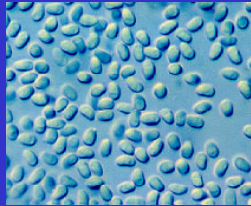


## Ecology of Disease

Weekly theme: WATER  
Lecture: Aquaculture



Prof Peter O'Donoghue

1

## FOOD

Wild harvest (hunter/gatherer)

- native plants (fruits, vegetables, cereals)
- wild game (mammals, birds, fish, crustacea)

Cultured food (farmer)

- plants (cereals, fruit, vegetables)
- terrestrial animals (mammals, birds)
- aquatic animals (fish, crustacea)

2

## AQUACULTURE

Land-based culture (not exclusively freshwater)

- aquaria, tanks, raceways, ponds

Sea-based culture (mariculture)

- diked tidal lagoons/pounds, net-pens/sea-cages

Products

- invertebrates (molluscs)
- fish (teleosts)
- aquatic plants (seaweeds)

3

## AQUACULTURE

Producers require thorough knowledge of:

- life cycle
  - reproduction, growth, development
- nutrition
  - diet, metabolic requirements
- produce
  - quantity, quality
- market
  - demand, return



4

## DISEASES

Impact of diseases

- mortality (death)
- morbidity (sickness)
- production losses (body weight)
- lesions (quality)

Parasitoses

- endo-parasites
- ecto-parasites
- epibiotic fouling organisms

5

## Invertebrates in aquaculture

### MOLLUSCA

- bivalves
    - oysters- meat
    - pearls
    - scallops
    - mussels
    - clams
  - gastropods
    - abalone
  - crustaceans
    - prawns
    - crayfish
    - crabs
- |                   |   |
|-------------------|---|
| <i>Saccostrea</i> |  |
| <i>Pteria</i>     |   |
| <i>Pecten</i>     |   |
| <i>Mytilus</i>    |   |
| <i>Tridacna</i>   |   |
| <i>Haliotis</i>   |   |
| <i>Penaeus</i>    |   |
| <i>Cherax</i>     |   |
| <i>Squilla</i>    |   |

6

## Oysters

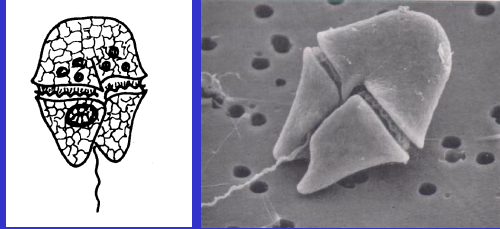
- sedentary bivalve - filter feeder
- life cycle: egg - veliger - spat - juvenile -adult
- culture: shell beds, sticks, trays, bags, longlines
- diseases: QX (*Martelia*), winter mortality (*Mikrocytos*), vibriosis, mudworm (*Polydora*)
- fouling organisms: barnacles, mussels, red weed, balloon weed, sponges, toxic algal blooms
- predators: crabs, starfish, octopus, fish, rays



7

## Paralytic shellfish poisoning

- dinoflagellate blooms (e.g. *Gymnodinium*)
- plankton taken up by filter-feeding shellfish
- minute traces of toxin sequestered in flesh
- toxin acts on nervous system of mammals



8

## mussels/scallops/clams

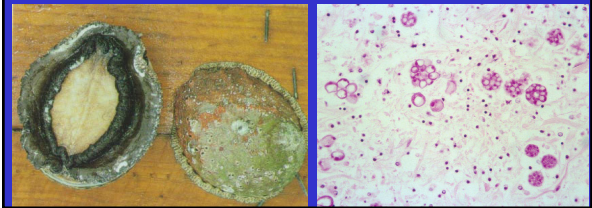
- sedentary bivalves - filter feeders
- life cycle involves motile trochophore and shelled veligers prior to pedal attachment
- cultured in tidal bays/lagoons
- pathogens/pests/predators to be characterized



9

## Abalone

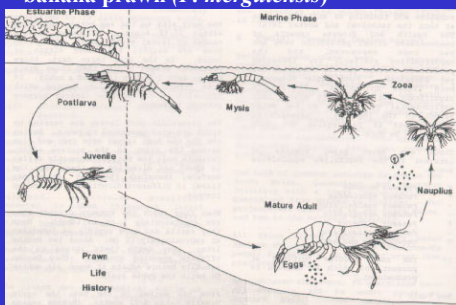
- gastropod - motile grazer (not filter feeder)
- life cycle: egg - planktonic larvae - juveniles
- diseases: *Perkinsus* necrotic lesions
- predators: fish, sharks, rays



10

## Prawns (*Penaeus* spp.)

- tiger prawns (*P. monodon*, *esculentus*, *semisulcatus*)
- king prawns (*P. plebejus*, *latisulcatus*)
- banana prawn (*P. merguensis*)

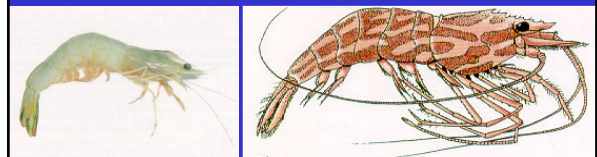


6-12  
month  
cycle

11

## Prawns

- normally feed on molluscs, crustaceans, polychaetes
- commercial mix added to grow-out pond (25/m<sup>2</sup>)
- harvest by drainage or netting
- water quality: 27-33°C, salinity 10-25 ppt, dissolved O<sub>2</sub> >2ppm (watch algal demand overnight), pH >5
- microbial decomposition H<sub>2</sub>S < 0.1ppm
- neutralize ammonia produced by prawns




12

### Prawn diseases

---

Viruses	<ul style="list-style-type: none"> <li>- BVP (baculovirus penaei)</li> <li>- MBV (monodon baculovirus)</li> <li>- BMNV (baculovirus midgut gland necrosis)</li> <li>- PBV (plebejus baculovirus)</li> <li>- HPV (hepatopancreatic parvo-like virus)</li> <li>- IHHN (inf. hypodermal.haemopoetic necr.)</li> <li>- REO (Reo-like virus)</li> </ul>
Bacteria	<ul style="list-style-type: none"> <li>- septicemia</li> <li>- shell disease</li> <li>- bacterial necrosis</li> </ul>
Fungi	<ul style="list-style-type: none"> <li>- larval mycosis</li> <li>- black gill disease (<i>Fusarium</i>)</li> </ul>




13

### Prawn diseases

---

Protozoa	<ul style="list-style-type: none"> <li>- microsporidiosis (muscle cysts)</li> <li>- black spot (apostome ciliates)</li> <li>- gregarines (gut cysts)</li> <li>- epibiotic peritrichous ciliates (biofouling)</li> </ul>
Helminths	<ul style="list-style-type: none"> <li>- trematodes (opecoelids, microphallids)</li> <li>- cestodes (<i>Prochristianella</i>, <i>Eutetrarhynchus</i>)</li> <li>- nematodes (<i>Spirocamallanus</i>, <i>Hysterothylacium</i>)</li> </ul>
Other	<ul style="list-style-type: none"> <li>- barnacles</li> <li>- leeches</li> <li>- copepods</li> </ul>




14

### Freshwater crayfish (*Cherax spp.*)

---

<ul style="list-style-type: none"> <li>• yabbie</li> <li>• marron</li> <li>• redclaw</li> <li>• gilgie</li> </ul>	<ul style="list-style-type: none"> <li><i>C. destructor</i></li> <li><i>C. tenuimanus</i></li> <li><i>C. quadricarinatus</i></li> <li><i>C. quinquecarinatus</i></li> </ul>
<ul style="list-style-type: none"> <li>• freshwater ponds</li> <li>• burrows in banks</li> <li>• up to 12 molts/yr</li> <li>• aggressive behaviour</li> <li>• cannibalism</li> </ul>	



15

### Diseases

---

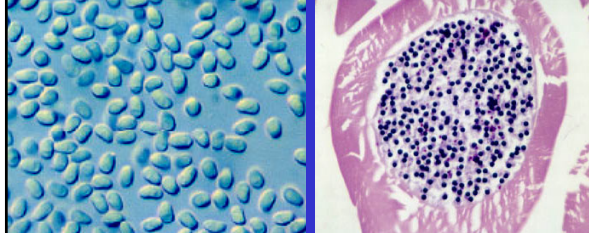
Viruses	- ?
Bacteria	- <i>Pseudomonas</i> , <i>Mycobacterium</i>
Fungi	- <i>Aphanomyces</i> (crayfish plague)
Protozoa	- <i>Psorospermium</i>
Nematode	- <i>Thelohania</i> (musculature)
Trematode	- epibiotic ciliates ( <i>Vaginicola</i> , <i>Cothurnia</i> , <i>Lagenophrys</i> , <i>Vorticella</i> , <i>Epistylis</i> , <i>Zoothamnium</i> , <i>Acineta</i> , <i>Tokophrya</i> )
Trematode	- <i>Gammarinema</i>
Trematode	- <i>Microphallus</i> (muscles)
Trematode	- flatworms ( <i>Temnocephala</i> , <i>Craspedella</i> , <i>Diceratocephala</i> , <i>Didymorchis</i> )

16

### Microspora

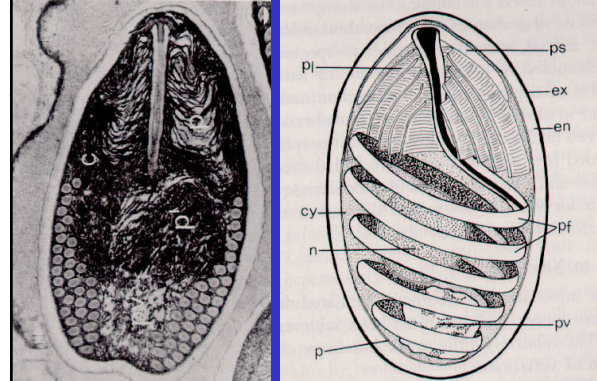
---

*Thelohania* infections  
muscle cysts  
weak tail flick response

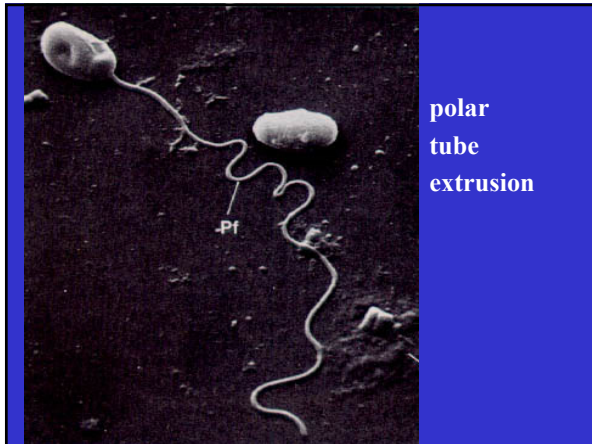


17

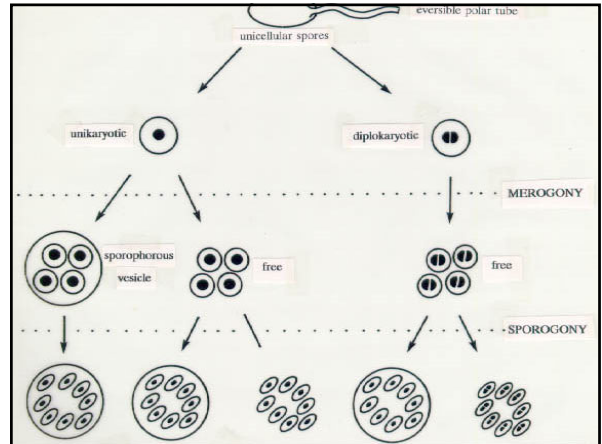
### Spore ultrastructure



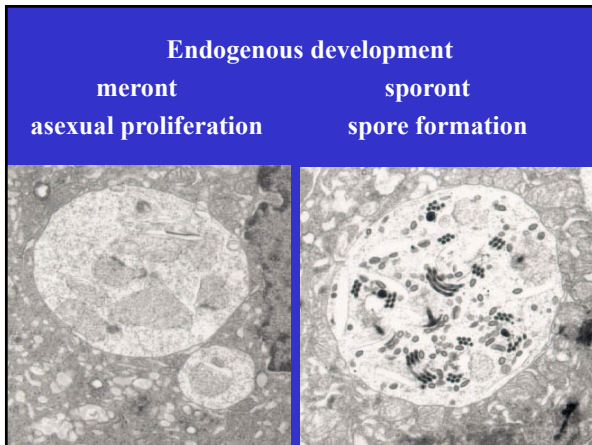
18



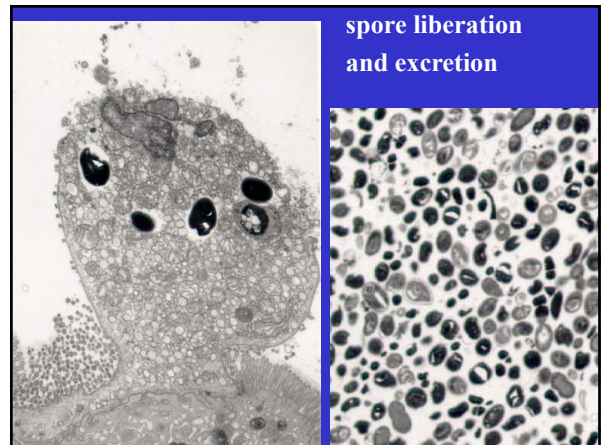
19



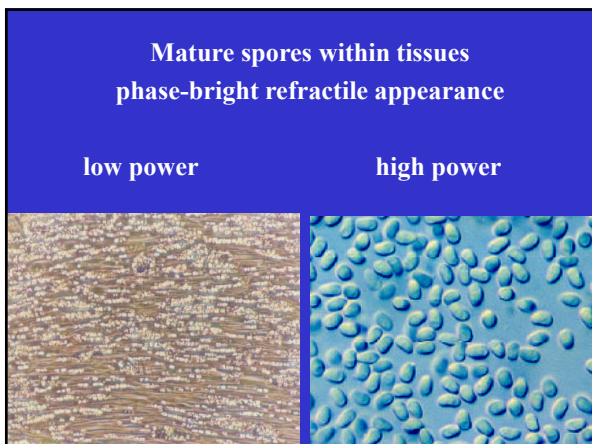
20



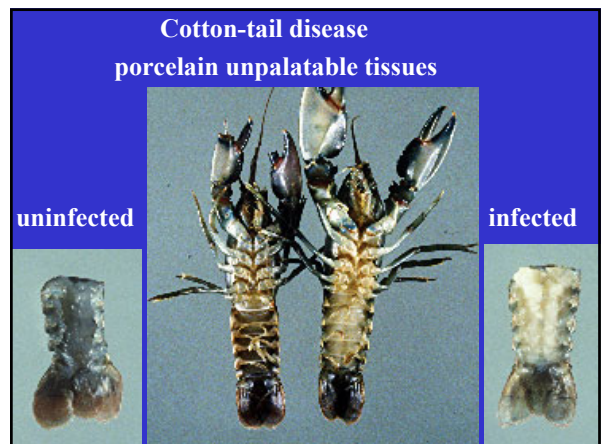
21



22



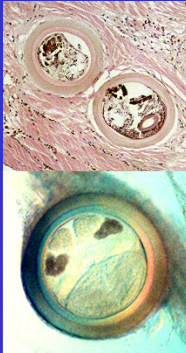
23



24

## Microphallus

- adult fluke found in water rats
- miracidia infect snails and release cercariae
- metacercariae develop in crayfish muscles
- impart sandy/gritty texture to flesh
- prevent infections by excluding water rats



25

## Temnocephalans

- adult flatworms harmless
- browse over surface of crayfish
- but cement eggs to carapace and gills
- unsightly fouling
- eggs not detached by cooking



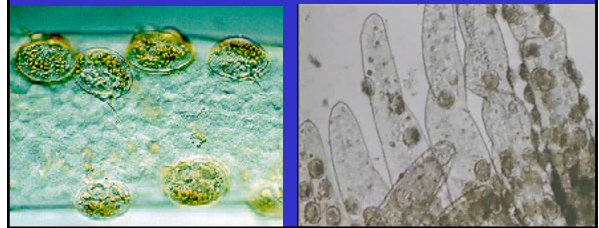
26



27

## Ectocommensal ciliates

- *Lagenophrys* - peritrichous ciliate
- filter-feeding bacterivores
- attach flattened loricae to gills
- heavy infestations suffocate crayfish



28

## Impact of Diseases

### Loss of product

- death through hypoxia (gill fouling)

### Poor quality of product

- *Thelohania* cotton-tail (chalky flesh)
- *Microphallus* metacercaria (gritty flesh)

### Unsightly product

- temnocephalan eggs (spotty appearance)
- peritrichous ciliates (slimy appearance)

29



## Aquaculture

Disease outbreaks can destroy businesses via:

- rapid onset (overnight)
- difficult containment (rapid spread)
- ineffectual treatment (lack of therapeutics)
- poor decontamination (drain & lime ponds)

Producers need to institute:

- barrier culture (quarantine imports)
- brood-stock validation (QA programs)
- routine water quality monitoring
- regular disease surveillance

30