

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

Marine Aquaculture Centre

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Background

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Key challenges of rotifer culture in Singapore

3

Analysis & Solutions

Unstable rotifer treatment

Quality rotifer diet

Good management protocol

Recirculating Rotifer Culture System

A.I. for rotifer counting

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Summary

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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

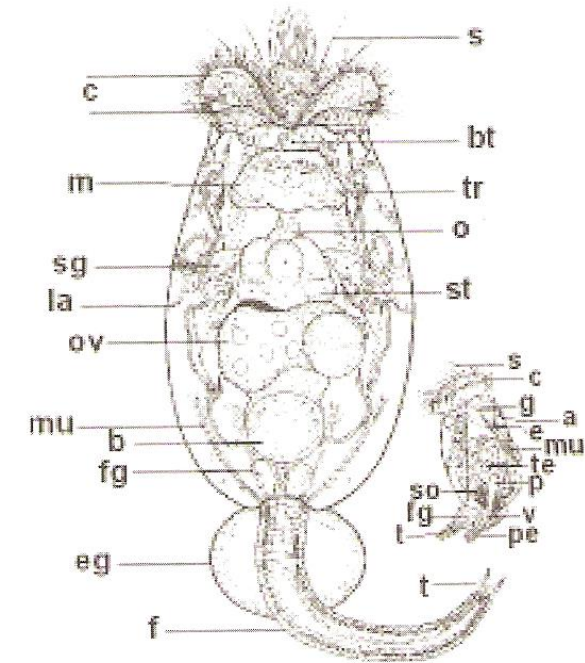


Fig. 2.2 Morphology and inner organisation of a *Brachionus* sp. female (left) and male (right). a, dorsal antenna; b, bladder; bt, buccal tube; c, corona; e, eye; eg, egg; f, foot; fg, foot gland; g, central ganglion; la, lateral antenna; m, mastax; mu, muscle; o, oesophagus; ov, ovary; p, prostate; 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

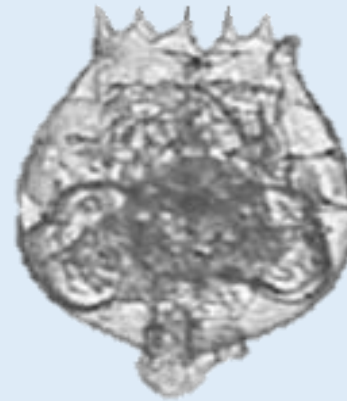


***B. plicatilis* (L)**

171-238μm

Low-temperatures
20-25°C

Euryhaline



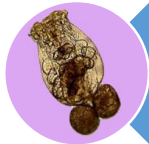
***B. rotundiformis* (S)**

121-162μm

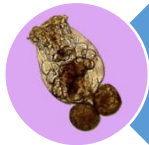
High-temperatures
28-35°C

Low-salinities

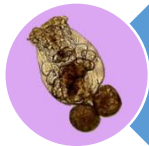
● Rotifer Life Cycle



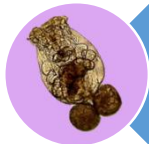
Asexual and Sexual



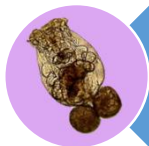
Nearly all the rotifers seen in nature are females



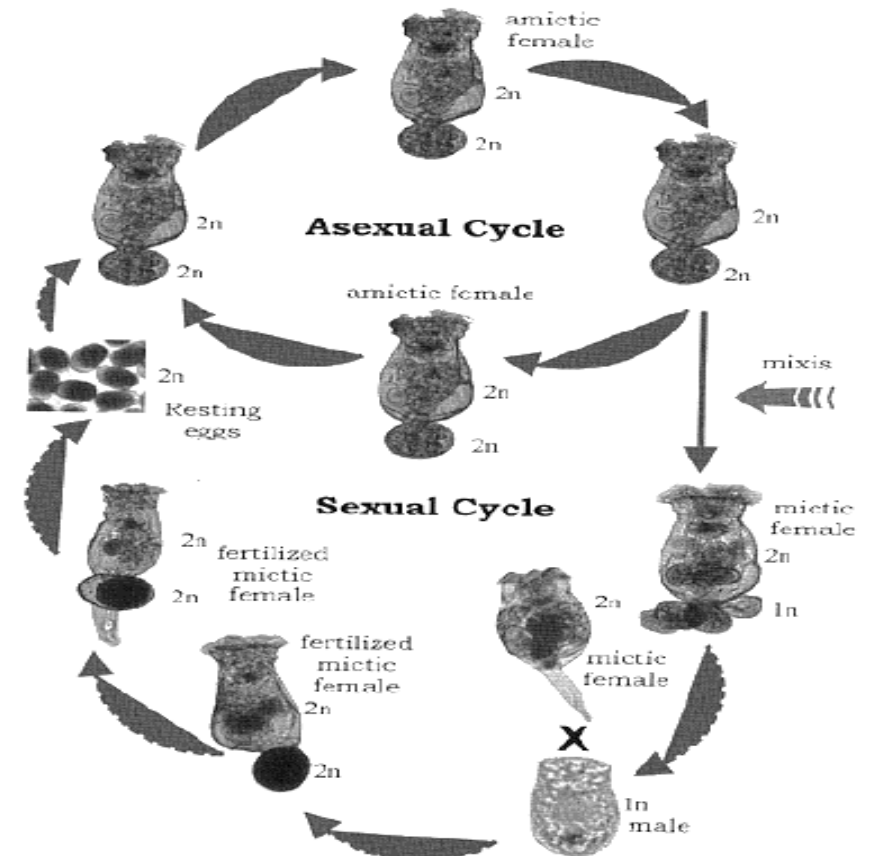
Males occur only for short periods



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°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 m²



Pond size: 120 m²



Pond size: 1200 m²

Density:
20-50 ind/ml

Productivity:
10 mil rotifer produced
per m³ 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 m³



Tank size: 2.5 m³



Tank size: 8 m³

Density:
200-500 ind/ml

Productivity:
100mil rotifer produced
per m³ per day

Manpower:
0.87 hr to produce
100 mil rotifer per day

Tanks needed:
5-8

02

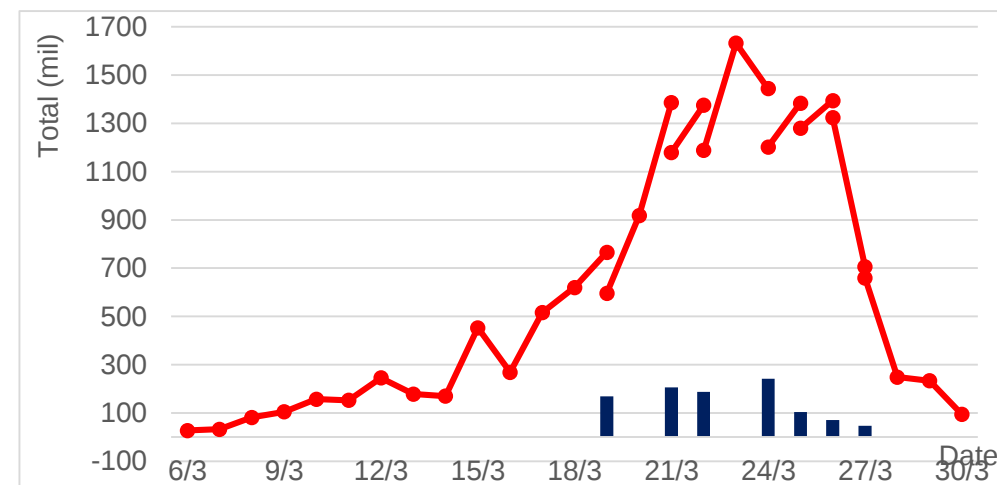
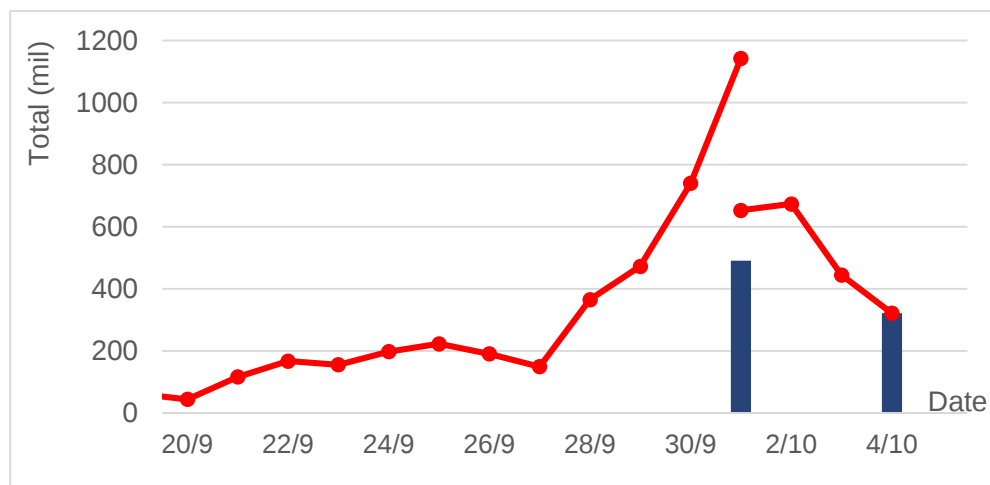
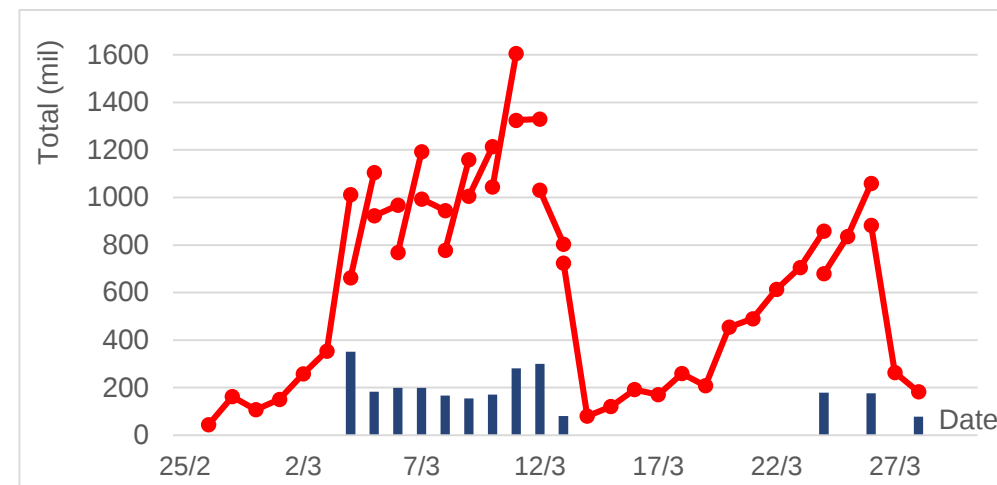
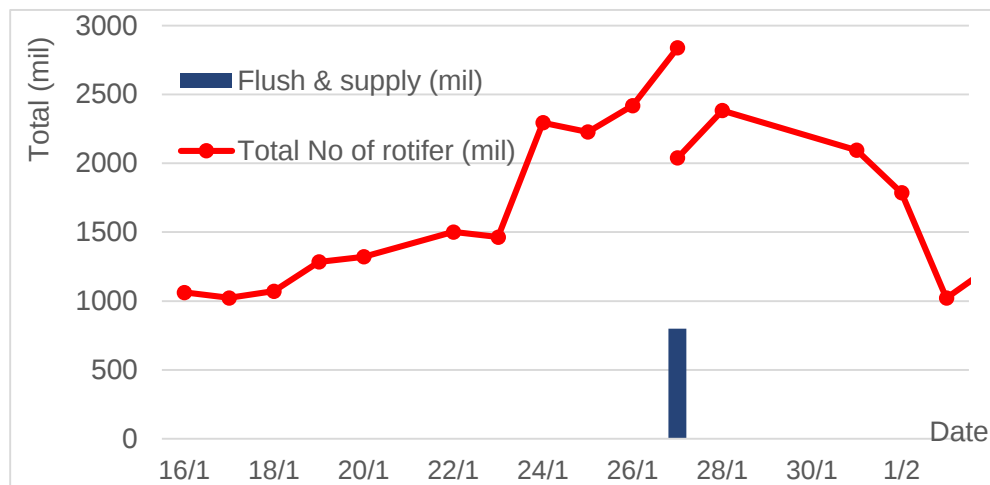


Part Two

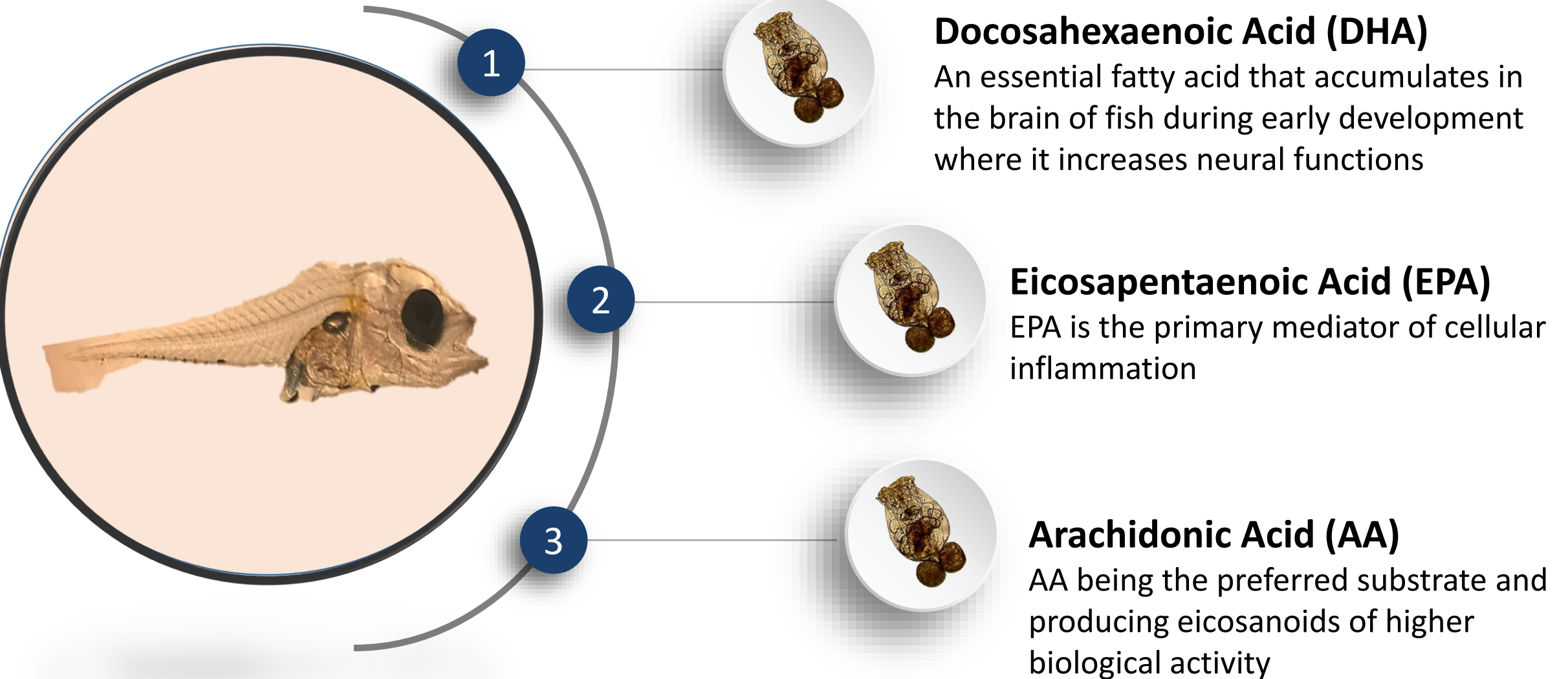
Key Challenges of Rotifer Culture in Singapore

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

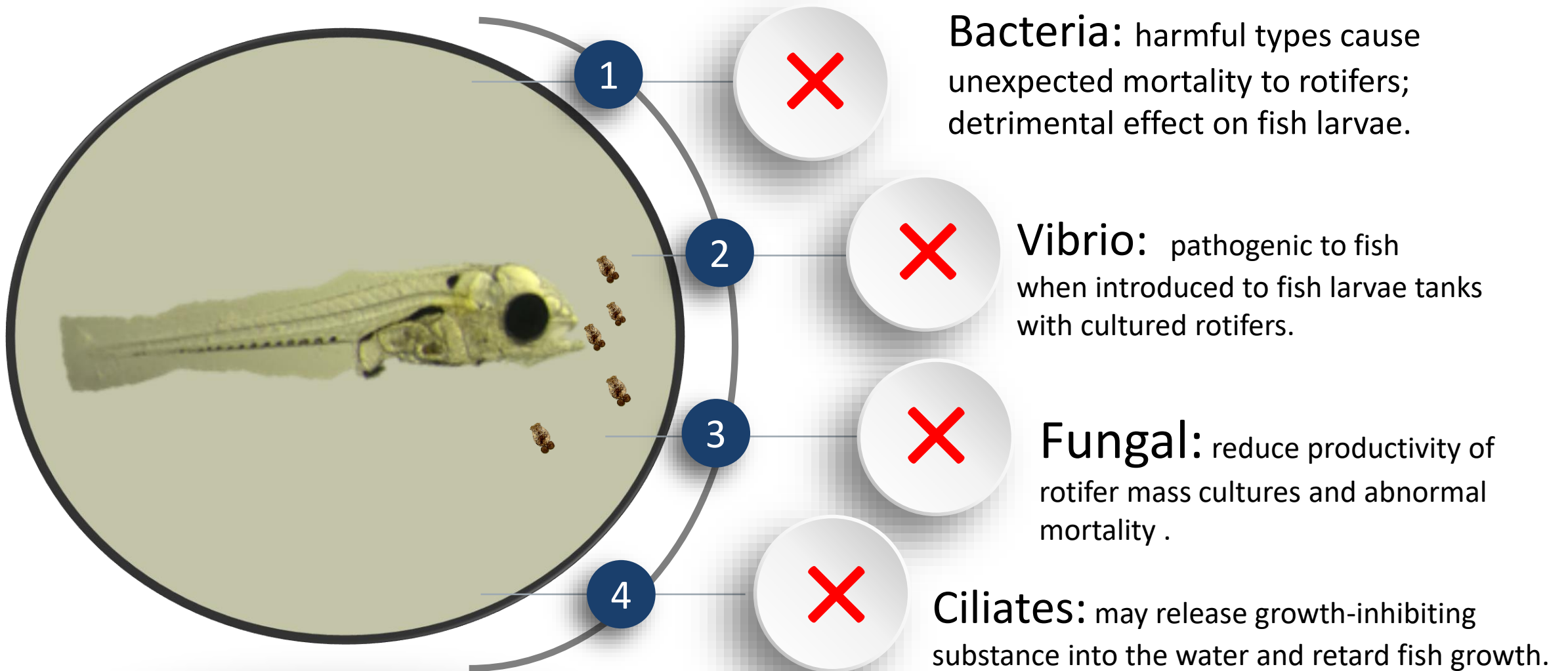
● Maintain Rotifer Culture Stability



● Producing Rotifers with Good Nutrition



● Producing Hygienic Rotifers



03



Part Three

Analysis & Solutions

1

Treatment for Rotifers with Unstable Growth

2

Proper Enrichment of Rotifers

3

Good Management Protocol

4

Recirculating Rotifer Culture System

5

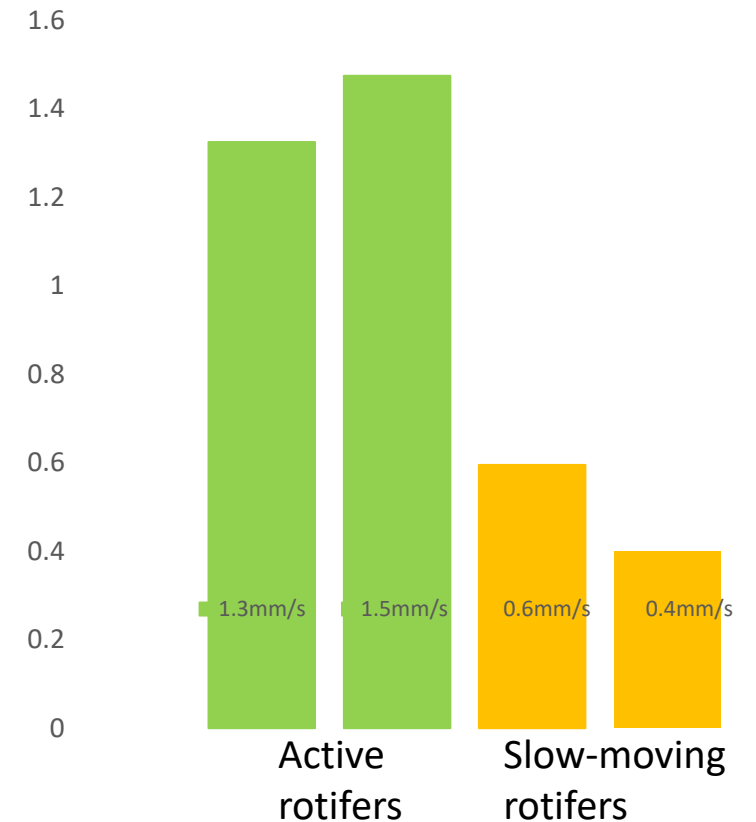
A.I. for Rotifer Counting

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

Avg swimming speed of rotifer



1

Treatment for Rotifers with Unstable Growth

Reasons for unstable rotifer:

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

Uronema
in rotifer

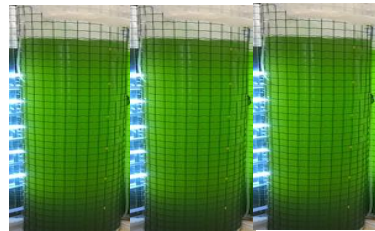
[Ciliates video](#)

- Infected rotifers cause a detrimental effect on fish larvae

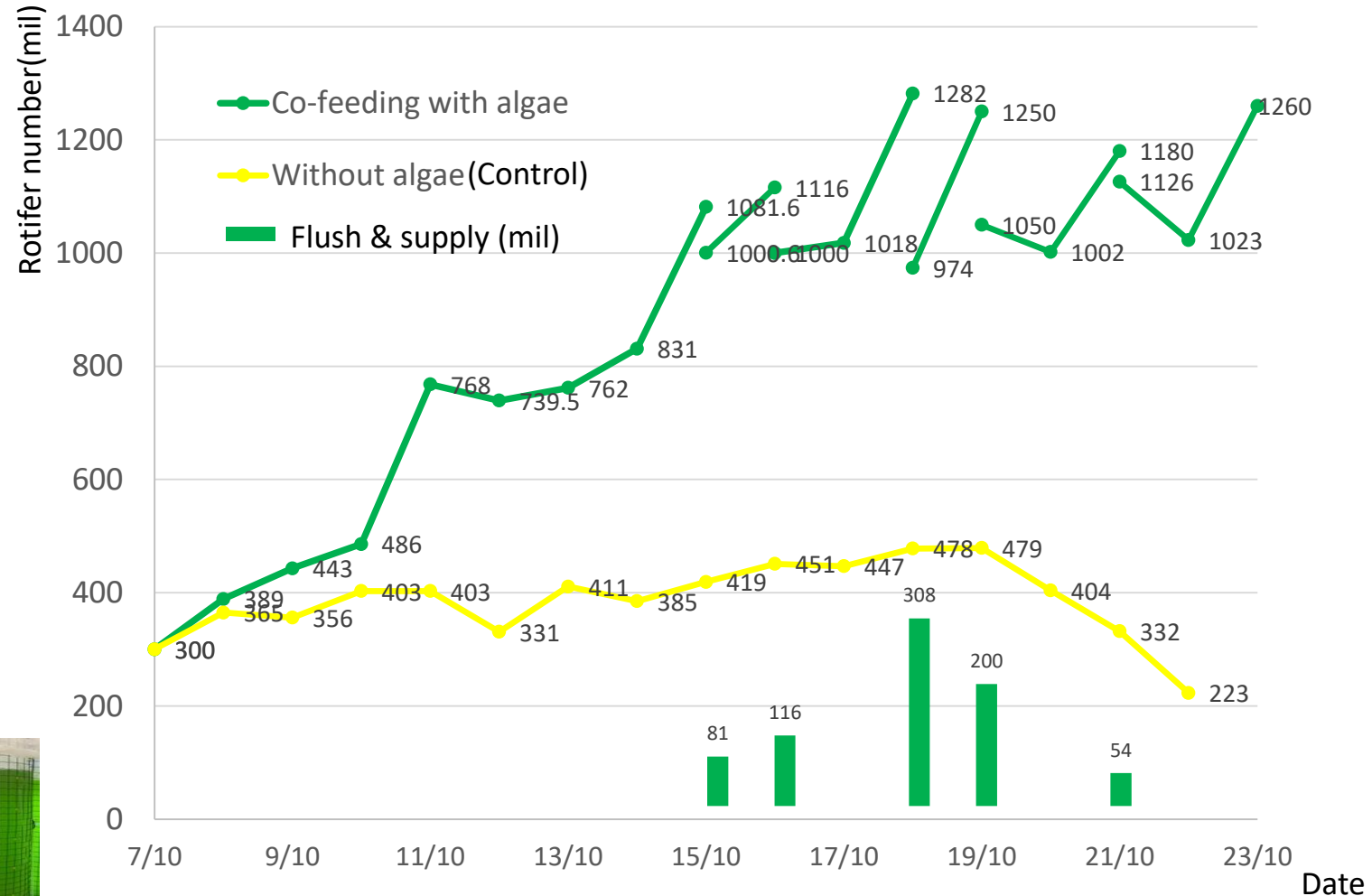
1 Solution: Live Microalgae Treatment

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



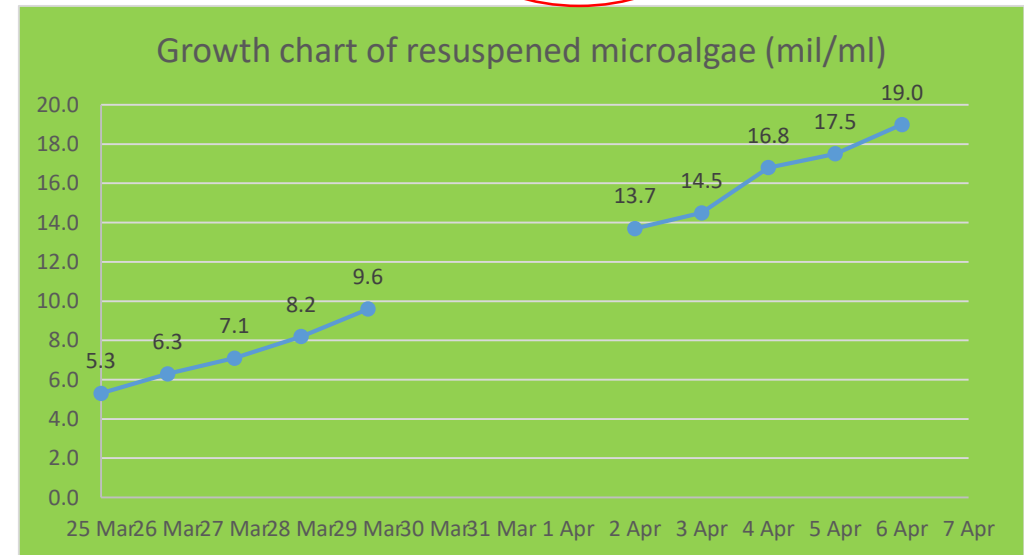
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Concentrated Microalgae Instead of Live Microalgae

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

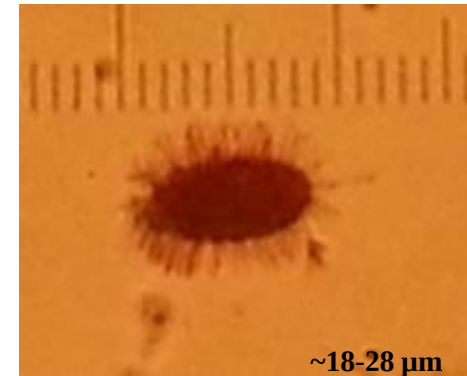


Selco® S.parkle

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



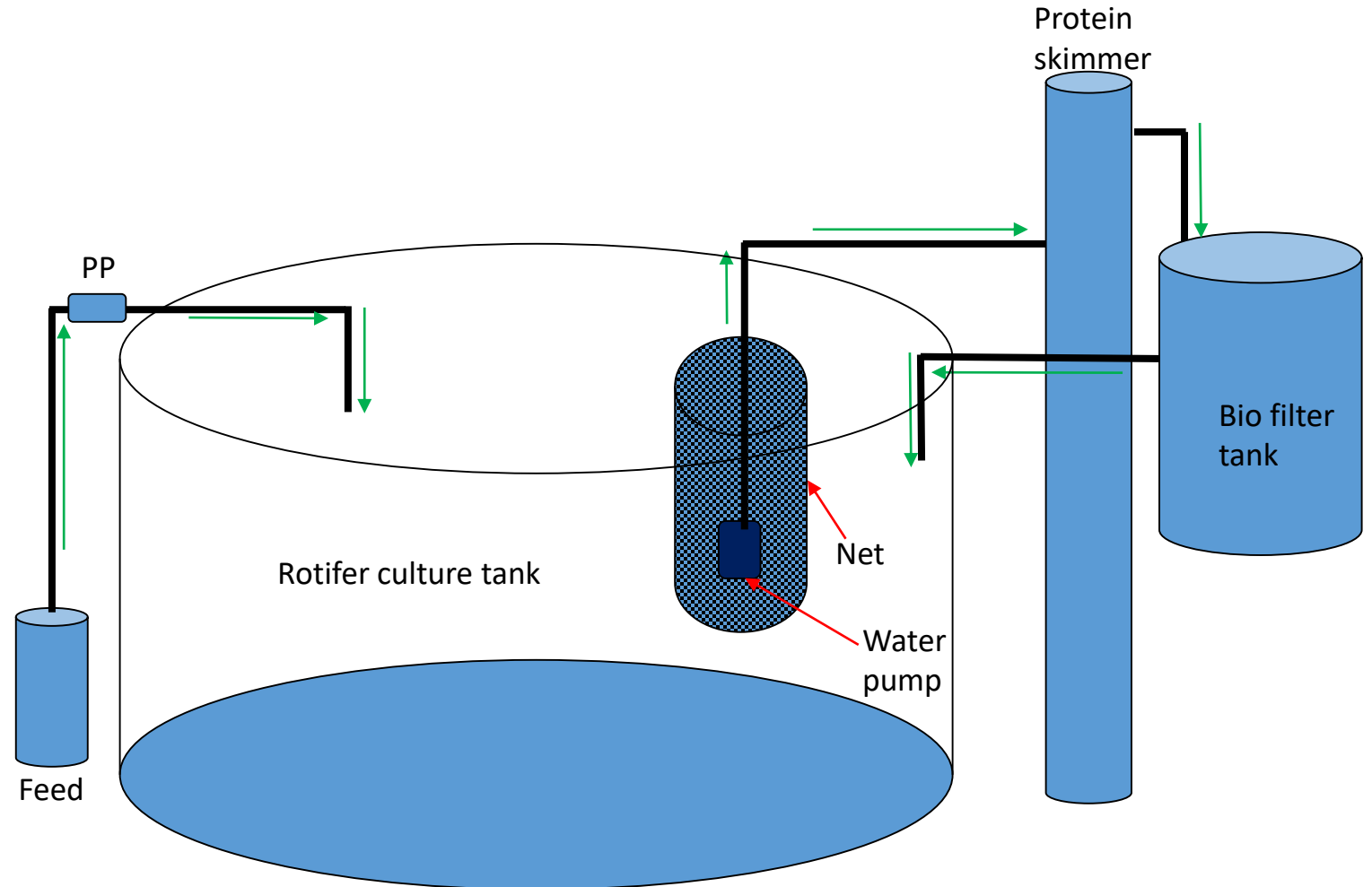
Uronema



Euplotes

4 Recirculating Rotifer Culture System

- 2.5m³ culture tank
- 45μm net
- Protein skimmer
- Bio filter
- Peristaltic pump



4 Rotifer Net Clogging Issue

Issue:
Clogging

- Rotifer net is easily clogged by debris and foam.

Solution:
Movable screen

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



[Video of
movable screen
under water](#)

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



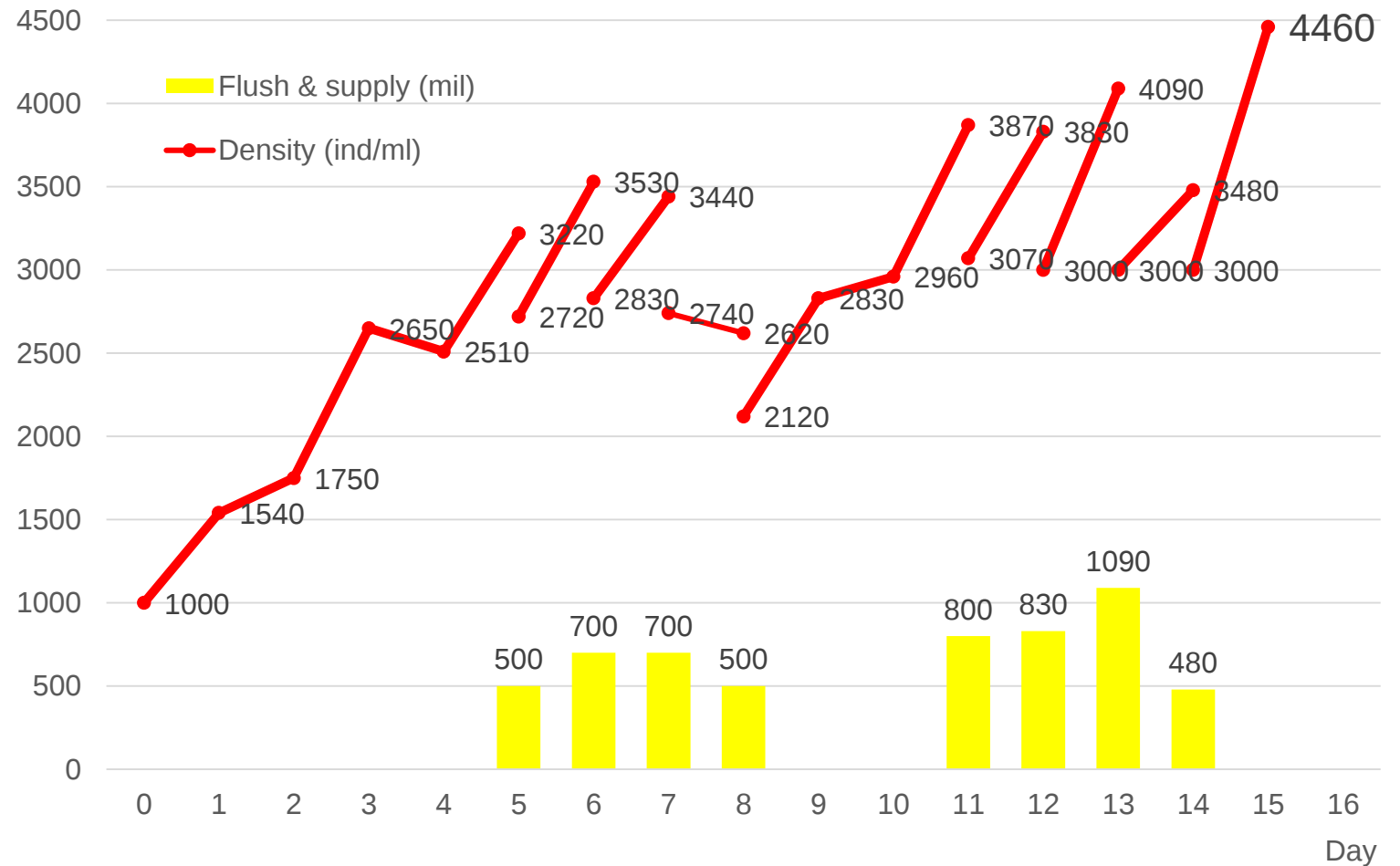
RAS continuous culture

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

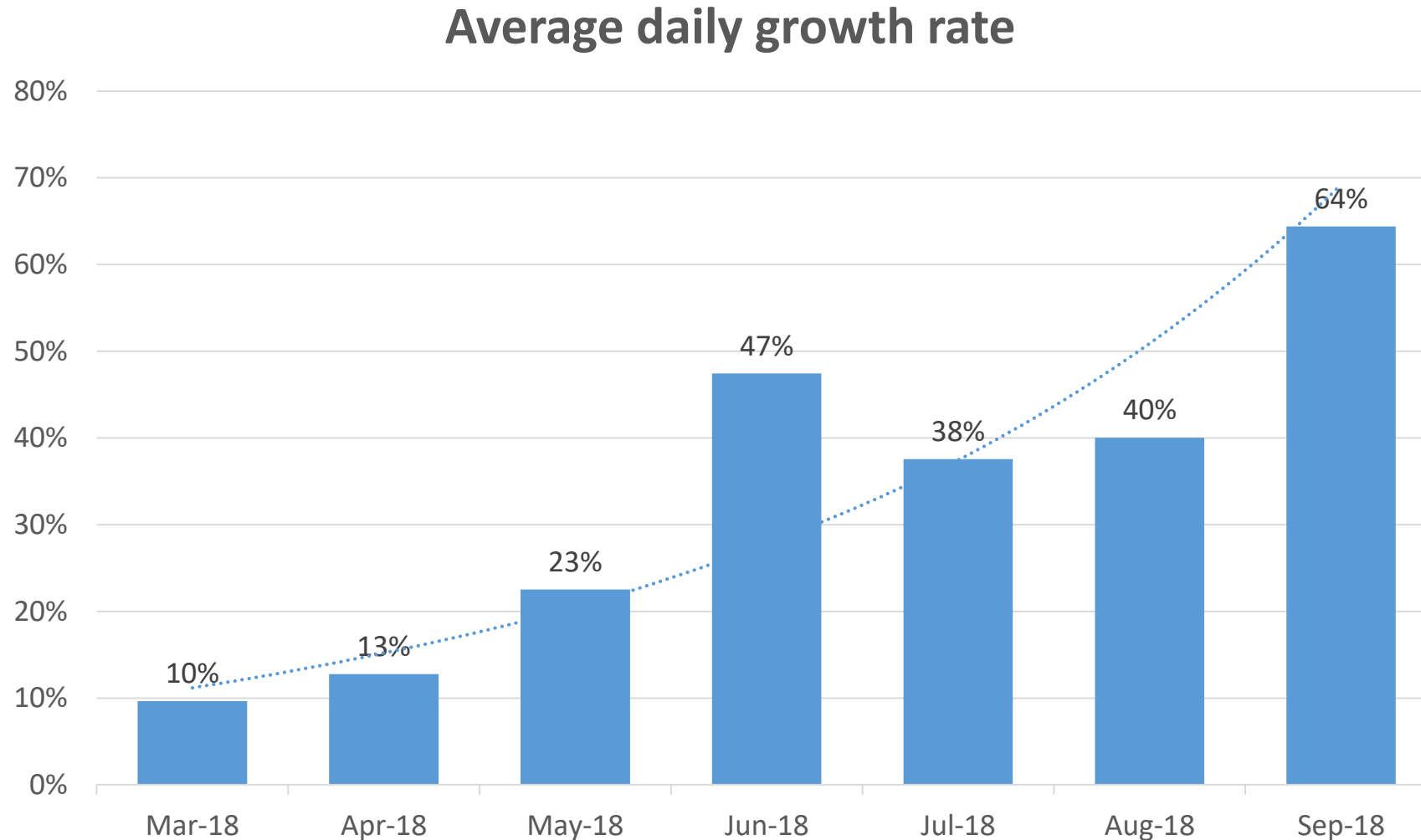
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High Density Rotifer in Recirculating Rotifer Culture System

- 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)

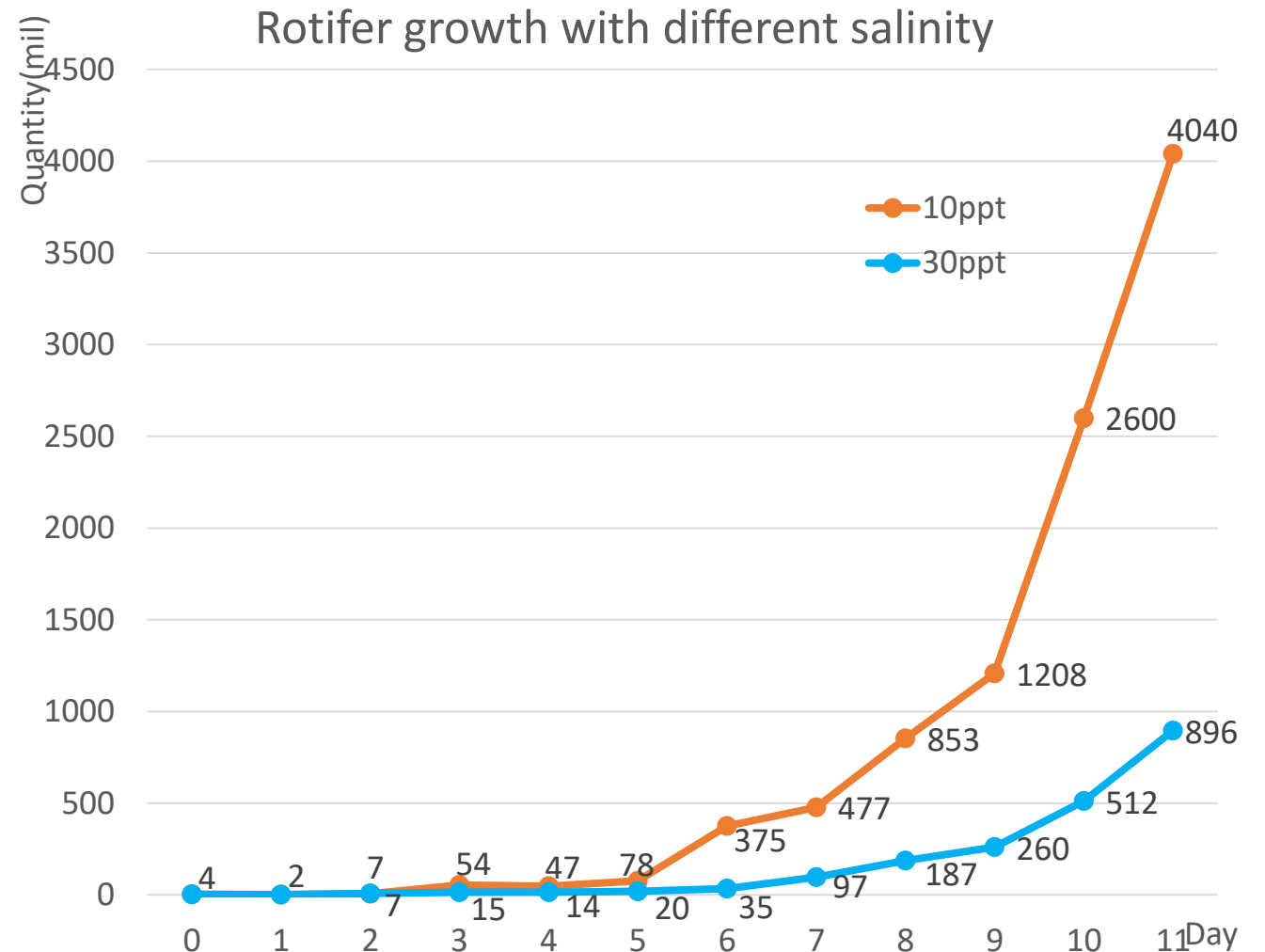
Preliminary observations:

- 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

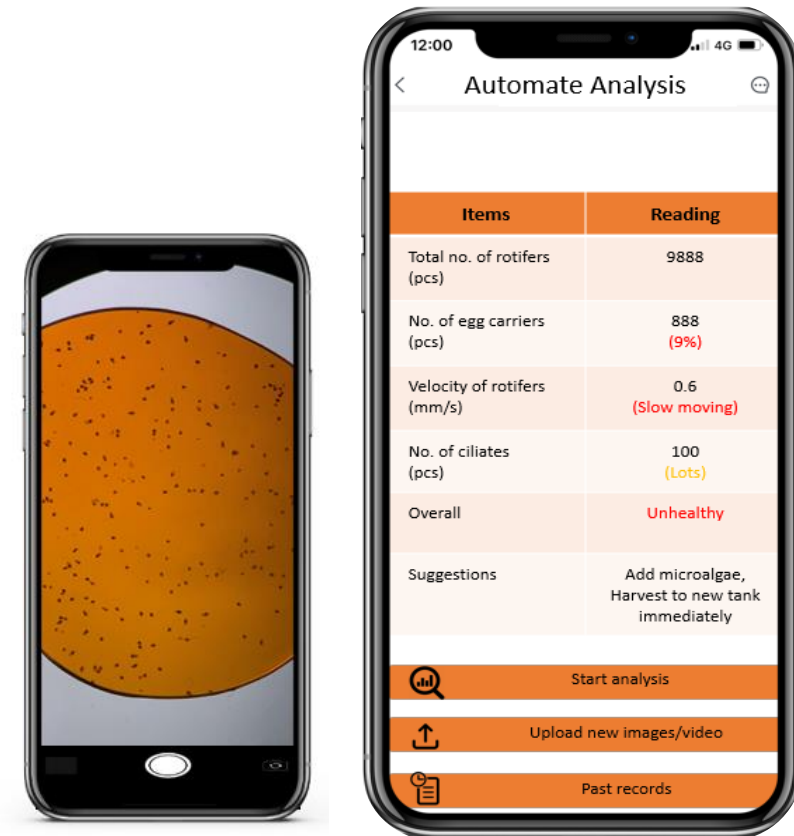
(Developed in collaboration with GovTech)

- ❖ 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!