Singapore Food Agency

Rotifer *(Brachionus rotundiformis)* Culture Technology for Hatchery Production in Singapore

Marine Aquaculture Centre

CONTENT

01

Part One

Background

- **Rotifer introduction**
- **Types of rotifer culture in Singapore**

Rotifer Introduction

- Rotifers are used extensively in aquaculture
  - Optimal size for fish larvae, shellfish, corals and other filter feeders
  - Good nutritional profile if properly enriched
  - High reproduction rate
  - Easy to culture

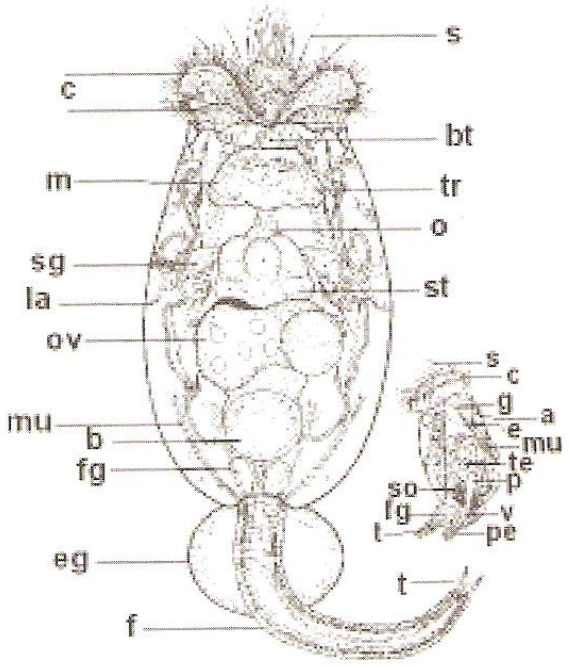
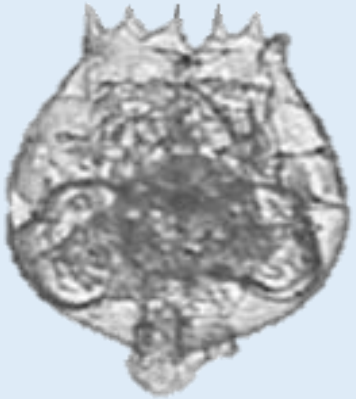


Fig. 2.2 Morphology and inner organisation of a *Brachionus* sp. female (left) and male (right). a, dorsal antenna; b, bladder; bt, buccal tube; c, corona; e, eye; eg, egg; f, foot; fg, foot gland; g, central ganglion; la, lateral antenna; m, mastax; mu, muscle; o, oesophagous; ov, ovary; p, prostate; pe, penis; s, sensory cirri; sg, stomach gland; st, stomach; t, toe; te, testis; tr, trophy; v, vas deferens. (From Koste & Shiel 1987. Reproduced from Invertebrate Taxonomy, Volume 7 with permission of CSIRO Publishing.)

Rotifer Introduction – Commonly Used Species

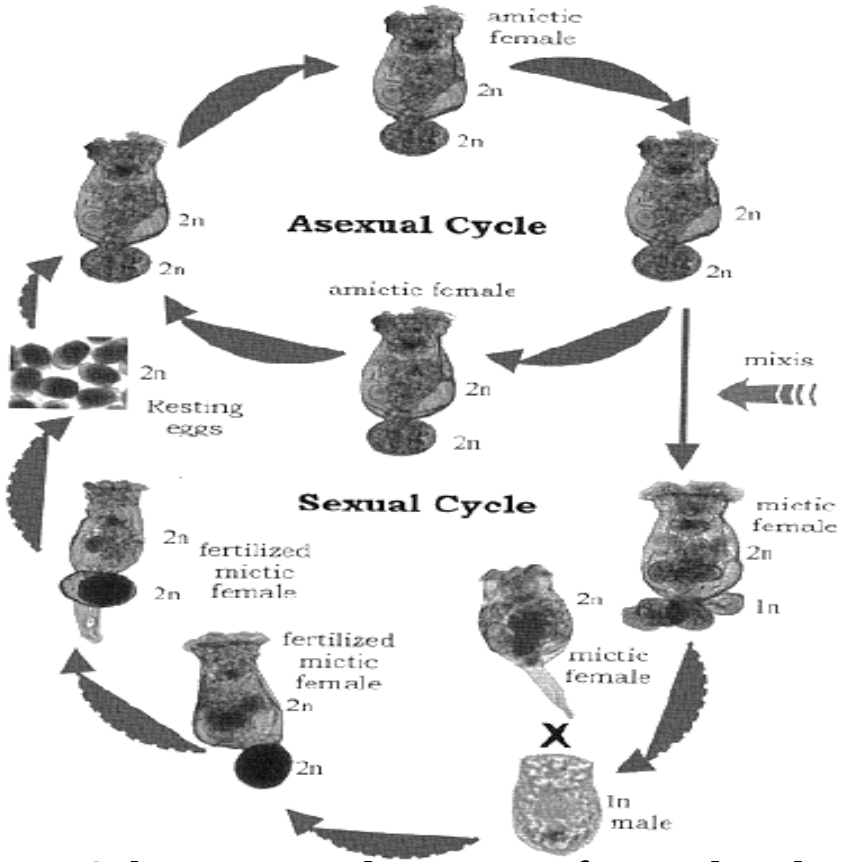
B. plicatilis (L)
171-238µm
Low-temperatures 20-25°C
Euryhaline



B. rotundiformis (S)
121-162µm
High-temperatures 28-35°C
Low-salinities

Rotifer Life Cycle

- Asexual and Sexual
- Nearly all the rotifers seen in nature are females
- Males occur only for short periods
- Life span of amictic females: 7 -12 days
- Number of eggs for amictic females produced per day: ~5 eggs



Schematic explanations of sexual and asexual cycles of reproduction of rotifer *Brachionus* (Lubzens and Zmora 2003)

Water Quality & Feed

➢ Water Quality

1. Dissolved oxygen → Above 4ppm
2. pH → 7.5 – 8.5
3. Unionized Ammonia → less than 1ppm
4. Salinity → 10-25 ppt
5. Temperature → 28-35^{o}C

➢ Feed

1. Rotifers are filter feeders
2. Prey size spectrum → 1.4 – 21µm in diameter
3. Need to feed every 4 hours
4. Food preferences → microalgae, yeast, bacteria

Types of Rotifer Culture in Singapore: Outdoor Pond

Tank size: 20 m^2

Pond size: 120 m^2

Pond size: 1200 m^2

Density:
20-50 ind/ml

Productivity:
10 mil rotifer produced per m^3 per day

Manpower:
0.39 hr to produce 100 mil rotifer per day

Ponds needed to start production:
3-5

Types of Rotifer Culture in Singapore: Indoor Batch Culture

Tank size: 1 m^3

Tank size: 2.5 m^3

Tank size: 8 m^3

Density:
200-500 ind/ml

Productivity:
100mil rotifer produced per m^3 per day

Manpower:
0.87 hr to produce 100 mil rotifer per day

Tanks needed:
5-8

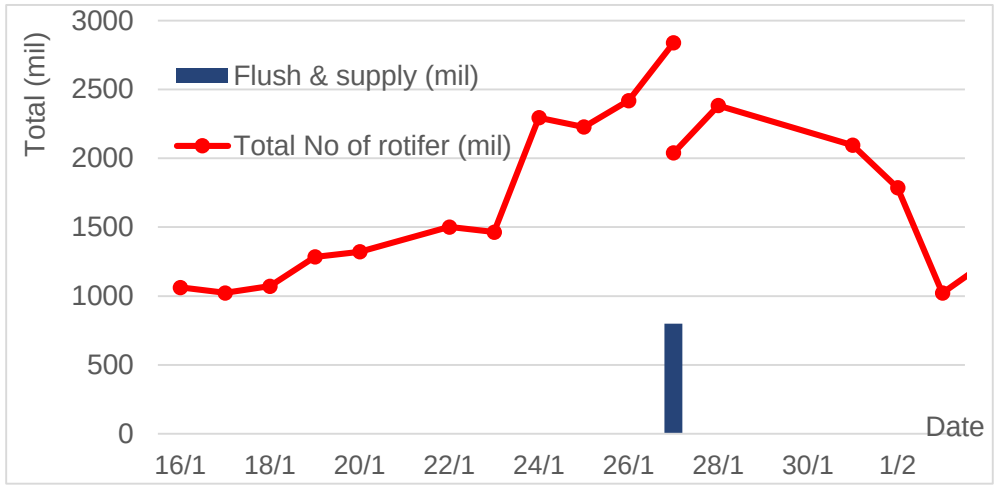
02

Part Two

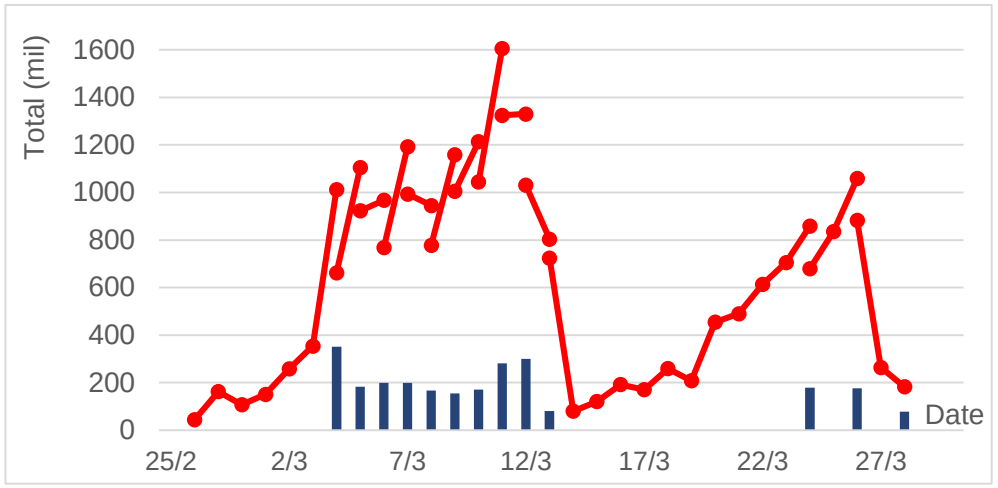
Key Challenges of Rotifer Culture in Singapore

- Maintain rotifer culture stability
- Producing rotifers with good nutrition
- Producing hygienic rotifers

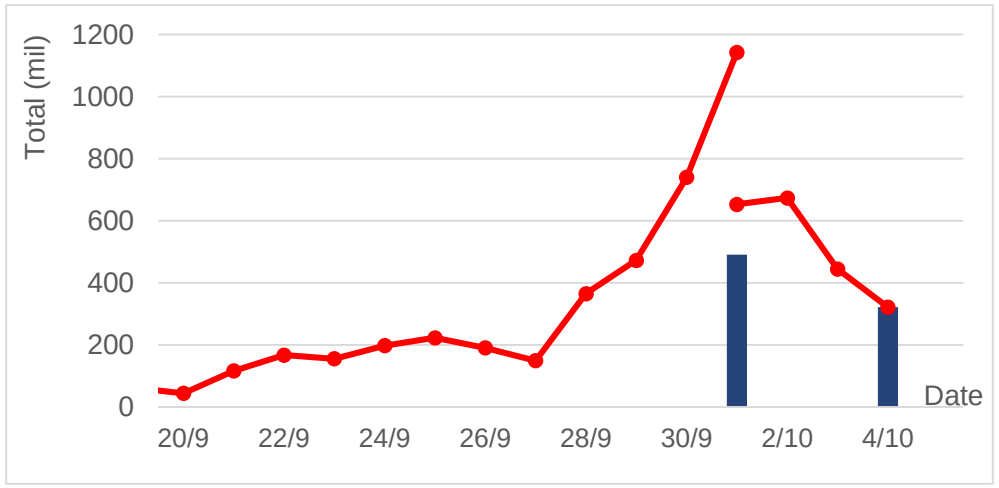
Maintain Rotifer Culture Stability



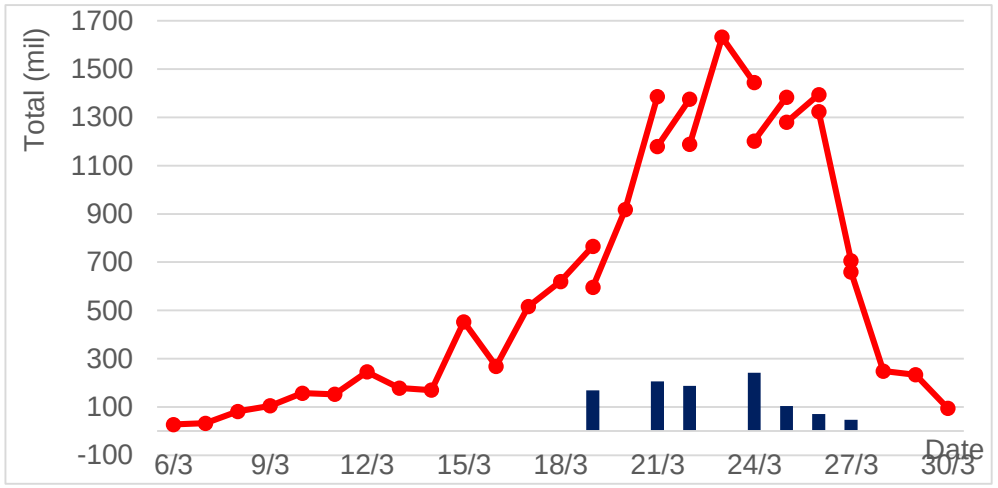
1st rotifer crash in 2017



2nd and 3rd rotifer crash in 2017

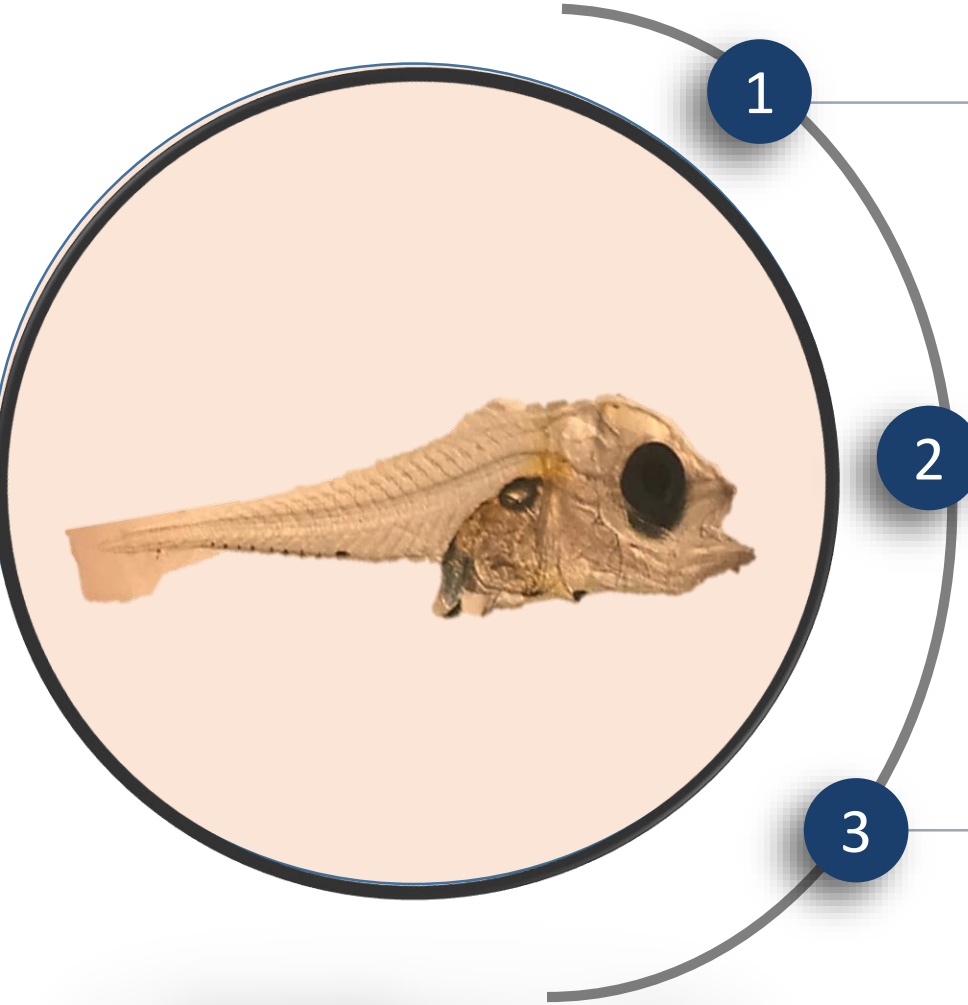


4th rotifer crash in 2017



5th rotifer crash

Producing Rotifers with Good Nutrition



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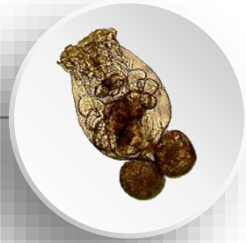


Docosahexaenoic Acid (DHA)

An essential fatty acid that accumulates in the brain of fish during early development where it increases neural functions

2

Eicosapentaenoic Acid (EPA)

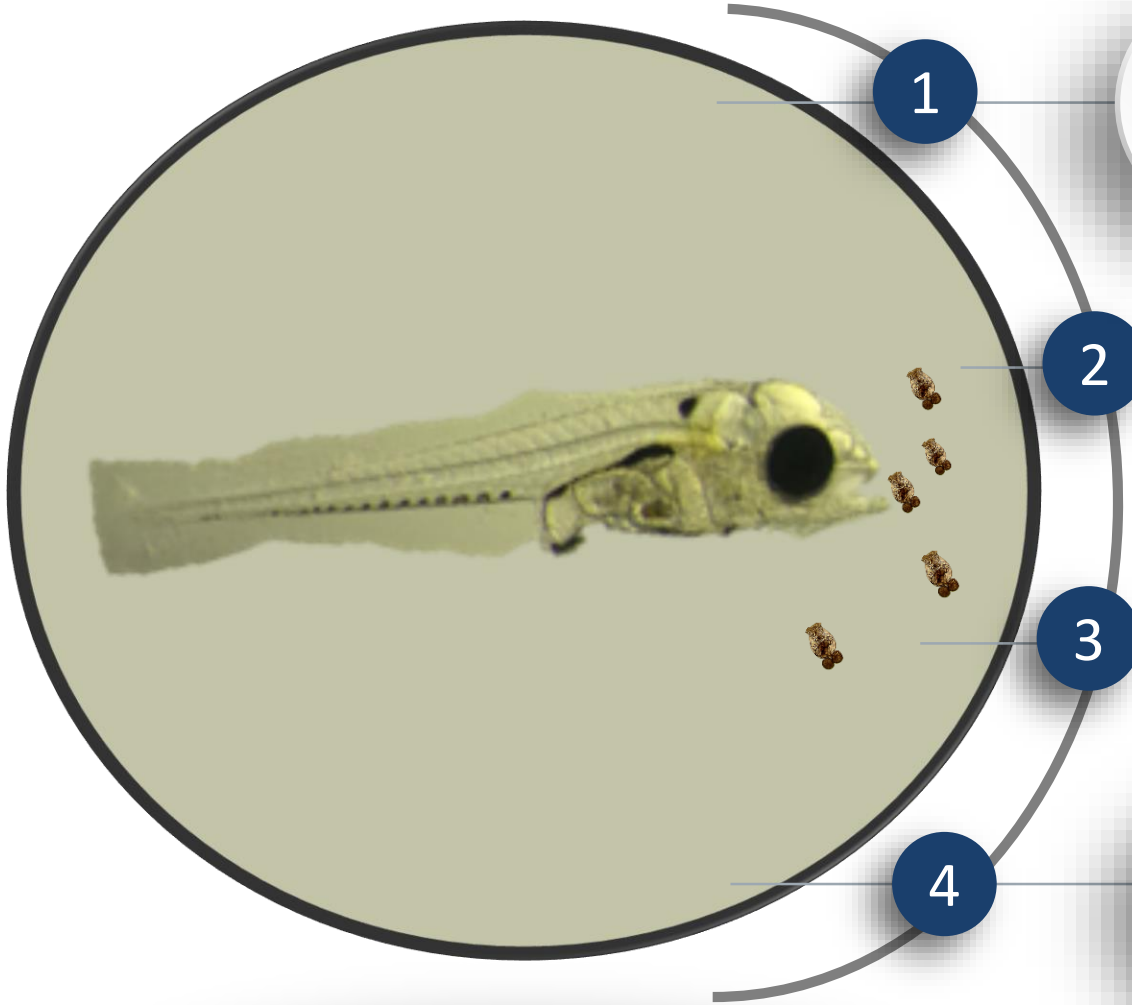
EPA is the primary mediator of cellular inflammation

3

Arachidonic Acid (AA)

AA being the preferred substrate and producing eicosanoids of higher biological activity

Producing Hygienic Rotifers



Bacteria: harmful types cause unexpected mortality to rotifers; detrimental effect on fish larvae.

Vibrio: pathogenic to fish when introduced to fish larvae tanks with cultured rotifers.

Fungal: reduce productivity of rotifer mass cultures and abnormal mortality .

Ciliates: may release growth-inhibiting substance into the water and retard fish growth.

03

Part Three

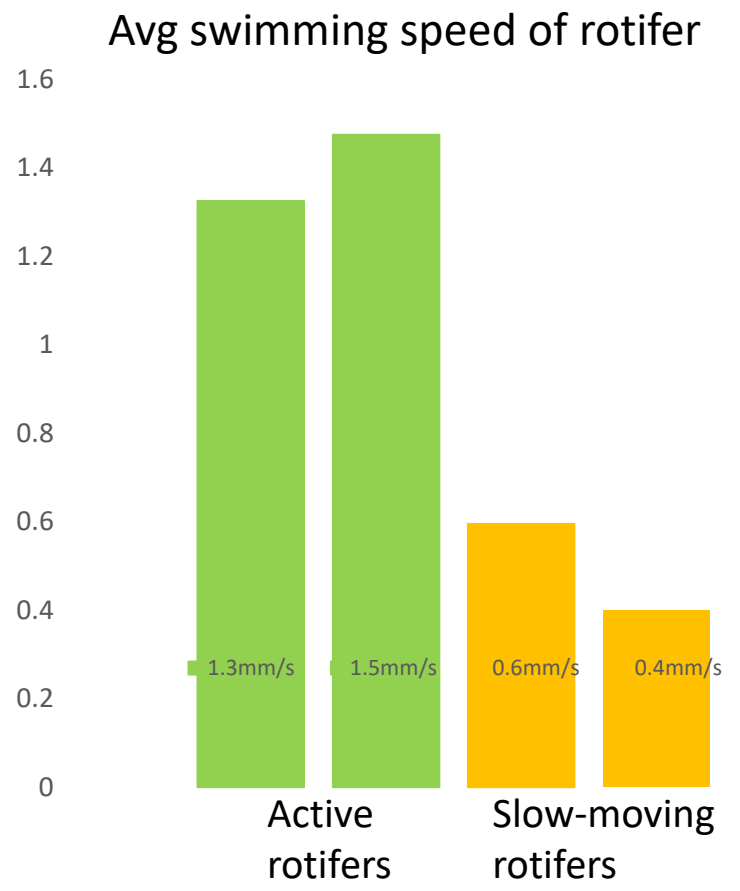
Analysis & Solutions

1. Treatment for Rotifers with Unstable Grow
2. Proper Enrichment of Rotifers
3. Good Management Protocol
4. Recirculating Rotifer Culture System
5. A.I. for Rotifer Counting

1 Treatment for Rotifers with Unstable Growth

Signs of unstable rotifer culture

	Healthy rotifer culture	Unhealthy rotifer culture
Egg carriers	High	Low
Movement	Active	Lethargic
Ciliates	None or few	A lot
Clumps	No	A large number
Gut content	Full	Empty



1 Treatment for Rotifers with Unstable Growth

Reasons for unstable rotifer:

- **Poor water quality**
- **Pathogenic bacteria infection**
- **Ciliates and copepod**
- **Over or under-feeding**

Ciliates video

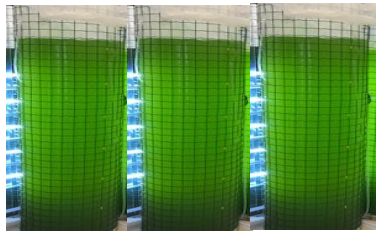
Uronema in rotifer

- Infected rotifers cause a detrimental effect on fish larvae

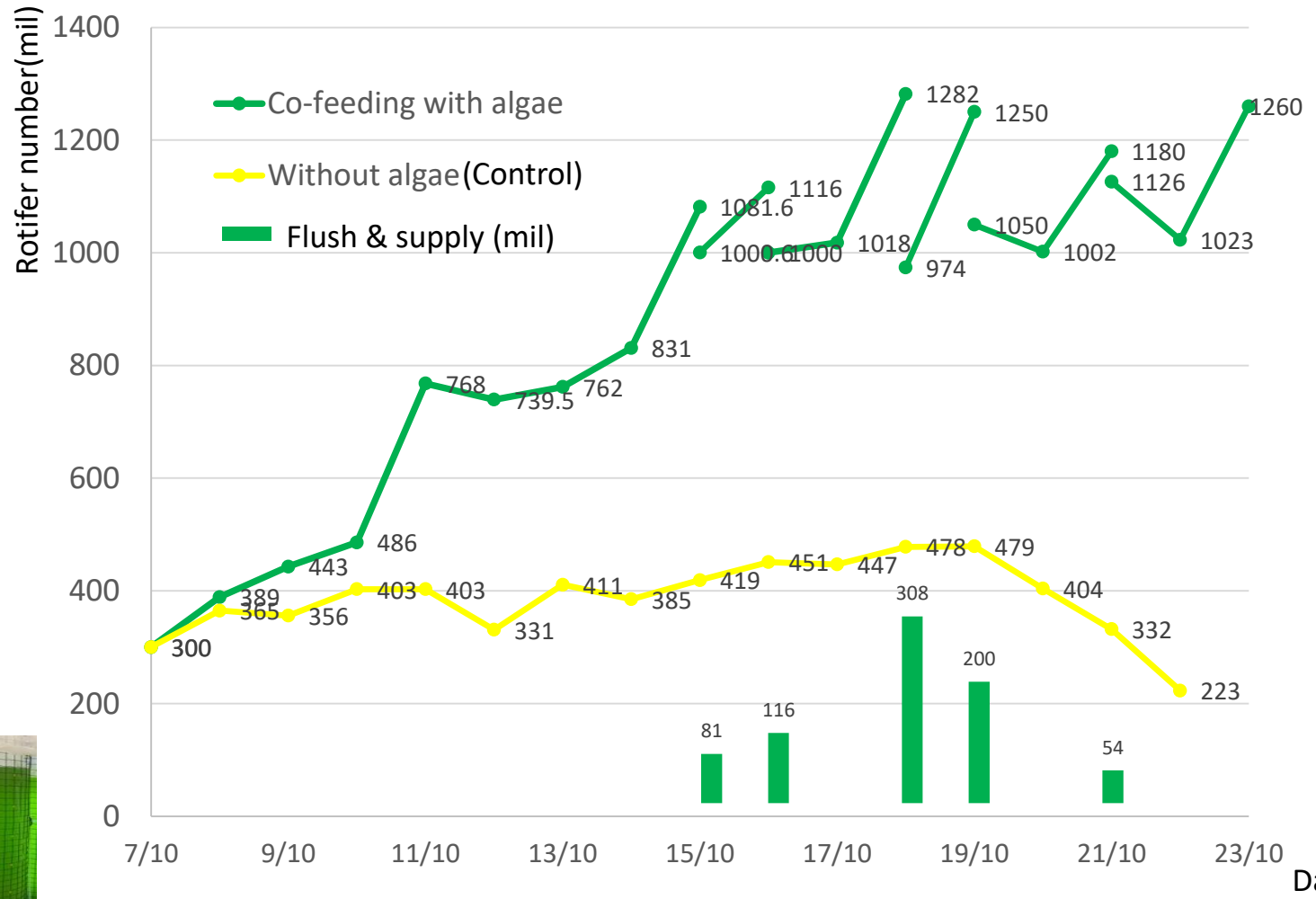
1 Solution: Live Microalgae Treatment

Unstable rotifer culture treated with live microalgae at MAC

- The unstable rotifer culture recovered and became stable
- Grew from 300mil to 1 billion within 8 days
- However, rotifers remained unstable in the control tank
- Microalgae has positive effect on the bacterial load in rotifer culture tank



Unstable rotifer → Stable rotifer

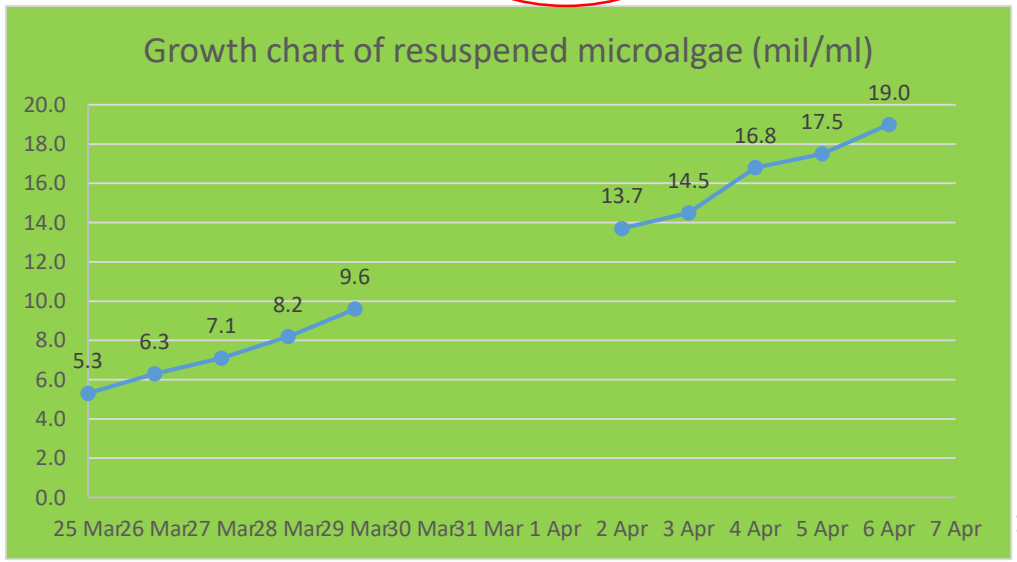


1 Concentrated Microalgae Instead of Live Microalgae

At Mac we concentrate live microalgae for ease of storage, transport and use

Benefits:

- Concentrated microalgae is alive compared to commercially-available freeze-dried microalgae
- Not harmful to fish larvae
- Easy to transport
- Can be stored for up to 6 months or more



2 Proper Enrichment of Rotifers

Enrichment includes:

- Short-term enrichment
- Long-term enrichment

Enrichment food:

- Microalgae
- Oil emulsions
- Formulated diets

Commercial enrichment products

Fresh Chlorella

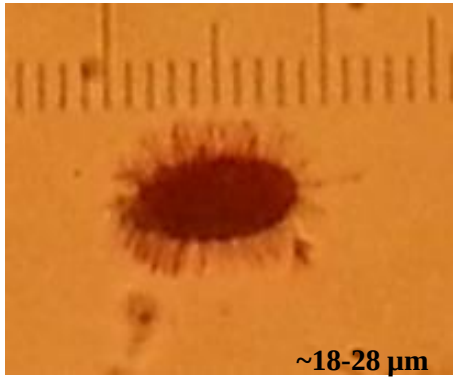
Instant microalgae

AlgaMac

Selco® S.parkle

3 Good Management Protocol

- Treatment of unstable rotifer culture
  - Immediate adding of live microalgae
- Prevention of disease
  - Treat water with filter and UV
  - Personal hygiene
  - Equipment and culture area disinfection

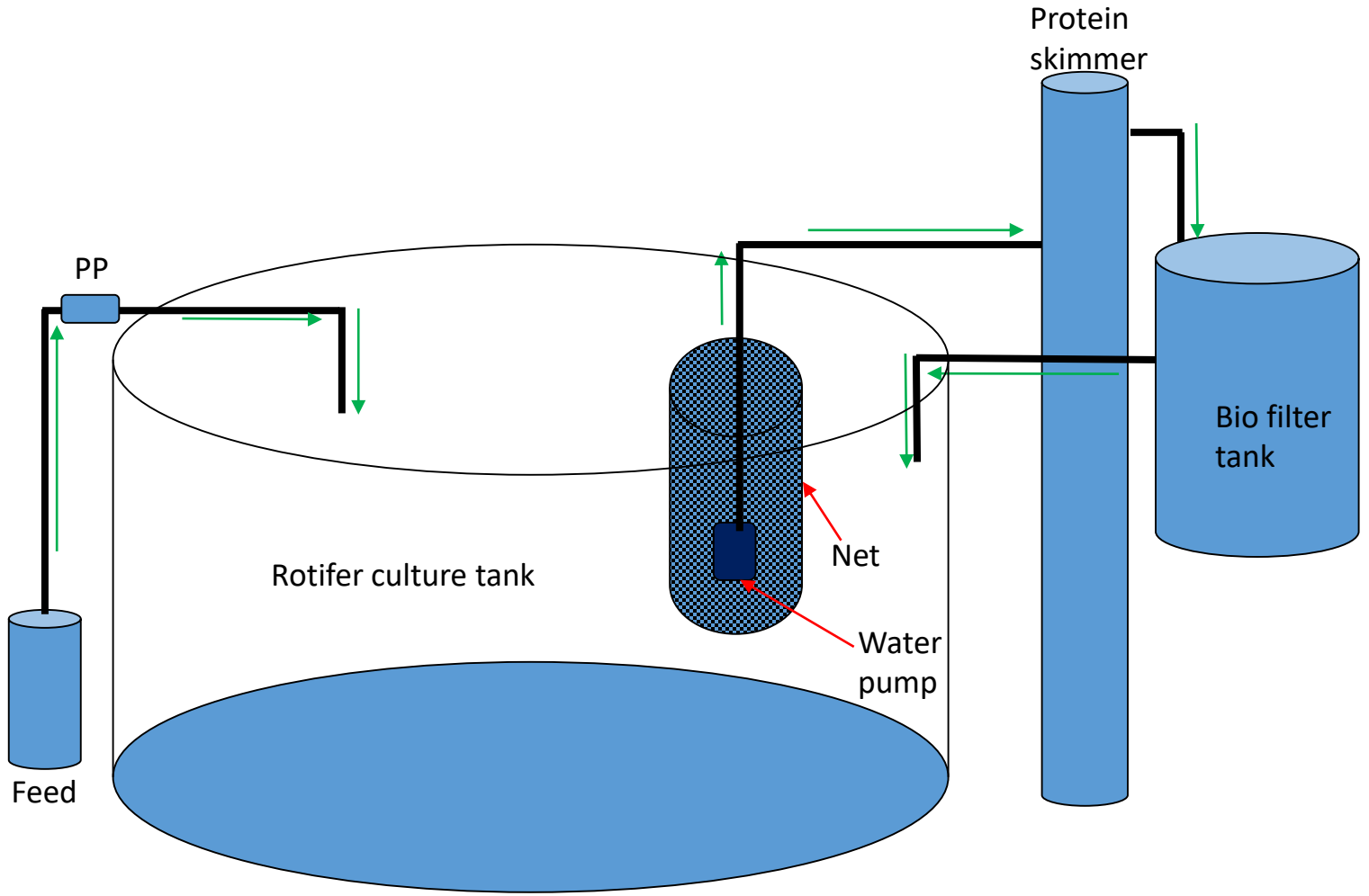


Uronema

Euplotes

4 Recirculating Rotifer Culture System

- 2.5m^3 culture tank
- 45μm net
- Protein skimmer
- Bio filter
- Peristaltic pump



4 Rotifer Net Clogging Issue

Issue:
Clogging

Solution:
Movable screen

Video of movable screen under water

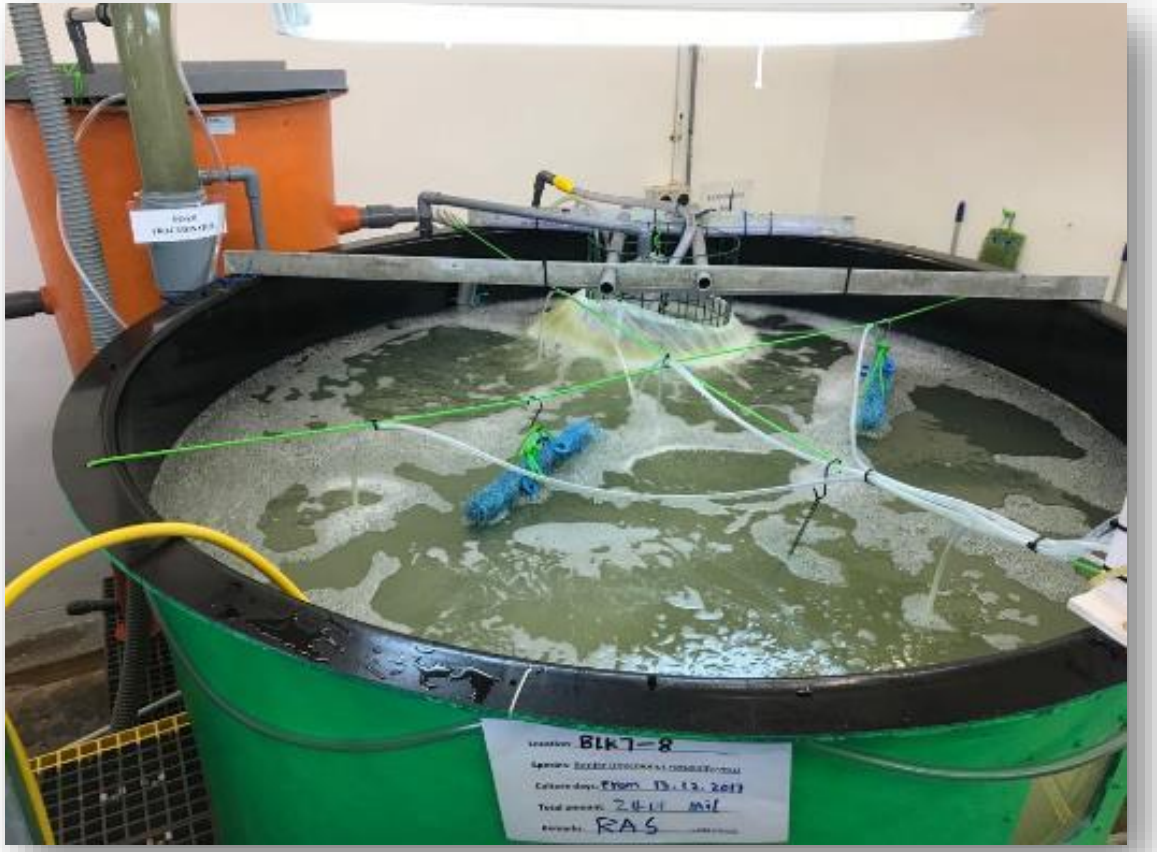
- Rotifer net is easily clogged by debris and foam.

- Strong aeration helped to clean the net, and eliminate the number of rotifers going though the net

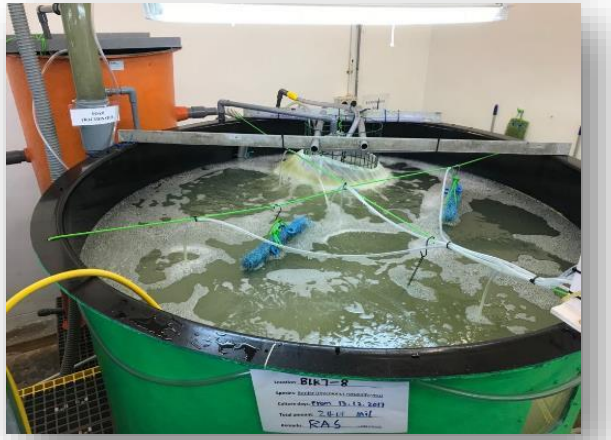
4 Recirculating Rotifer Culture System

Advantage:

- More hygienic
- Higher density
- Higher productivity
- Less manpower
- Stable



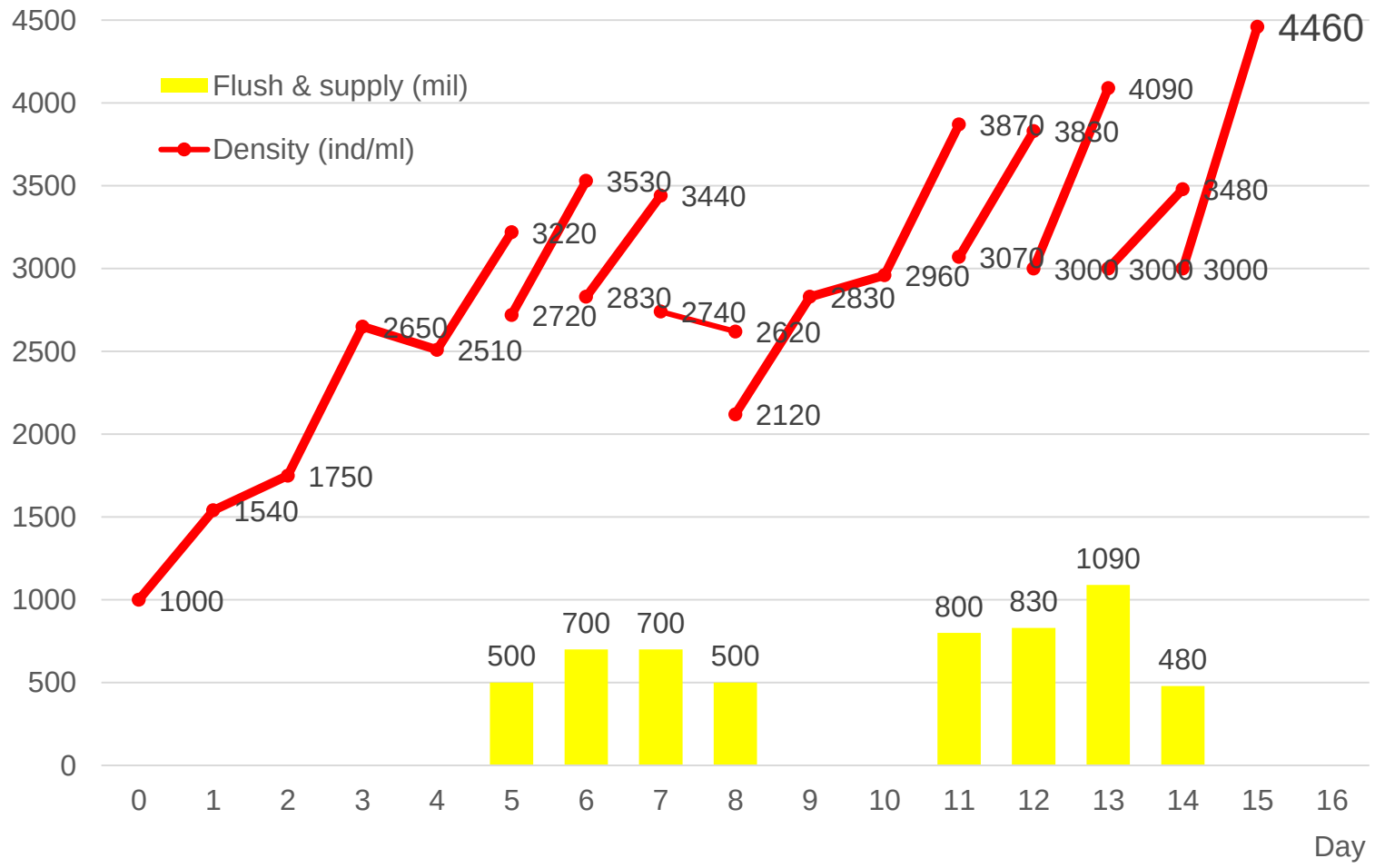
4 Comparison of Different Culture Systems



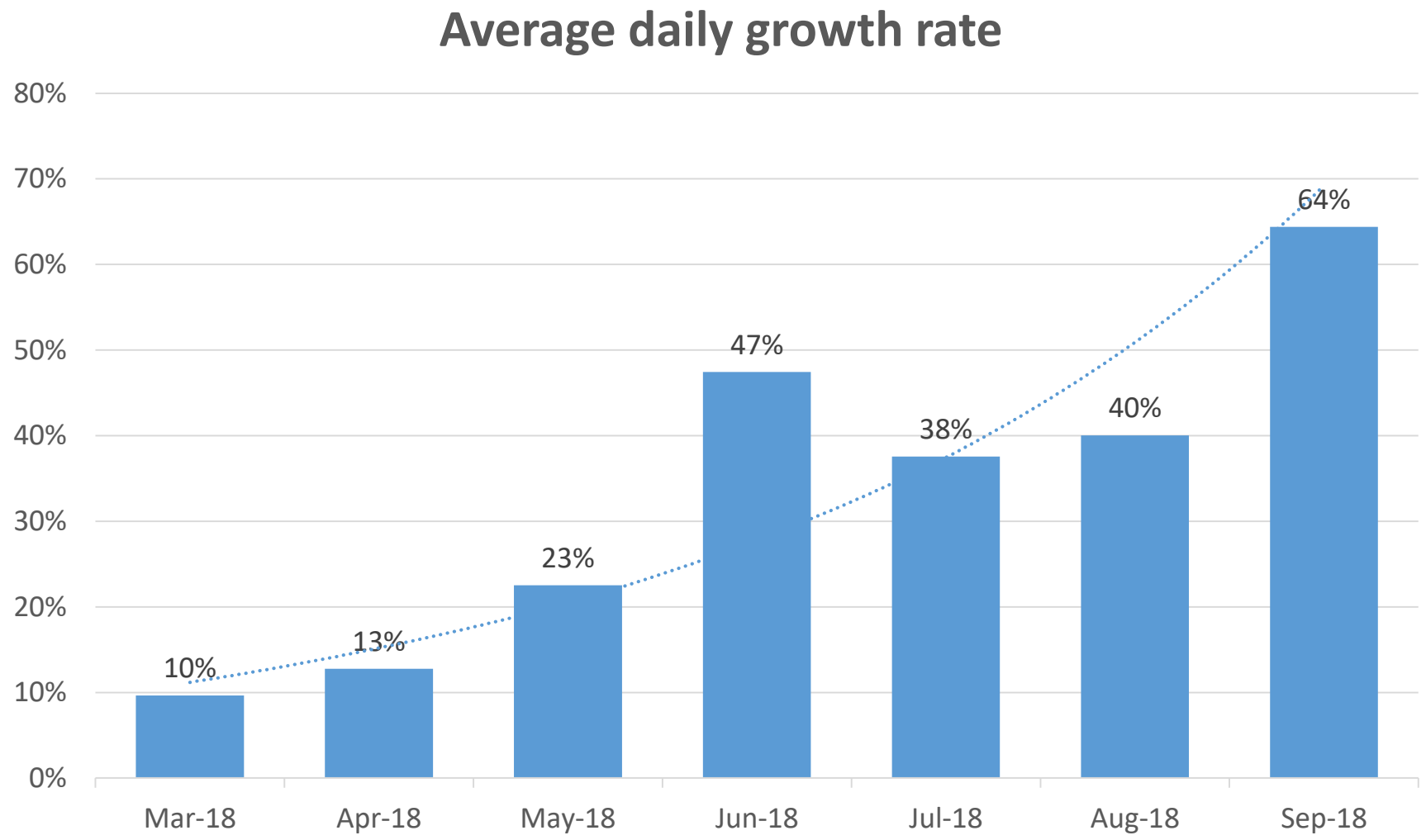
	Outdoor pond culture	Indoor batch culture	RAS continuous culture
Volume:	1200 m^3	2 m^3	2.5 m^3
Density:	20-50 ind/ml	200-500 ind/ml	800-1000 ind/ml
Productivity: (rotifer produced per m^3 per day)	10 mil	100 mil	200 mil
Manpower: (produce 100 million rotifer per day)	0.39 hr	0.87 hr	0.39 hr

4 High Density Rotifer in Recirculating Rotifer Culture System

- High density: 3000-4000 ind/ml
- Compact
- Stable
- Continuous supply
- High productivity



Improvement in Rotifer Growth Rate



Others: Protocols to Enhance Rotifer Growth Rates (On going)

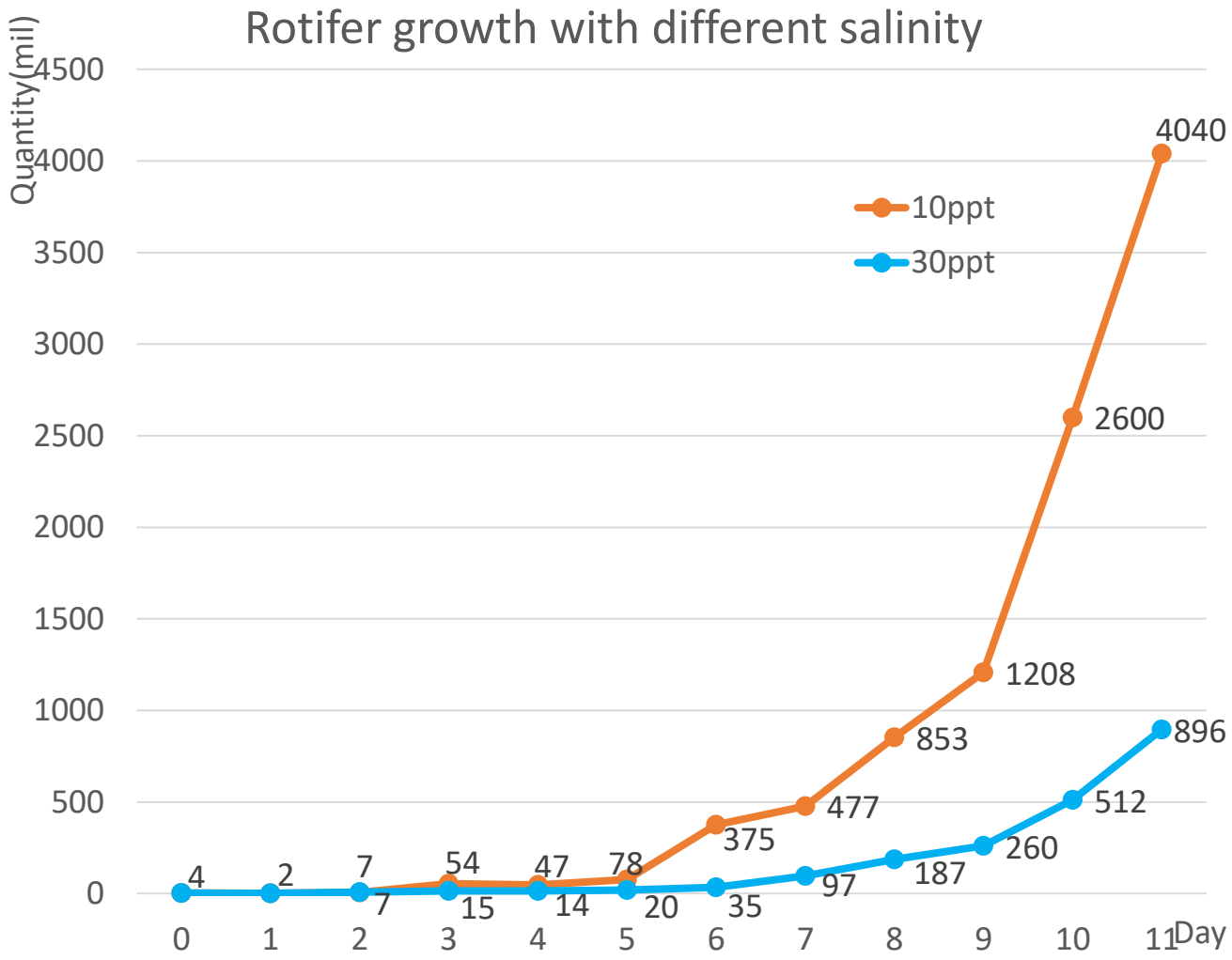
Preliminary observations:

- Rotifer grew 1000times from 4mil to 4bil within 11 days at 10ppt.
- Daily growth rate is 150%, which is higher than 30ppt.

Benefits:

- Save manpower
- Save cost
- Increase productivity
- Reduce preparation time

	10ppt	30ppt
Daily growth rate	150%	95%



5 A.I. for Rotifer Counting

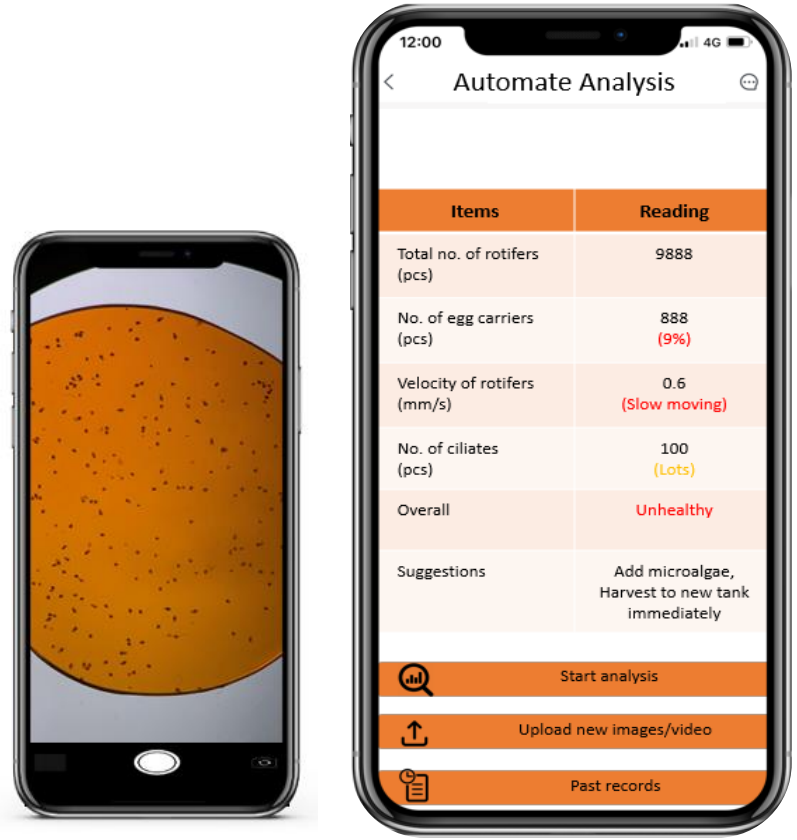
(Developed in collaboration with GovTech)

- A mobile app software which is able to assess and analyse rotifer culture health from photos taken of rotifer samples.

Advantage:

- Faster counting of rotifers
- Saves time and manpower

(QR code to software will be updated)



04

Part Four

Summary & Future study

- Summary
- Future Study

Summary

1. Produce rotifers intensively and consistently on a small footprint is important for Singapore hatcheries
2. Live microalgae treatment is one of the solutions to treat unstable rotifer culture
3. Recirculating Rotifer Culture improves productivity and can support large-scale hatchery production

Future Study

1. Protocols to enhance rotifer growth rates
2. Transfer of technology to local fish farm

Thank you!