Disease in Marine Aquaculture

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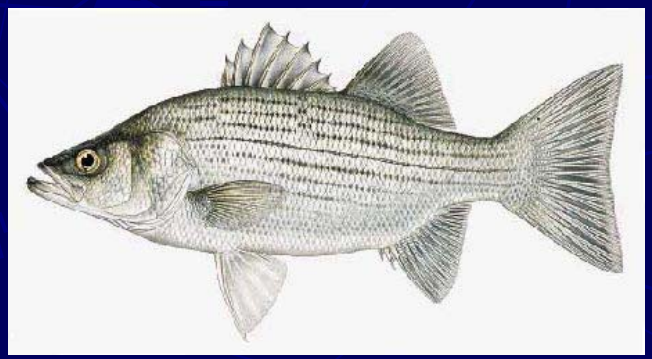
Past Attempts at Marine Aquaculture in Louisiana were at Inshore Marsh Locations.

These farms experienced good growth of fish most of the year but in periods of disease susceptibility (11-18ºC water temperature) mortality was excessively high and the farms eventually went out of business.

Past Attempts at Marine Aquaculture

Cage Culture : Louisiana Marsh 1989-95

Hybrid Striped Bass

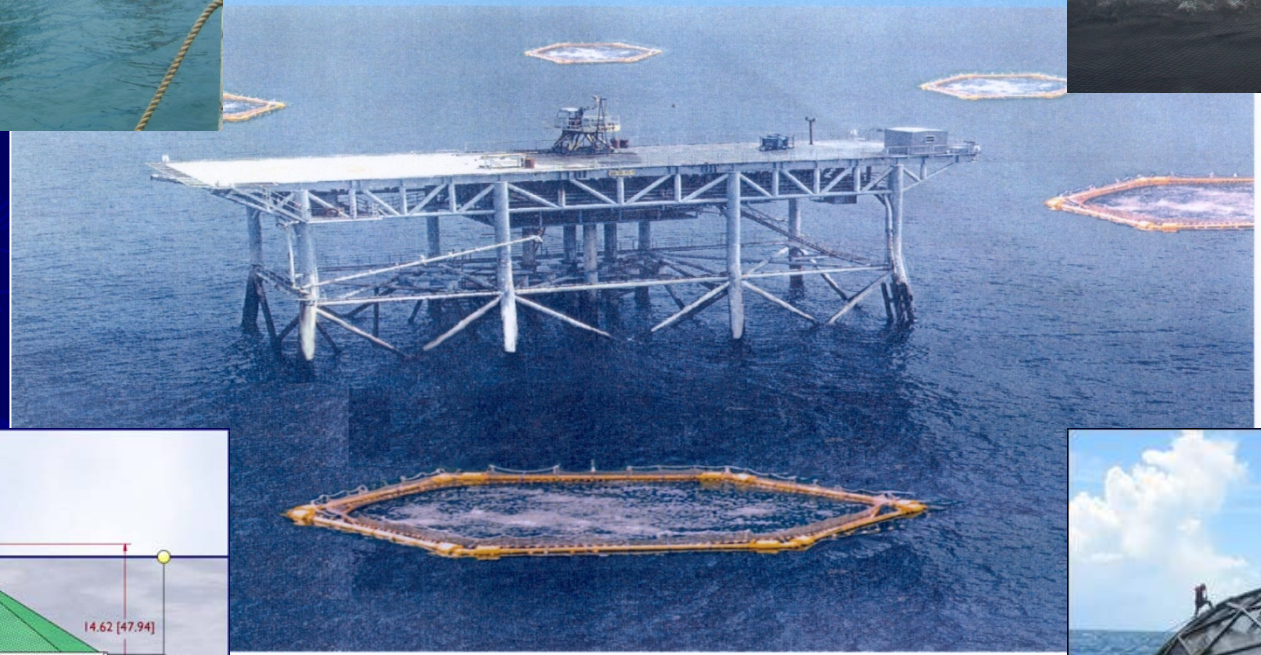


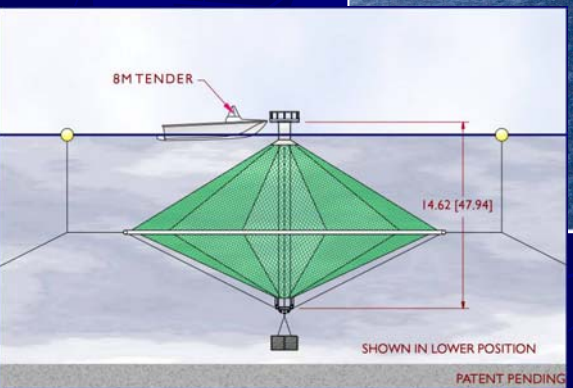
Net Pen Culture: Louisiana Marsh

Red Drum and Hybrid Striped Bass 1990-99

Proposed Aquaculture in the Gulf of Mexico will take advantage of better water quality and more stable environmental conditions. Improved cage designs and suitable candidate species will influence the outcome.

Proposed Offshore Mariculture in the Gulf of Mexico



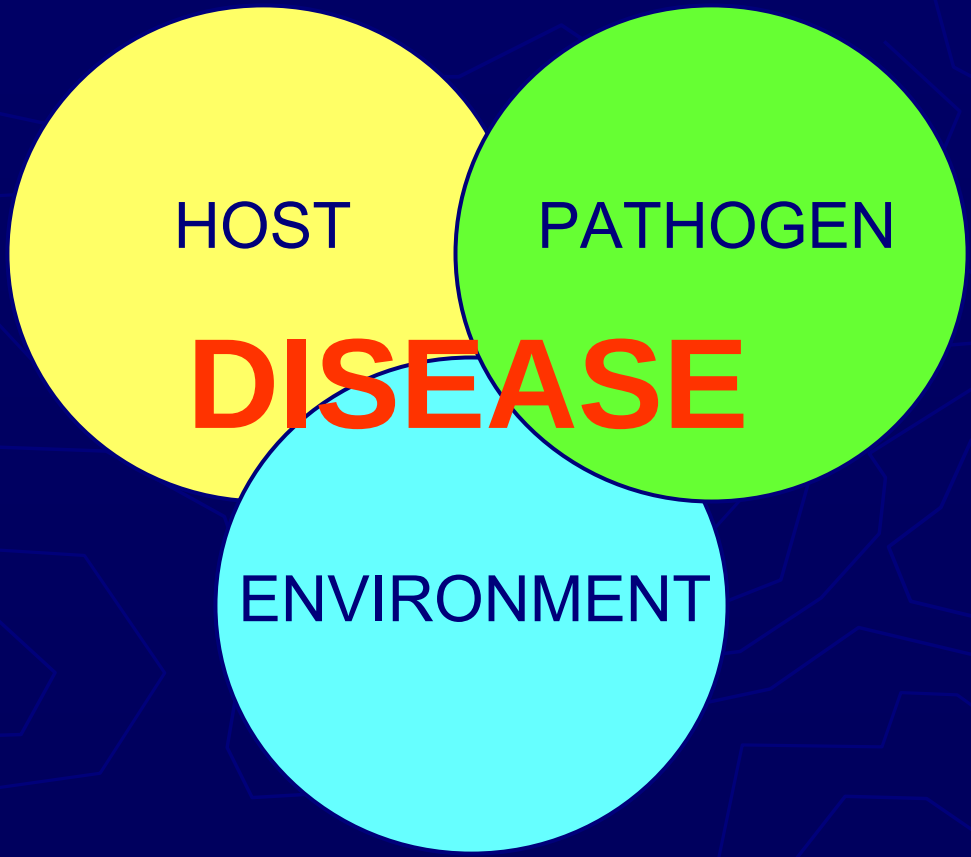


Should Disease Be a Major Concern in Offshore Aquaculture ?

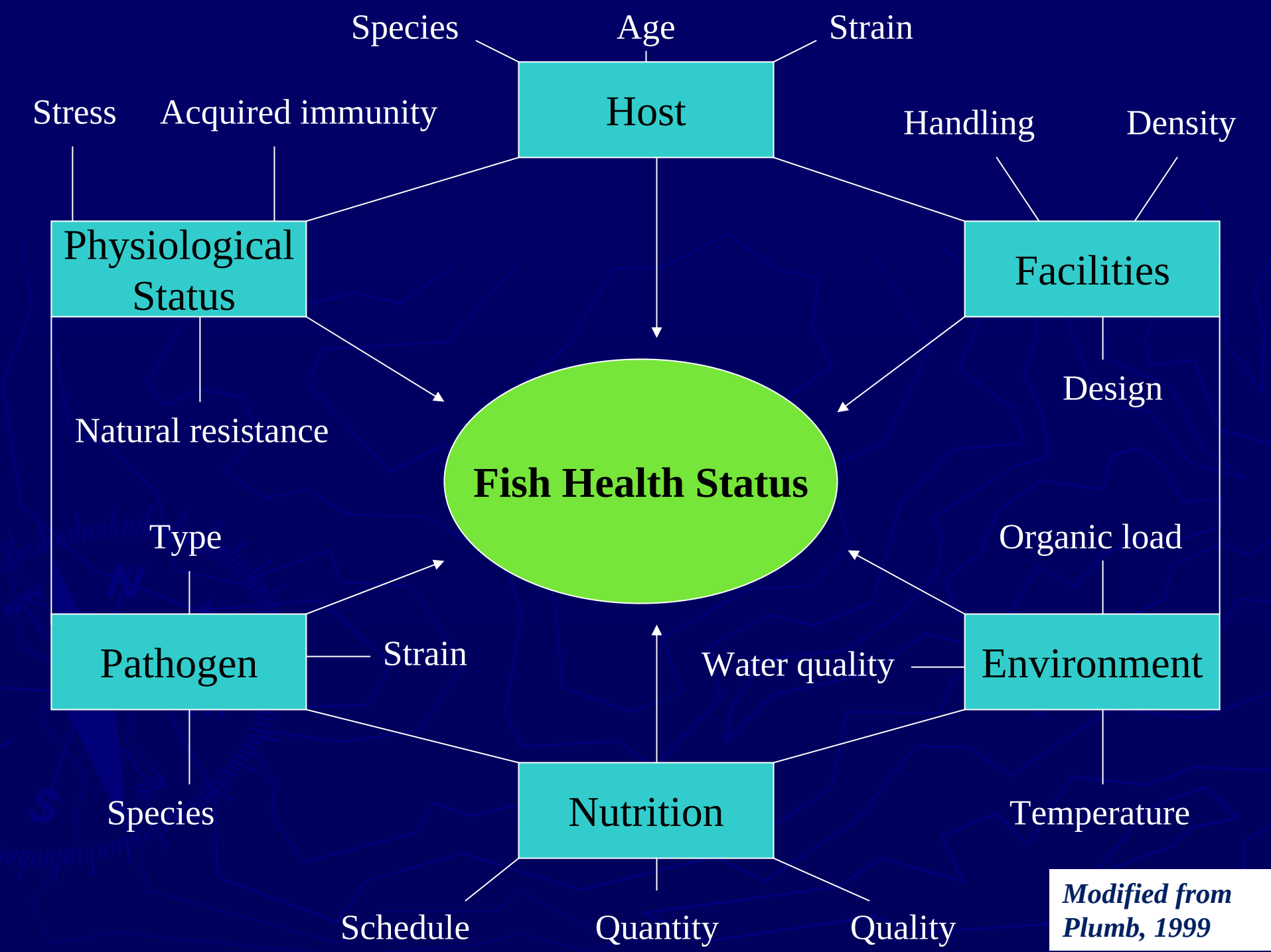
Disease is a fact of life in all forms of aquaculture but proper management can reduce the impact!

Topics to be Covered

- Relationship of host, pathogen and environment.
- Diseases that have caused fish kills in wild fish populations
- Diseases that are expected to cause problems in marine aquaculture in GOM.
- Management of disease in marine aquaculture.



Snieszko 1974


Species
Age
Strain
Host
Stress
Acquired immunity
Handling
Density
Physiological Status
Facilities
Natural resistance
Design
Fish Health Status
Type
Organic load
Pathogen
Strain
Water quality
Environment
Species
Nutrition
Temperature
Schedule
Quantity
Quality
Modified from Plumb, 1999

Causes of Fish Kills

- Water Quality (dissolved oxygen, ammonia)
- Chemical Toxins (pesticides, chemicals)
- Algal Toxins (*Pfiesteria, Prymnesium*, red tide)
- Infectious Disease (bacteria, viruses, parasites)
- Non-infectious Disease (nutritional deficiencies)

Disease in Natural Populations

- Why are fish kills in natural fish populations caused by infectious agents such a rare occurrence?
  - Parasites and diseases commonly exist in wild fish populations.
  - Natural populations of fish are normally in a state of balance with pathogens present in their environment.
  - When this balance shifts, disease can result!

Disease in Natural Populations

- Examples of loss of equilibrium:
  - Overcrowding (disease is one of nature's population control mechanisms)
  - Introduction of an Exotic Pathogen
    Examples: VHS in the Great Lakes 2006
    Largemouth Bass Virus 1996
    White Spot Virus in Crawfish 2007
  - Poor water quality + infectious disease
    Examples: *Streptococcus* in Escambia Bay, Florida 1972.
    Photobacterium in Chesapeake Bay 1964.

Disease in Aquaculture

- Disease is a fact of life in aquaculture. Of all losses, 10% are due to disease.
- High fish density, stress, and ease of transmission increase susceptibility of the fish population to diseases and parasites.
- In marine aquaculture, diseases present in wild fish can infect cultured fish and spread rapidly through the population.

Disease Susceptibility

Dependent on Candidate Species!

Species	Susceptibility
1. Red Drum	low
2. Pompano	moderate
3. Striped bass	high
4. Amberjack	moderate
5. Cobia	moderate
6. Red Snapper	moderate

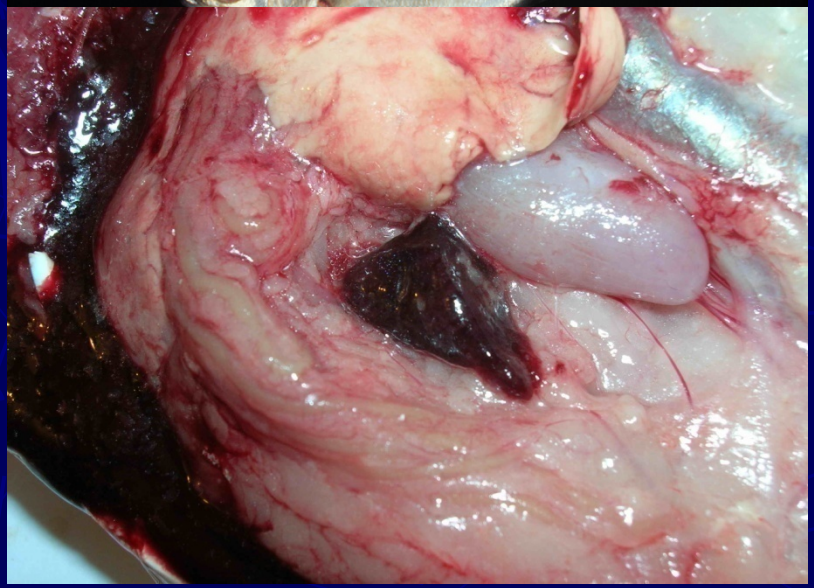
Bacterial Diseases possible in GOM

- *Streptococcus iniae*
- *Streptococcus agalactiae*
- *Photobacterium damselae* subsp. *piscicida*
- *Photobacterium damselae* subsp. *damselae*
- *Vibrio anguillarum*
- *Vibrio* spp.
- *Aeromonas* spp.
- *Mycobacterium marinum*
- *Nocardia seriolae*
- *Piscirickettsia/Francisella*

Streptococcus susceptible hosts GOM

- Wild populations of estuarine fish: menhaden, sea catfish, spotted seatrout, striped mullet, croaker, bluefish, striped bass.
- Cultured fish: striped bass, amberjack, red snapper, pompano.
- Marine baitfish: “cocahoe minnow”

Clinical signs: *Streptococcus*

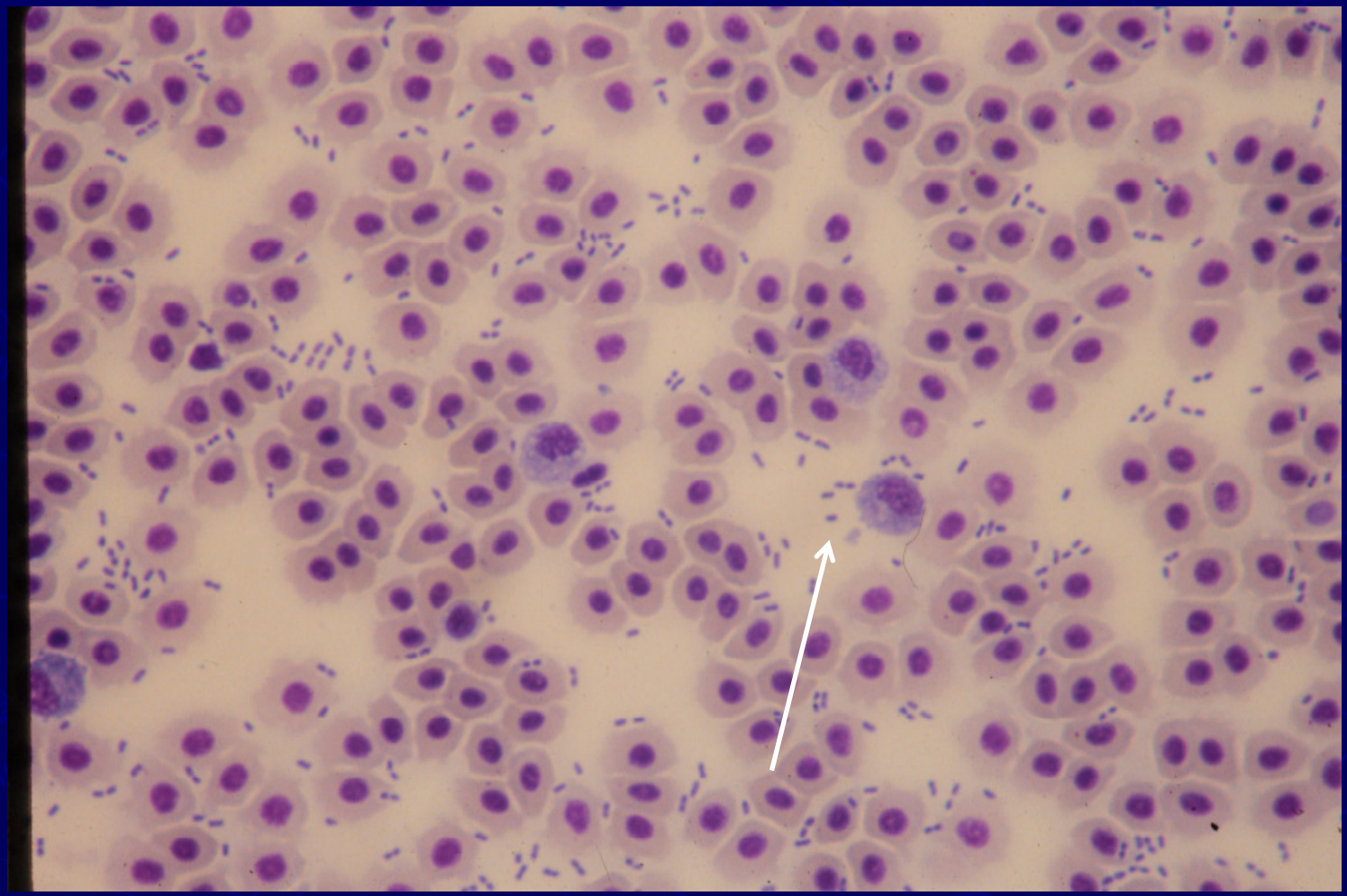


Photobacterium susceptible hosts in GOM

- Striped bass
- Amberjack
- Cobia

Acute Photobacteriosis

blood smear

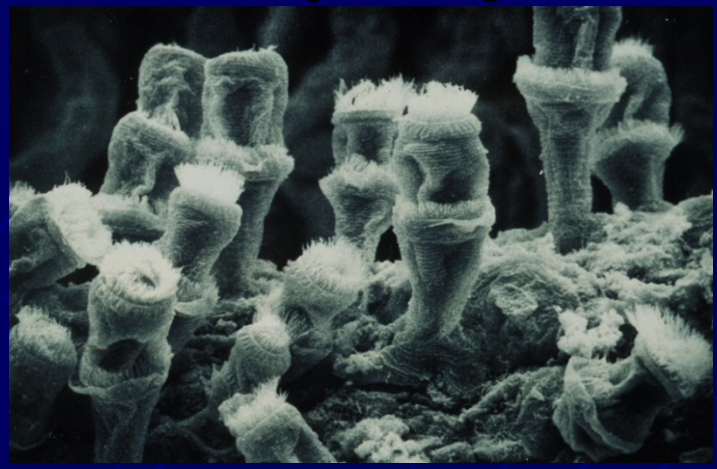


Parasitic Diseases possible in GOM

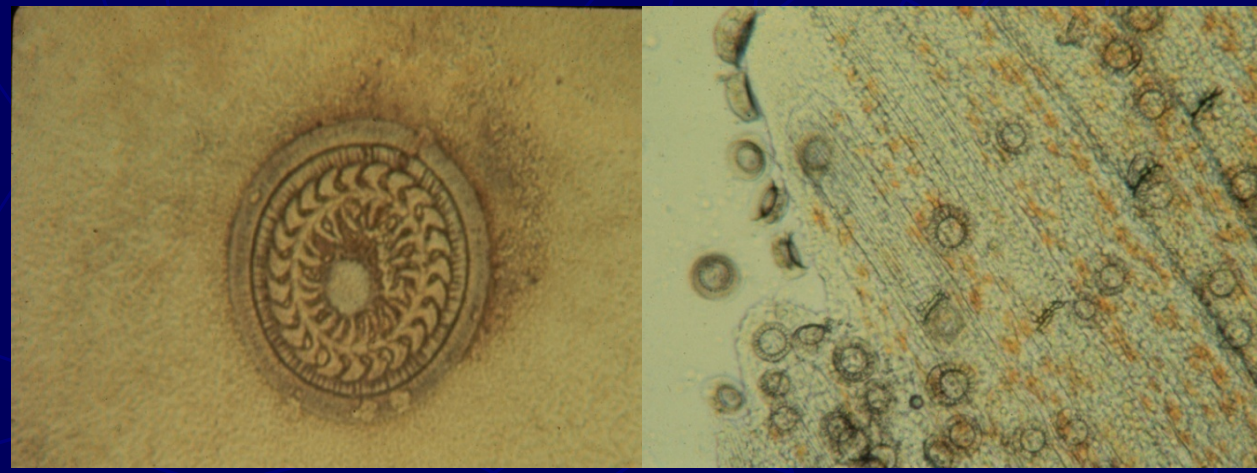
- Ectocommensal protozoans
- Parasitic protozoans
- Trematodes (gill worms)
- Crustaceans (sea lice, fish lice)

Ectocommensal Protozoans (simple life cycle)

- *Apiosoma*
- *Ambiphrya*
- *Riboscyphidia*
- *Trichodina*
- *Trichodinella*
- *Paratrichodina*
- *Dipartiella*



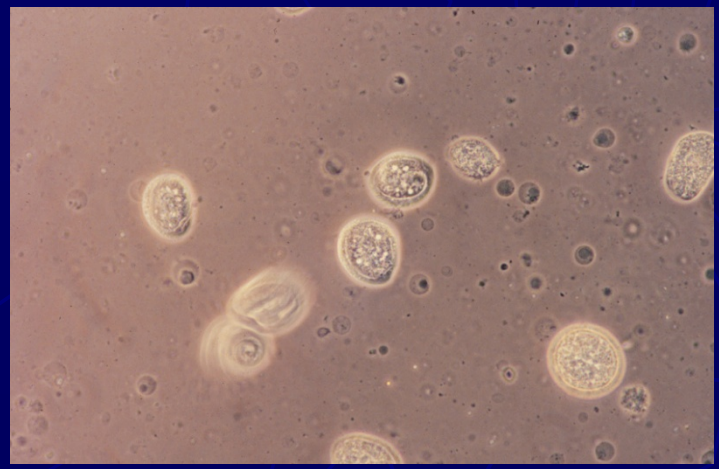
Ambiphrya



Trichodina

Obligate Protozoan Parasites (simple life cycle)

- *Chilodonella*
- *Brooklynella*
- *Uronema*
- *Cryptobia*
- *Paramoeba*

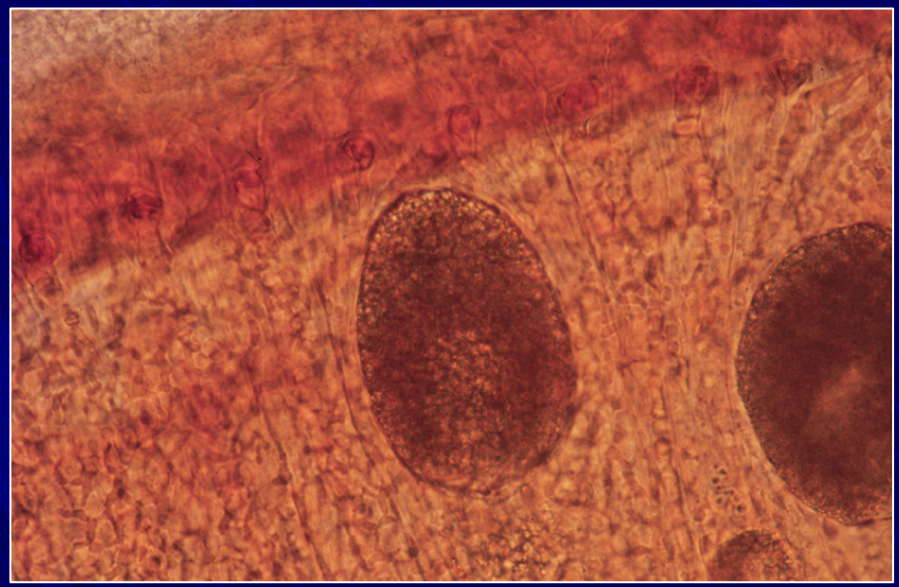


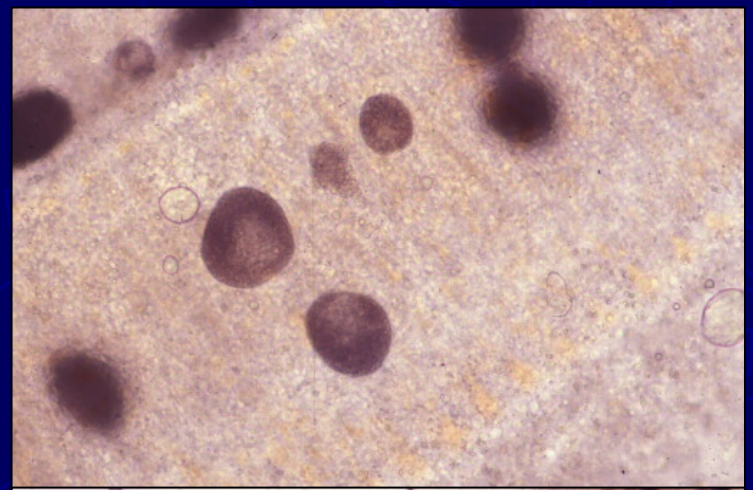
Chilodonella / *Brooklynella*

Protozoan Ectoparasites
(obligate pathogens with a complex life cycle)

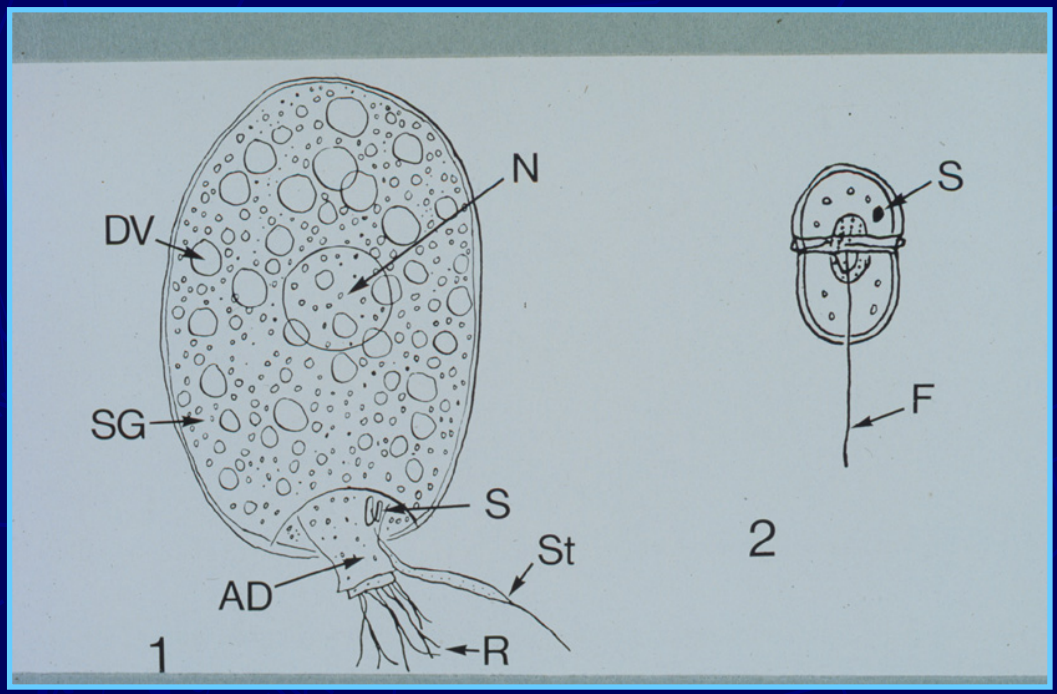
- *Amyloodinium ocellatum*
- *Cryptocaryon irritans*

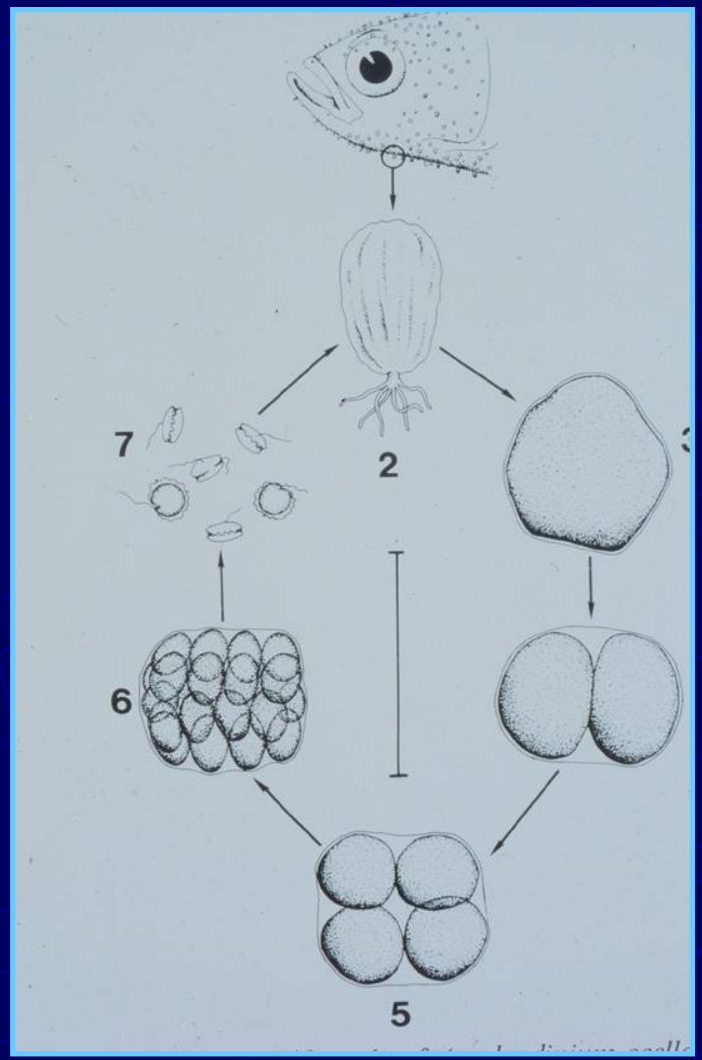
Amyloodinium ocellatum





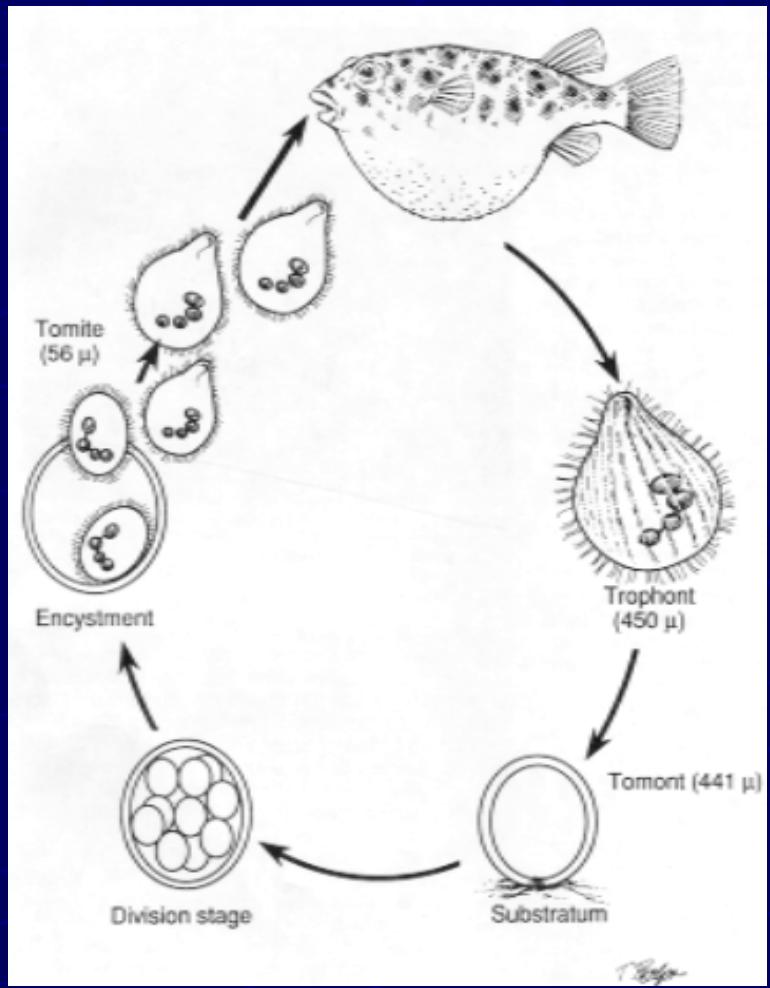
Amyloodinium ocellatum (life cycle)





Noga et al.

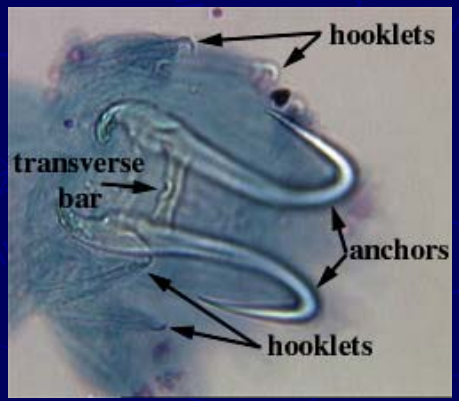
Cryptocaryon irritans (life cycle)

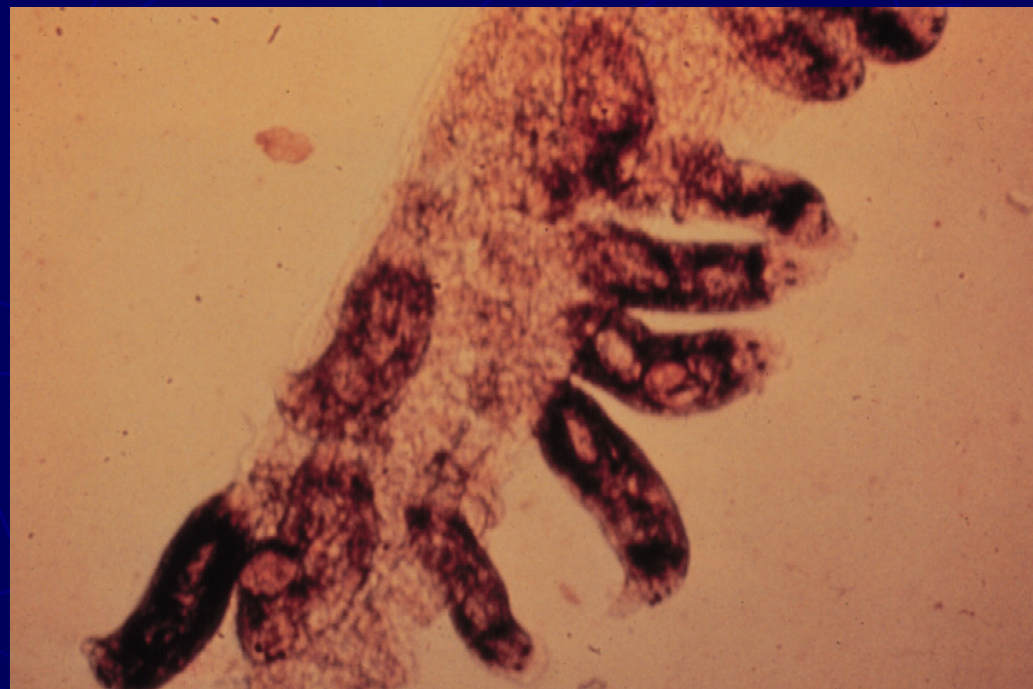


Noga et al.

Trematodes

- *Benedenia*
- *Neobenedenia*
- *Haliotrema*
- *Microcotyle*
- *Dactylogyrus*





Crustaceans

- *Argulus*

  "Fish Lice"

- *Caligus*

  "Sea Lice"

Viruses
(not much known from GOM!)

- VNN – Viral Nervous Necrosis virus (Betanodavirus group)
  A. Striped jack NNV
  B. Puffer NNV
  C. Grouper NNV
  D. Flounder NNV
- Iridovirus group

Fungi

brackishwater and marine fish

- *Aphanomyces*
- *Fusarium*
- *Exophiala*

Ulcerative Mycosis

Chesapeake Bay late 1990's, Calcasieu Lake 2003

- Menhaden

Black Drum

Aphanomyces invadans

Impact of Disease in Offshore Marine Aquaculture May be Reduced by Proper Management Strategies

Management strategies: 1. Broodstock Quarantine

- It must be assumed that broodstock captured from the wild are infested with low numbers of parasites that may not be detectable upon initial examination.
- Freshwater bath or chemical bath treatment may be adequate for protozoans with a simple life cycle. Repeat treatments may be necessary for those with a complex one.

2. Avoidance
spawning systems

- Employed in the temperature-photoperiod closed recirculating system
- Fish are not handled or treated
- UV sterilization and/or ozonation of water
- Micro-filtration (10µm) of water
  dinospores are 8-13 x 10-12 µm
  tomites/theronts are 30-60 µm

3. Avoidance and Prophylaxis
hatchery phase

- Use a pathogen free water source
- Probiotics
- Use pathogen free food sources (decapsulate and rinse artemia cultures)
- Maintain good water quality

4. Prophylaxis and Treatment fingerling phase

- Pathogen free water source (saline well water to fill ponds)
- Immunostimulants in the feed
- Chemical treatment
- Antibiotic therapy (last resort) pending FDA approval of available antibiotics for candidate species.
- Vaccination – Vaccines have contributed to the success of the aquaculture industry.

5. Treatment
growout

- Antibiotic therapy (medicated feeds) - Aquaflor, Romet, pending FDA approval for candidate species.
- *There are currently no FDA approved antibiotics for use with the candidate species for offshore marine aquaculture.
- Autogenous vaccines

Vaccine Strategies

- Application of the proper vaccine may afford protection against pathogens
- Knowledge of the important pathogens of each species is essential.
- Immersion vaccination of fingerlings with a booster prior to moving offshore.

  Photobacterium LSU P1 and P2
- Injection vaccination is likely feasible only with high dollar fish.

Summary

- Infectious diseases are common in aquaculture but rare in natural populations.
- Spread of pathogens from aquaculture fish to wild fish near cages is possible but widespread transmission and disease development is not likely.
- Diseases encountered in offshore aquculture will be dependent on host species.

Summary cont.

- A competent aquatic diagnostic laboratory should be identified to perform health inspections on fish destined for offshore culture.
- A fish health management plan should be developed to reduce the risk of disease for each species.

Louisiana Aquatic Diagnostic Laboratory

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Esteban Soto
Judy Wiles

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