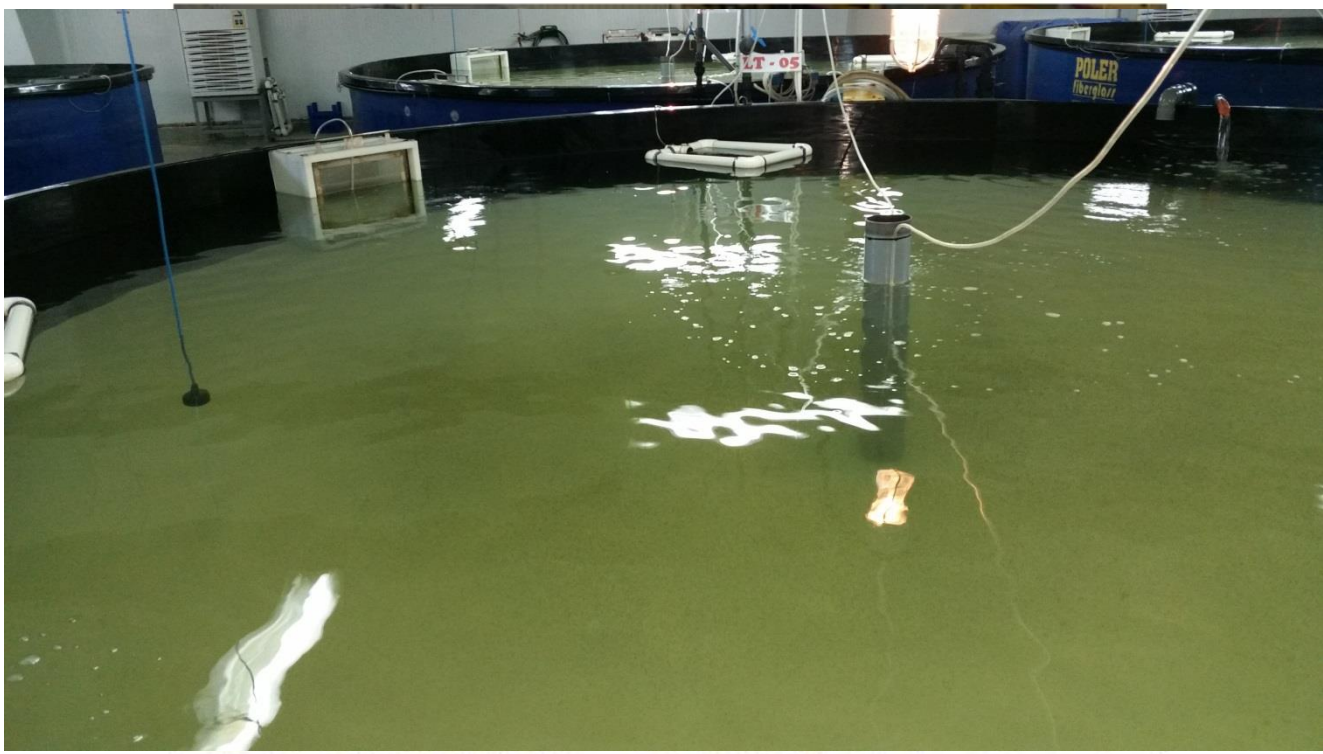
Feeding 9 billion people in 2050

feeding the future

The hatchery “edge” is the contrived boundary where natural process meet controlled environment.



“It’s the edge effect.”



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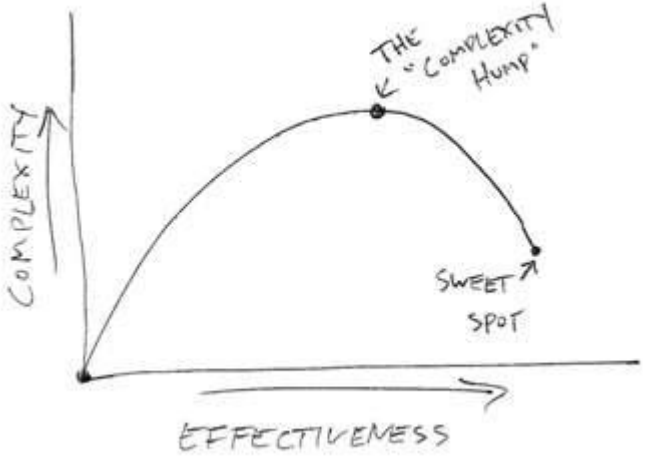
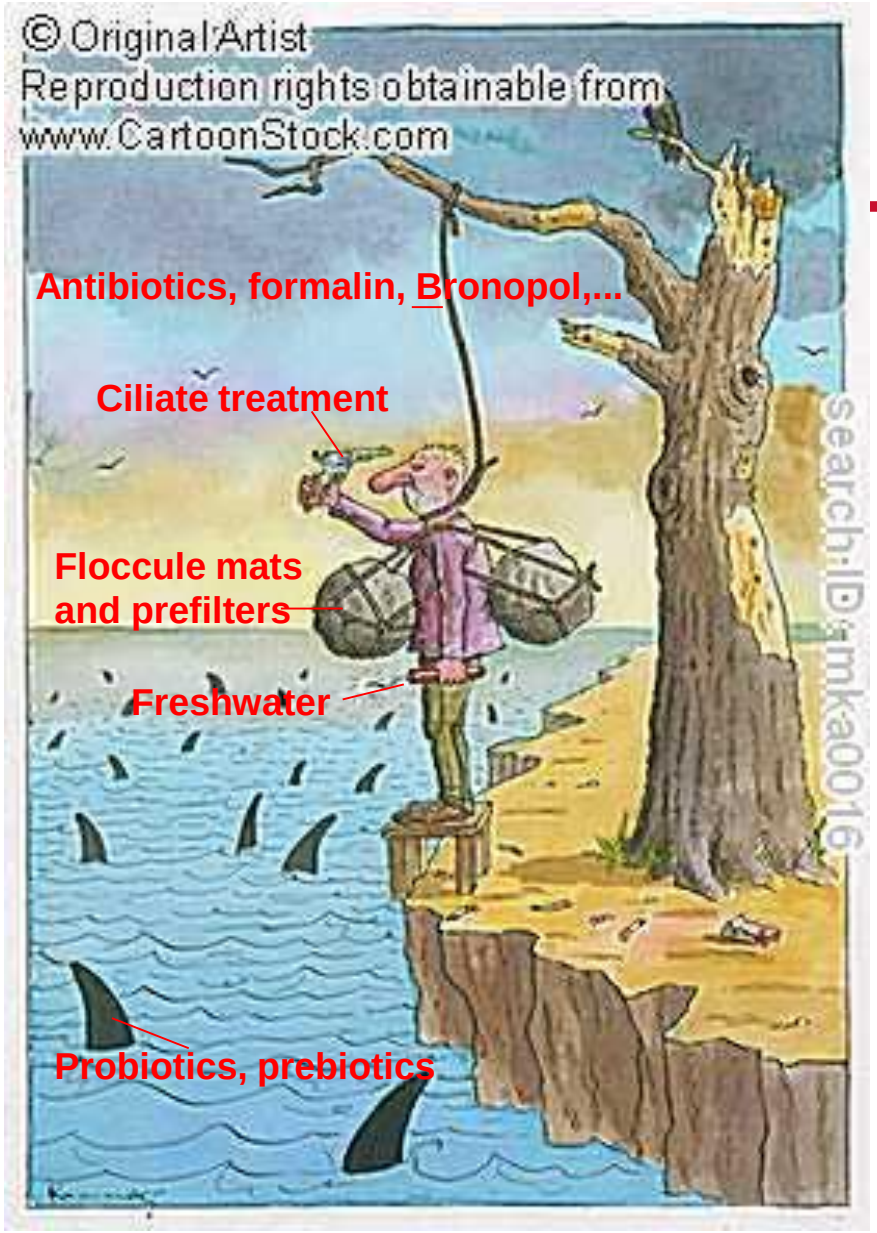
Simplicity is the ultimate sophistication

Leonardo da Vinci





Live feed management

Survey source:
Rotigen EU Fair project (Q5RS-2002-01302)

Rotifer crashes:

Human error	28%
Ciliates	18%
Oxygen	13%
Bacteria	13%
Floccules	5%
Ammonia	5%
Change feed	5%
Season	5%
Feed type	3%
Virus	3%

Most of the times :
-more work
-more problems
-more costs

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Rotifer Production Process

2-8 h
Enrichment

70%

ProBiotics
Biocides
PreBiotics

Rotifer culture cycle

3-4 days

2 diets:
- **Culture (OC)**
- **Enrichment (OG)**

Stand-alone diet (OO)

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Larval rearing process…

Water supply

2°filtration
UV

temp, sal,
pH, gas sat.
ammonia, DO

masters
scale-up
culture

ALGAE

scale-up
culture
enrichment

ROTIFERS
(cold storage)

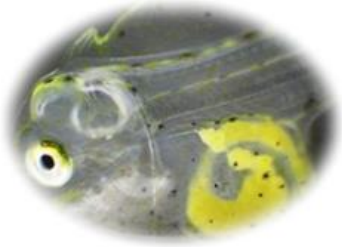
Product: weaned juvenile

1. 50% survival
2. High quality
   a. Deformity
   b. Size variation
   c. Pigmentation
   d. Activity level
   e. Parasite/disease free

lights
air temp/
ventilation

ARTEMIA
(cold storage)

Weaning
diet



Recirculation
system

decaps
hatch
enrichment

water out

brood → egg → **larval rearing** → nursery

60 days

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Early Weaning

- Hatchery today
  - Survival: 1-60% ϖ ~ 25% (state of the art?)
  - Costs increasing: Food 20%, labor 40%, energy 20%, others 20%
- Food: 50% is Artemia costs and increasing
- Artemia is a limiting resource
- Increasing survival, quality & consistency is key
- Risk of change… but the risk of not changing?

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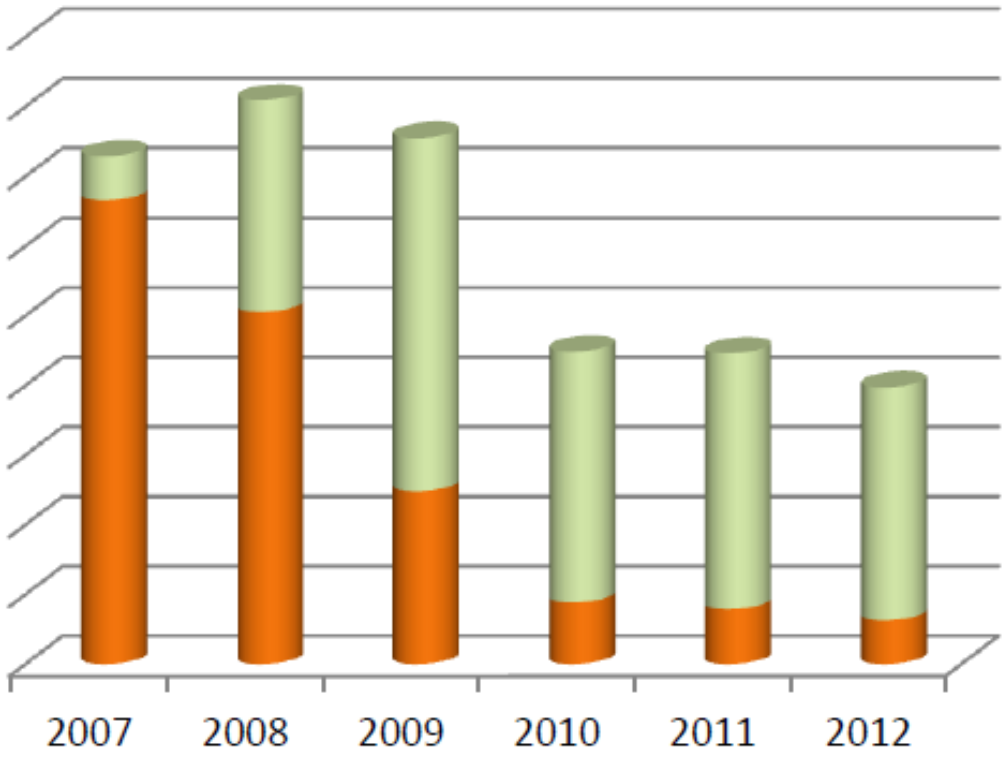
Improved output



Graph 3 : Evolution of purchase costs of larval food (for 1 million fingerlings invoiced)

microparticle

cysts+enrichment

15%
10%
5%
0%

cycles in chronological order

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Larval rearing process…

Water supply

2°filtration
UV

temp, sal,
pH, gas sat.
ammonia, DO

masters
↓
scale-up
↓
culture

ALGAE

ROTIFERS
(cold storage)

scale-up
↓
culture
↓
enrichment

Product: weaned juvenile

1. 50% survival
2. High quality
   a. Deformity
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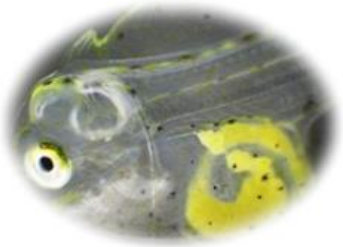
lights
air temp/
ventilation

ARTEMIA
(cold storage)

Weaning
diet



Recirculation
system

decaps
↓
dech
↓
enrichment

water out

brood → egg → **larval rearing** → nursery

60 days

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The Danger

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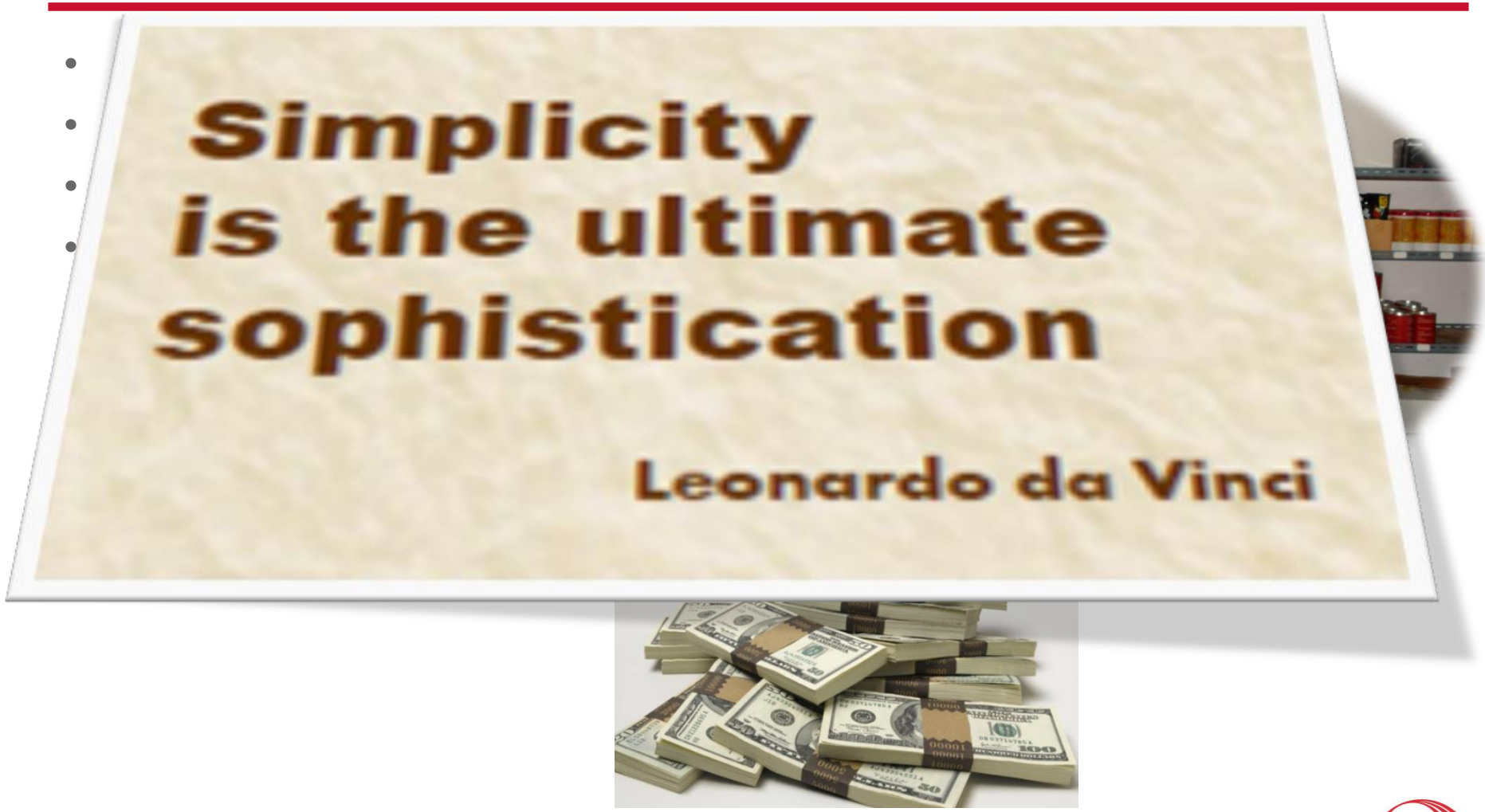
Shrimp Hatchery Scenario

-
-
-
-



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Typical Hatchery Feeding Approach

Price/Quality

Why do we do this?
DP?
DE?

Life Stage →

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Cocktail Feeding

- Why?
- All diets lack some specific “thing”
- Good diets are too expensive

- How?
- Mix various feeds to cover all basis
- Typically use cheaper feeds which are more likely to be lacking

Vietnam - THE COCKTAIL FEEDs

Big/medium hatchery

ZOEA period: 40% Frippak1 + 40% LansyS + 20% Higashimaru
Average cost: US$57.26/kg

MYSIS period: 25% Frippak2 + 35% LansyZM + 40% Higashimaru
Average cost: US$42.52/kg

PL1 to PL7: 25% FrippakPL + 35% LansyMP + 40% Higashimaru
Average cost: US$18.35/Kg

PL8 to PL14: 20% FrippakPL + 40% LansyPL + 40% Higashimaru
Average cost: US$13.80/Kg

Other medium/small hatchery

ZOEA period: 30% Frippak1 + 50% Others + 20% Higashimaru
Average cost: US$34.26/kg

MYSIS period: 20% Frippak2 + 40% Others + 40% Higashimaru
Average cost: US$25.32/kg

PL1 to PL7: 60% Other products + 40% Higashimaru
Average cost: US$10.92/Kg

PL8 to PL14: 60% Other products + 40% Higashimaru
Average cost: US$9.72/Kg

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Cocktail feed prep

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PL

Advanced larval & post larval nutrition for shrimp

PL is Skretting's high quality shrimp starter diet designed to offer advanced nutrition to shrimp hatcheries. **PL**, with its unique innovative marine algal blend, is produced with a sophisticated technology utilising low temperatures to ensure maximal nutrient availability, freshness and stability.

PL is part of Skretting's Spectrum portfolio of feeds for marine hatcheries.

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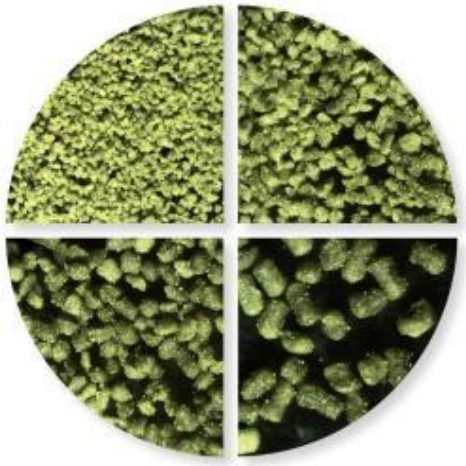
PL - Shrimp Larval and Post Larval diet

- Cold extruded for decreased protein denaturation and increased attractability & digestibility
- Softer particles & increased water stability
- Algae inclusion for natural diet & stability
- High protein mix & HUFA with low fat
- High Phospholipids and Cholesterol
- Vitamin C, E and Immunostimulants
- Based on principals of natural bacterial and viral suppressors



- COMPLETELY BALANCED : NO NEED FOR COCKTAILS

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Feed program for Vietnam Trial

FEEDING GUIDE

MINH PHU FEEDING TABLE

unit : g/mil larvae

Stages	Fresh alage	F#1	F#2	Artemia cyst	Liquid Artemia	M1	M2	M4	Note
N-Z1									*fed tank with fresh algae when seeing the first Z1 larval*
Z1	2.5	2 x 8							
Z2	3	4 x 8							
Z3	3.5	6 x 6			12 x 2				
Z3-M1		7 x 6			15 x 2				
M1			7 x 6		20 x 2				Liquid Artemia was well shaked before use
M2			7 x 6		25 x 2				
M3			8 x 6		25 x 2				
M3-P1			9 x 6		30 x 2				
P1				35 x 4		9 x 2		9 x 2	- PL1 - PL4 fed with unenriched Artemia nauplii - PL5 - PL8 fed with enriched Artemia. - Fed M4 in between of M1 and M2.
P2				40 x 4		9 x 2		9 x 2	
P3				45 x 4		10 x 2		10 x 2	
P4				50 x 4		10 x 2		10 x 2	
P5				55 x 4			14 x 2	14 x 2	
P6				60 x 4			17 x 2	17 x 2	
P7				70 x 4			20 x 2	20 x 2	
P8				70 x 4			22 x 2	22 x 2	

FEEDING GUIDE

SKRETTING

unit : g/mil larvae

Stages	Fresh alage	PL#0	PL#0 + Instar	Artemia cyst	Liquid Artemia	PL#1	PL#2	PL#3	Note
N-Z1									*fed tank with fresh algae when seeing the first Z1 larval*
Z1	2.5	2 x 8							
Z2	3		4 x 8						
Z3	3.5		6 x 8						
Z3-M1			7 x 8						
M1					20 x 2	7 x 6			Liquid Artemia was well shaked before use
M2					25 x 2	7 x 6			
M3					25 x 2	8 x 6			
M3-P1					30 x 2	9 x 6			
P1				35 x 4			9 x 4		- PL1 - PL4 fed with unenriched Artemia nauplii - PL5 - PL8 fed with enriched Artemia.
P2				40 x 4			9 x 4		
P3				45 x 4			10 x 4		
P4				50 x 4			10 x 4		
P5				55 x 4				14 x 4	
P6				60 x 4				17 x 4	
P7				70 x 4				20 x 4	
P8				70 x 4				22 x 4	

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Result Trial in Vietnam

- Survival: Skretting 53% Control 50%
- Length: Skretting 6.7mm Control 6.1mm

Tank	Treatment	Nauplii	Avg Nau/tank	PL8	Avg PL8/tank	Total length (mm)	Avg total length (mm)	Survival	Avg survival
Control 1	Control	1,000,000	1,000,000	469,891	**497,827**	6.13	6.14	47.0%	**49.8%**
Control 2		1,000,000		525,764		6.15		52.6%	
Skretting 1	Skretting	1,000,000	1,000,000	594,642	**531,457**	6.85	6.66	59.5%	**53.1%**
Skretting 2		1,000,000		468,273		6.47		46.8%	
Total/Avg		**4,000,000**		**2,058,569**				**51.5%**	

Mexico

- Trial performed in Maricultura Del Pacifico
- 25M^3 tanks stocked with 400nauplii per litre
- Fed Skretting PL diet versus Hatchery cocktail
- Survival evaluations and final weight at PL10

Stage	Skretting PL %	Spirulina %	Artemia Flake %
Zoea	80	20	
Mysis	70	15	15
PL1-PL4	60	10	30
PL5-PL10	60		40

Tank	Density Nauplii/L	Surv. Mysis %	Surv. My-PL10 %	Surv. N-PL10 %	Final Weight mg
Control	371	92	54	50	2.2
PL	386	90	85	77	1.9

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Ecuador:

Evaluation from PL7- PL14

	Survival	g/day	Animals/kg
Skretting	91%	82-88	169
Control	89%	77-82	184
Improsa	87%	75-80	200

- Bigger animals
- Slightly higher survival

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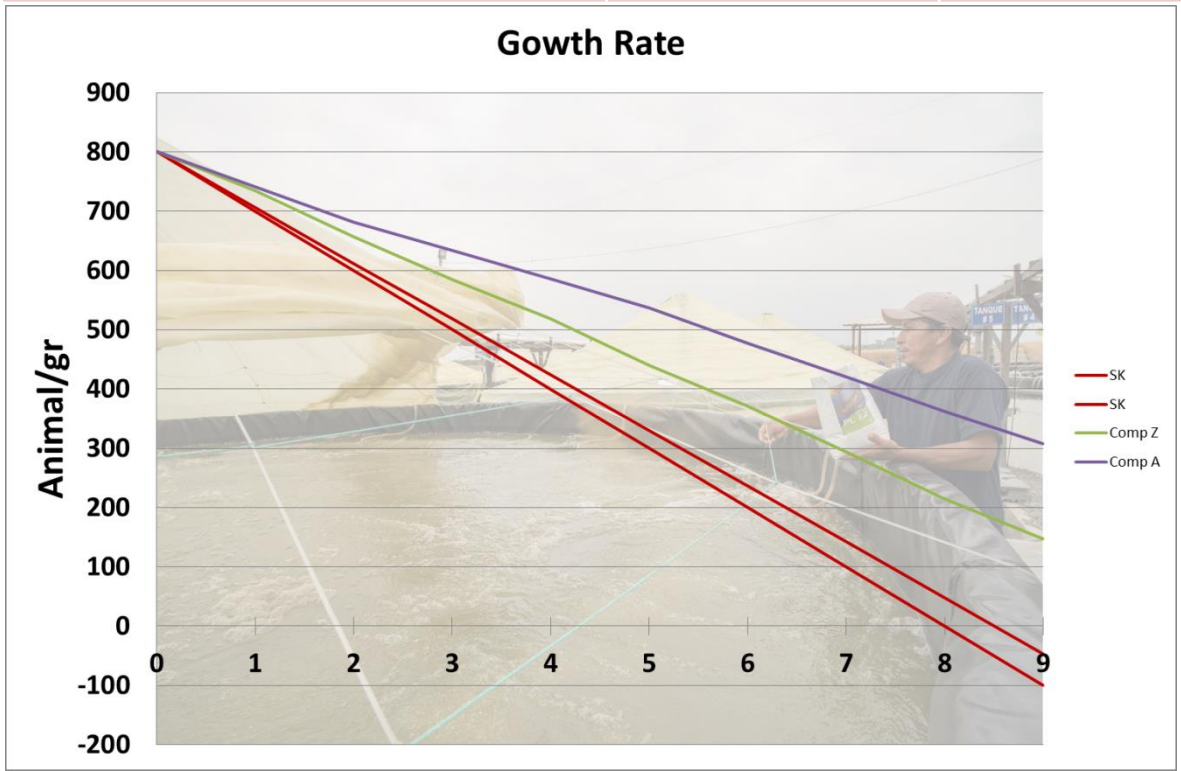
Ecuador:

- Boosting of PL to get maximum growth and health benefit before the release in the ponds

	PL_7	PL_{12}	PL_{28}
Days gained on best control	≥ equal	~2 days	~5 days



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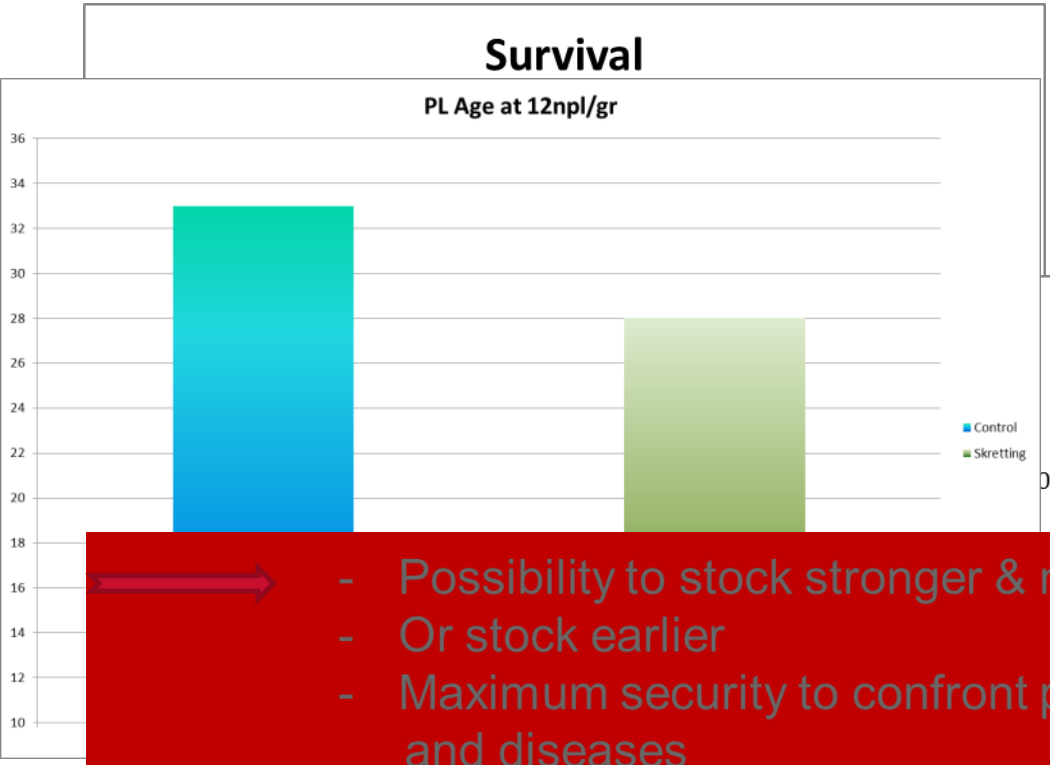
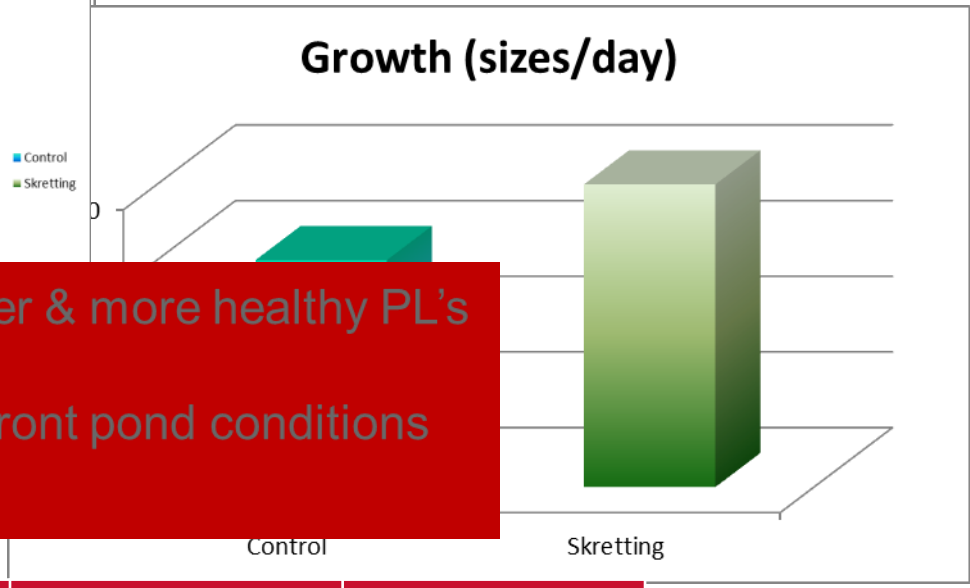
Raceway Application

- Objective: Reach 12animal/gr





- Possibility to stock stronger & more healthy PL's
- Or stock earlier
- Maximum security to confront pond conditions and diseases

	PL_{14-21}	PL_{21-25}	PL_{25-28}
Diet used	PL#3	PL#4	PL#4 & GO

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Conclusion on PL diets from users in Asia & S. America

- Very nice results obtained in very different rearing conditions showing that the products have potential
- The PL diets are at least as good as the n°1 diet in different area's and perform as well as various cocktail mixes
- Recognition that thanks to its Expertise in Larval feeds Skretting could change the usual practice of using a mix of several diets to one single product
- High quality & high protein diets with a balanced protein/fat ratio show an increased growth and health condition of PL's
- Possibility to reduce *Artemia* consumption
- Possibility to enhance pre stocking size and condition
- EU diet specification followed by Skretting is a guarantee for quality
- A diet manufacturer outside the biohazard zone (EMS,…) is seen as an advantage for biosecurity

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Our Values


Capable
Caring
Innovative
Collaborative
feeding the future