
Starter Feeds – size and quality
& live food substitution

PHYSICAL AND BIOLOGICAL CRITERIA

- **Tank design : Shape/Volume …**

* **Tank Hydrology : SWIMBLADDER/FEEDING SYSTEM …**

* **Water Management**

* **AERATION SYSTEM AND STRATEGY**

* **INSTALLATION OF JET SURFACE CLEANERS**

* **USE OF AUTOMATIC FEEDERS : ARTEMIA / ARTIFICIAL DIETS**

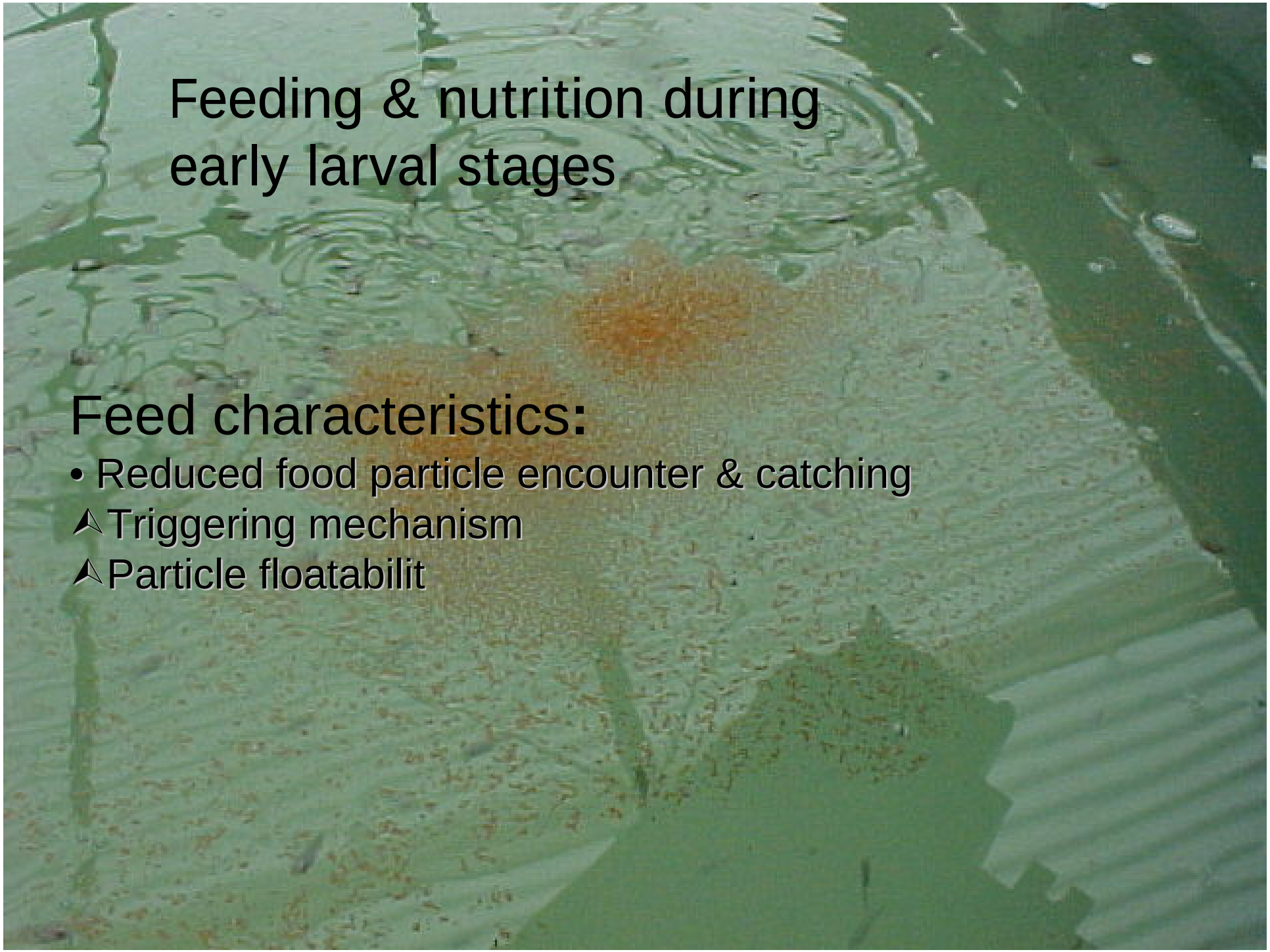
* **INSTALLATION OF BOTTOM SIPHONING DEVICES**

* **LIGHT SYSTEM AND STRATEGY**

FEEDING - WEANING STRATEGY,
-REGIME,
-FREQUENCY

Feed technologies

- Extrusion technologies
- Species specific requirements
- Legislative restriction of ingredients, labeling and traceability
- Bio-availability of macro and micro components
- Natural solutions promoting health and performance
- Environmental impact concerns (Nitrogen, Phosphorous etc.)



Feeding & nutrition during early larval stages

Feed characteristics:

- Reduced food particle encounter & catching
  - Triggering mechanism
  - Particle floatabilit

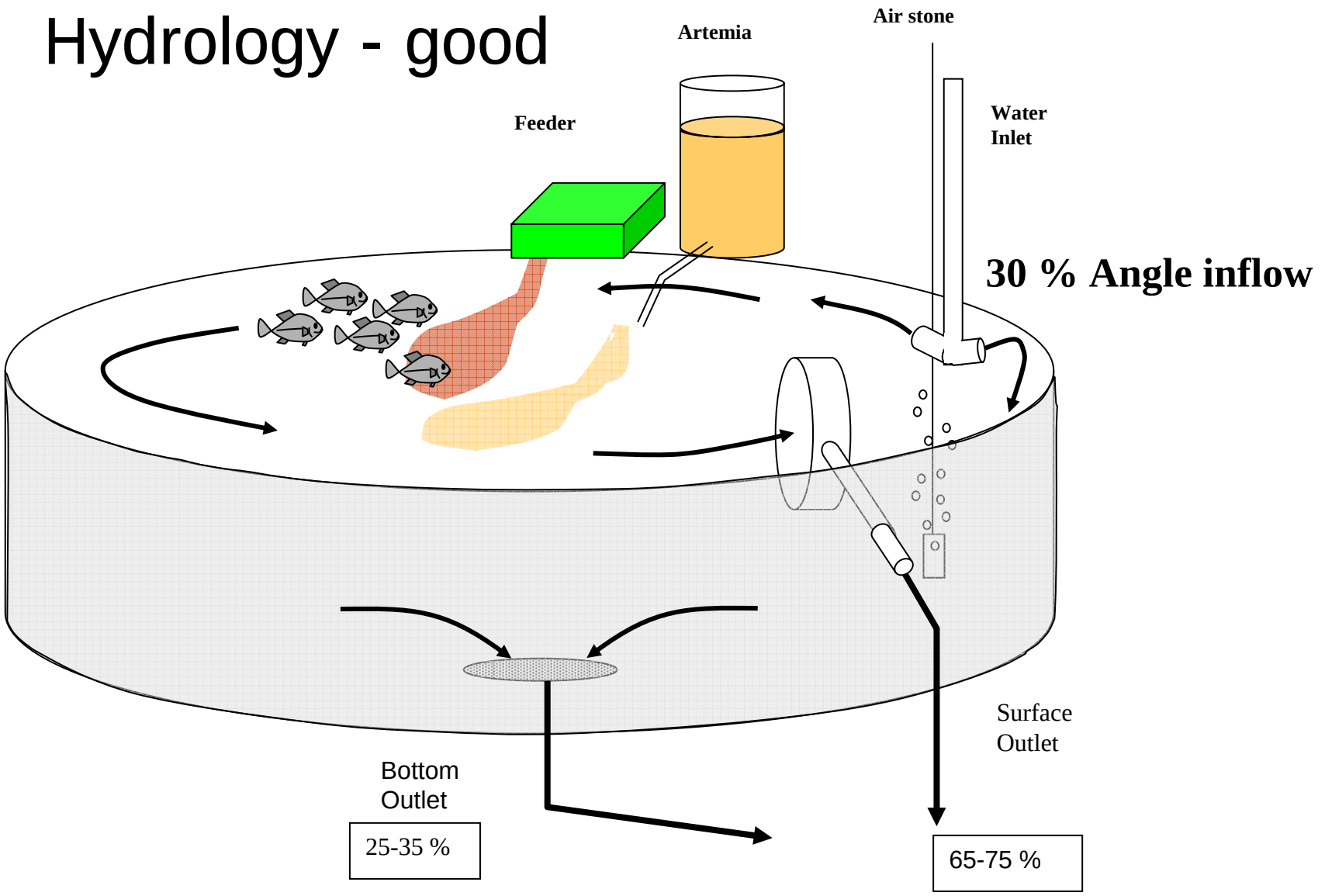
Early weaning

1. Essential **co-feeding**
2. **High quality diet**
3. Management strategy

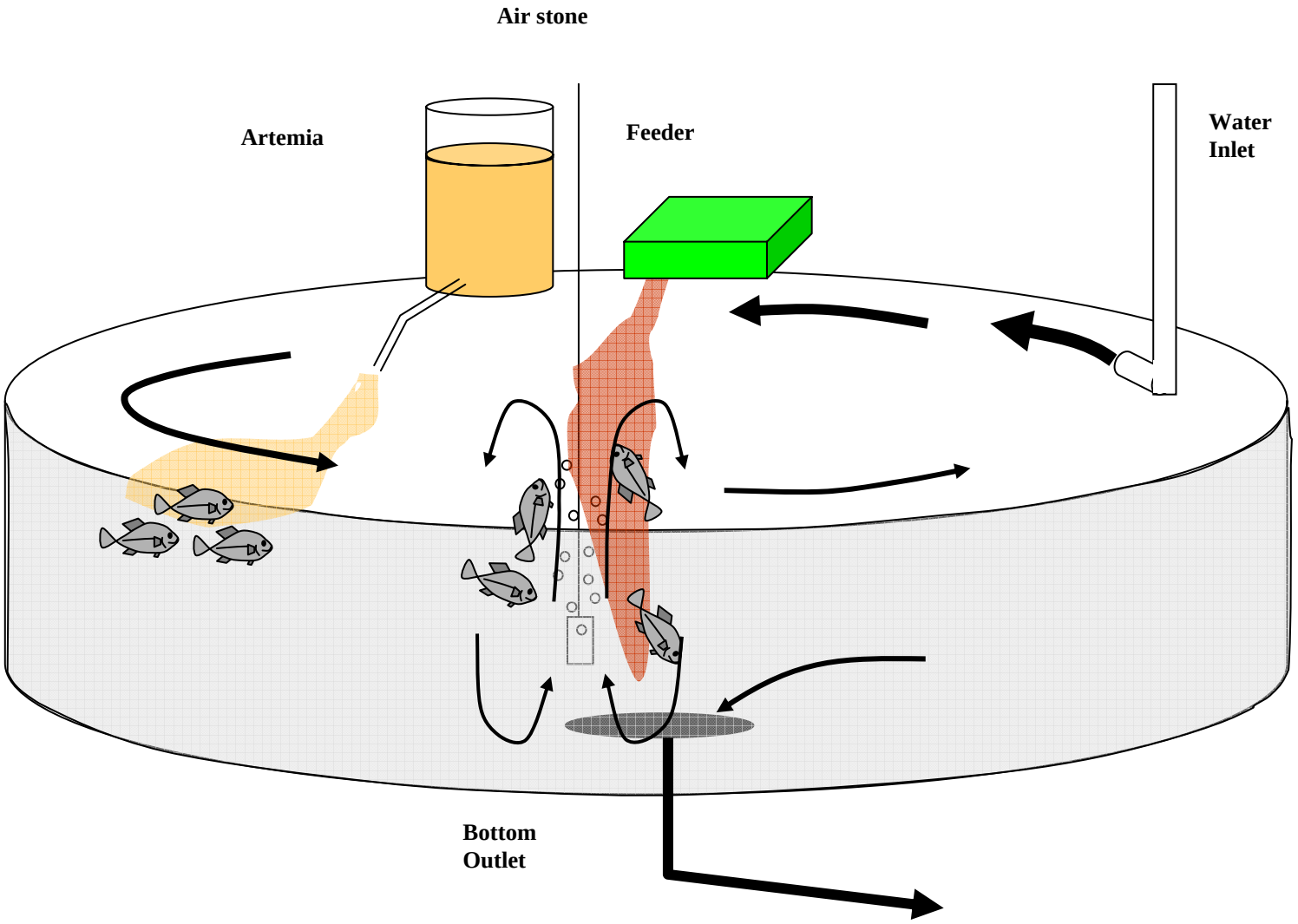
Weaning

1. Division of the tank into Zones
2. Good water exchange
3. Tactical feed distribution

Hydrology - good



Hydrology - Bad

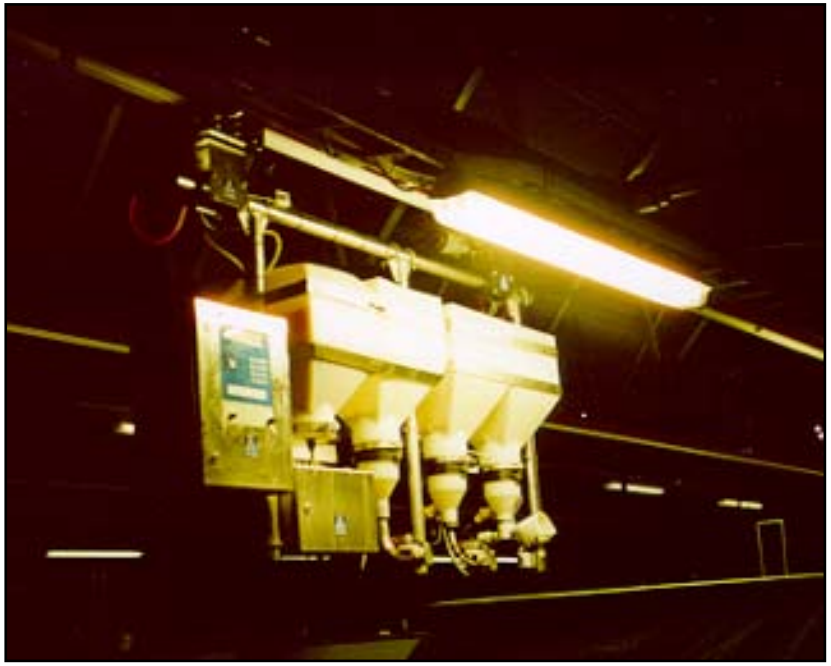


Feeders

Automatic & Semi-automatic Feeding systems

Live food feeding

Pond and tank feeding

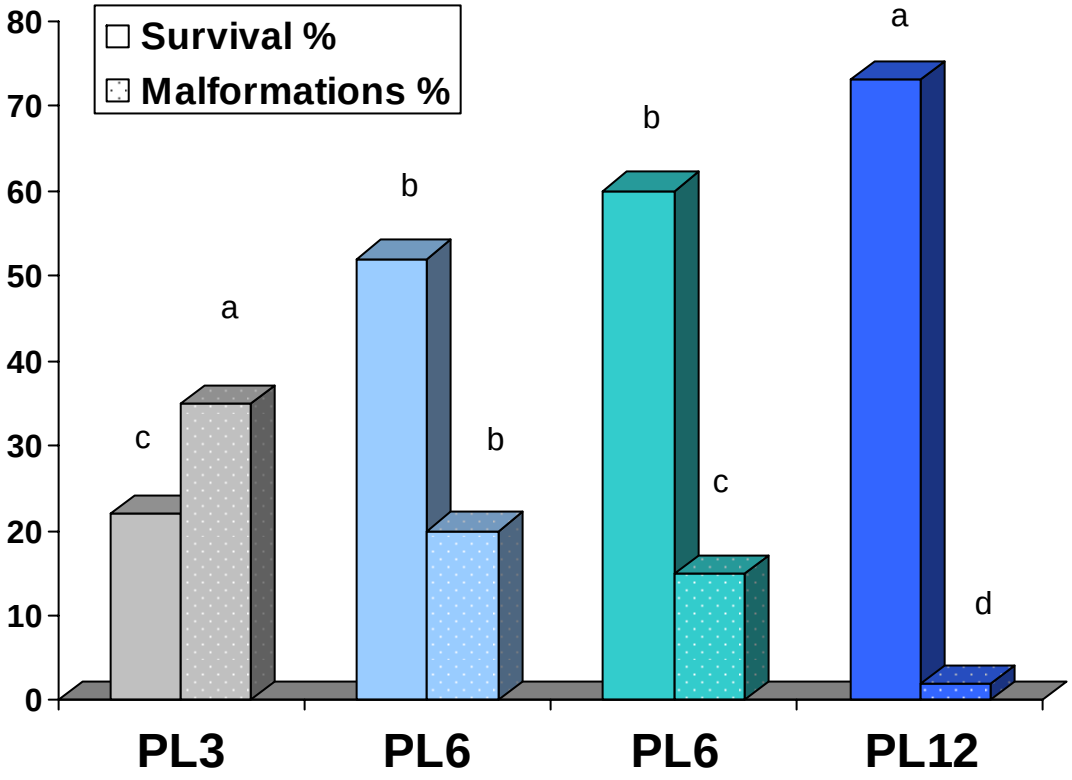


Early weaning, co-feeding diets vs live food

LIVE FOOD		DRY FEED
Naturally perfectly buoyant	⟷	Mostly sinking
Naturally perfectly encapsulated	⟷	Very fast leaching
Contains large fractions of soluble protein, small peptides: digestibility	⟷	Insoluble protein
Nutritionally imbalanced	⟷	Nutritionally well balanced
Not always right size	⟷	All sizes possible

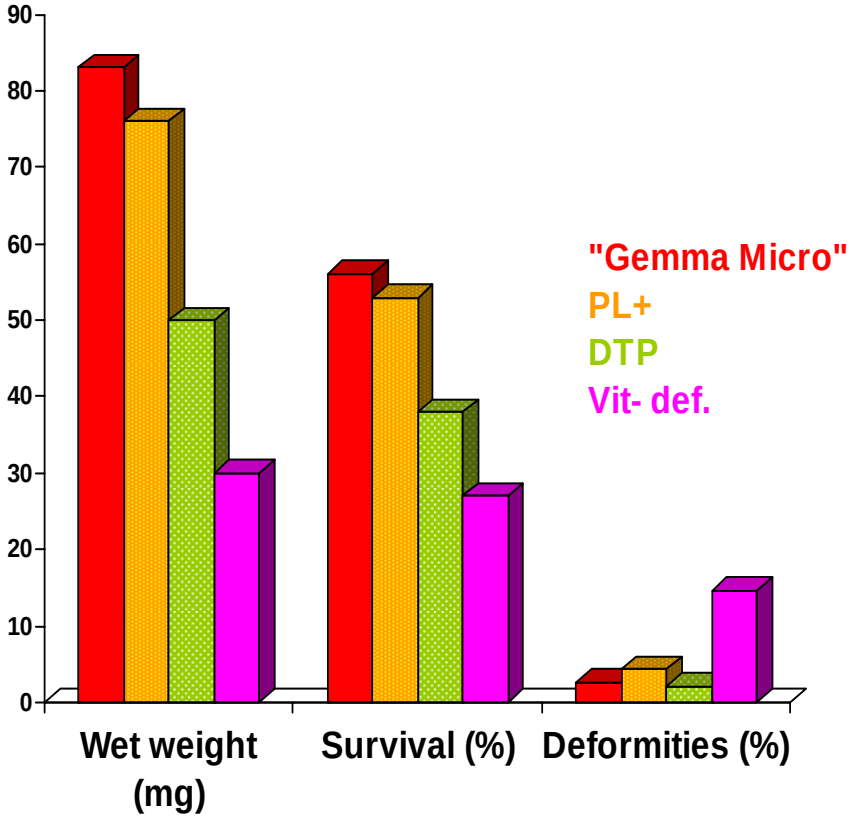
Optimal phospholipid level in larval diets

(Cahu *et al.* , in press)



Highest levels of phospholipids, p-choline and p-inositol gave the best survival and lowest malformations

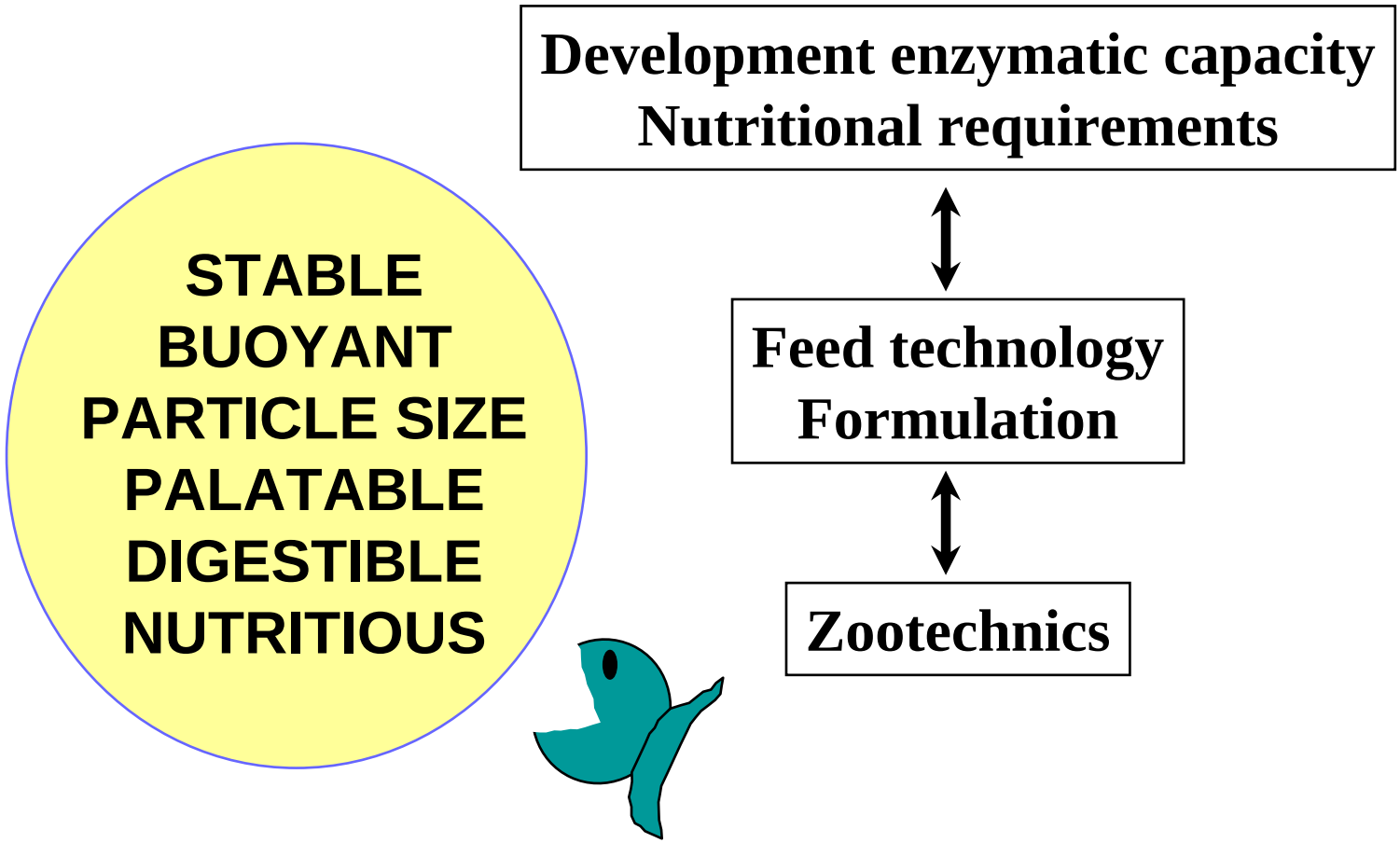
Performances of Mediterranean sea bass fed experimental diets to day 40



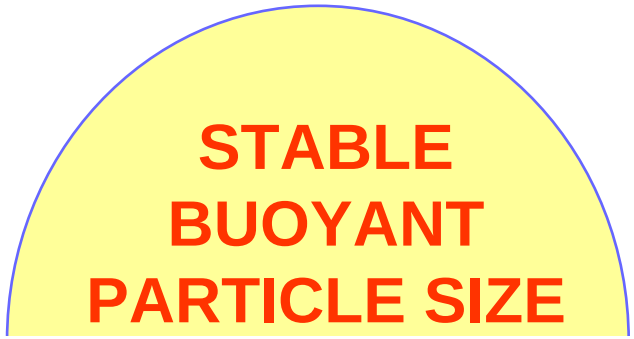
11% of phospholipids is sufficient to ensure good larval development.
An addition of protein hydrolysate induces lower growth and survival rate.
A decrease in vitamin and mineral content creates high percentage of deformed larvae.

Nutreco

Development of New weaning diets

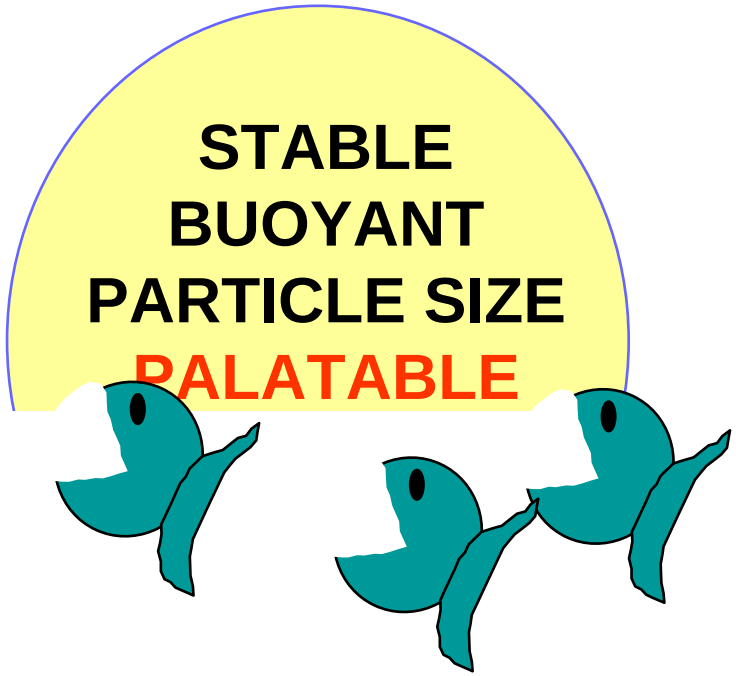


Physical characteristics



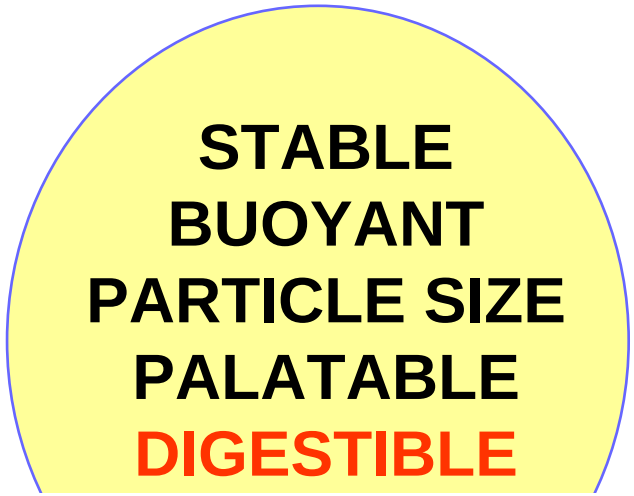
- processing
  - twin screw extrusion
  - break and sieve technology
- formulation technology
  - internal fat
  - binding
- quality control

Palatability



- selection of raw materials
  - protein quality
    - TVN
    - biogenic amines
    - soluble protein
    - free amino acids
    - AA balance
    - others..
  - fat quality
    - POV, Totox, Anisidine
- nutritional balance

Digestibility



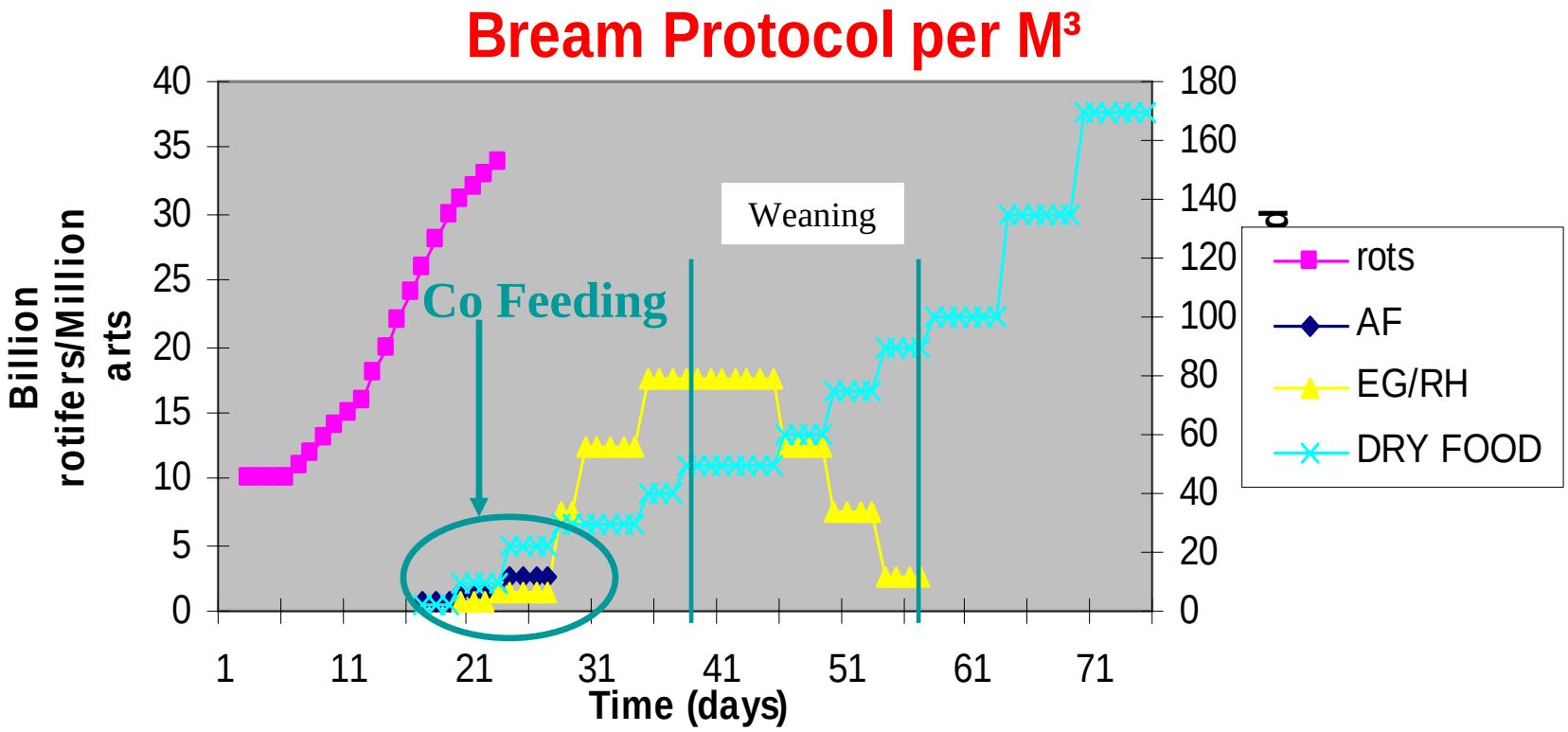
- Digestible protein
  - screening/selection of protein sources
- Digestible fat
- Digestible starch
- Digestible/metabolisable energy
  - reduce starch
  - reduce ash content
  - high dig protein
  - high dig fat
- Gentle processing

Feed development

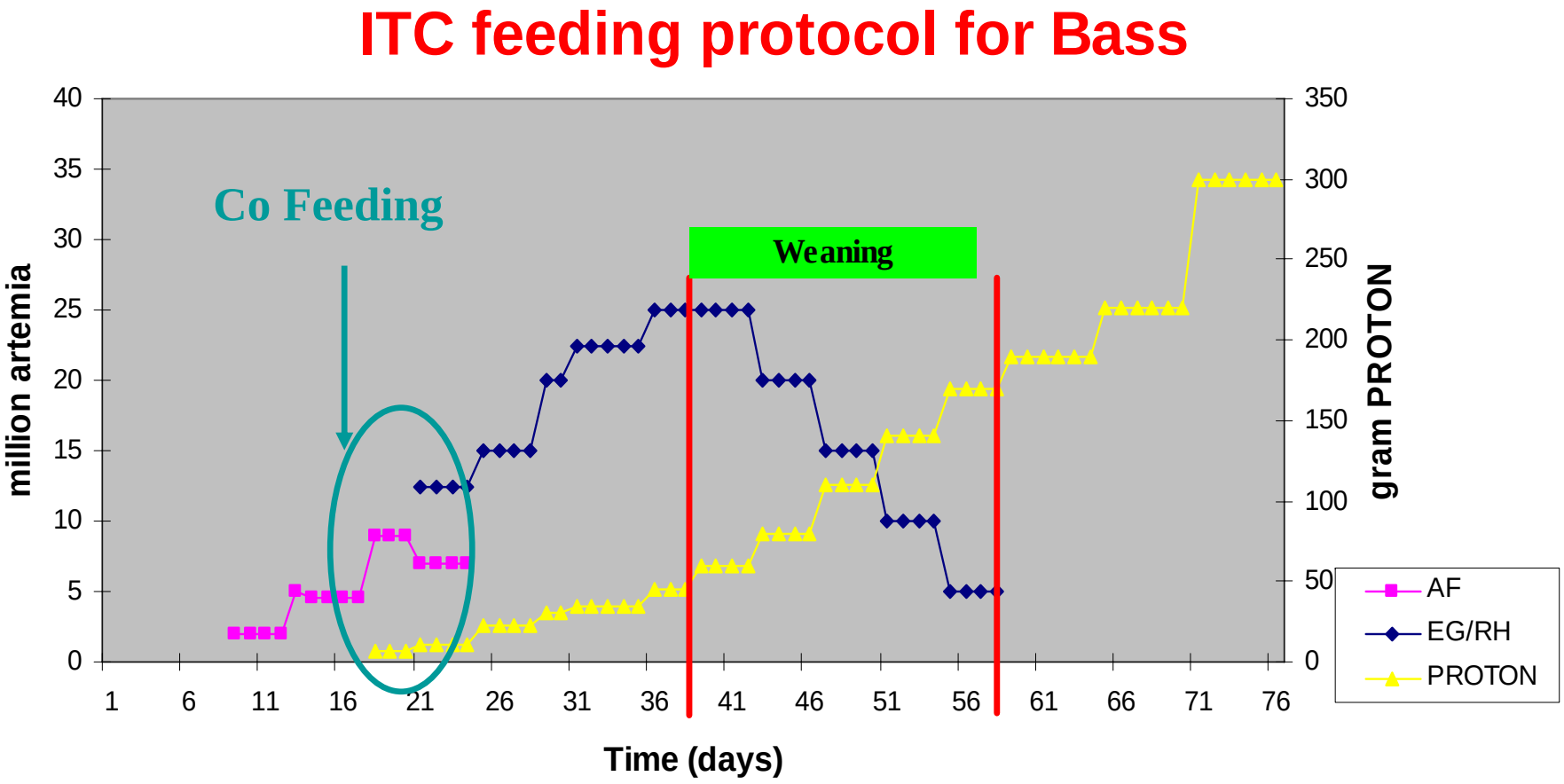
- **Feeding strategies evolved over years**
  - Broodstock
    - Egg quality, Larval quality, nutrition
  - Live food
    - Optimization
      - Nutrition >> enrichment
      - Production >> high density cultures, hatching
    - Automation >> devices
    - Hygiene >> Disinfection
    - Availability >> Sources
  - Feeds
    - Co-feeding practices >> early weaning
    - Fast weaning

- **Concerns**
  - What is the effect on deformities???

Protocol for small larvae

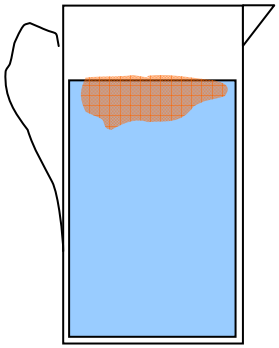


Protocol for larger larvae

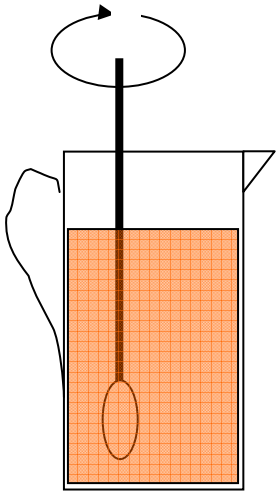


Wet feeding technique

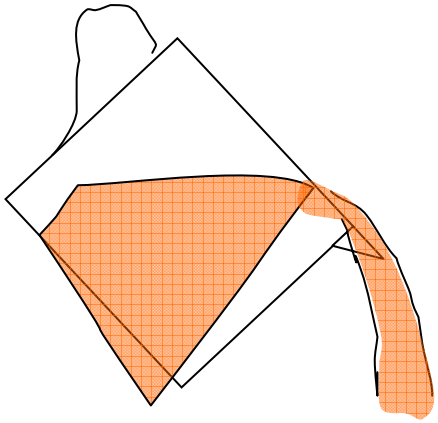
During the **co-feeding** stage, ‘wet’ feeding is recommended.



Add some diet in a beaker of water at 10g/l



Stir very gently



Feed to larvae in small doses like feeding Artemia

Second phase: adaptation of the larvae : START of weaning

As soon as the larvae are used to the presence of the feed particles, the amount of *Artemia* is gradually decreased in favour of the diets.

Third phase: MID weaning

Artemia concentration continues to decrease. At the same time part of the **PROTON 2** (150-300 µm) is gradually replaced by **PROTON 3** (200-400 µm) .

Final phase: END weaning

Feeding Artemia is coming to an end. As larvae continue to grow, the **PROTON 2&3** are further replaced by **PROTON 4** until it is used as the sole diet.

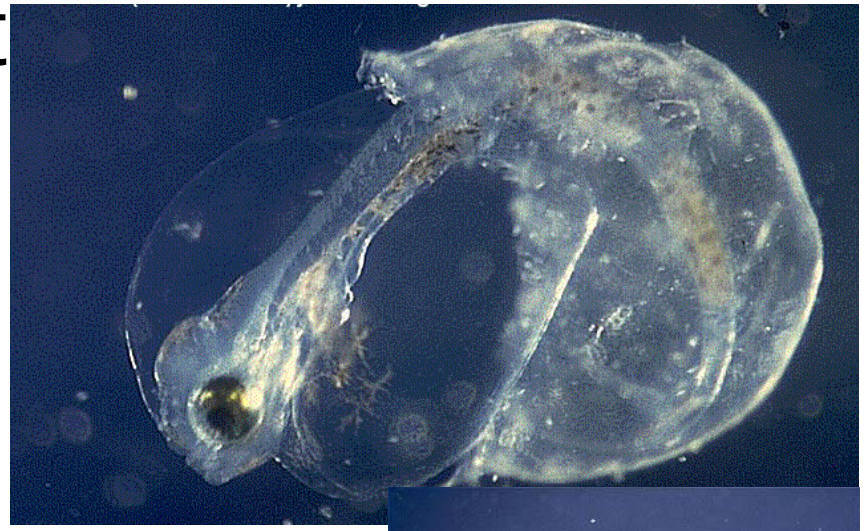
Nursery/pre-growth phase

Compound feeding is ± 100% automatically and no Artemia is given. The **PROTON 4** is gradually replaced **Lansy W3-NRD 3/5-ALFA 1. These diets are** gradually replaced by the larger sizes of **NRD-ALFA** as the fish grow (see feeding regimes).

Weaning fry at transfer - 40 days

Larvae development (Cod)

- Yolk sac
- First feeding
- Larvae



Larval development (Cod)

- Newly hatched 4.5 mm
- Open mouths Day 3
- Take dry feed Day 14 (7mm)
- metamorphosis Day 30 - 40 (12 mm)
- sensitive period Day 45 - 60
- first grading Day 60 at 0.2 gram
- 2 gram size Day 90

Cod larvae

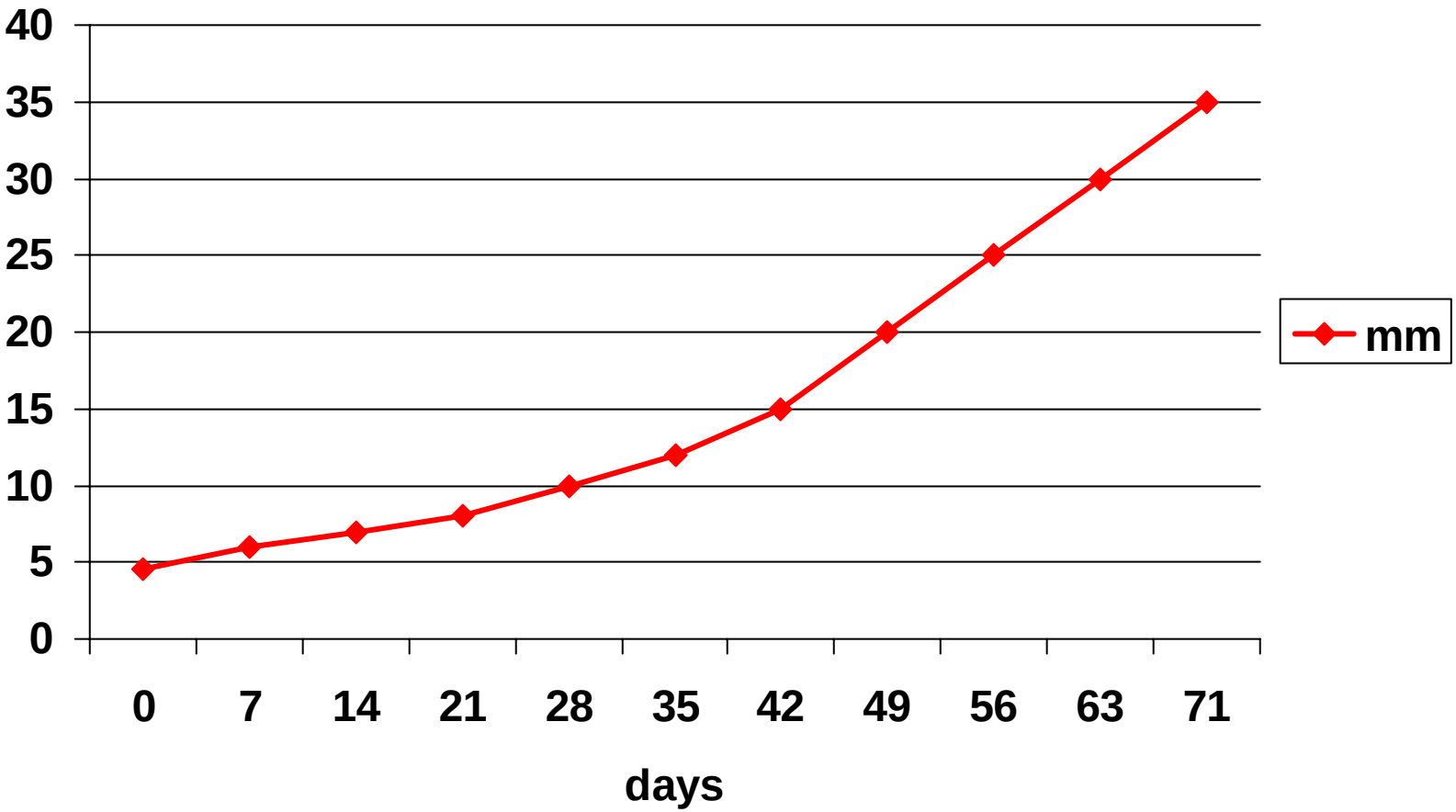
Days	Length	Weight
0	4	2.0 mg
7	6	2.5 mg
14	7	3.4 mg
21	8	5.1 mg
28	10	10.0 mg
35	12	17.3 mg

Metamorphosis

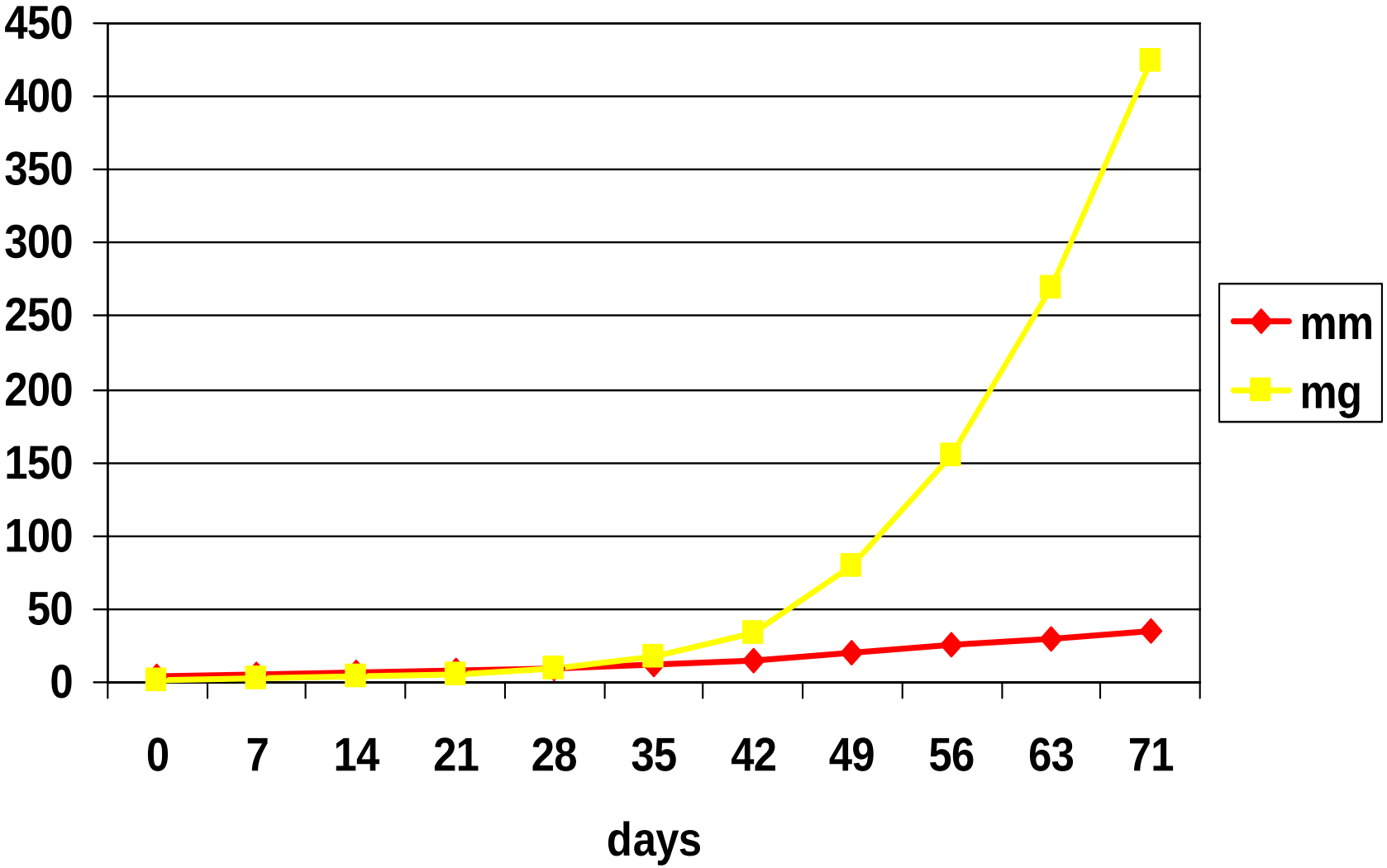
First grade 1.5 mm

Days	Length	Weight
35	12	17.3 mg
42	15	33.8 mg
49	20	80.0 mg
56	25	155 mg
63	30	270 mg
71	35	425 mg

Growth - length



Growth - weight (CF=1)



Larval survival

- Collection of good eggs - 80% (60 to 100%)
- incubation of eggs - 65% (50 to 80%)
- Hatched larvae to 8 mm - 45% (30 to 60%)
- Weaning 8 to 14 mm - 30% (10 to 50%)
- Nursery 14 to 40 mm - 65% (60 to 70%)

Total survival from stocked egg to 40 mm 8%