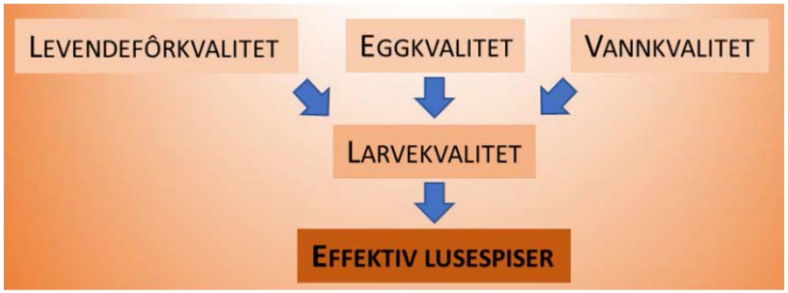
STARTRENS PROJECT WP2: START FEEDING BALLAN WRASSE

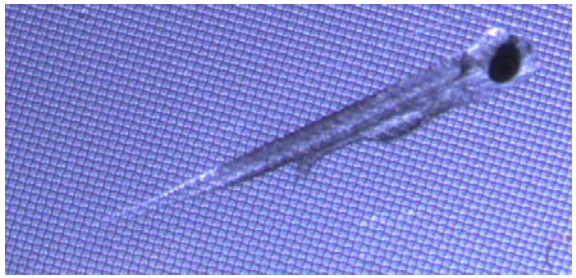
Arne Malzahn, Åsmund Johansen, Marius Selnæs, Bjarne Kvæstad, Heidi Hagen, Laura Calvo, Anna Aase, Elin Kjørsvik, Deni Ribicic, Antonio Sarno & Andreas Hagemann

STARTRENS – Optimalisert produksjon av Rensefisk (FHF #901561)

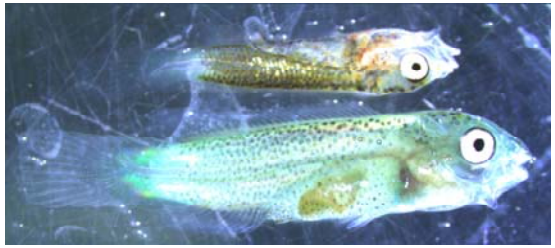
- Egg quality & Feed quality & Water quality → Healthy fish
- Ballan wrasse needs live feed as a starter: Usually Rotifers & Artemia, both inferior in nutrition
- *Can we replace rotifers and Artemia with natural products to produce healthier fish?*



Experimental Set up



- Feeding ballan wrasse from first feeding till 2 weeks weaning (48 dph)
- Norwegian Centre For Plankton Technology (NFR #245937/F50) hosted by SINTEF Ocean and NTNU
- Larvae (1-2 dph) obtained from MOWI Rensefisk, avd. Stord
- Flow-through system
  - 200 L tanks
  - Dynamic WER regime
  - 100 larvae per litre
  - 3 replicates



Feeding regimes

Phase 1 (20 days) Rotifers or replacers (Copepods or experimental cirripeds)

Phase 2) (18 days) Artemia or replacer (large cirripeds)

Phase 3) (16 days) Dry diets (Gemma micro, Trofico)

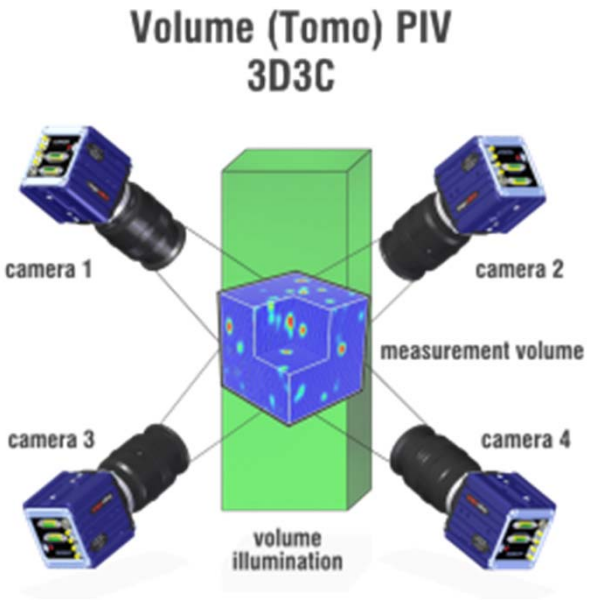
		Control				Copepod Regime				Cirriped Regime				Copepod/Cirriped Regime						
Date	Day post hatch	Rotifers (feedings/day * ind/ml)	Artemia (feedings/day * ind/ml)	Dry feed	Sive mesh size (µm)	Artemia (feedings/day * ind/ml)	Dry feed	Acartia tonsa n1-n2 (feedings/day * ind/ml)	Acartia tonsa n4-n6 (feedings/day * ind/ml)	Sive mesh size (µm)	Dry feed	Cirriped, small (feedings/day * ind/ml)	Cirriped, large (feedings/day * ind/ml)	Sive mesh size (µm)	Dry feed	Cirriped, large (feedings/day * ind/ml)	Acartia tonsa n1-n2 (feedings/day * ind/ml)	Acartia tonsa n4-n6 (feedings/day * ind/ml)	Sive mesh size (µm)	Water exchange (%/day)	Light (hours on)	Temparature (°C)
21.2.20	1				250					64				250					64	200	0	12
22.2.20	2				250					64				250					64	200	0	12
23.2.20	3				250					64				250					64	200	0	12
24.2.20	4	1 * 3			250			1 * 20		64		4* 5		250			1 * 20		64	200	24	12
25.2.20	5	1 * 3			250			3*3,3		64		4* 5		250			3*3,3		64	200	24	12
26.2.20	6	2 * 3			250					64		4* 5		250						200	24	13
27.2.20	7																			200	24	13
28.2.20	8																			200	24	13
29.2.20	9																			200	24	13
1.3.20	10																			200	24	13
2.3.20	11																			200	24	13
3.3.20	12																			200	24	14
4.3.20	13																			200	24	14
5.3.20	14											4* 5		250						200	24	14
6.3.20	15	3 * 3			250				3* 10	350		4* 5		250				3* 10	350	200	24	15
7.3.20	16	3 * 3			250				3* 10	350		4* 5		250				3* 10	350	200	24	15
8.3.20	17	3 * 3			250				3* 13	350		4* 5		250				3* 13	350	200	24	15
9.3.20	18	3 * 3	1 * 3		350	1 * 3			3* 13	350		4* 5	2* 3	350		2* 3		3* 13	350	400	24	15
10.3.20	19	3 * 3	1 * 3		350	1 * 3			3* 10	350		4* 5	2* 3	350		2* 3		3* 10	350	400	24	15
11.3.20	20	3 * 3	2 * 3		350	2 * 3			3* 10	350		4* 5	4* 3	350		4* 3		3* 10	350	400	24	15
12.3.20	21	3 * 3	3 * 3		350	3 * 3			2* 10	350		4* 5	4* 3	350		4* 3		2* 10	350	400	24	15
13.3.20	22																					
14.3.20	23				0	3 *				350										400	24	16
15.3.20	24				0	3 *				350										400	24	16
16.3.20	25				0	3 *				350										400	24	16
17.3.20	26				0	3 *				350										600	24	16
18.3.20	27				0	3 *				350										600	24	16
19.3.20	28				0	3 *				350										600	24	16
20.3.20	29				0	3 *				350										600	24	16
21.3.20	30				0	3 *				350										600	24	16
22.3.20	31				0	3 *				350			4* 3	350		4* 3			350	600	24	16
23.3.20	32				0	3 *				700	A		4* 3	700	A	4* 3			700	600	24	16
24.3.20	33		3 * 3	A	700	3 * 3	A			700	A		4* 3	700	A	4* 3			700	800	24	16
25.3.20	34		3 * 3	A	700	3 * 3	A			700	A		4* 3	700	A	4* 3			700	800	24	16
26.3.20	35		3 * 3	A	700	3 * 3	A			700	A		4* 3	700	A	4* 3			700	800	24	16
27.3.20	36		3 * 3	A	700	3 * 3	A			700	A		4* 3	700	A	4* 3			700	800	24	16
28.3.20	37			A	700		A			700	A			700	A				700	800	24	16
29.3.20	38			B	700		B			700	B			700	B				700	800	24	16
30.3.20	39			B	700		B			700	B			700	B				700	800	24	16
31.3.20	40			B	700		B			700	B			700	B				700	800	24	16
1.4.20	41			B	700		B			700	B			700	B				700	800	24	16
2.4.20	42			B	700		B			700	B			700	B				700	800	24	16
3.4.20	43			C	700		C			700	C			700	C				700	800	24	16
4.4.20	44			C	700		C			700	C			700	C				700	800	24	16
5.4.20	45			C	700		C			700	C			700	C				700	800	24	16
6.4.20	46			C	700		C			700	C			700	C				700	800	24	16
7.4.20	47			C	700		C			700	C			700	C				700	800	24	16
8.4.20	48			C	700		C			700	C			700	C				700	800	24	16

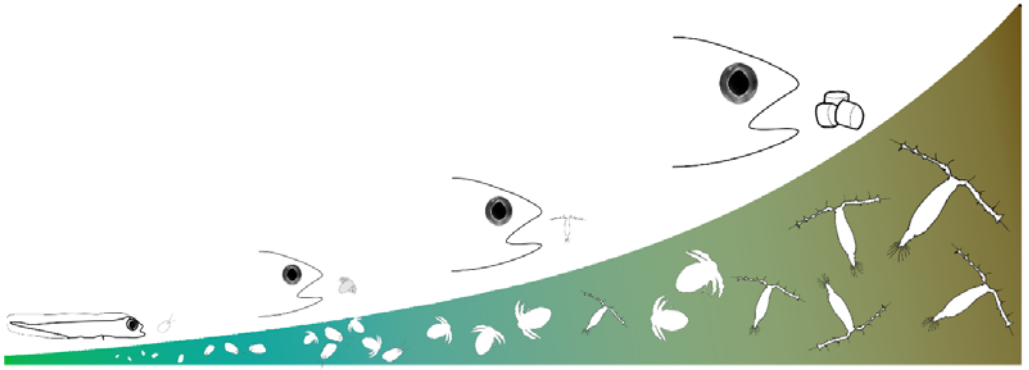
Sampling dates

	A	B	C
Gemma Micro 150:	50 %	25 %	
Gemma Micro 300:		25 %	50 %
Trofico 200-300:	50 %	50 %	50 %

Sampling

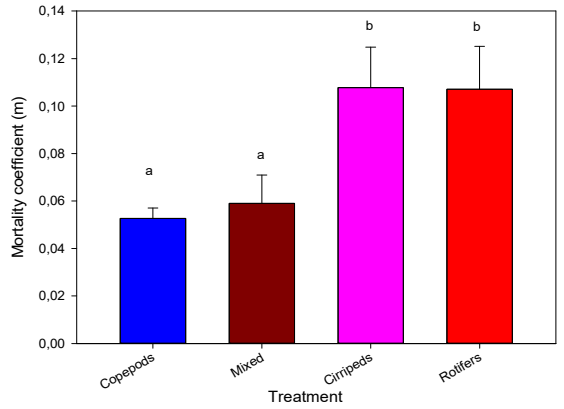
- Focus at transitions between feed types (underlined will be touched in the next minutes)
  - Survival
  - Growth
  - Biometry
  - Biochemistry
  - Respiration & carbon (DEB modelling)
  - Bone development & deformities
  - Gut & liver histology
  - Behaviour
  - Gene expression
  - Microbiology (Fish, feed and water)

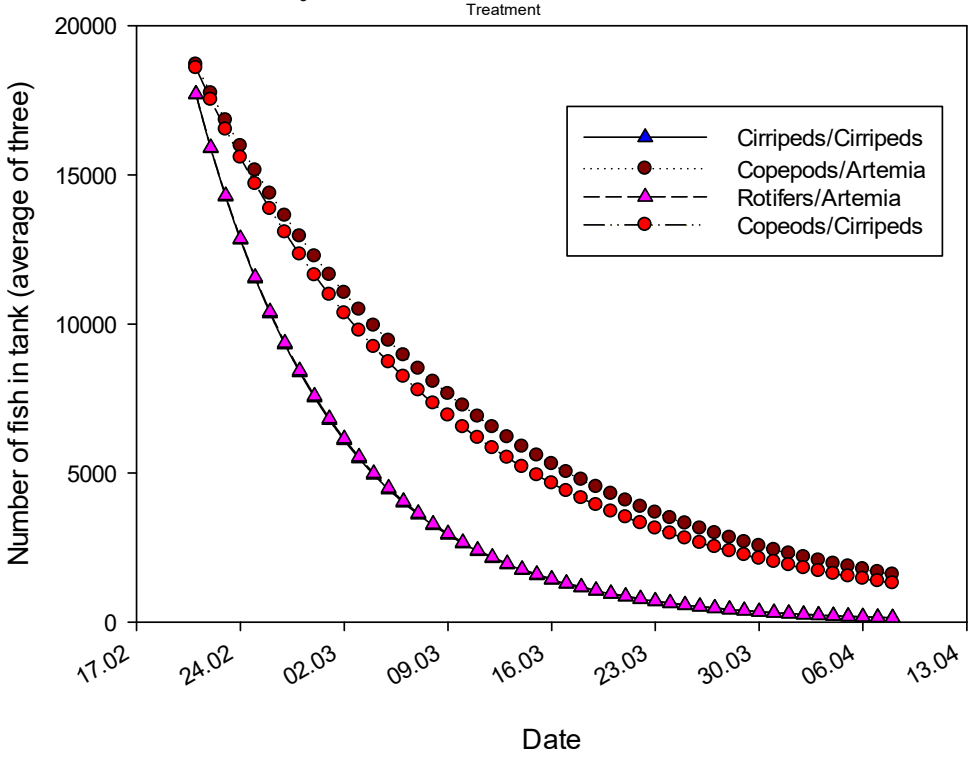




Mortality

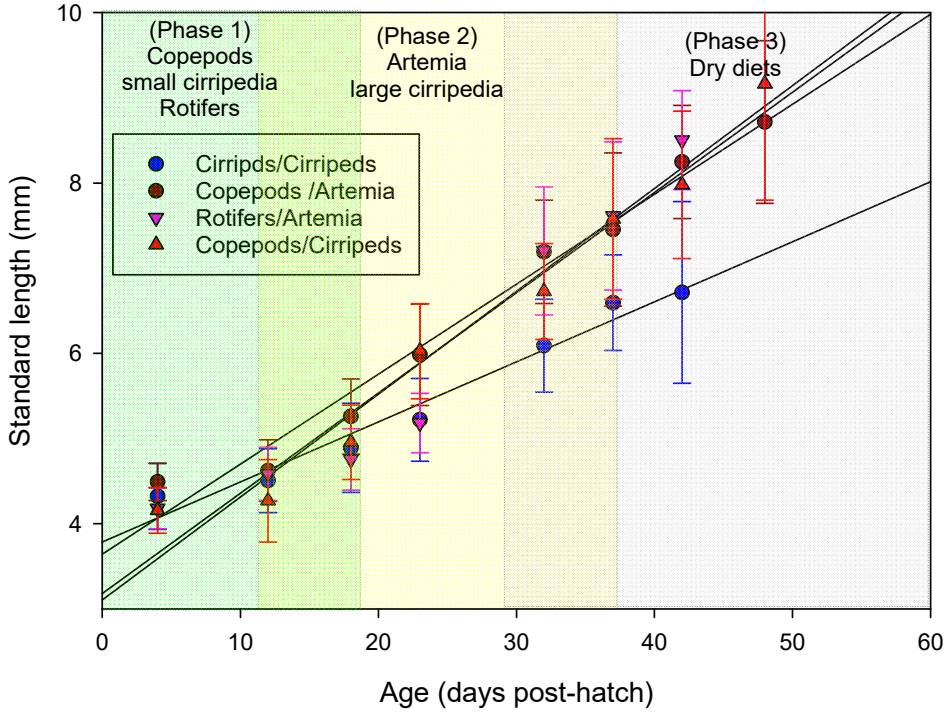
- Survival very similar in groups received copepods in the beginning
- Rotifers and 'Experimental cirripeds' as start feed performed less good





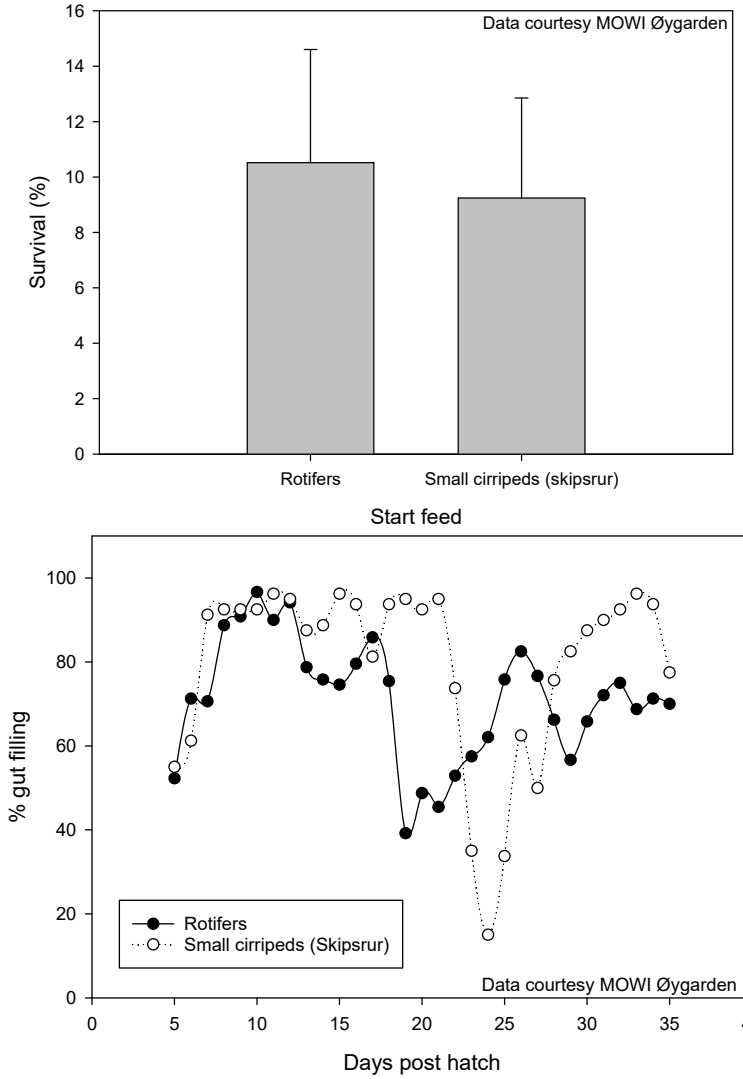
Growth

- Copepod-started larvae grew well
- Transition from copepods → large cirripeds resulted in higher growth rates than copepods Artemia
- 'Experimental cirripeds' larvae grew significantly slower
- The rotifer/Artemia group grew just as the copepod-started groups

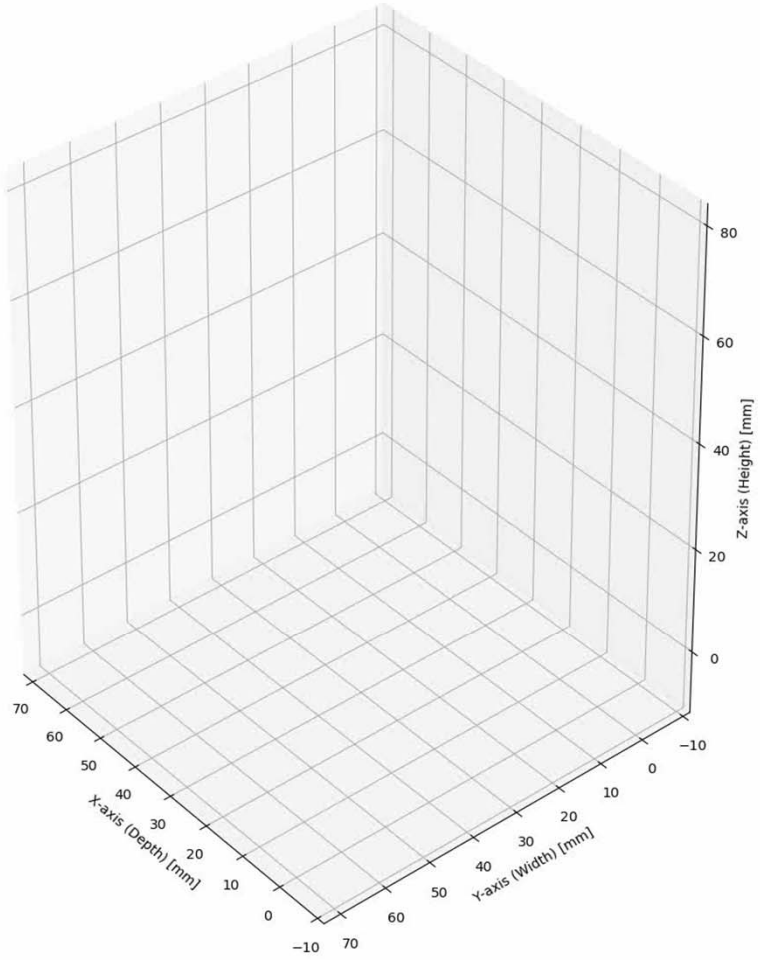


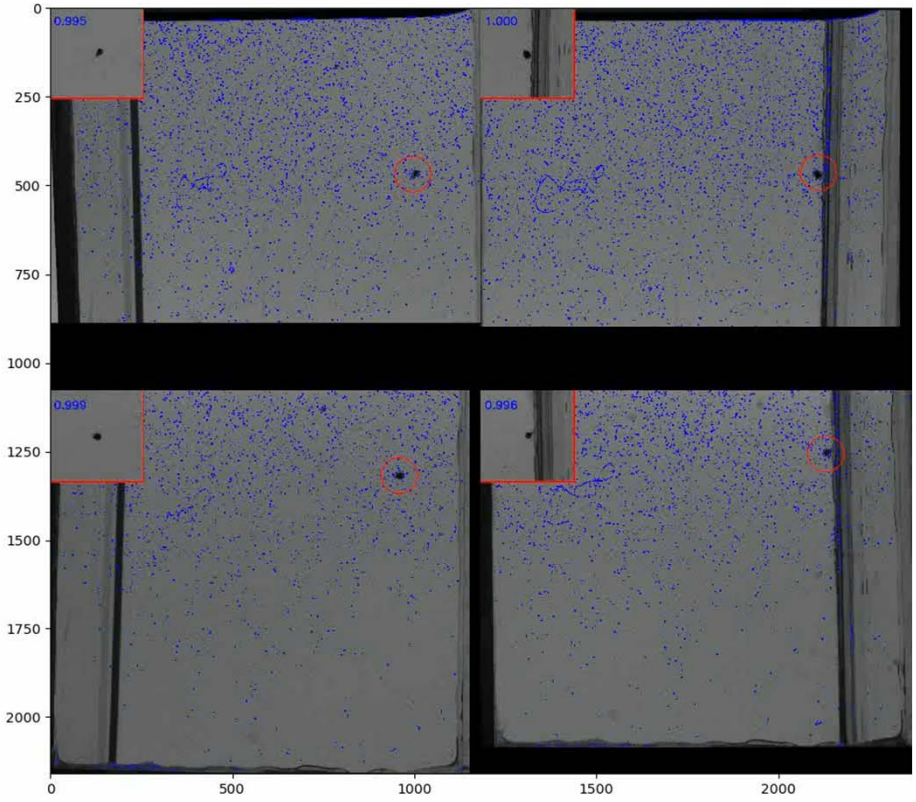
Experimental cirriped results in perspective

- MOWI Øygarden used the commercial verison of the experimental cirripeds we used.
- At MOWI results are comparable to rotifers.
- Child diseases over



Behaviour

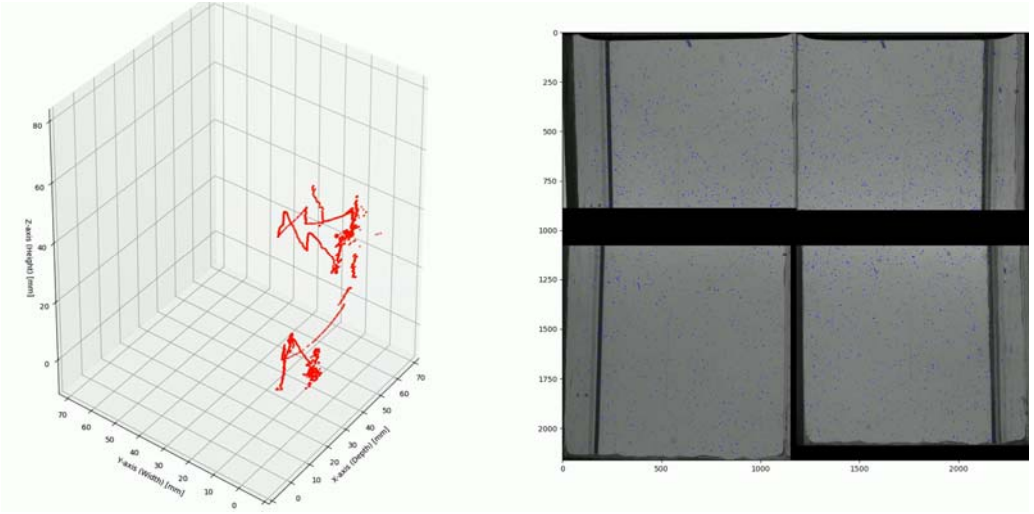


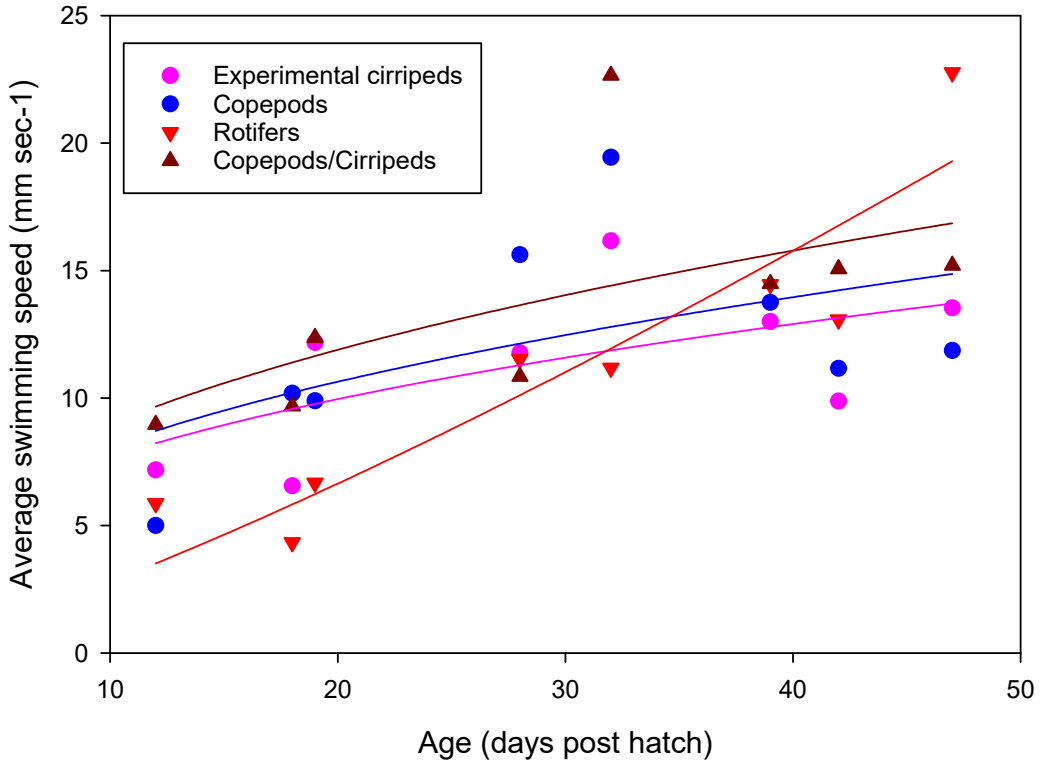


18 days post hatch

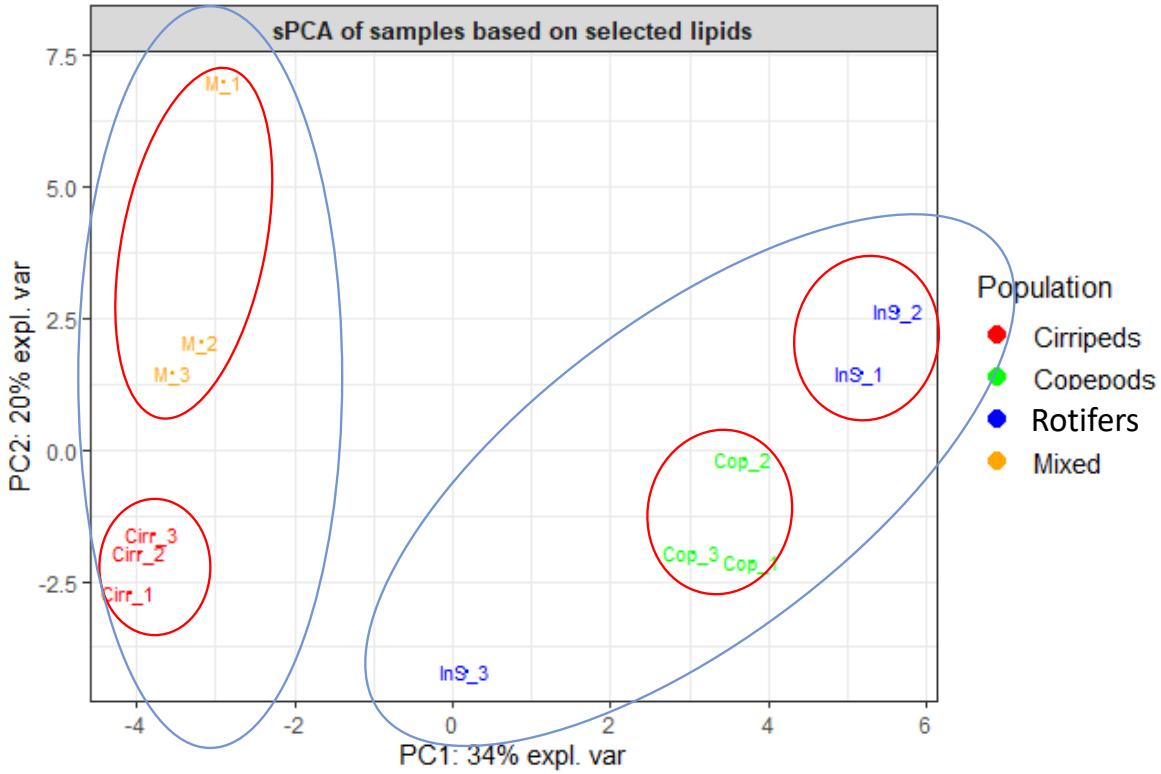
Activity in relation to feed

- First steps, so far no pronounced differences between groups



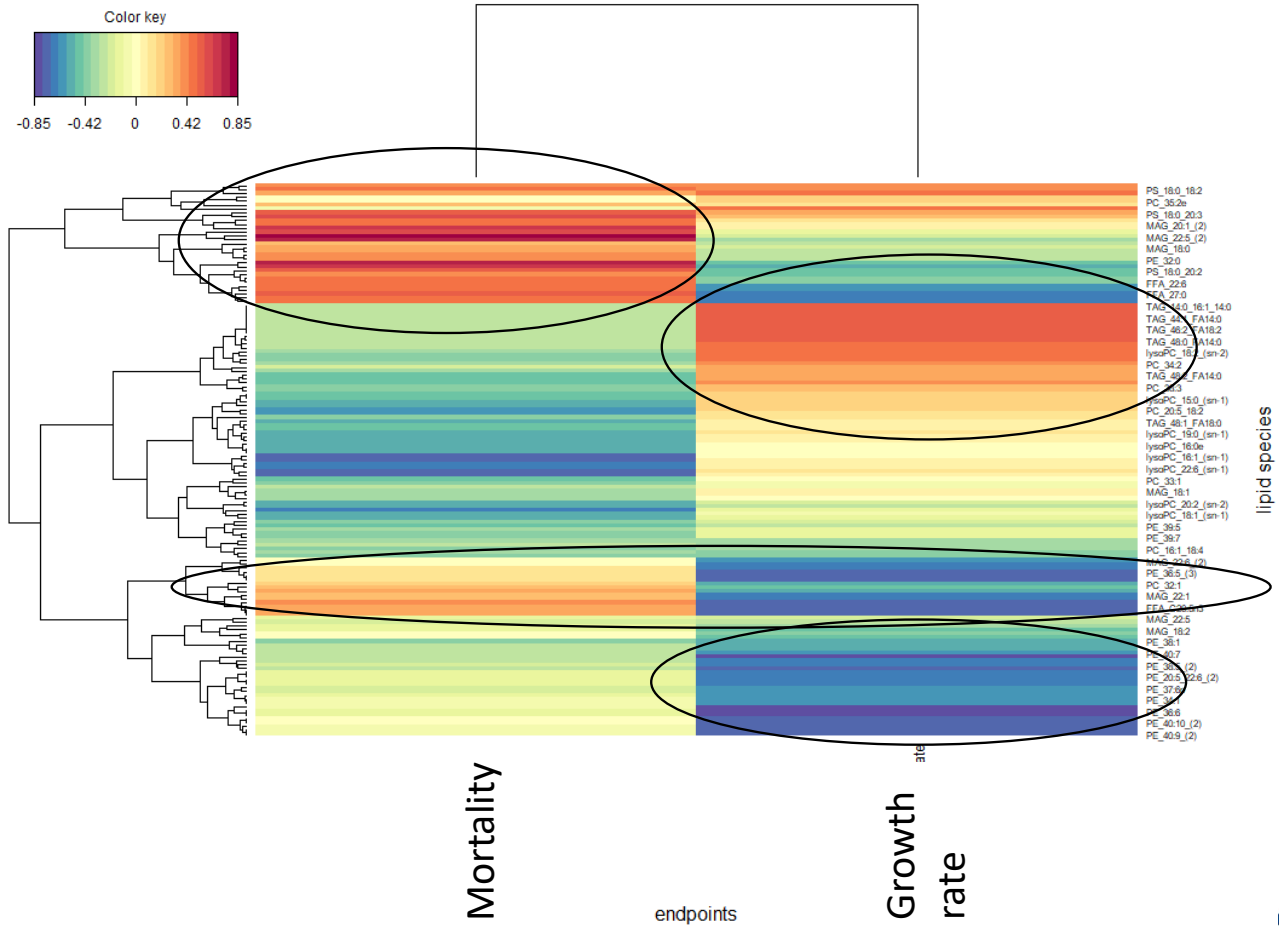


Lipidomics at final sampling (48 dph)



- Sparse principal component analysis
- Samples group together based on whole feeding history
- Group by second feed type after receiving the same diet for at least 2 ½ weeks

Lipidomics and end point prediction (48 dph)

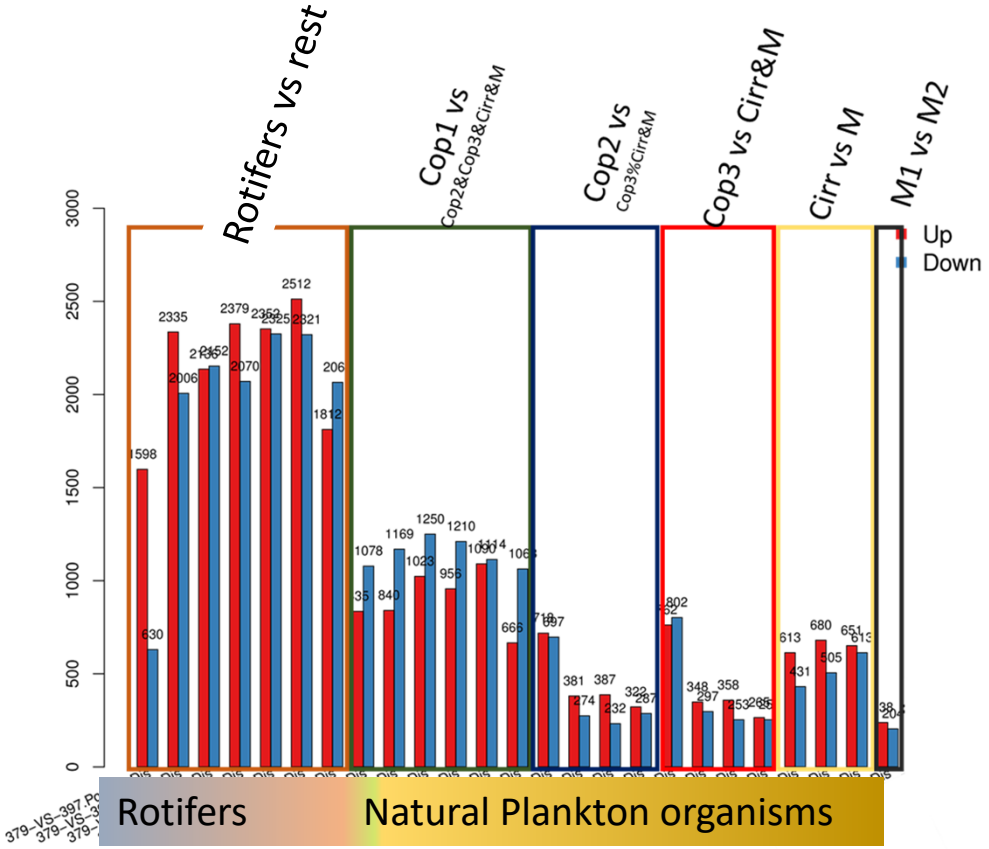


- Clustered image map
- Comparing selected number of lipids with *endpoint data* (mortality coefficient and growth rate)
- Deep red positively correlates
- Deep blue negatively correlates

- Monoacylglycerides (MAGs) showed strong positive correlation with mortality coefficient
- Several triacylglycerides (TAGs) were positively related to growth.
- Phosphatidylethanolamines (PEs) showed strong negative correlation with growth rate

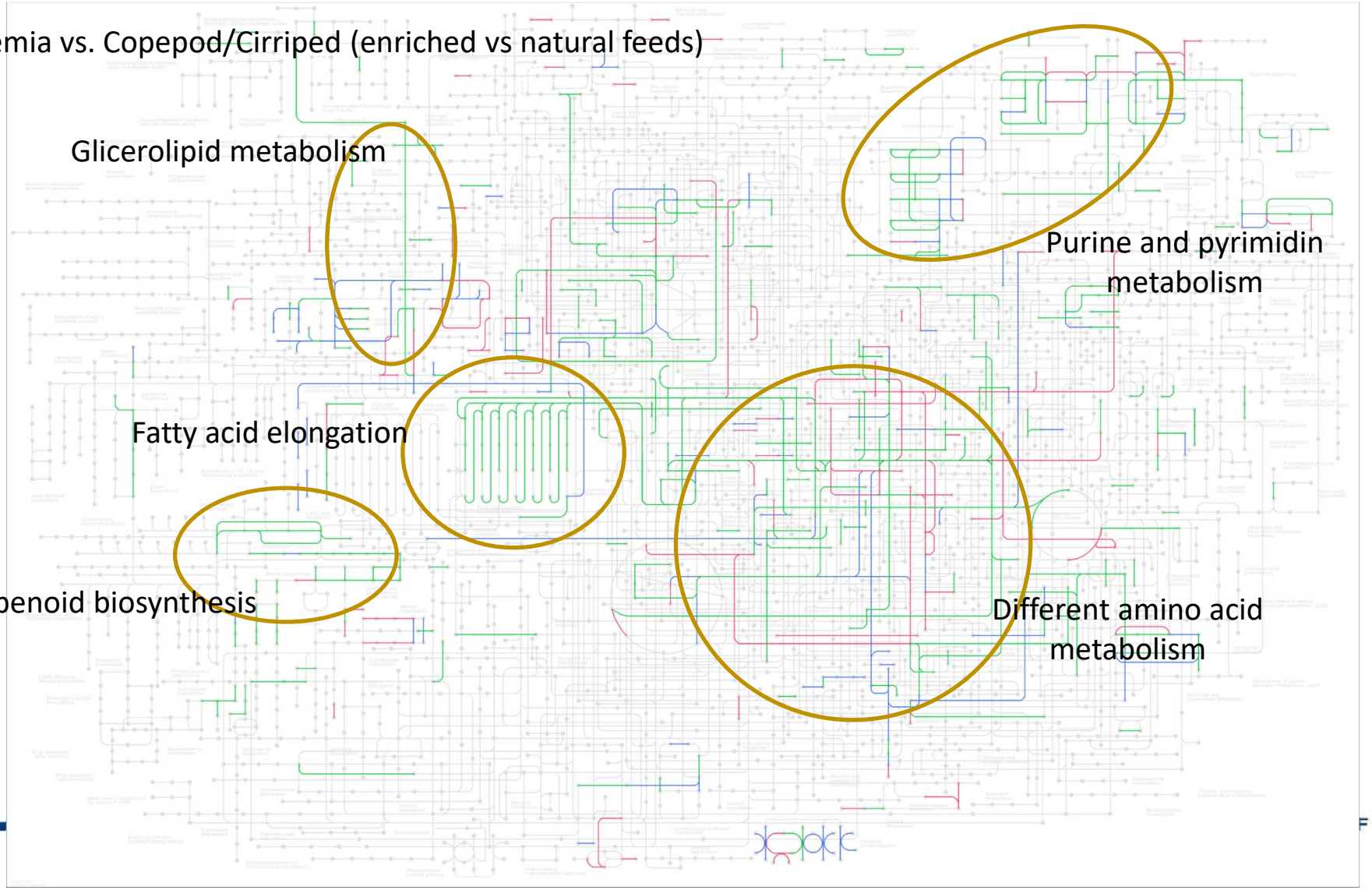
Gene expression in relation to feed types eaten (48 dph)

- Global gene expression on last sampling day (48dph, 14 days dry feeds)
- Biggest differences were found between larvae started on *Rotifers* vs. *natural live feeds*, less differences within larvae started on natural live feeds
- Can be visualised on Metabolic Pathway maps (KEGG Pathway Maps)



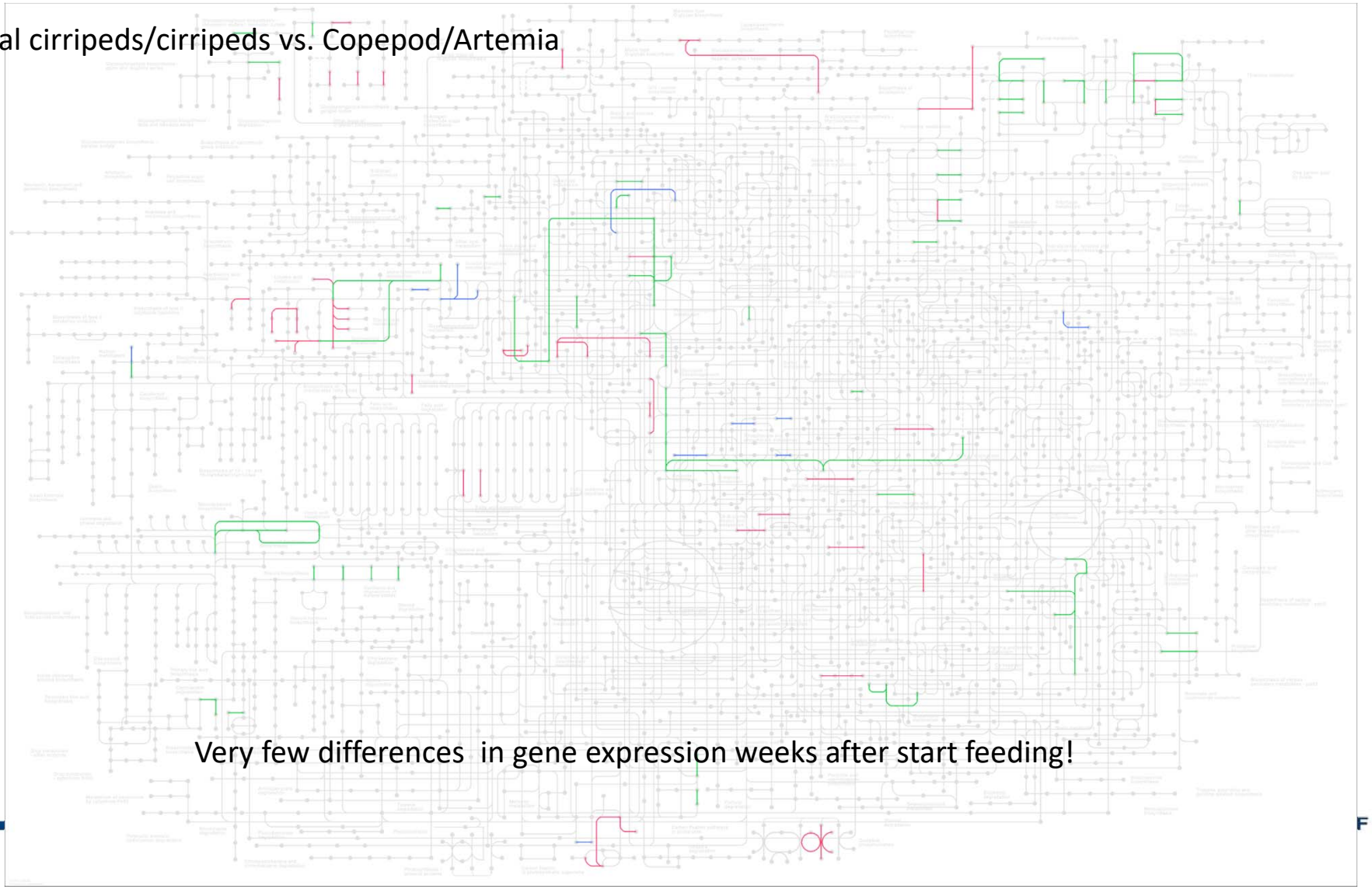
Differential gene expression analysis (48 dph)

Rotifers/Artemia vs. Copepod/Cirriped (enriched vs natural feeds)



Differential gene expression analysis (48dph)

Experimental cirripeds/cirripeds vs. Copepod/Artemia



Very few differences in gene expression weeks after start feeding!

Differential gene expression analysis (48dph)

Copepod/Cirriped vs. Copepod/Artemia

Virtually no differences in gene expression weeks after start feeding!

Wrap up & Future perspectives

- Natural live feeds (copepods and cirripedes) resulted in higher growth and survival.
- Carry over effects from the first days of exogenous feeding were observed in larvae by gene expression analyses after weeks of sole feeding on dry feeds.
- Experimentally exploit findings of lipidomics and gene expression →
  - Add positive lipids to feeds
  - Avoid adverse lipids
  - Why is e.g. fatty acid elongation upregulated when eating enriched diets?
- Extend activities beyond successful weaning to identify start feeding effects later in life (nutritional programming)

Financed by:

FHF
FISKERI- OG HAVBRUKSNÆRINGENS FORSKNINGSFINANSIERING

SINTEF

NTNU

Project group:

SINTEF

NTNU

DEBtox Research

PLANKTONIC

cFEED

Reference group:

Ingrid Overrein, **Mowi ASA**
Kjersti Beate Rosland, **Rensefiskgruppen AS**
Claudia Wittwer, **Arctic Cleanerfish AS**