Use of non-ablation in Shrimp hatcheries: production and animal welfare

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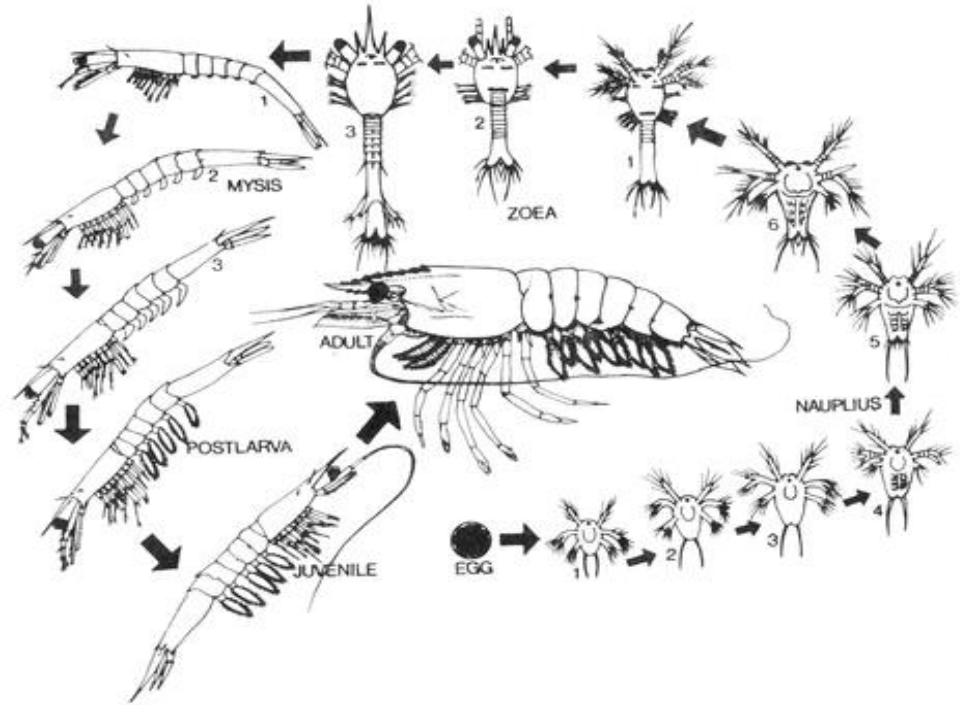
BE THE DIFFERENCE

Shrimp Hatcheries: Unilateral eyestalk ablation

Rapid Egg Production



Eyestalk ablation X Welfare Issues

BAP CERTIFIED

LABEYRIE FINE FOODS

FARMED RESPONSIBLY asc CERTIFIED ASC-AQUA.ORG TM

ASDA

Sainsbury's

TESCO Every little helps

GLOBALG.A.P.

Animal welfare NGOs

ALTERNATIVE (S)

Non-ablation PROJECT part 1

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Aquaculture

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Reproductive performance and offspring quality of non-ablated Pacific white shrimp (*Litopenaeus vannamei*) under intensive commercial scale conditions

Simão Zacarias*, Stefano Carboni, Andrew Davie, David C. Little*

Institute of Aquaculture – University of Stirling, FK9 4LA Stirling-Scotland, UK

Honduras

Experimental design

Maturation and Reproduction (61 Days)

5 Tanks with **Non-Ablated female**

5 Tanks **with Ablated female**

Larviculture I (3 tanks per treatment – 16 days)

Larviculture II (5 tanks per treatment – 16 days)

20 days

86 days

86 days

20 days

Nursery: 2 ponds

Grow-out: 3 ponds

Grow-out: 3 ponds

Nursery: 2 ponds

Results

Table 1: Reproductive performance of non-ablated and ablated female

Reproductive Performance		
Study I	**NAF**	**AF**
Mating success per day (%)	3.2 ± 0.0[b]	7.6 ± 0.0[a]
Spawning event day (%)	90.1± 0.1[a]	95.5 ± 0.0[a]
Hatching rate per day (%)	78.0± 0.0[a]	81.7 ± 0.0[a]
Mortality of female per day (%)***	1.3 ± 0.0[b]	2.3 ± 0.0[a]
Number of eggs/spawned female/day	142 413 ± 4558[a]	116 752 ± 3568[b]
Number of nauplii/spawned female/day	112 610 ± 4923[a]	95 127 ± 2954[b]
Number of eggs/tank/day	811 004 ± 86 858[b]	1440 285.7 ± 116 344[a]
Number of nauplii/tank/day	653 004 ± 73 466[b]	1186 450 ± 103 853[a]

Sex ratio 1:2

NAF - non-ablated; **AF** - ablated female

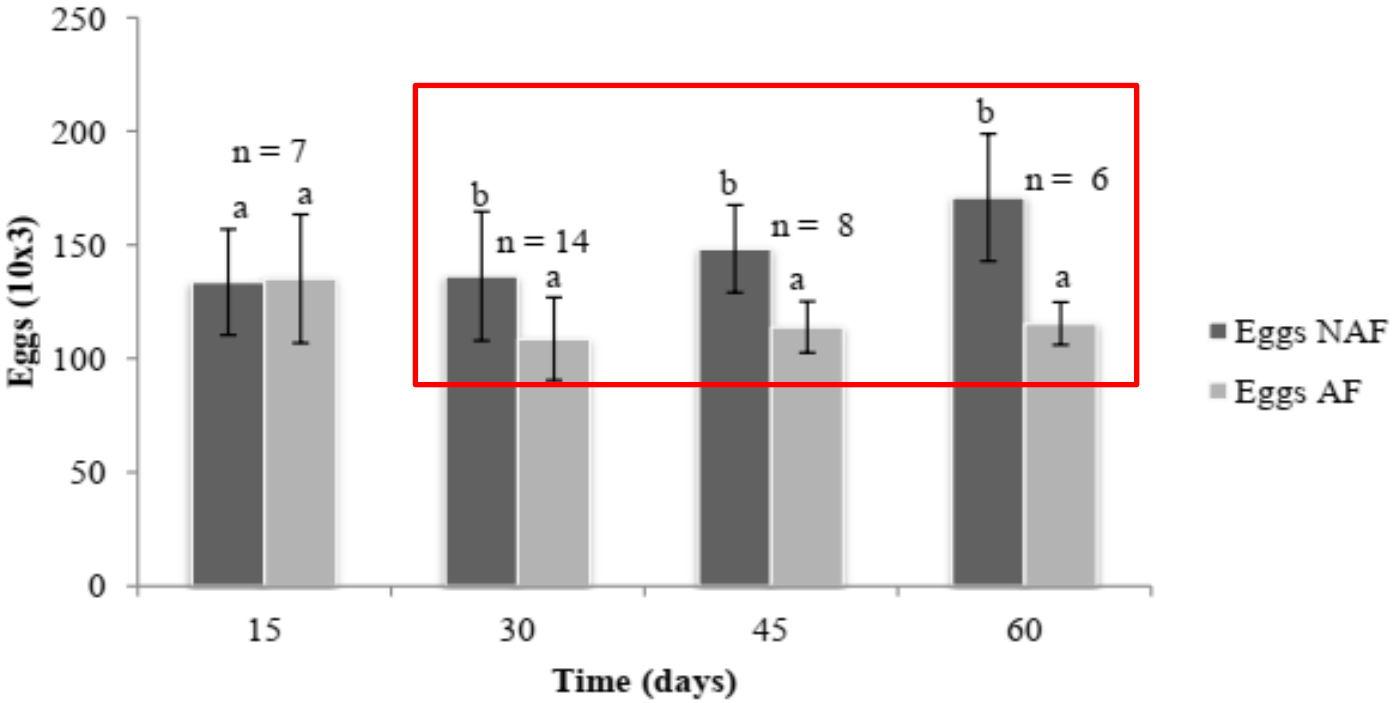


Fig. 1: Egg production per non-ablated (NAF) and ablated female (AF) over time

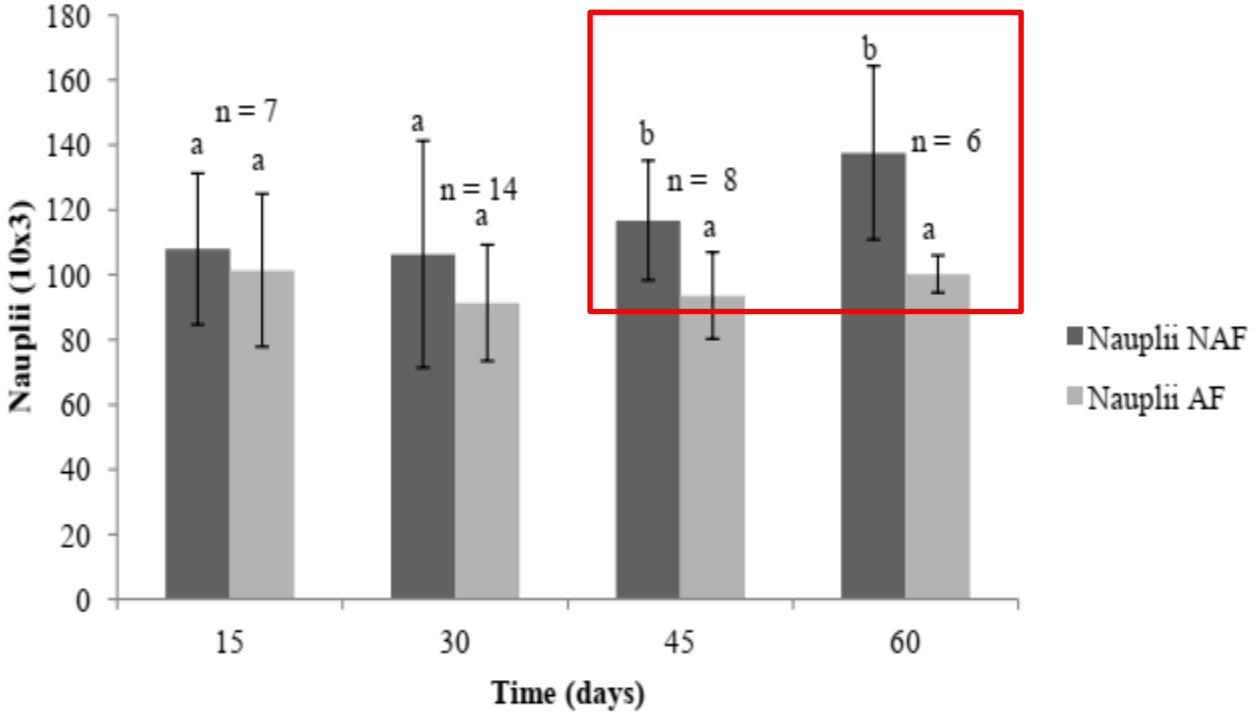


Fig. 2: Nauplii production per non-ablated (NAF) and ablated female (AF) over time

Larval growth and development of non-ablated and ablated female

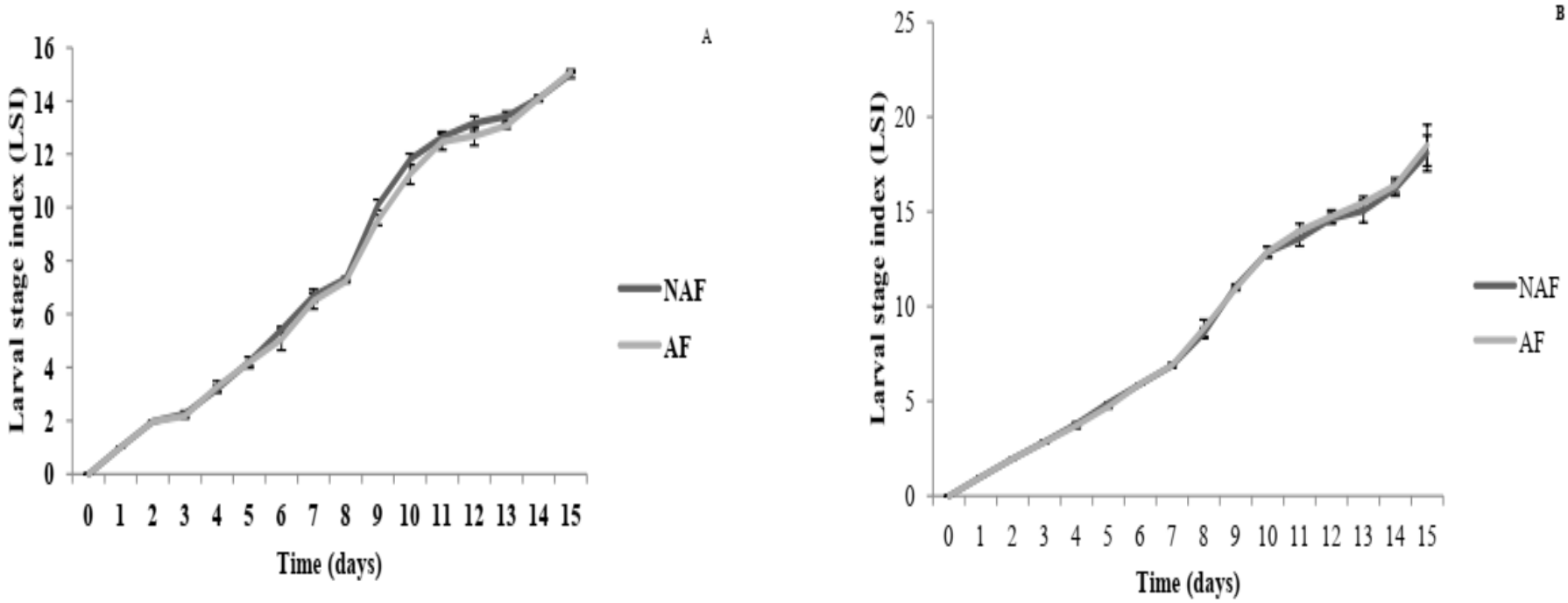


Fig. 3: Larval stage index from non-ablated (NAF) and ablated female (AF)

Table 3: Growth performance, final survival and survival of PLs from non-ablated (NAF) and ablated female (AF)

Study I	Larviculture I		Larviculture II	
Parameters	**NAF**	**AF**	**NAF**	**AF**
Survival to SST (%)	94.7 ± 2.6[a]	85.7 ± 6.1[a]	97.4 ± 0.2[a]	94.9 ± 0.5[b]
Final survival (%)	48.0 ± 8.7[a]	41.7 ± 7.0[a]	48.8 ± 2.6[a]	43.9 ± 5.6[a]
Final weight (mg)	3.4 ± 0.3[a]	3.7 ± 0.2[a]	6.5 ± 0.6[a]	6.7 ± 0.8[a]
Study II	**Larviculture III**		**Larviculture IV**	
Parameters	**NAF**	**AF**	**NAF**	**AF**
Eggs diameter (µm)*	269.6 ± 8.5[a]	264.3 ± 1.3[a]	282.4 ± 1.1[a]	282.9 ± 2.0[a]
Nauplii length (µm)*	437.7 ± 5.4[a]	451.0 ± 2.8[a]	449.4 ± 3.1[a]	445.2 ± 2.9[a]
Survival to SST (%)	99.0 ± 0.0[a]	96.0 ± 1.0[b]	90.0 ± 0.6[a]	87.7 ± 0.9[b]
Final survival (%)	42.6 ± 3.7[a]	42.1 ± 3.8[a]	43.8 ± 3.3[a]	41.0 ± 6.0[a]
Final weight (mg)	6.7 ± 0.4[a]	6.2 ± 0.1[a]	5.0 ± 0.6[a]	5.3 ± 0.9[a]
PLs length (mm)	8.9 ± 0.3[a]	8.7 ± 0.0[a]	8.6 ± 0.4[a]	8.6 ± 0.4[a]

Table 4: Growth performance and final survival of offspring from non-ablated (NAF) and ablated female (NF)

Nursery	Study I		Study II	
Parameters	**NAF**	**AF**	**NAF**	**AF**
Final Weight (g)	0.5 ± 0.0	0.6 ± 0.0	0.8 ± 0.0	0.8 ± 0.1
Weekly Growth (g)	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.0	0.2 ± 0.0
Final survival (%)	40.2 ± 7.5	45.4 ± 3.0	89.2 ± 2.3	92.2 ± 1.8
FCR*	0.9 ± 0.1	0.7 ± 0.1	0.9 ± 0.1	0.8 ± 0.1
Yield (Kg/ha)/ (g/m3)	273.7 ± 32.8	340.6 ± 41.1	165.4 ± 14.6	188.4 ± 22.0
Grow-out				
Parameters	**NAF**	**AF**	**NAF**	**AF**
Initial weight (g)	0.6 ± 0.0	0.6 ± 0.0	0.8 ± 0.0	0.8 ± 0.0
Final weight (g)	14.7 ± 0.5	14.9 ± 0.2	14.3 ± 0.0	14.5 ± 0.3
weight gain (g)	14.1 ± 0.5	14.2 ± 0.2	13.5 ± 0.0	13.7 ± 0.3
Weekly Growth (g)	1.2 ± 0.0	1.2 ± 0.0	3.1 ± 0.0	3.2 ± 0.01
SGR (%)**	3.7 ± 0.0	3.7 ± 0.0	8.9 ± 0.0	8.9 ± 0.1
Final survival (%)	51.7 ± 0.9	47.7 ± 2.5	93.0 ± 1.4	95.9 ± 0.8
FCR	1.3 ± 0.1	1.3 ± 0.1	0.7 ± 0.0	0.8 ± 0.0
Yield (Kg/ha)/ (g/m^3)***	1875.2 ± 27.6	1776.6 ± 82.8	591.6 ± 8.6	617.7 ± 7.5

Key points

1. Egg commercial production with non-ablated female can depend on SEX RATIO change

2. Non-ablation does not affect larval, post-larlavae and juveniles growth performance and survival

3. Offsping of non-ablated animals might be more resistant to environmental stress

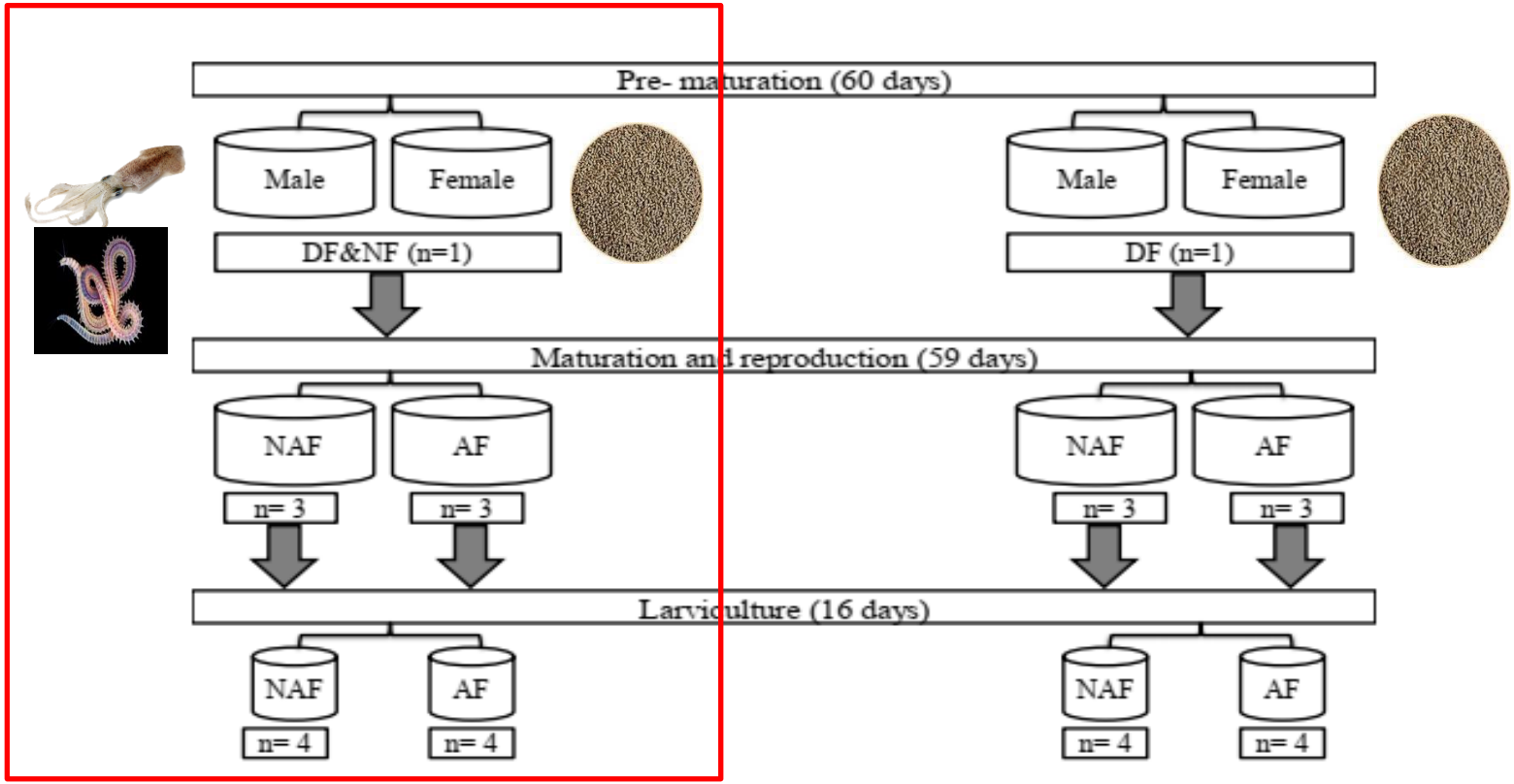
Non-ablation PROJECT part 2

Literature Review

Broodstock pre-conditioning: **Feed Type**

Effect of pre-maturation conditioning on **broodstock reproductive performance** and **offspring quality** of non-ablated Pacific white shrimp (*Litopenaeus vannamei*)

Experimental design



DF – Dry feed; **NF** – Natural Feed; **NAF** - Non-ablated female; **AF** - Ablated female

Results

Zacarias et al. Under prep.

Table 1: Sperm quality during pre-maturation **DF** – Dry feed; **NF** – Natural Feed

Time (Days)	1		22		45		Signficance		
Parameters	DF&NF	DF	DF&NF	DF	DF&NF	DF	F	T	FxT
GSI (%) (n= 10)	1.5 ± 0.3^{ab}	1.7 ± 0.6^{ab}	0.9 ± 0.1^{b}	2.4 ± 0.2^{a}	1.7 ± 0.4^{ab}	1.5 ± 0.3^{ab}	ns	ns	*
HPSI (%) (n= 10)	3.5 ± 0.2	3.5 ± 0.3	3.4 ± 0.1	4.2 ± 0.2	3.1 ± 0.3	3.1 ± 0.3	ns	*	ns
Spermatophore weight (mg) (n= 7)	35.2 ± 2.5	30.4 ± 2.9	38.5 ± 4.6	46.0 ± 4.6	43.0 ± 3.3	50.6 ± 5.9	ns	*	ns
Sperm Count (10^6) (n= 7)	17.5 ± 2.5	11.8 ± 1.9	24.1 ± 4.5	28.9 ± 5.2	35.6 ± 3.2	24.1 ± 4.0	ns	*	ns
Dead Sperm (%) (n= 7)	21.1 ± 7.4	22.8 ± 7.4	28.2 ± 8.7	17.2 ± 3.8	28.3 ± 6.0	32.2 ± 2.7	ns	ns	ns

Table 2: Reproductive performance

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	DF&NF		DF		Significance		
Parameters	**NAF**	**AF**	**NAF**	**AF**	**F**	**A**	**FxA**
Mating success per day (%)	5.8 ± 0.5	6.9 ± 0.6	3.8 ± 0.1	7.0 ± 0.7	ns	*	ns
Spawning event per day (%)	92.1 ± 1.9	90.0 ± 0.9	92.3 ± 0.7	91.8 ± 1.9	ns	ns	ns
Hatching rate per day (%)	55.5 ± 1.0	53.1 ± 1.4	50.6 ± 1.4	51.3 ± 1.0	*	ns	ns
Fertilization rate (%)	78.4 ± 0.5[a]	70.5 ± 1.4[b]	69.7 ± 2.1[b]	68.6 ± 0.5[b]	*	*	*
Number of eggs/spawned female/day	158090 ± 8212	140364 ± 2351	169938 ± 2341	146582 ± 3372	ns	*	ns
Number of nauplii/spawned female/day	85708.1 ± 1984.1	71942 ± 2261	85049 ± 3180	74474 ± 2109	ns	*	ns
Number of eggs/tank/day	924598 ± 70823	1142248 ± 66564	851764 ± 46620	1165342 ± 24034	ns	*	ns
Number of nauplii/tank/day	506501 ± 34489	590934 ± 35189	453077 ± 25441	594259 ± 13703	ns	*	ns
Mortality of female per day (%)	5.0 ± 1.2	3.8 ± 0.3	3.5 ± 0.1	4.9 ± 0.9	ns	ns	ns

DF – Dry feed; **NF** – Natural Feed; **NAF** - Non-ablated female; **AF** - Ablated female

Table 3.

Feed composition

Parameters (mg/g)*	Squid	Polychaete	Dry Feed
Proteins	907.2 ± 23.8^{a}	414.0 ± 10.3^{b}	357.7 ± 1.5^{c}
Carbohydrates	30.3 ± 4.4^{b}	46.6 ± 3.7^{b}	274.4 ± 11.0^{a}
Total lipids	121.9 ± 1.3^{b}	137.7 ± 1.8^{a}	117.4 ± 0.1^{b}
Total saturated	16.6 ± 0.4^{a}	15.3 ± 1.3^{a}	17.7 ± 0.3^{a}
Total monounsaturated	6.3 ± 0.0^{b}	3.6 ± 0.4^{c}	23.5 ± 0.3^{a}
Total n-6 PUFA	1.3 ± 0.0^{b}	0.9 ± 0.0^{c}	25.5 ± 0.4^{a}
Total n-3 PUFA	31.5 ± 1.3^{a}	20.2 ± 0.4^{b}	9.5 ± 0.1^{c}
18:2n-6	0.2 ± 0.0^{c}	0.9 ± 0.0^{b}	24.8 ± 0.4^{a}
20:4n-6	0.4 ± 0.0^{a}	0.4 ± 0.0^{a}	0.3 ± 0.0^{a}
20:5n-3	8.1 ± 0.4^{a}	8.1 ± 0.4^{a}	3.7 ± 0.1^{b}
22:6n-3	22.5 ± 0.9^{a}	3.1 ± 0.4^{b}	0.2 ± 0.1^{c}

Table 4: Larval growth performance and survival

Zacarias et al. Under prep.

	DF&NF		DF		Significance		
Parameters	**NAF**	**AF**	**NAF**	**AF**	**F**	**A**	**FxA**
LSI at Z1	1.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0	ns	ns	ns
LSI at M1	3.9 ± 0.0	3.7 ± 0.2	3.7 ± 0.1	3.9 ± 0.1	ns	ns	ns
LSI at PL1	6.7 ± 0.1	6.6 ± 0.1	6.6 ± 0.1	6.7 ± 0.09	ns	ns	ns
LSI at PL10	15.4 ± 0.2	15.3 ± 0.2	15.6 ± 0.1	15.6 ± 0.1	ns	ns	ns
Survival to SST PL10-11 (%)	88.5 ± 2.9	82.7 ± 5.1	90.0 ± 2.5	80.0 ± 1.2	ns	*	ns
Final weight (mg)	2.2 ± 0.0	2.2 ± 0.3	2.4 ± 0.3	2.2 ± 0.0	ns	ns	ns
Final Survival (%)	37.1 ± 3.9	34.8 ± 1.6	41.0 ± 3.7	30.4 ± 2.2	ns	ns	ns
Parameters (mg/g)	**NAF**	**AF**	**NAF**	**AF**	**F**	**A**	**FxA**
Total lipids	22.9 ± 1.4	20.0 ± 0.4	19.3 ± 0.8	19.7 ± 0.9	ns	ns	ns
Total saturated	2.4 ± 0.1	2.3 ± 0.0	1.8 ± 0.4	2.4 ± 0.1	ns	ns	ns
Total monounsaturated	2.0 ± 0.1	1.9 ± 0.0	1.5 ± 0.3	2.2 ± 0.1	ns	ns	ns
Total n-6 PUFA	1.5 ± 0.3	1.5 ± 0.0	1.2 ± 0.2	1.7 ± 0.1	ns	ns	ns
Total n-3 PUFA	1.9 ± 0.2	1.9 ± 0.0	1.4 ± 0.3	1.9 ± 0.1	ns	ns	ns
18:2n-6	1.0 ± 0.0	1.1 ± 0.0	0.8 ± 0.2	1.2 ± 0.1	ns	ns	ns
20:4n-6	0.3 ± 0.0	0.3 ± 0.0	0.2 ± 0.0	0.3 ± 0.0	*	ns	ns
20:5n-3	0.7 ± 0.1	0.8 ± 0.1	0.6 ± 0.1	0.8 ± 0.0	ns	ns	ns
22:6n-3	0.9 ± 0.0	0.9 ± 0.0	0.7 ± 0.0	0.9 ± 0.0	ns	ns	ns

DF – Dry feed; **NF** – Natural Feed; **NAF** - Non-ablated female; **AF** - Ablated female

Key points

1. Supplementing squid and polychaete in pre-maturation is a potential key step to success of non-ablated shrimp female

2. Non-ablation does not affect larval and post-larlavae growth performance and survival

3. Offspring of non-ablated animals might be more resistant to environmental stress

Non-ablation PROJECT part 3

Salinity stress test: Non-ablated shrimp broodstock produced ROBUST OFFSPRING

Focus :

Is there a link between non-ablation and the “fitness” of the offspring?

Disease Challenge

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Increased robustness of postlarvae and juveniles from non-ablated Pacific whiteleg shrimp, *Penaeus vannamei*, broodstock post-challenged with pathogenic isolates of *Vibrio parahaemolyticus* (Vp_{AHPND}) and white spot disease (WSD)

Simão Zacarias[a,*], Daniel Fegan[b], Siriroj Wangsoontorn[b], Nitrada Yamuen[c], Tarinee Limakom[c], Stefano Carboni[a], Andrew Davie[a], Matthijs Metselaar[d], David C. Little[a], Andrew P. Shinn[a,c,d]

Experimental Set Up

1. Challenge *P. Vannamei* Postlarvae with AHPND/EMS

2. Challenge *P. Vannamei* Juveniles with WSD

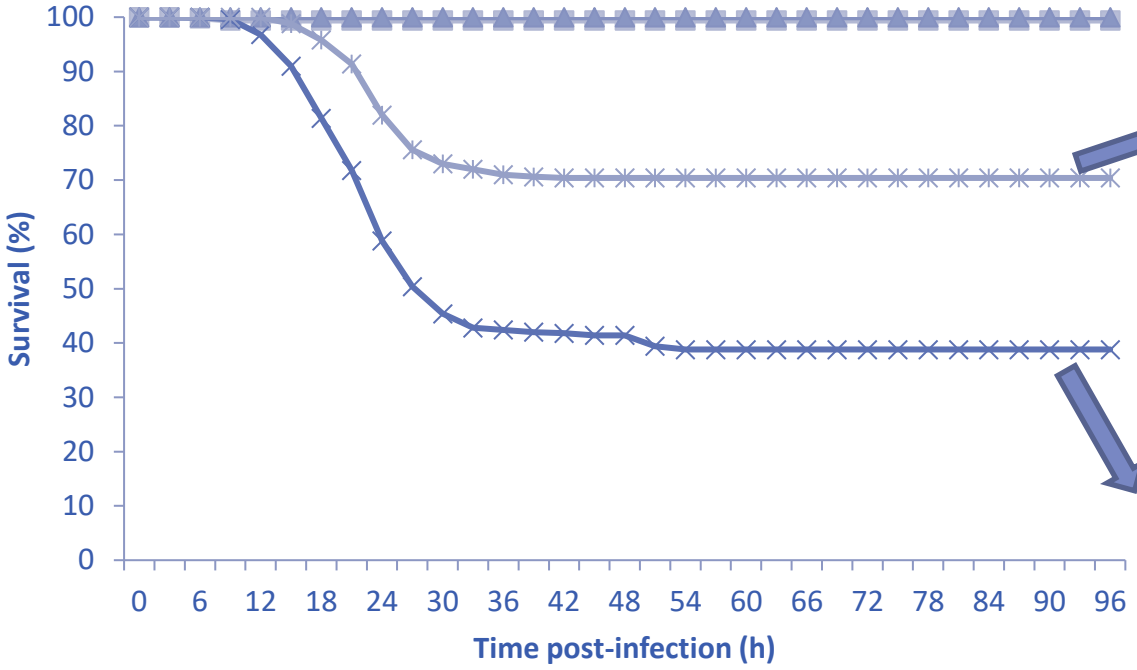
Benchmark Holdings plc

SyAqua
Greater Yield, Faster Growth

Thailand

Results

1. Survival of *P. vannamei* Postlarvae challenged with and without AHPND/EMS



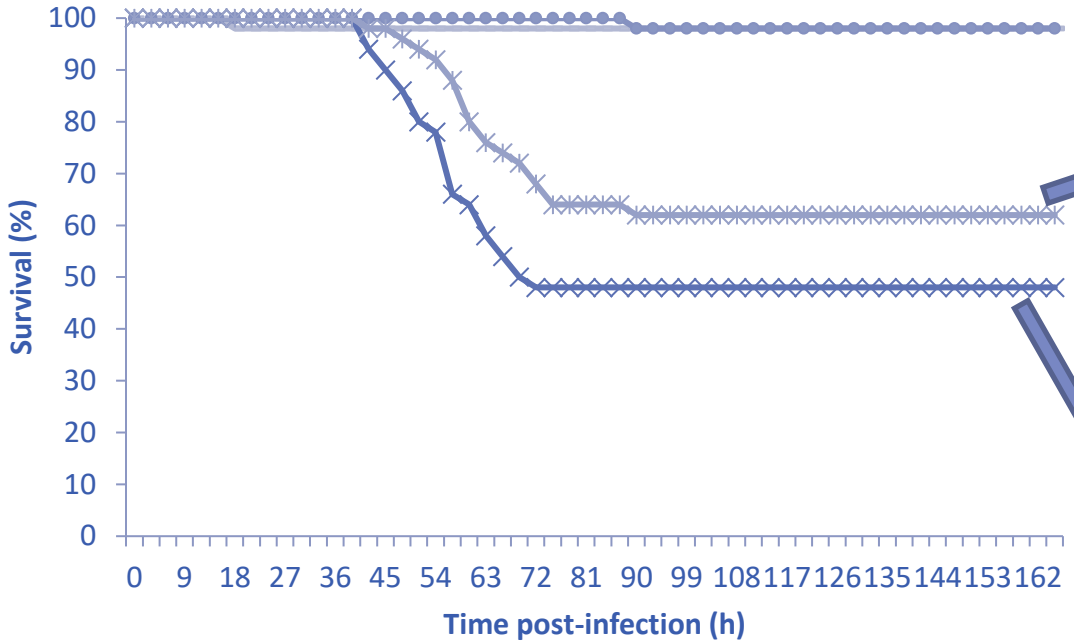
70.4% - NAF

38.8% - AF

+31.6%

AF – Ablated female
NAF – Non-ablated female

2. Survival of *P. vannamei* Juveniles challenged with and without WSSV



62% - NAF

48% - AF

+14%

AF – Ablated female
NAF – Non-ablated female

Key points

1. Offspring of non-ablated female are robust and more resistant to typical diseases

2. Validation of the data under commercial conditions are still required

3. Understanding mechanistic factors contributing to robustness improvement of offspring from non-ablated is also required

Final considerations

1. Adopting Non-ablation will require change in some practices including SEX RATIO MANIPULATION and/or include or improve pre-maturation conditioning

2. Non-ablation does not affect larvae, post-larlavae and juvenile growth performance and survival under normal conditions

3. Offspring of non-ablated female are more resistant to diseases

Other Key Considerations

1. Broodstock Genetic or Strain: different response to non-ablation

2. Selective breeding program: Increase selection frequency

3. Maturation system: RAS or flowthrough

Global use of Non-Ablation


THANK YOU!
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Global Seafood ALLIANCE
Best Aquaculture Practices
Best Seafood Practices
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