

Teaching Plan:

Module: Walleye - Section E

Problem Area: Feeding Walleye

Goal: The goal of this problem area is to identify the types of rations and feed requirements of walleye and to develop an understanding of the term “conversion.”

Learning Objectives: Upon completing this problem area, students will be able to:

- describe the types of walleye feed available
- identify the nutritional requirements of walleye
- identify the feeding schedule required by walleye
- identify the different feeding methods
- explain what is meant by “food conversion rates”

Resources The following instructional resources are needed to complete this problem area

Essential:

Transparencies.

Additional:

Walleye Culture Manual, by Richard, P.D. & J. Hynes, Ontario Ministry of Natural Resources. 1986

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## Content and Procedures

### Preparation (Interest Approach):

Discuss the importance of feeding in any livestock production system. Highlight feeding rates, efficiency and quality. Also, discuss how feed can be the largest expense to the producer.

### Presentation:

#### A. What types of feed are available to the walleye producer?

Call or write to several of the local feed mills and receive a list of the feeds produced. Discuss the list with the class and determine if any of the feeds would be suitable for walleye culture. See if you can get the owner or manager of a mill to visit. Discuss with him/her the possibilities of getting the proper feeds from a local mill.

1. Feed availability depends upon geographic location. It is an economical strain to have to transport large quantities of feed great distances, so the local walleye producer should try to locate a feed source within a few hundred miles.
2. Small quantities of fry or fingerling feeds maybe ordered from across country.
3. The walleye industry is so new that feeds for adult walleyes have not been specifically developed, but many companies are producing diets which are satisfactory.

#### B. What are the nutritional requirements of the walleye?

Use TM EI or the chalkboard to feed a disussion on the nutritional requirements of the walleye.

1. The natural foods of the walleye include a variety of zooplankton, insects, crustaceans, and fish.
2. Fry. Walleye fry feeds should contain at least 45-50% protein.
3. Fingerlings. Walleye fingerling diets should contain at least 35% protein.
4. Adult. Adult walleye need 40-50% of their diet to be protein
5. Protein sources. Good sources of protein are krill, shrimp, pellets, insects, minnows, etc.

#### C. How much and how often should the walleye be fed?

UesTM E2 or the chalkboard to lead a discussion on the feeding of walleye. Review the material on the methods of distribution feeds from the first semester material.

Larvae in intensive culture must have feed available 24 hours per day. An automatic clock type feeder, set to feed every five minutes will work.

D. What are the 4 methods for feeding walleye?

1. Hand feeding is good for fingerlings and adults in pond culture, at dusk,
2. Manual/mechanical.
3. Automatic/timer,
  - a. Care must be taken when calibrating an automatic feeder to insure that no more feed than the fish will eat is being fed, while on the other hand there must be enough feed provided to insure optimum growth.
  - b. Walleye fingerlings, advanced fingerlings and adults will acclimate to a solenoid feeder.
4. Demand, Walleye are feed ad libitum — as they desire.

Review:

Review by having students demonstrate their knowledge and understanding of the objectives for this problem area, Lead a discussion with students by asking questions that cause the students to explain the content that goes with each objective.

Evaluation:

Evaluation will be based on class participation, quizzes and a final examination. Example exam questions are attached.

## Nutritional Requirements of Walleye

- Larvae:
  - 45+% protein
  - 8+% fat
- Fingerlings:
  - 35-45% protein
  - 6+% fat
- Adults:
  - 32+% protein
  - 4-10% fat

## Feeding Rates for Walleye/Manual Feeding

- 1-3-inch Fingerlings:  
5-10% of body weight per day
- 3-6 Inch:  
5% of body weight per day
- 6-inch Plus:  
3-5% of body weight per day
- Adults:  
2-3% of body weight per day

Quiz for Section E

Name:

Date:

Quiz on Feeding Walleye

1.     T     F     A demand feeder allows the fish to get feed when they want to eat.
2.     T     F     A walleye fry diet should contain roughly 25% protein.
3.     T     F     Feeds designed for adult walleye are available from many sources.
4.     T     F     Walleye fry in intensive culture require feed to be available nearly constantly.
5.     T     F     Using demand feeders can improve feed efficiency.
- 6-10.   List the natural foods of walleye.

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### Key for Quiz - Section E

1. T
2. F
3. T
4. T
5. F
  
6. Zooplankton
  
7. Insects
  
8. Crustaceans
  
9. Fish
  
10. Krill

Teaching Plan:

Module: Walleye - Section F

Problem Area: Controlling Pests and Diseases

Goal: The goal of this problem area is to identify the types of disease and predator problems faced by walleye producers and learn methods of controlling these problems.

Learning Objectives: Upon completing this problem area, students will be able to:

- discuss the types of walleye diseases
- identify a disease problem
- discuss the prevention and treatment of walleye diseases
- identify the different methods of pest control

Resources: The following instructional resources are needed to complete this problem area

Essential:

Transparencies.

Water Quality in Ponds for Aquaculture. by Boyde, C. E., 1990.

Additional:

Slides of infected fish. Microscope, dissecting kit, several .5 to 1.5 lb fish.

Textbook of Fish Health, by Post, G., TFH Publication, Neptune City, N.J., 1987.

# Aquaculture Curriculum Guide

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## Content and Procedures

### Preparation (Interest Approach):

Have the students dissect a fish, Identify the parts. Discuss how various pests and diseases can attack certain internal parts as you are identifying them. Tell the students that it is critically important to identify diseases as early as possible, as progress is of disease is quick in warm water. Tell them they should keep daily mortality records and watch for behavioral changes.

### Presentation:

#### A. What diseases are walleye susceptible to?

Use TM F1 as a guide as you lead a discussion on the diseases of walleye. Slides showing infected fish would help.

##### 1. Bacterial diseases- *Flexibacter columnaris*.

- a. Can occur as an internal, systemic infection, an external infection, or both simultaneously. Internal infections may cause the fish to stop eating, swim listlessly in shallow water and die.
- b. External infections generally will appear as gray or dark yellow lesions or ulcerations on the skin. Infections often occur on the gills and in the mouth, these are usually dark yellow to brown.
- c. Diagnosis of the disease is made by identifying the bacteria either microscopically or through isolation and biochemical testing.
- d. An external infection of Columnaris can be treated with potassium permanganate. The amount of potassium required will vary with the amount of organic material in the water.
- e. For tank treatments, the most common method of treatment is to add 2 ppm to the water every hour, using a constant flow siphon or a chemical meter, until the red color persists for several hours. An internal infection should be treated with Terramycin medicated feed.
- f. Columnaris generally appears as a stress related disease, usually from handling and crowding heavily, whether it be trapping, grading or tank capacity conditions. It is a common harvest problem. Keep handling of fish to a minimum,

##### 2. Bacterial disease- *Aeromonas* and *pseudomonas*.

- a. Are common bacteria of fresh water which may cause subacute or chronic infections following a period of stress.
- b. Behavioral changes caused by an infection may include: reduced feeding activity, lethargy, and swimming listlessly in shallow water.
- c. Clinical signs of these infections are highly variable but may include: small hemorrhages which look like pin pricks on the body and fins, irregular red or gray lesions on the skin, eroded fins, raised scales, protruding eyes (exophthalmia) swollen abdomen, and a discharge of fluid from the anus.
- d. Internal signs may include pale liver and kidney, hemorrhaging of the internal organs and body cavity, fluid in the stomach and intestine. *Aeromonas* can be treated with medicated feeds.

### 3. Protozoan parasites - *Ichthyophthirius multillis* (Ich),

UseTM F2 to describe the life cycle of Ich.

- a. Ich can decimate a producer's stock once it becomes infected. Ich is the only protozoan parasite of fish that can be seen with the unaided eye.
- b. The disease signs include small white spots on the skin, fins and gills which, when examined under a microscope, are shown to be large ciliated protozoans with a crescent-shaped nucleus.
- c. The complex life cycle of Ich makes it difficult to treat. The mature parasite is found just under the skin of the fish and can't be treated when encysted because the skin protects the parasite from any chemical treatment. After spending one to three weeks (varies with temperature) in the fish, the adult leaves the fish and attaches to the bottom or side of the tank or pond,
- d. There it will develop into a mature trophont within 24 hours and will then rupture and release up to 2,000 free swimming tomites, which must find a fish to infect within 2 days or die.
- e. Treatment of Ich requires multiple applications of chemicals, because only the free swimming stage can be killed.

### 4. Protozoan parasites - other protists.

UseTM F3 to demonstrate what some of the parasites of walleye look like.

- a. There area wide variety of protozoan parasites of walleye. Most of these occur as external parasites of the skin and gills.
- b. A healthy fish will almost always harbor a small population of these parasites, but when the fish's natural ability to control this population is disrupted by stress, e.g., when fingerlings are going through a starvation period associated with conversion to dry diets, the population of protozoans can multiply rapidly.
- c. A severe infection can interfere with the fish's ability to respire or may open a pathway for a bacterial pathogen to infect the fish.

### 5. Trematodes.

- a. Monogenetic (meaning one host). External parasitic flatworms are common, but generally are not a problem unless the fish are stressed and the population of flatworms increases dramatically.
- b. Digenetic (meaning at least two hosts). Yellow grubs, white grubs and black spot are all names for various trematodes which infect walleye. Each has a specific area within the body in which it lives.
- c. There are not any known cures for these grubs and the only prevention is to break the life cycle of the parasite.
- d. Their life cycle involves living as an adult in piscivorous (fish-eating) birds and shedding eggs into the water, The eggs hatch and infect snails, where the parasite reproduces and, after an incubation period, releases large numbers of young which search for and infect fish. If the fish is eaten by a bird, the parasite will finally reach the adult stage in the bird.

## ***Aquaculture Curriculum Guide***

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6. Viral diseases.
  - a. Lymphocystis is a viral disease that is most common in walleyes.
  - b. The disease can be identified by the gray or white warty growths that form on the fins and skin of infected fish.
  - c. The disease is rarely fatal, but will reduce the market value of the fish.
  - d. There is no known therapy for lymphocystis the best treatment would be to isolate the infected stock, and sterilize the facility.
  
7. Fungi.
  - a. Fungal infections can occur either internally or externally in fish, but the majority of infections will be external.
  - b. Saprolegnia is the fungus that causes an external fungal infection on fish.
  - c. Fungal infections can be identified by the white or gray mossy patches which form on the fish's skin, gills, or fins.
  - d. Infections usually begin on the margins of the fins or gills and work toward the center of the fish.
  - e. Fungal infections not severe enough to kill the host may open a port of entry for another infectious agent, or weaken the fish's defenses enough to allow a parasite problem to develop.
  - f. Fungal infections themselves are usually a secondary invader, following injury or bacterial infection in the fish.

B. How can the producer diagnose the causative agent?

The best way for a producer to be sure of the causative agent of a problem is to take some of the sick fish to a diagnostic lab to take a short course on disease identification in fish.

C. What are the disease prevention and treatment techniques?

Check with local authorities on the safety of all chemicals by using the one on food fish

ShowTM F4.

1. For columnaris
  - a. Minimum handling, no more than absolutely necessary
  - b. Proper maintenance of O<sub>2</sub> concentration.
  - c. Proper water quality.
  - d. Slow tempering of fish from pond temperature to tank temperature.
  - e. Keep fish as stress free as possible.
  
2. Bacterial diseases.
  - a. Water quality maintenance tank cleaning and maintain DO.
  - b. Removal of advanced disease infected fish and prompt removal of dead fish.
  - c. Proper sanitary practices, e.g., quarantine of materials, use of clean tools, decontamination, etc.
  - d. Medicated feeds.
  - e. Chemical baths.
  - f. Chemical injection.

3. Ich.
    - a. Examine all fish prior to stocking and never release infected fish.
    - b. Disinfect all equipment with chlorine or formalin after handling infected fish.
    - c. Isolate the discharge water from infected fish to prevent spreading.
    - d. Formalin. A prolonged treatment of 25 ppm every other day for 10 days should cure the problem, A treatment of 1 ppm copper sulfate for every 100 ppm of hardness every 2 or 3 days for at least 3 treatments.
  
  4. External protists.
    - a.  $\text{CuSO}_4$
    - b. Formalin -be aware of possible toxicity to walleye.
    - c.  $\text{KMnO}_4$ .
    - d. Salt.
  
  5. Trematodes.
    - a. Monogenous. Formalin at 25 ppm for a prolonged treatment or at 250 ppm for a 1 hour bath should remove the parasites.
    - b. Digeneous. There is not a cure for these parasites. The only prevention is to break the life cycle, by either removing the snails or by keeping the birds away.
  
  6. Fungi.
    - a. Fungi can be treated with formalin at 25 ppm for a prolonged period, or at 250 ppm for 1 hour.
    - b. A 500 to 1000 ppm or 1 -3% solution salt bath will also help to combat a fungal infection.
    - c. Egg treatment -1:600 for 15 minutes flow-through.
- D. What are the major pest problems in pond culture, and how are they controlled?
1. Fry predation by aquatic insects, mud minnows, etc.
  
  2. Snakes.
    - a. Eradication.
    - b. Removal of cover,
    - c. Barriers,
  
  3. Birds.
    - a. Scare. Many techniques involving firecrackers, scare crows, and propane cannons have been developed to keep birds away from valuable fish stocks. None of them are completely effective alone, but with perseverance and some imagination the birds will stay away.
    - b. Depredation permits. Some producers maybe eligible for a federal depredation permit which will allow limited killing of some piscivorous birds. These permits are granted by the U.S. Fish and Wildlife service, Department of Animal Control.
    - c. Prevent access, Many ingenious arrays of mesh netting and wires have been used to prevent birds from getting to the fish; most work with limited success and should not be relied upon totally for protection.
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4. Mammals.
  - a. Removal by trapping or hunting if legal.
  - b. Prevent access.

E. How can aquatic weeds become a problem?

1. Impede harvest.
2. Cause low DO at night and prevent fish from getting to aerator.
3. Hamper feeding.
4. Ecological and environmental impact of depredation today and tomorrow.

### Review

Review by having students demonstrate their knowledge and understanding of the objectives for this problem area. Lead a discussion with students by asking questions that cause the students to explain the content that goes with each objective.

### Evaluation:

Evaluation will be based on class participation, quizzes and a final examination. Example exam questions are attached.

## **Diseases of walleye**

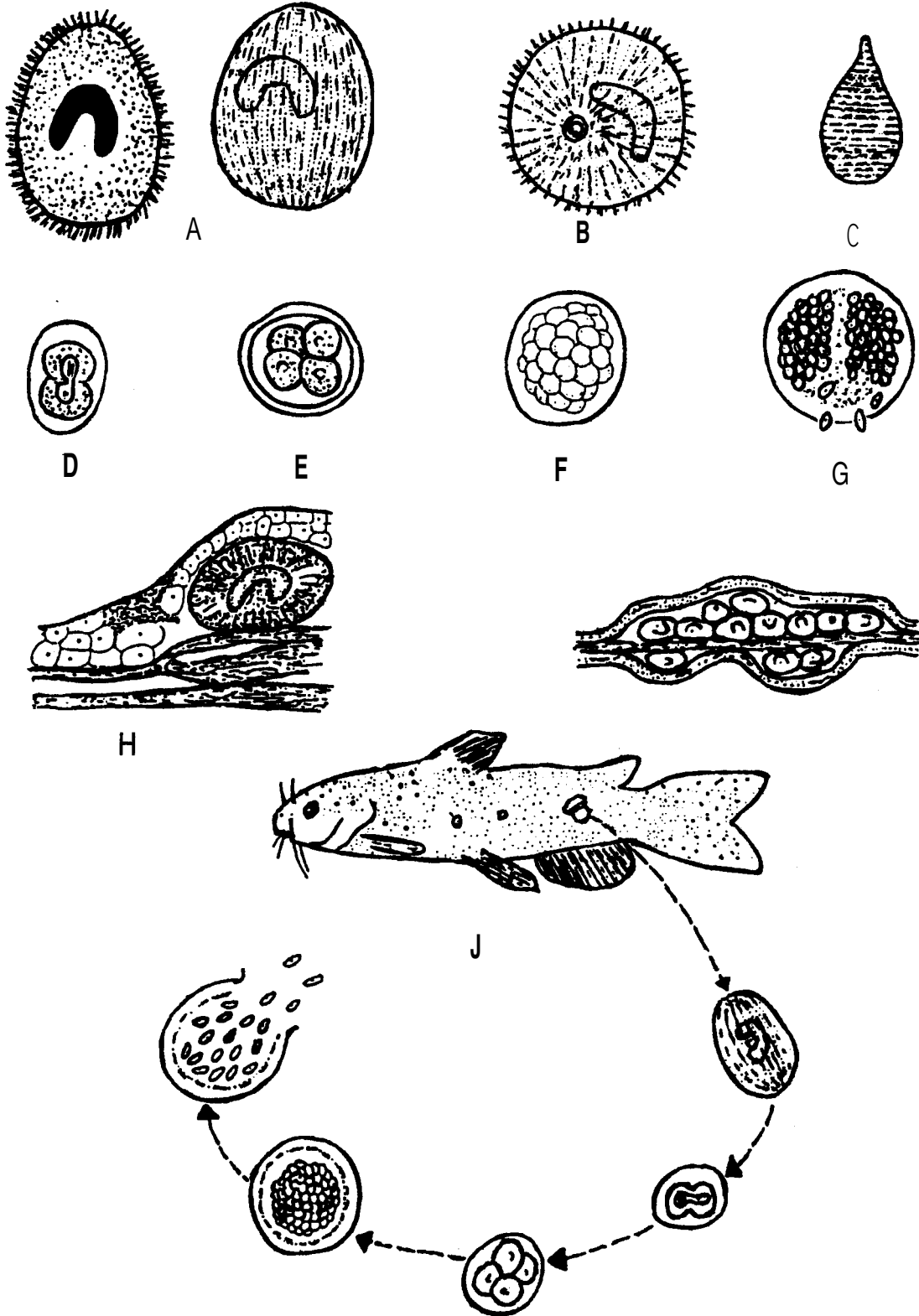
### Bacterial diseases:

Columnaris

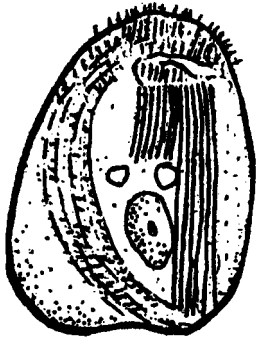
Aeromonas and pseudomonas

- Parasites:
  - Ich
  - Other protists
  - Trematodes
- Viral
- Fungi (saprolegnia)

# Life Cycle of Ich



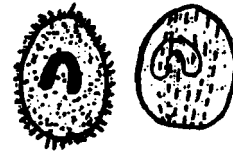
# Parasites



Chilodonella



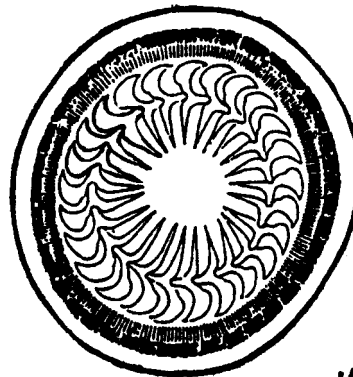
Trichophyra



Ichthyophthirius



Epistylis



Trichodina



Ambiphyra

## **The Most Important Aspects of Fish Health**

- Prevention of stress

Quiz for Section F

Name:

Date:

Quiz on Controlling Pests and Disease

Circle a T for True statements or an F for False statement.

1.     T     F     There is no treatment for Ich.
2.     T     F     Saprolegnia can be treated with formalin.
3.     T     F     A monogenous trematode lives in fish-eating birds as an adult.
4.     T     F     Bacterial infections are generally treated with medicated feeds.
5.     T     F     Lymphocystis can cause massive fish kills.
- 6-10.   List some behavioral changes that a sick fish may exhibit.

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### Key for Quiz - Section F

1. F
2. T
3. F
4. T
5. F
  
6. Stop eating.
  
7. Swim listless if in shallow water.
  
8. Lethargy.
  
9. Small hemorrhages.
  
10. Protruding eyes.  
Swollen abdomen.  
Discharge of fluid from anus.  
Lesions on skin.  
Eroded fins.  
Raised scales.