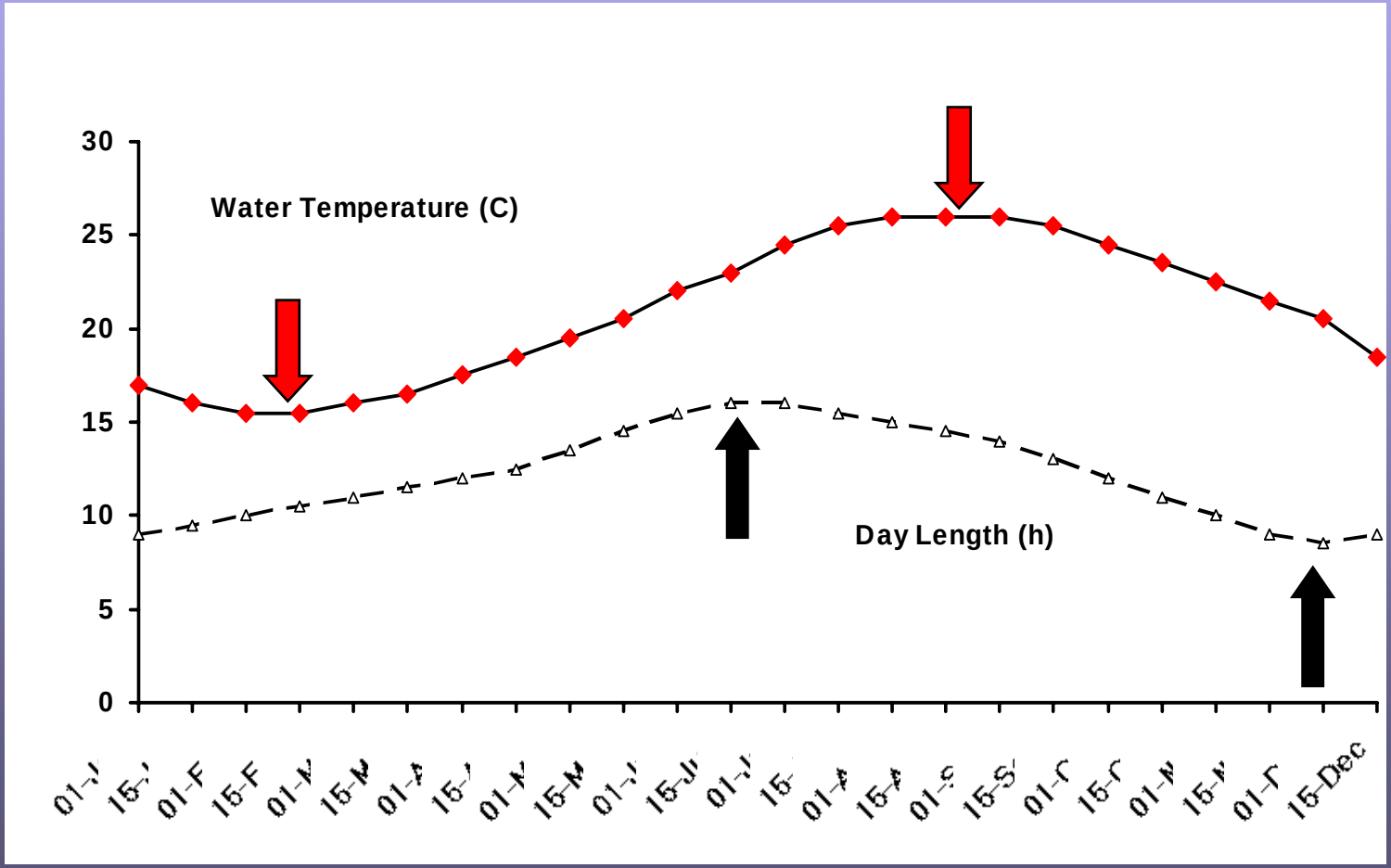
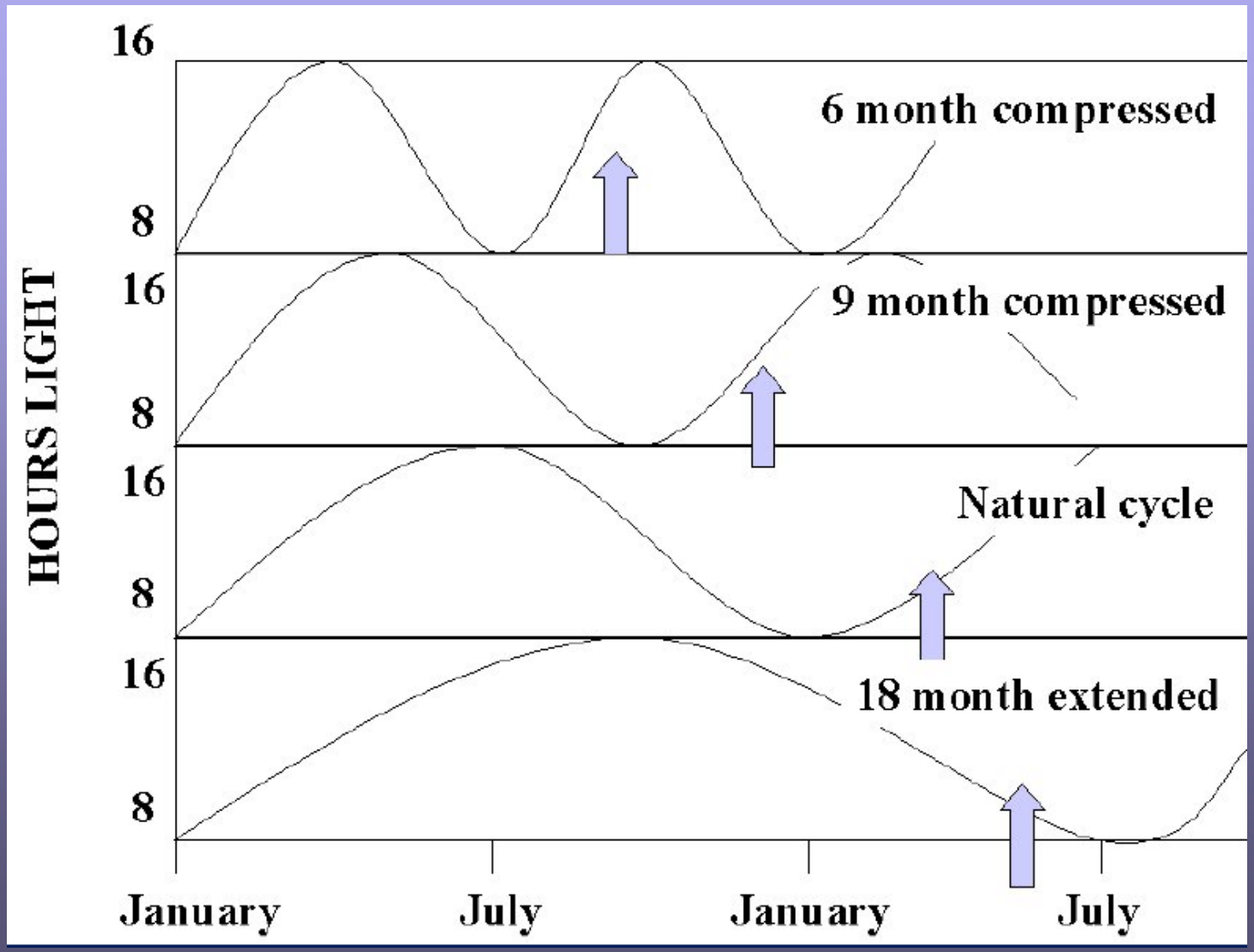
Spawning
advanced and delayed control
photoperiod control
temperature control

Photoperiod control

Day Length and Temperature

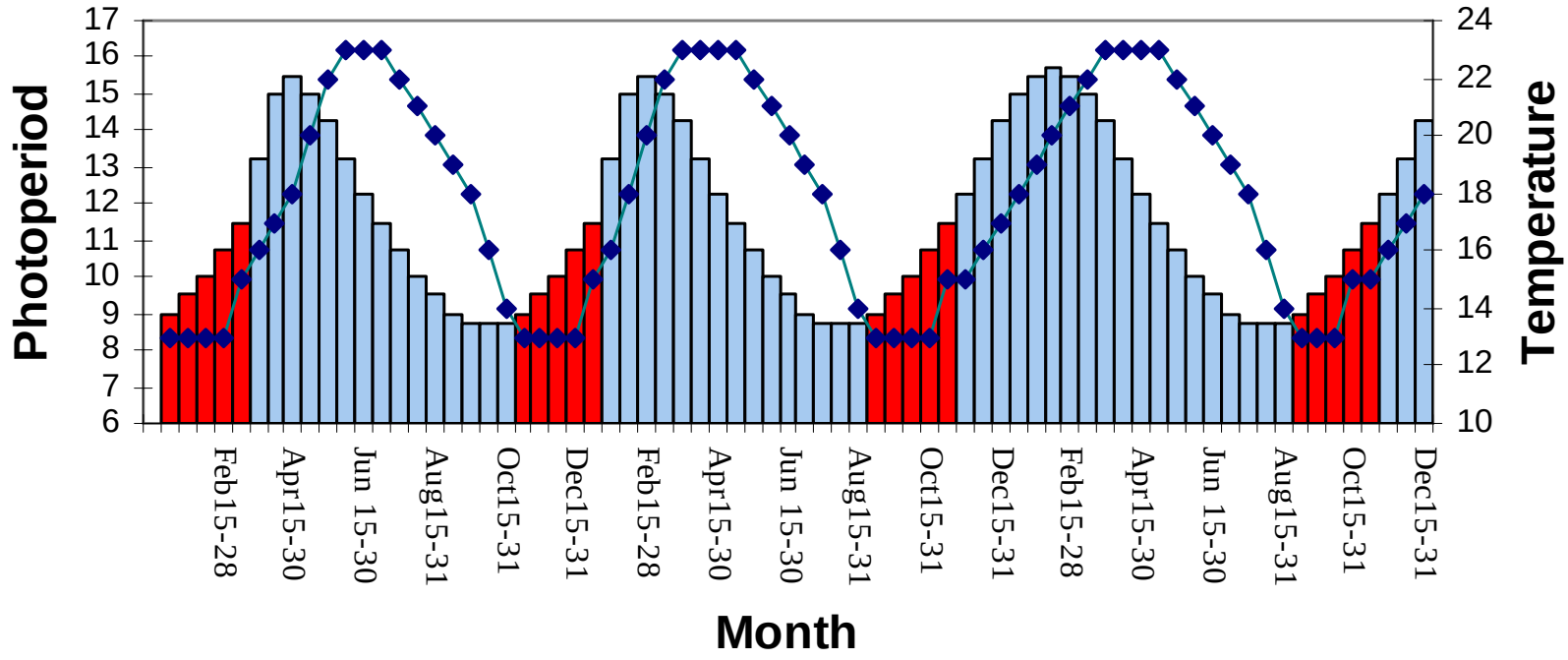


Advancing or delaying spawning



From Broodstock management and selective breeding Yonathan Zohar

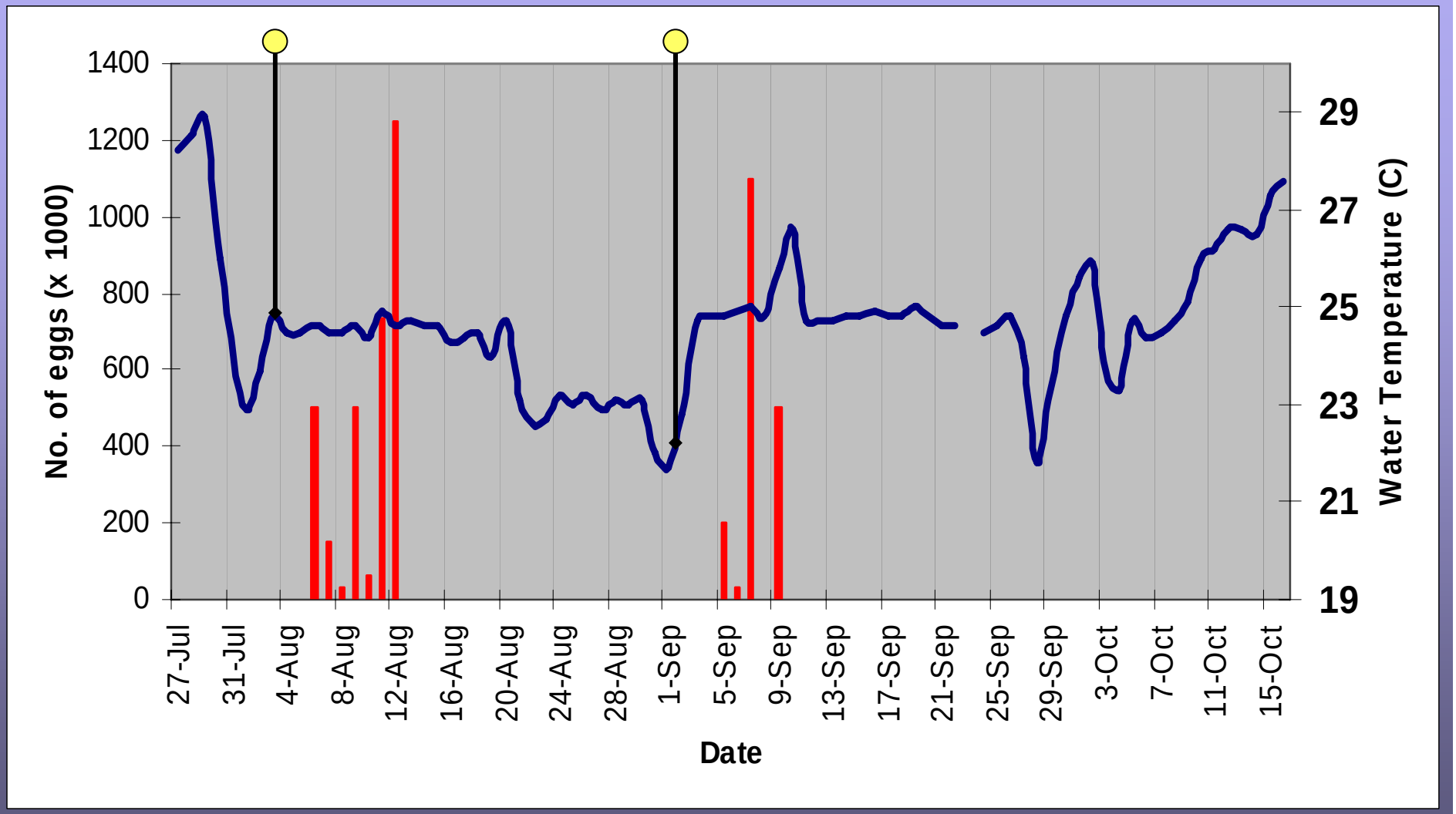
Advanced bass photoperiod



Broodstock conditioning systems

50,000 liter
95% recirculating
Artificial substrate
Photoperiod control
Water temperature control

NATURAL SPAWN Lunar cycle

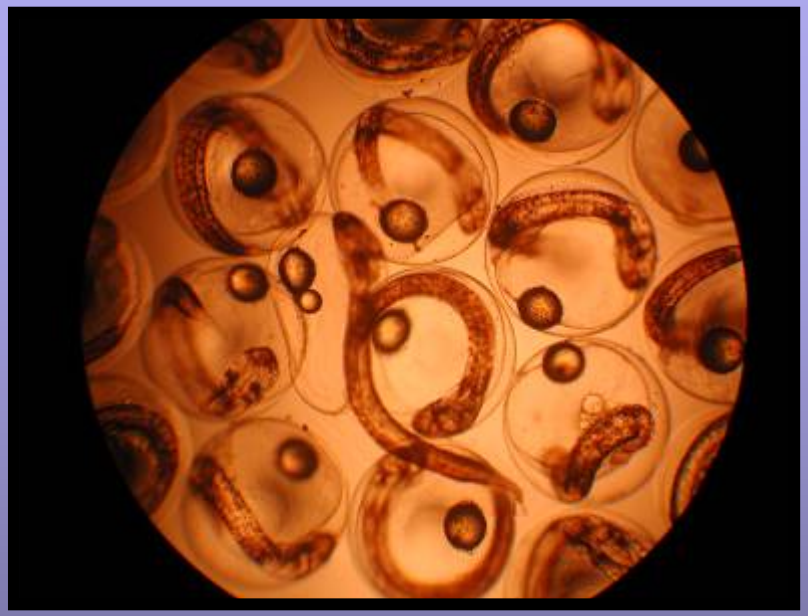


FULL MOON

	Wt. Range	Avg. Weight	Avg. FL
6 MALES	4 – 8 kg.	6 kg.	62.8 cm.
6 FEMALES	4.5 – 8.75 kg.	7.1 kg.	64 cm.

Broodstock tanks with natural temperatures

Egg and larval production



A recent extended genetic study (Cameron Brown R. et al, 2005) carried out at Stirling on a commercial gilthead sea bream hatchery discovered that:

- the effective breeding population was consistently low (26 to 32% of the broodstock population)

- the individual contribution to spawning was highly variable, especially for males

- larger and smaller broodstock in weight had a reduced reproductive success compared to the performances of fish at the mean size

This information is undoubtedly of interest for hatchery managers…..

Broodstock Nutrition

Feeding (Pellets, trash fish)
Feed supplements (Vit E, HUFA’s)

Broodstock nutrition

Egg quality is a function of broodstock nutrition

- **Enriching broodstock feed with oils**
  - **omega 3**
- **Enriching broodstock feed with vitamins**
  - **Vitamin C**
  - **Vitamin E**
- **Feeding with natural feeds once per week**
  - **squid**
  - **mussels**
  - **fish**

Broodstock nutrition plays important role on:

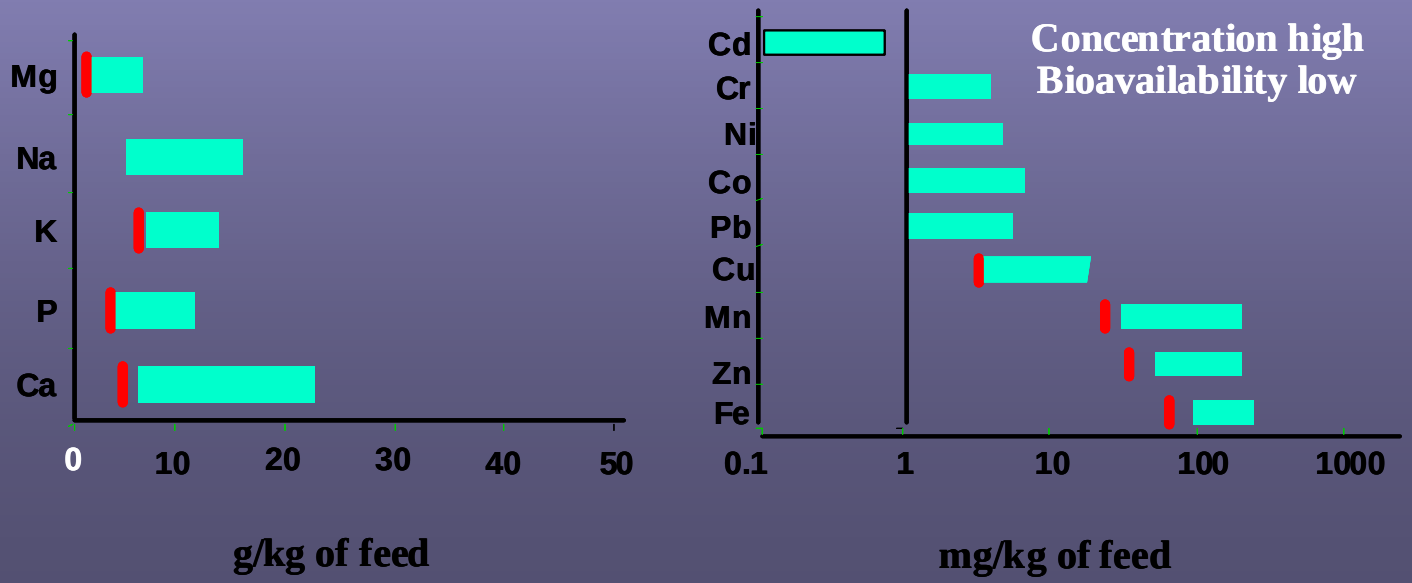
- Reproductive behaviour
  - Essential nutrients for gonadal development
- Reproductive performance
  - Egg size, larval size, timing of reproductive season, spawning frequency
  - Fecundity, gametogenesis, gamete quality
- Egg and larval quality
  - Endogenous supply of essential nutrients
- Larval capacity to switch to artificial diets
- Overall hatchery performance

Criteria for broodstock diet formulation – catfish - Pangasius

- Total protein : 35-40 % ; Total lipids : 5-10 % (% dry matter),
- Use of diverse ingredient sources – use several primary matters sources (example, for the protein : soy meal / fish meal / meat meal),
- Glucidic ingredients should be 20-30 % to cover the energy requirements and ensure a diet that is well bound
- Add a premix containing essential nutrients, trace minerals and vitamins

Dietary requirements - often unknown

- Protein requirement for optimal reproductive performance will vary with species, size, dietary protein and energy sources and rearing system
  - Tilapia – 30-40% protein P/E ratio 23.6g/MJ
  - Channel catfish 28-35% protein
- Mineral content of salmonid feed



Effect of broodstock nutrition on embryo development

- Vitamin A, E and C
  - Important for embryo and larval development
- Suboptimal levels result in
  - Low embryonic survival
  - Reduced larval survivals
  - Increased developmental abnormalities

Effect of lipid manipulation in broodstock diets

- Lipids – fats & fatty acids
  - Play an essential role in reproductive maturity and gonadal development in fish through lipid mobilization from the liver and muscle to developing gonads
  - Vital for normal embryionic and larval development
- Deficiencies or unbalanced diet
  - Reduced egg viability and sperm quality
  - Low embryionic survival
  - Embryionic malformations
- Freshwater species Salmonidae, Cyprinidae, Catfish and eel need 18:2(n-6) and 18:3 (n-3) (linolenic acid) fatty acids due to their ability to elongate and desaturate 18-carbon fatty acids
- Marine species need more elongated and unsaturated FA EPA - 20:5(n-3) and DHA - 22:6(n-3)
- Arachidonic acid 20:4 (n-6) is also required in some species as it stimulate reproductive hormone production and courtship behaviour

USE OF TRASHFISH

- Availability? Freshness? Stable quality?
- Unpractical and risk of water pollution
- Deficiency for some nutrients
- Risk of spreading viral or bacterial diseases among the valuable broodstock animals

Broodstock diet issues – Asia

- Objective - Optimal broodstock conditioning
- Feeds
  - ‘trash’ fish use
  - need for cost-effective grow-out and broodstock diets

Commercial diets

Innovative breed concept for marine broodstock, available in three different formulations

- Lansy Breed Maturation: soft maturation pellet enhancing the nutritional quality of the offspring

- Lansy Breed Recovery: soft recovery pellet facilitating recuperation after intensive spawning

- Lansy Breed Pause: maintenance diet for optimal balance in nutrition and economics during the broodstock's resting and preparatory phase

- consistent, high quality concentrate for moist broodstock feeds

Broodstock vaccination

Vaccination response

FISH

- Teleost fish have a number of adaptive immune responses and immune memory, involving B cells and T cells, antibody and phagocytic cells.
- This adaptive immune response enables them to specifically “remember” exposure to pathogens and respond with increased efficiency on subsequent encounters, forming the basis of vaccination
- Understanding of these immune mechanisms and how the pathogens interact has allowed the development of successful vaccines.

Vaccination in finfish

- Major success story in 1990's in salmon farming
- Part of an overall health programme to prevent disease infection
- All effective vaccines for farmed fish are injectable and oil adjuvanted
- Aqueous immersion vaccines
  - limited duration of immunity and variable efficacy
  - Used for juvenile stages to offer protection prior to injection
- Oral vaccines
  - available commercially
  - variable success as primary immunogens

Vaccines available in Asia - Intervet

Product	Description
Aquavaccol ™	Licensed as an aid in the prevention of columnaris disease in channel catfish
Aquavac-Esc®	Vaccine against Enteic septicemia
Norvax ® Strep Si	Vaccine against streptococcal disease in susceptible fish species like Asia seabass
Norvax® Vibrio mono	Vaccine against vibriosis in yellowtail

While the concept of vaccines is new to farmers in Asia this may change due to increased awareness of food safety issues and the availability of vaccine products

Specific Pathogen Free (SPF) Broodstock

Wild broodstocks

- Worldwide many hatcheries and ongrowing facilities are wholly dependant on wild caught broodstock
- Disease risk
  - Study in Malaysia (2006) indicated that 70% of wild black shrimp broodstock were infected or were carriers with one or more pathogeni
  - Viral pathogens
    - White spot syndrome virus (WSSV)
    - Taura syndrome virus (TSV)
    - Monodon baculovirus (MBV)
    - Yellow head virus (YHV)
    - Hepatopancreatic parrovirus (HPV)
    - Koi herpesvirus (KHV)
    - Large mouth bass virus (LMBV)

Specific Pathogen Free (SPF) Broodstock

- This is a dynamic process
- Indicates present pathogen status
- Function of
  - Reliable non-lethal pathogen diagnosis PCR / RT-PCR
  - Ability to physically exclude pathogen from the facilities
  - Pose a significant threat to the industry

SPF & Biosecurity

- SPF status is a function of level of biosecurity in the facilities where species are cultured
- Physical isolation
  - Enclosed facility
- Exclusion of water and air borne disease vectors
  - Recirculation systems & control of water quality
  - Effective water treatment
  - Air conditioning systems
- Additional factors
  - Minimised handling
  - Optimised nutrition

Development of SPF broodstock

- Primary quarantine – elimination of contaminated or carrier broodstock
  - Rigorous broodstock screening
  - Individual tanks
  - Tagging
    - Fish– pit tags / branding
    - Shrimp – VIE (Visible Interior Elastomer)
- Secondary quarantine – maturation and larval rearing facilities
  - Avoidance of cross contamination
  - Restricted movements
- On-growing facilities for broodstock development
  - F1 generation production parameters generally decreased cf offspring wild broodstock
  - Subsequent generations – production performance improved

Tagging

- Mark with PIT-TagsTM
- (PIT = Passive Internal Transponder)
- Read the tags electronically.
- The tag is a small capsule of 10 mm x 2.
- It is injected into the dorsal muscle or under the skin of an anethetised fish
- The fish is identified by a 10 digit number.