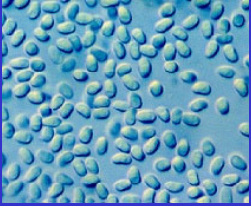


Ecology of Disease

Weekly theme: **FOOD**
 Lecture: **Mariculture**



Prof Peter O'Donoghue

1

MARICULTURE

net-pens, sea-cages, raceways, impoundments




2

Fish species

Salmonids

• Atlantic salmon	<i>Salmo salar</i>
• amago	<i>Oncorhynchus rhodurus</i>
• chinook/quinnat	<i>O. tshawytscha</i>
• chum	<i>O. keta</i>
• coho	<i>O. kisutch</i>
• kokanee/sockeye	<i>O. nerka</i>
• cherry/masou	<i>O. masou</i>
• pink	<i>O. gorbuscha</i>
• rainbow trout (steelhead)	<i>O. mykiss</i>
• brown trout (sea trout)	<i>S. trutta</i>



3

MARICULTURE


• striped bass	<i>Morone saxatilis</i>
• mullet	<i>Mugil</i> spp.
• snook	<i>Thyrsites atun</i>
• snapper	<i>Chrysophrys</i> spp.
• tuna	<i>Thunnus</i> spp.
• dolphin fish	<i>Coryphaena hippurus</i>
• barramundi	<i>Lates calcarifer</i>
• redfin perch	<i>Perca fluviatilis</i>
• Murray cod	<i>Maccullochella peeli</i>
• golden perch/callop	<i>Macquaria ambigua</i>
• Macquarie perch	<i>Macquaria australasica</i>



4

Viral diseases of salmon

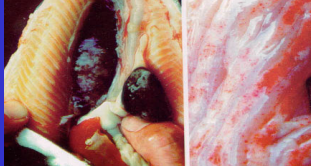
IHNV	infectious haematopoietic necrosis virus
IPNV	infectious pancreatic necrosis virus
SPDV	salmon pancreatic disease virus
ISA	infectious salmon anaemia
HKD	haemorrhagic kidney disease
VEN	viral erythrocytic necrosis
EIBS	erythrocytic inclusion body syndrome
herpes	salmonid herpes virus 2



5

Bacterial diseases of salmon

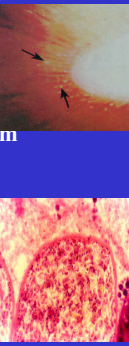
<i>Renibacterium</i>	bacterial kidney disease
<i>Vibrio</i>	vibriosis
<i>Aeromonas</i>	furunculosis
<i>Yersinia</i>	yersiniosis
<i>Cytophaga</i>	myxobacteriosis
<i>Piscirickettsia</i>	salmon rickettsial septicaemia
rickettsia?	epitheliocytosis



6

Protozoal diseases of salmon

amoeba:	<i>Paramoeba</i>	paramoebic gill disease
flagellate:	<i>Cryptobia</i>	cryptobiosis
microspora	<i>Loma</i>	gills
	<i>Nucleospora</i>	haemoblasts
	<i>Microsporidium</i>	nervous system
myxozoa	<i>Parvicapsula</i>	kidney
	<i>Kudoa</i>	muscle
	<i>Myxobolus</i>	cartilage
	<i>Chloromyxum</i>	liver
ciliates	<i>Cryptocaryon</i>	white spot



7

Cryptocaryon

trophozoites

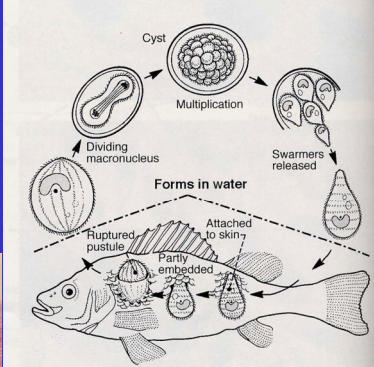
- invade skin
- engorge

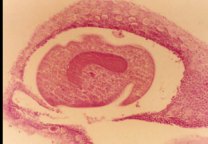
cyst formation

- reproduction

swarmers

- seek hosts






8

Cryptocaryon – impact of infection

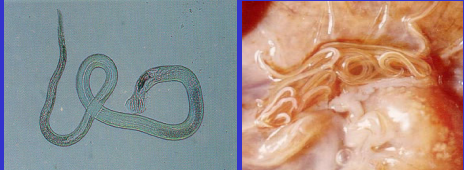
- erosive skin lesions
- gill impairment
- creeping white spots
- erratic behaviour
- mortality



9

Helminth diseases of salmon

cestodes	<i>Eubothrium</i>	adults in gut
	<i>Gilquinia</i>	metacercodes in eye
trematodes	<i>Neascus</i>	metacercaria in skin
	<i>Cryptocotyle</i>	metacercaria in skin
	<i>Diplostomum</i>	metacercaria in eye
nematodes	<i>Hysterothylacium</i>	adults in gut
	<i>Anisakis</i>	larvae in viscera



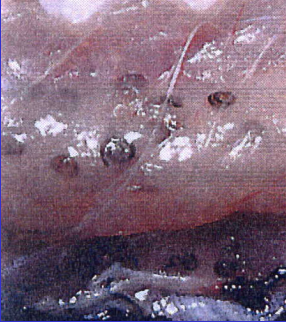
10

Anisakis

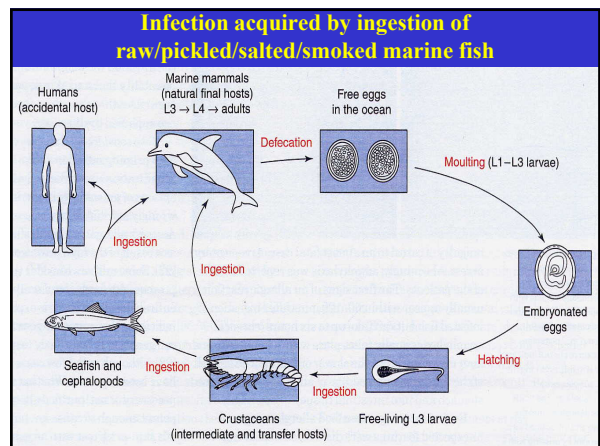
Order: Ascaridida

Anisakis/Phocanema/Contracaecum spp.

- larval nematodes acquired from marine fish
- form granulomas



11



12

Pathogenesis

- larvae penetrate gut wall (occasionally throat)
- become embedded in eosinophilic granulomas
- nausea, vomiting (mimic ulcer/carcinoma/etc)
- low grade eosinophilia, positive stool occult blood
- surgical removal required



13

Southern bluefin tuna - sea cage culture



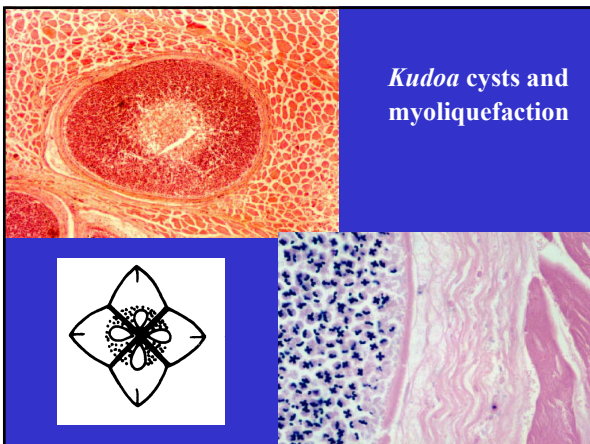
14



15



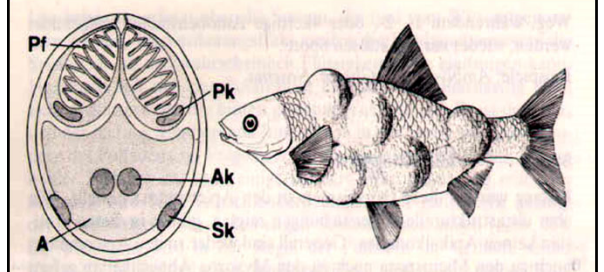
16



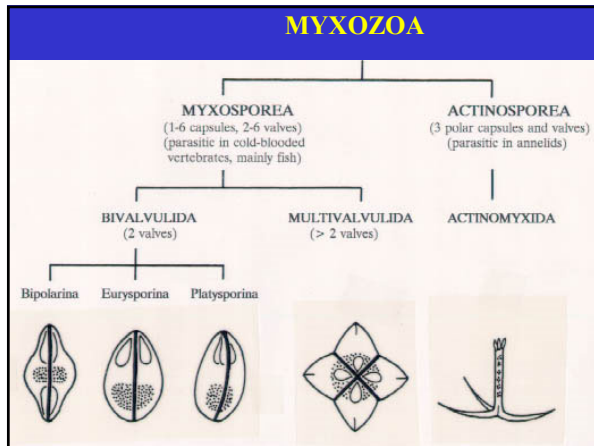
Kudoa cysts and myoliquefaction

17

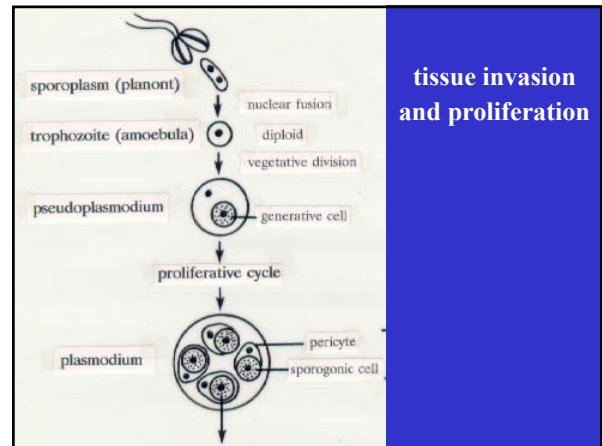
MYXOZOA



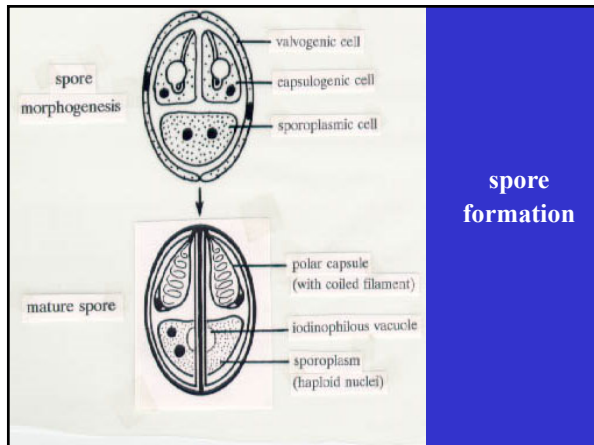
18



19



20



21



22

Life-cycle?

Endogenous development known but fish-fish transmission unclear

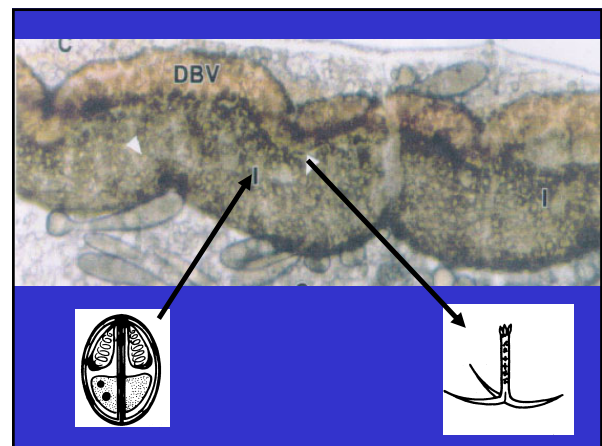
Resistant spores formed → exogenous phase

Spores may be freed ante-mortem (eruptive lesions) or post-mortem (histolysis)

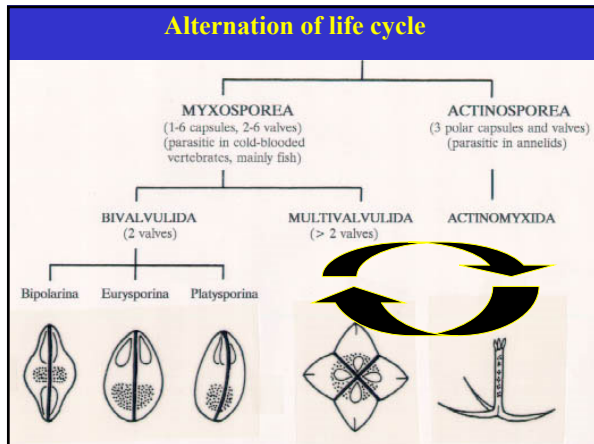
Alternatively, infected flesh may be ingested by predator/scavenger (carnivory)

Freshwater myxozoan studies (need mud)

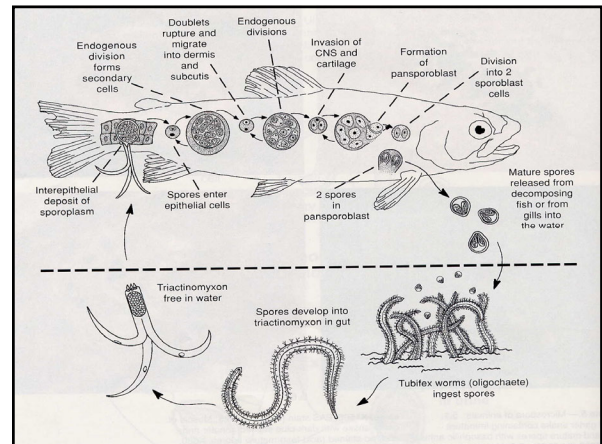
23



24



25



26

Problem with marine species

Tuna do not eat worms and do not frequent shallow inshore wormy waters

Possible accession through food chain via carnivory of paratenic? hosts

Pilchard (trash fish) diet

27

Future needs

Diagnostics (species-specific/stage-specific probes)

Economic impact (prevalence/intensity surveys)

Risk assessment (surveillance programs)

Control options (treatment/prevention modalities)

All based on better knowledge of:

- parasite biology (life-cycles, intermediate hosts)
- molecular biology (pathogenicity, phylogeny)
- biochemistry (drug susceptibility)

28