Fish Health Management

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Two Problematic Parasites

- *Henneguya ictaluri*
  - Causative agent of Proliferative Gill Disease (PGD)
    - “Hamburger Gill”

- *Bolbophorus damnificus*
  - Trematode

- Both are associated with significant losses in the commercial production of channel catfish

- Strategic management can reduce losses associated with both parasites
Proliferative Gill Disease

- 3rd most commonly diagnosed disease at the Aquatic Research and Diagnostic Laboratory (ARDL), Stoneville, MS
- Primarily a problem in the spring, and to a lesser extent in the fall
  - Water temperatures between 15-25 C
- Mostly problematic in fingerlings, but can affect all sizes of fish
- Mortalities can reach 100% in some severe cases

Proliferative Gill Disease

Percentage of PGD cases by month (2007-2009)

- Pond water temperature (°F)
- Percentage of PGD cases submitted

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Proliferative Gill Disease

- Caused by the myxozoan parasite *Henneguya ictaluri*

- The complex life cycle of the parasite involves the oligochaete worm *Dero digitata* and the channel catfish

- Exposure of the channel catfish to the actinospore stage of the parasite results in significant gill damage, resulting in respiratory duress
  - “Hamburger gill”

*Henneguya ictaluri*
Treatment options

- No treatments available
  - Supplemental aeration and salt to reduce respiratory and osmoregulatory stress

- Chemical treatments to eradicate oligochaetes are ineffective
  - Doses required to eliminate oligochaetes are lethal to fish

- Chemical treatments targeting the infective stage would require continuous reapplications
  - Some outbreaks can persist for 4-6 weeks

PGD Management

- PGD is present at some level in nearly all catfish ponds during the spring
  - The oligochaete host is present in bottom muds of nearly all catfish ponds

- Little can be done to feasibly predict an outbreak
  - PGD window ranges from March – June; September – November, whenever water temps are between 15-25 C

- However, losses in fish restocked following an outbreak can be prevented
PGD Management

- Following an outbreak which results in significant losses, need to determine when it is safe to re-stock.
  - For reasons that are not entirely clear, not all populations within a pond suffer the same degree of disease severity
  - Even if fish are no longer dying and resident fish show no signs of disease parasite levels can still be lethal to newly stocked fish

- Optimally, parasite levels should be evaluated prior to restocking following an outbreak.

Sentinel Fish Exposures

- Parasite free fish are held in nylon mesh cages to allow free exchange of water within the cage and placed in pond to be restocked

- After 7 days, fish are examined for “breaks” in the gill filaments
  - Calculate the percentage of gill filaments exhibiting at least 1 “break”

- Repeat until sentinel fish no longer show signs of disease or if disease severity has significantly decreased between samplings

- During a given outbreak, the disease will typically cycle through the pond only once
## Sentinel Fish Exposures

<table>
<thead>
<tr>
<th>Percent of filaments exhibiting cartilage breaks</th>
<th>Score</th>
<th>Effect on Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5%</td>
<td>Mild</td>
<td>Little to no effect on fish health</td>
</tr>
<tr>
<td>6-15%</td>
<td>Medium</td>
<td>If environmental conditions are optimal, no direct mortalities involved</td>
</tr>
<tr>
<td>&gt;15%</td>
<td>Severe</td>
<td>Expect mortalities within 2 weeks</td>
</tr>
</tbody>
</table>


## Molecular Analysis of Pond Water

![Molecular Analysis Images]
Sampling for Molecular Analysis

- 1 liter samples collected from at least two different pond locations and determine average spore concentration of the two.
- 7 days later, process is repeated. We average the concentrations from the two different days to determine the disease severity as well as dynamics of the outbreak.
- Tells us if parasite levels are increasing, decreasing or staying the same.

Molecular Analysis of Pond Water

### Molecular Analysis of Pond Water

<table>
<thead>
<tr>
<th>Number of Actinospores/Liter</th>
<th>Score</th>
<th>Effect on Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>Mild</td>
<td>Little to no effect on fish health</td>
</tr>
<tr>
<td>10-25</td>
<td>Mild/Medium</td>
<td>If environmental conditions are optimal, no direct mortalities involved</td>
</tr>
<tr>
<td>25-50</td>
<td>Medium/Severe</td>
<td>Expect mortalities within 2 weeks</td>
</tr>
<tr>
<td>&gt;50</td>
<td>Severe</td>
<td>Expect mortality within 72 hours</td>
</tr>
</tbody>
</table>

### PGD Management

![Graph showing PGD management over time](https://via.placeholder.com/150)

- **PGD Kill**
- **Fish stop dying**
- **Safe to restock**

The graph indicates the risk levels of PGD over time, with Pond Checks marked at specific dates. The risk levels are categorized as Low, Moderate, and High, with corresponding actions for restocking and checking.

- **High Risk of PGD**
- **Moderate Risk of PGD**
- **Low Risk of PGD**
PGD Management

- Following PGD outbreaks, ponds with mild to moderate infections, decreasing in severity, should receive priority for re-stocking.

- Fish should not be stocked into ponds where severe disease signs are present in sentinel fish caged fish or that possess high concentrations of infectious agents.

- Ponds graded as high risk should be reevaluated in 1-2 weeks until parasite concentrations or disease severity in sentinel fish is significantly decreased.

Biological Control?

- Current research regarding potential of small mouth buffalo to reduce populations of *D. digitata* within the pond

- In a simulated pond environment, stocking small mouth buffalo resulted in a nearly 90% reduction in total oligochaetes

- Pond trials are scheduled for spring
Bolbophorus damnificus

- Digenetic trematode sequentially infects the American White Pelican, Ram’s Horn Snail and channel catfish
- Mortalities and significant reductions in overall production associated with infection in the channel catfish
- Life cycle can be broken by chemotherapeutic eradication of snail populations

Photos courtesy of Linda Pote

Economic Impact

<table>
<thead>
<tr>
<th>Pond Type</th>
<th>Fish Production</th>
<th>Net Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uninfected</td>
<td>100%</td>
<td>$1,526/ha</td>
</tr>
<tr>
<td>Light Infection</td>
<td>86%</td>
<td>$592/ha</td>
</tr>
<tr>
<td>Moderate Infection</td>
<td>65%</td>
<td>-$781/ha</td>
</tr>
<tr>
<td>Heavy Infection</td>
<td>60%</td>
<td>-$1,123/ha</td>
</tr>
</tbody>
</table>

Trematode Maintenance

- Reduce snail habitat by keep vegetation around pond banks to a minimum

- Operations with history of trematode problems must be diligent in keeping snail populations at a minimum
  - Whole pond copper sulfate treatments (2.5-5.0 ppm) applied in spring can significantly reduce snail populations
    - Requires hard water (>150 mg/L as CaCO₃) and cooler temperatures to reduce toxicity to fish.

- If farm-level snail eradication is not feasible, be aware of changes in fish behavior indicative of low level trematode infestations (reduced feeding, yet no sick fish)
  - May need to manually examine fish for presence of trematode

Treatments

- Unfortunately, release of the cercaria by the snail host is temperature dependant, which coincides with warmer temperatures, when copper toxicity to fish is increased
  - Low level copper sulfate (0.5-1.0 ppm) treatments have brought fish back on feed mid-summer, but there is significant risk involved.
  - Copper sulfate or hydrated lime around the pond margins
    - Only kills snails adjacent to bank, reapplications may be necessary
  - Safe bet is to wait until fall, when temperatures are lower and whole pond treatments sufficient to eradicate snails can be applied.
Have a plan

- Through strategic management and planning losses attributed to these two parasites can be significantly reduced.

- If you have any questions contact your local aquatic diagnostic lab or:

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  662-686-3580
  griffin@cvm.msstate.edu

  David Wise, PhD
  662-686-3239
  dwise@drec.msstate.edu
Disease Trends

Lester Khoo

General

- Most catfish diseases have a seasonal occurrence
  - Optimal temperature or environment for pathogens, intermediate hosts (e.g. ESC)
  - Suboptimal temperature or environmental conditions for fish (e.g. Saprolegnia)
- Trend data based on submissions to the diagnostic lab
  - Bias – dependent on what is submitted
    - Savvy, experienced producers
  - Still the best data to provide information on prevalence in the industry
Major Disease Diagnosis as a Percentage of Case Submissions (2009)

Yearly Trends in Disease Diagnosis as a Percentage of Submissions

<table>
<thead>
<tr>
<th>Disease</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columnaris</td>
<td>42.6</td>
<td>37.2</td>
<td>44.5</td>
<td>44.7</td>
<td>40.9</td>
<td>48.3</td>
<td>66.4</td>
<td>37.5</td>
<td>36.7</td>
<td>26.8</td>
<td>42.5%</td>
</tr>
<tr>
<td>ESC</td>
<td>33.6</td>
<td>38.4</td>
<td>39.8</td>
<td>34.7</td>
<td>30.8</td>
<td>33.6</td>
<td>26.5</td>
<td>32.6</td>
<td>18.6</td>
<td>15.0</td>
<td>33.2%</td>
</tr>
<tr>
<td>PGD</td>
<td>29.8</td>
<td>20.1</td>
<td>16.3</td>
<td>10.6</td>
<td>10.7</td>
<td>8.9</td>
<td>17.8</td>
<td>18.4</td>
<td>33.7</td>
<td>21.4</td>
<td>18.8%</td>
</tr>
<tr>
<td>Saprolegnia</td>
<td>10.5</td>
<td>10.4</td>
<td>10.1</td>
<td>5.3</td>
<td>3.7</td>
<td>4.1</td>
<td>8.4</td>
<td>8</td>
<td>9.2</td>
<td>9.4</td>
<td>7.9%</td>
</tr>
<tr>
<td>CCV</td>
<td>2.3</td>
<td>7.3</td>
<td>5.8</td>
<td>8.9</td>
<td>10.8</td>
<td>9.2</td>
<td>5.9</td>
<td>2</td>
<td>0</td>
<td>7.2</td>
<td>5.9%</td>
</tr>
<tr>
<td>Anemia</td>
<td>4.9</td>
<td>5</td>
<td>5.9</td>
<td>5.2</td>
<td>2.1</td>
<td>4.6</td>
<td>4.9</td>
<td>19.7</td>
<td>2.7</td>
<td>3.8</td>
<td>4.9%</td>
</tr>
<tr>
<td>VTC</td>
<td>2.6</td>
<td>2</td>
<td>3.7</td>
<td>3.2</td>
<td>1.0</td>
<td>3.1</td>
<td>1.3</td>
<td>5.4</td>
<td>3.4</td>
<td>2.6%</td>
<td></td>
</tr>
<tr>
<td>Bolbophorus</td>
<td>5.6</td>
<td>4.4</td>
<td>2</td>
<td>1.1</td>
<td>2.6</td>
<td>3.6</td>
<td>0.7</td>
<td>1.5</td>
<td>0.3</td>
<td>1.8</td>
<td>2.4%</td>
</tr>
<tr>
<td>Ich</td>
<td>2.7</td>
<td>1.8</td>
<td>2.2</td>
<td>0.5</td>
<td>5</td>
<td>1.3</td>
<td>0.8</td>
<td>0.6</td>
<td>0.8</td>
<td>3.1</td>
<td>1.9%</td>
</tr>
<tr>
<td>Number of Cases</td>
<td>2189</td>
<td>1602</td>
<td>1057</td>
<td>832</td>
<td>778</td>
<td>602</td>
<td>945</td>
<td>1144</td>
<td>630</td>
<td>678</td>
<td>1036</td>
</tr>
</tbody>
</table>
Columnaris disease (saddle back)

- *Flavobacterium columnare* (Chondrococcus, Flexibacter)
- Gram negative rod
- Optimum temp – 15-25C (59-77F)
- Lesions – skin, fins, mouth, gills
- Dx – characteristic lesions; skin scrapes, gill clips - bacteria in haystacks; characteristic growth on specialise media
- Tx – antibiotics
- Attenuated live vaccine available
Enteric Septicemia of Catfish (ESC)

- *Edwardsiella ictaluri*
- Gram negative rod
- Optimum temp 22-28C (72-82F)
- Hemorrhage and congestion in the fins, skin, exophthalmia, cranial ulcerative lesion (hole in the head), ascites, hemorrhage in the GI, hepatitis, swollen and pale posterior kidney
ESC

- Dx - presumptive - characteristic lesions (ddx – *Edwardsiella tarda* – usually warmer temperatures – 28°C and above; bullae/abcess formation – malodorous putrefactive lesions); definitive- bacterial culture – colony morphology, biochemical tests and culture temperature
- Tx – Antibiotics; take off feed
- Management - vaccines – live attenuated; reduce feed
Proliferative Gill Disease (Hamburger Gill disease)

- *Henneguya ictaluri*: actinospore stage *Aurantiactinomyxon ictaluri*; intermediate host - aquatic oligochaete (*Dero digitata*)
- Optimum temperature - 15-25°C
- Fish on surface gasping; behind aerators even when oxygen levels usually considered adequate
Proliferative Gill Disease

- Swelling, hemorrhage often with blunted gill filaments (hamburger-like appearance)
- Dx - gill clips – fractures in lamellar cartilage; histopathology and molecular techniques
- Tx - palliative – increase aeration and add salt; others have recommended adding other spp. (fathead minnows) to consume intermediate host; some have recommended moving fish to non-affected pond
Saprolegnia

- *Saprolegnia* (also *Achyla, Dictyuchus* water molds – oomycetes - classification)
- Optimal temperature range 15°C and below – rapid drop in water temperature (5°C in 24hr) – redistribution/loss of mucus cells – fungus grows best at the warmer temperatures
- Superficial cottony/woolly (on gills, skin, fins and eggs; color varies due to entrapment of sediment or algae; early lesions – pale focus surrounded by a ring of erythema (redness)
- Tx: No viable treatment in ponds
Channel catfish virus disease (CCV)

- Channel catfish virus (unclassified herpesvirus)
- Optimum temperature – 28°C and higher
- Ecchymotic hemorrhage skin and fins, exophthalmia, pendulous abdomen – ascites, hemorrhage on internal organs (herpes in other animals)
- Dx- Virus isolation – look for CPE on CCO or BB
- Size of fish (6” or less susceptible), highly contagious prevent spread or secondary bacterial infections
- Tx: No treatment
Channel catfish anemia

- White-lip or no blood disease
- Etiology – unknown
- Dx – Check pack cell volume
- Listless on side of bank; behind aerator
- Usually larger fish affected
- Late summer/fall/winter
- Tx - Palliative – increase aeration and salt
Visceral toxicosis of catfish

- Toxin - Botulium type E associated
- Optimum temperatures – Early spring and late fall (SE USA)
- Externally usually none although may have intestinal or gastric mucosa in oral cavity; internally – chylous effusion, pale proximal intestinal tract with prominent blood vessels (congestion), intussusceptions, congested spleen, reticular pattern in liver

Visceral toxicosis of catfish

- Abnormal behavior – schooling; porpoising; listless on edge of bank; barbels quivering or muscle fasciculations
- Dx - based on gross internal lesions and ability to recreate lesions via IP injection of serum of affected fish – die within 24 hrs usually with similar lesions
- Tx - None
Bolbophorus damnificus (Trematode)

- Complex life cycle involving American White Pelicans (final host) and rams horn snail (intermediate host); catfish (intermediate host)
- Optimum temperature – above 16°C
- Mortalities; decrease feed intake
- Dx – remove intermediate stage (metacecaria) in channel catfish and identify
- Tx – break life cycle – kill rams horn snail – copper sulfate or hydrated lime – pond edge treatments
Ichthyophthiriosis (Ich – white spot)

- Protozoal parasite
- Optimum temperature - Cooler months (winter and spring in Southeastern US) 26°C and below
- Small pin-point white spots on fish
- Dx – Skin scrapes or gill clips – look for infective stage
- Tx – Copper sulfate or formalin; treatment regime dependent on water temperature as treating parasite off the fish; warmer temperatures life cycle faster need to treat more often; treat until one past a negative test
Atypical Aeromonas hydrophila

- Unusual Aeromonas hydrophila infections in fish from AL (limited to AL, 1 case in east MS, 1 in MS Delta 2004)
- Typical Aeromonas sp. infections usually 2
- AL fish had gross lesions suggestive of bacterial septicemia
- Pure isolates of Gram –ve bacilli
- Coded out different on BBL Crystal kit (also API) from the typical A. hydrophila (also proven genetically)
- Snagged and sentinel fish from affected ponds – no gross lesions, culture negative but have histological lesions

Documented Aeromonas hydrophila Cases in Alabama in 2009

Courtesy of Bill Hemstreet
Alabama Fish Farming Center
Gross lesions

External
- Ecchymotic hemorrhages on the skin
- Iridial hemorrhage
- Congestion/hemorrhage at vent
- Hemorrhage at fin bases

Gross Lesions

Internal lesions
- Hemorrhage/congestion on all visceral organs including peritoneal lining and visceral fat
- Congested spleen
- Congested liver (reticular pattern)
- Hemorrhage in muscle
Atypical *Aeromonas hydrophila*

- **Dx** – Culture and isolate bacteria; biochemistry; molecular methods (latter being develop)
- **Tx** - Antibiotics

**Summary**

- There is variation from year to year for occurrence of diseases
- Usually a seasonal occurrence
- Although some diseases have hallmark lesions some have similar lesions e.g. ESC, *Edwardsiella tarda* and atypical *A. hydrophila*
  - Need for submissions
    - Antibiotic sensitivity
    - Identifying changes in prevalence
    - Identifying new or emerging diseases
Assessing the benefits of medicated catfish feeds

Patricia S. Gaunt, DVM, PhD

Treatment regimes for catfish bacterial infections: (NAHMS, 2003)

- **Withhold feed**
  - **Pro**: No additional expense, reduces mortality
  - **Con**: Do not grow

- **Feed non-medicated feed**
  - **Pro**: Continue to grow
  - **Con**: Losses and wide swings in survival

- **Feed Medicated feed**
  - **Pro**: Continuous feeding and growth of fingerlings if used early and for full treatment
  - **Con**: Additional expense
From the field: “Why use medicated feed?”

- “It's hard to put a financial price on it until you experience the negative impact (loss) of the disease.”
- “Dead fish: no return.”

Catfish medicated feeds

<table>
<thead>
<tr>
<th>Medicated feed</th>
<th>Label Indications</th>
<th>Label Instructions</th>
<th>Cost/ ton</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romet</td>
<td>ESC</td>
<td>1x/day for 5 days</td>
<td>$875 base $462</td>
<td>Over the counter¹</td>
</tr>
<tr>
<td>Terramycin</td>
<td><em>Aeromonas hydrophila</em> and <em>Pseudomonas sp.</em></td>
<td>1x/day for 10 days</td>
<td>$713 base $300</td>
<td>Over the counter¹</td>
</tr>
<tr>
<td>Aquaflor</td>
<td>ESC and Columnaris disease</td>
<td>1x/day for 10 days</td>
<td>$975 base $562</td>
<td>Veterinary Feed Directive Drug (VFD)*²</td>
</tr>
<tr>
<td>Aquaflor® -CA1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Can be used extra-label through veterinary prescription.
² Veterinary Client Patient Relationship (VCPR) must exist

*VCPR must exist
²Can be used as an INAD
Management of fingerlings during ESC

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Medicated feed</th>
<th>Non-medicated feed</th>
<th>Withhold feed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome</td>
<td>Fewer mortalities, 6 inch fingerlings by fall</td>
<td>More mortalities; 6 inch fingerlings by fall</td>
<td>Fewer mortalities; 5 inch fingerlings by fall</td>
</tr>
</tbody>
</table>

Hanson, Terrill. The economic implications of feeding fingerlings during outbreaks of enteric septicemia in catfish. AquaFocus: SPAH-AQF-43. 2006

Calculating break-even cost of medicated feeds in food fish to treat bacterial diseases

- 30,000 (60,000 lbs) food fish
- 1 ton of Medicated feed will treat 10,000 lbs of fish (2% bw)
- 60,000/10,000 = 6 tons of Medicated feed
- $450* x 6 tons = $2,700 per treatment
- $2,700/$0.85 per lb = 3,176 lbs of fish
- 3176 lbs / 2 lb = 1,588 fish

* Mean cost of medication in feeds
Production impact of restricted feeding for bacterial disease management

Feed withheld 15 days in spring
Feed withheld 15 days in fall
**Total 30 days – No Feed**

30 days X 125 lbs feed/acre = 3,750 lbs feed/acre

3,750 lbs feed per acre/ 2.5 FCR = 1,500 lbs of *unrealized GAIN*/acre

Financial impact of missing feed days

100 Acre Farm
1500 lbs per acre *unrealized gain*

<table>
<thead>
<tr>
<th>Percentage Affected</th>
<th>Total Feed Lost (lbs)</th>
<th>Value (lb x $0.85)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25% affected</td>
<td>37,500 lbs</td>
<td>$31,875</td>
</tr>
<tr>
<td>50% affected</td>
<td>75,000 lbs</td>
<td>$63,750</td>
</tr>
<tr>
<td>100% affected</td>
<td>150,000 lbs</td>
<td>$127,500</td>
</tr>
</tbody>
</table>
Weighing benefits/cost of medicated feed

- Calculate if income from increased size and/or number of survivors outweigh medicated feed costs
  - If benefits offset costs, producer will have larger return with medicated feed vs. non medicated approaches to bacterial disease control

Maximizing efficacy of medicated feeds

- To obtain full benefit of medicated feeds, use as directed on label and at 1st sign of disease
- Feedback from the field: Lack of efficacy with medicated feed was in large part associated with extra-label usage
Why do farmers use medicated feed extra-labelly?

- “No choice; limited number of medications”
- “To see if they’ll work”
- Economic reasons: “To stretch the dollar”

Potential consequences of extra-label abuse

1. Lack of efficacy → Wasted resources
   - For example, every third day treatment
     - Romet® withdrawal: 3 days
       - Enough medication is depleted from catfish system to be safe when fillet consumed by humans or animals
       - Medication concentration is inadequate in the fish to combat bacteria pathogens

2. Resistance of bacteria to medicated feeds
   - Suboptimal dosage of antibiotics selects for bacteria with genetic mutations that encode for antibiotic resistance
Understanding good practices for using medicated feeds

- *E. ictaluri* shed from experimentally infected fish for over 6 days post challenge and persists in pond water and mud for 10 and 90 days, respectively, at 25°C.
  - Antimicrobials assist fish’s immune system in fighting infection; they do not totally eliminate bacteria.
- Medicated feed is not a silver bullet
  - Should be used in conjunction with good husbandry, vaccines, and genetics.

How to enhance efficacy and reduce production costs associated with medicated feed

- Begin medicated feed at 1st disease sign
  - Diseases frequently diagnosed from lesions
  - Culture bacteria to assess antimicrobial susceptibility
- With delay, bacteria become refractory to antimicrobial treatment
  - ESC: Fish anorectic
  - Columnaris disease:
    - Fish not anorectic in tank studies
      - Probably true in field until mouth becomes extremely necrotic
    - Studies show *F. columnare* infections worsened when feed withdrawn
Conclusions

- Calculate if income from increased number and length of surviving catfish will offset medicated feed cost.

- For maximal efficacy and to retain bacterial susceptibility, use medicated feeds according to label directions.

Thanks for your attention!