

Yellow Perch

AQUACULTURE CURRICULUM GUIDE

YEAR TWO SPECIES MODULE

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Description: The module consists of the following eight problem areas:

Module: Yellow Perch (*Perca flavescens*)

Problem Areas:

- Learning the Taxonomy of Yellow Perch
- Determining the Economic Importance of Yellow Perch
- Describing the Reproduction and Development of Yellow Perch
- Describing the Growth Cycle of Yellow Perch
- Describing Feeding Habits of Yellow Perch
- Performing Experimental Work With Yellow Perch
- Obtaining Aquaculture Information
- Describing Health of Yellow Perch

Objectives: The objectives for each problem area are given below.

- A. Learning the Taxonomy of Yellow Perch
 - List the name of the order, suborder, and family of Yellow Perch
 - Describe the anatomical features of the Perciformes
 - Describe the specific attributes of the Yellow Perch.
- B. Determining the Economic Importance of Yellow Perch
 - Explain the factors that determine the commercial demand for Yellow Perch
 - Calculate percent increase in 1985 retail prices needed for profit
- C. Describing the Reproduction and Development of Yellow Perch
 - Explain the energy requirements for the development of eggs and sperm
 - Explain the sexual development of the Yellow Perch
 - Name the major hormones associated with sexual reproduction
 - Describe the reproductive cycle
 - Describe the development of the embryo
 - Describe the development of Yellow Perch larvae
 - Explain the behavior characteristics of larvae and fry
- D. Describing the Growth Cycle of Yellow Perch
 - Explain how environmental factors affect the growth of Yellow Perch
 - Define the growth parameters of Yellow Perch maturity
- E. Describing Feeding Habits of Yellow Perch
 - Describe the natural feeding characteristics of Yellow Perch
 - Explain the factors that determine the food selection of the Yellow Perch
- F. Performing Experimental Work With Yellow Perch
 - Explain 3 major problems facing researchers in Yellow Perch aquaculture
 - Describe the experiments being done to enhance Yellow Perch production
- G. Obtaining Aquaculture Information
 - Explain the procedures used in a commercial operation
 - Discuss the optimum growth rate of commercially raised Yellow Perch
 - Explain the pond culture requirements of Yellow Perch

H. Describing Health of Yellow Perch

- Explain the host-parasite relationship
- Describe the causative agents of diseases affecting Yellow Perch

Teaching Plan:

Module: Yellow Perch - Section A

Problem Area: Learning the Taxonomy of Yellow Perch

Goal: The goal of this problem area is to learn the anatomy of Yellow Perch.

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

list the names of the order, suborder, and family of the Yellow Perch

describe the anatomical features of the Perciformes
describe the specific attributes of the Yellow Perch

Instructional Resources:

Essential:

The Biology of Perch and Related Fish, Craig, J.F., Croom Helms, London, 1987.

Overhead projector and transparencies.

Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, ask the students if they have animals at home or on the farm. Ask them to explain the different characteristics that are used to differentiate one variety from another. Look up the taxonomy of some common animals like dogs or cattle. Compare this to the taxonomy of fish and of Yellow Perch.

Presentation:

A. How is the Perch family classified?

Show TM A1 and discuss the difference between order, suborder, and family of the Yellow Perch.

1. Order - Perciformes.
2. Suborder - Percoidei.
3. Family - Percidae

B. What are the Perciformes?

Show TM A2 and lead a discussion about the characteristics of Perciformes.

1. Largest group of vertebrates.
2. Especially common in tropical and subtropical areas.
3. Anatomy.

Show TM A3 and lead a discussion about the anatomy of the Yellow Perch.

- a. Have laterally compressed bodies.
- b. Have catenoid scales. (Tooth-like projections are found on the free edge of the scales.)
- c. They are physoclists. The duct between the swim bladder and the gut is closed.
- d. Have two dorsal fins.
- e. Do not have adipose fin.
- f. Pelvic fins are spined.
- g. The skull is elongated and well ossified.
- h. Both jaws contain well-developed teeth.
- i. Gill rakers are toothed.
- j. Have 24 or more vertebrae.

C. What are the Percoidei?

1. Largest suborder of Perciformes.
2. Probably the original group.

D. What are the Percidae?

YYellow Perch

1. Confined to fresh water.
2. Native to North America and northern Europe.
3. Three species of Perch:
 - a. *P. fluviatilis* Linnaeus, "Eurasian Perch."
 - b. *P. schrenki*, found in eastern Kazakh, Russia.
 - c. *P. flavescens*, Yellow Perch, native to North America.

E. How are Yellow Perch unique?

Show TM A4 and lead a discussion about the characteristics of Yellow Perch.

1. Distinguished from other Perch by the following:
 - a. Mouth is large.
 - b. Canine teeth are not present.
 - c. Anal fin has 2 spines and 6 to 8 soft rays.
2. Original habitat - from Labrador to Georgia and west to the Mississippi.
3. Early culture:
 - a. Fingerlings were being raised by the early 1900s.
 - b. Eggs were taken from wild.
 - c. By mid-1920s, U.S. hatcheries were raising 1.25 million fingerlings.
 - d. Fingerlings naturalized, therefore no further need for culturing. By 1983, only 0.5 million eggs. Fry and fingerlings were raised by U.S. hatcheries.

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 them to explain the content that goes with each objective.

Evaluation:

Evaluation will be based on class participation, quizzes, and a final exam.

Taxonomy

- Order - Perciformes
- Suborder - Percoidei
- Family - Percidae

The Perciformes

- Largest order of vertebrates
- Most common in tropical and subtropical areas

Anatomy

- Laterally compressed bodies
- Accented scales on fins
- Are physoclists
- Have 2 dorsal fins
- Have no adipose fin
- Pelvic fins are spined
- Skull is elongated and ossified
- Both jaws contain well-developed teeth
- Gill rakers are toothed
- Have 24 or more vertebrae

Perch are a modern species on an evolutionary basis.

Characteristics

- A. Different From Other Perch
 - 1. Have large mouths
 - 2. Absence of canine teeth
 - 3. Anal fin has 2 spines and 6-8 soft rays

- B. Original Habitat - Labrador to Georgia and west to the Mississippi

- C. Early Culture
 - 1. Fingerlings raised by the early 1900s
 - 2. Eggs taken from wild
 - 3. 1.25 million fingerlings raised in 1922
 - 4. Fingerlings naturalized, therefore production stopped

- D. Modern Culture - Due to increased desire for fish products, new research is being done to promote commercial Yellow Perch production.

Quiz for Section A

Name:

Date:

Quiz on Learning the Taxonomy of Yellow Perch

Match the terms on the left with the short definition on the right by writing the appropriate letter in the space provided.

1. ____ *Perca flavescens*

A. Ossified

2. ____ Physoclists

B. Yellow Perch

3. ____ Are toothed

C. Largest group of vertebrates

4. ____ Pelvic fins

D. Gill rakers

5. ____ Are not present

E. Duct between swim bladder and gut is closed

6. ____ Perciformes

F. Are spined

G. Canine teet

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Key for Quiz - Section A

- | | |
|------|--|
| 1. B | A. Ossified |
| 2. E | B. Yellow Perch |
| 3. D | C. Largest group of vertebrates |
| 4. F | D. Gill rakers |
| 5. G | E. Duct between swim bladder and gut is closed |
| 6. C | F. Are spined |
| | G. Canine teeth |

Teaching Plan:

Module: Yellow Perch - Section B

Problem Area: Determining the Economic Importance of Yellow Perch

Goal: The goal of this problem area is to learn the economic importance of Yellow Perch.

Learning Objectives: Upon completion of this problem area, the student will be able to:
Yellow Perch explain the factors that determine the commercial demand for
profit calculate the percent increase in 1985 retail prices needed for

Instructional Resources:

Essential:

The Biology of Perch and Related Fish by Craig, J., Croom Helm, London, 1987.

Culture of Nonsalmonid Freshwater Fishes: Yellow Perch, Sea Grant College Program, Heidinger, R.C. & Kayes T.B. , Reprint #WIS-SG-86-795, University of Wisconsin, 1986.

Molison, NCRAC.

Additional:

Wisconsin Trail Magazine, "Fish Farming in Wisconsin," by Smith, P., Jan/Feb 1973.

Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, divide class into two groups. Have one group represent a commercial fishing interest group. Have the other group represent a "Perch Growers Association." Ask the students to discuss the pros and cons of developing a Yellow Perch aquaculture business.

Presentation:

A. What is the demand for Yellow Perch?

Have the students return to the groups that they formed in the Interest Approach. Have several students go to the board and figure what the price of cultured Perch would need to be to make the operation financially successful. Convert the weight/price ratio to pounds.

1. Demand is primarily in north central United States and Canada.
2. People in Wisconsin consume 75% (7-9 million kg) of Yellow Perch caught in the Great Lakes.
3. Traditionally from Lake Erie or Green Bay, Wisconsin.

B. What is Yellow Perch's primary value?

Valued as a sport, forage, and commercial food fish.

C. On what does the demand of Yellow Perch depend?

Show TM B1 and lead a discussion on the demand for Yellow Perch.

1. Season.
2. Price, compared to competition: cod; Ocean Perch, which is actually red snapper; Atlantic redfish; or rockfish.
3. Commercial catch.

D. What is Yellow Perch's commercial value?

Show TM B2 and lead a discussion on the commercial value of Yellow Perch.

1. Largest catch in 1969: 17 million kg; ex-vessel price was \$.25/kg.
2. Value increasing:
 - a. By 1976, price was \$1.64/kg.
 - b. By 1984, price was between \$2.00 and \$3.50/kg.
3. Added-value price - Unbreaded filets: 1990-1991 Lake Erie Perch filets in Ohio were selling for \$8-12.00 lb.

4. Estimated cost (in 1985 dollars) for tank grown fish about \$8.65/kg, gross. Filets' weight only about 40% of this.

E. What is the present economic situation concerning Yellow Perch?

1. Demand for Yellow Perch exceeds catch.
2. Interest in commercial culture is increasing.
3. Commercial operations not now economically feasible. Price has to go up or per unit production costs must come down.
4. Greater commercial demand for Perch is in winter when wild caught fresh fish are in low supply.

F. What is the commercial operation for Yellow Perch?

1. Optimum market weight approximately 3-5/lb.
 - a. Commercial harvest in Michigan starts at .25 lb.
 - b. Most farm-raised Perch in Ohio sold at .5 lb or slightly larger.
2. Need to harvest year-round.

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 them to explain the content that goes with each objective.

Evaluation:

Evaluation will be based on class participation, quizzes, and a final exam.

Demand Depends on:

- Season
- Price compared to competition
- Cod
- Ocean Perch
- Commercial catch

Prices of Yellow Perch

- Estimated high-end cost of production for tank-grown fish (in 1985 dollars): \$8.65/kg
- 40% marketable meat (filets)
- $\$8.65 / .40 = \$21.62/\text{kg}$ or $.40 = 2/5$

$$\$8.65 \times 2/5 = \$21.62 \text{ kg}$$

- Conversion rate of kg to lbs is 2.2

$$\$21.62 / 2.2 = \$9.83/\text{lb}$$

If the top price (1986) for unbreaded filets was \$17.50/kg, what is the percent increase needed to make the business profitable?

$\$21.62/17.50 = \1.235 or
24% increase in price need

Quiz - Section B

Name:

Date:

Quiz on Determining the Economic Importance of Yellow Perch

Fill in the blanks to complete the following questions.

1. The two things that the price of Yellow Perch are dependent upon are

_____ and _____.

2. The two things that can happen to make Yellow Perch more attractive as a cash crop are

_____ and _____.

3. For the following question, calculate the amount of increase that the price of Yellow Perch would have to go up to make it commercially successful: The estimated commercial growing price for Yellow Perch is \$5.00 per pound. Fifty percent of the weight is lost in preparing a fish for market. If the top retail price paid for unbreaded filets is \$8.50 per pound, what percent would the retail price have to increase to make it economical to raise Yellow Perch?

Key for Quiz - Section B

1. The two things that the price of Yellow Perch are dependent upon are season and price compared to competition.

2. The two things that can happen to make Yellow Perch more attractive as a cash crop are the selling price can go up or the production cost can go down.

3. For the following question, calculate the amount of increase that the price of Yellow Perch would have to go up to make it commercially successful to raise it: The estimated commercial growing price for Yellow Perch is \$5.00 per pound. Fifty percent of the weight is lost in preparing a fish for market. If the top retail price paid for unbreaded filets is \$8.50 per pound, what percent would the retail price have to go up make it economical to raise Yellow Perch?

$$\$5.00/.50 = \$10.00 \text{ per pound}$$

$$\$10.00/8.50 = \$1.18 \text{ or } 18\%$$

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Teaching Plan:

Module: Yellow Perch - Section C

Problem Area: Describing the Reproduction and Development of Yellow Perch

Goal: The goal of this problem area is to understand how Yellow Perch reproduce and develop.

Learning Objectives: Upon completing this section, the student will be able to:

- explain the energy requirements for the development of eggs and sperm
- explain the sexual development of Yellow Perch
- describe the reproductive stages of Yellow Perch
- name the major hormones associated with sexual reproduction
- describe the reproductive cycle
- describe the development of the embryo
- describe the development of Yellow Perch larvae
- explain the behavior characteristics of larvae and fry

Instructional Resources:

Essential:

The Biology of Perch and Related Fish, by Craig, J.F., Croom Helms, London, 1987.

Aquarium with filter, light, etc., fish larvae, overhead projector, transparency masters.

Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, contact a local hatchery or pet store and obtain some fish larvae. Have the students set up the aquarium. Examine fry and larvae under the microscope. Discuss the importance of water quality, temperature, etc. Compare and contrast the reproductive requirements of Yellow Perch to those of other commercial livestock.

Presentation:

A. What are the energy requirements of the Yellow Perch?

Show TM C1 and lead a discussion about the energy requirements of Yellow Perch.

1. Part of the overall bioenergetic model of fish, which includes food ingested, respiration, growth, etc.
2. Many researchers think that females have much higher energy requirements than males. This energy is used in egg production.
 - a. Females use approximately 87% of their energy to produce eggs.
 - b. Males use only 10% of their energy to produce milt.
3. Might explain why females must be larger than males, i.e., they need more stored energy.
4. Number of eggs produced is proportional to energy available; is proportional to food available.

B. How do the gonads and female sexual organs develop?

Show TM C2 and lead a discussion about the development of the gonads.

1. Sex differentiation begins when fish reaches a length of 10-12 mm.
2. Oogenesis (when ovum is formed) begins at 35 mm.
3. Vitellogenesis (when the yolk begins to develop) and spermatogenesis (when sperm starts to develop) start at 85 mm.

C. What are the reproductive stages of the Yellow Perch?

Show TM C3 and lead a discussion about the reproductive stages.

1. Gametogenesis - Eggs or sperm are formed from a simple germ cell.
2. Gonadal stages or preparation for spawning.
3. Females :

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- a. Liberation of gametes (germ cells)
 - b. Meiosis resumption (division of germ cells).
 - c. Oocyte (egg) maturation.
 - d. Ovulation.
 - e. Oviposition: raises concern about resorption. If spawning is interrupted, it may impact spawning for the next year.
4. Males: spermiation and sperm release.

D. How do Yellow Perch spawn?

Show TM C4 and lead a discussion about spawning.

1. Spawn annually in spring for 2 weeks. Happens between February and July.
2. Affected by substrate conditions, water temperature, water levels, velocity, and social interactions.
3. When spawning, Perch move from deep or turbid water to shallow water in rivers, or at pond or lake edges.
 - a. Males arrive first.
 - b. Duration of spawn is about 2 weeks.
 - c. Female accompanied by at least 2 males
 - d. At least 2 males produce milt for each female.
4. Physiology

Show TM C5 and lead a discussion about the physiology

1. The egg tube is transparent, gelatinous and unfolds in a long accordion-like way.
 - a. May be a meter long and 4-5 cm wide.
 - b. It takes from several minutes to several days to extrude the egg mass, depending on temperature.
 - c. No protection is given to egg mass.
2. Female drags it through the milt, which has been left by 2 to 25 males.
3. Habitat requirements: submerged tree branches, etc., that act as snags to unfold egg ribbon for fertilization and oxygen absorption.
4. Good incubation temperatures are 10- 20°C.
5. Need chill period for late stage yolk development and final maturation of eggs between 160 and 185 days below 10°C.
6. Experiments tend to show that in captivity changing light periods does not have much effect on spawning cycle.

E. What are the hormonal factors - gonadotrophin (GTH)?

Show TM C6 and lead a discussion about the effects of gonadohormones

1. Gonadotrophin-releasing hormones (GnRH).
2. Gonadotrophin release inhibiting hormones (GRIF)

F. How does the embryo of the Yellow Perch develop?

Show TM C7 and lead a discussion about the development of the embryo.

1. Egg strand:
 - a. Is a transparent, gelatinous accordion-folded strand.
 - b. Becomes entangled in submerged vegetation.
2. Egg: NOTE: A lot of interesting embryological changes take place between the following events. See other modules for additional information.
 - a. Pale amber color.
 - b. Within 3 minutes of fertilization, egg membrane swells and hardens.
 - c. Incubation time to hatching depends on water temperature.
 - d. Hatching takes place in 10 to 25 days.

G. How do the larvae develop?

Show TM C8 and lead a discussion about larval development.

1. Newly hatched prolarvae are between 4.6 and 6.6 mm long.
2. Swim bladder inflations takes place within 1 week of hatching.
3. Larval stage reached at 14-14 mm.
4. Small larvae are slow swimmers, therefore, need slow water velocity. Large larvae and fry are good swimmers, approximately 3 cm per sec.
5. Recommended temperature about 23- 25°C though lower temperatures are often found.
6. Feeding of prepared food at larval stage is difficult and success depends on size.
 - a. With larvae less than 16 mm, fewer than 50% will live.
 - b. With larvae over 18 mm, 80% will live.

H. What is the behavior of larvae and fry?

Show TM C9 and lead a discussion about the behavior of larvae and fry.

1. Sac-fry or newly hatched larvae free themselves from the egg strand.
2. Are phototactic move toward light.
3. Find areas of little water flow and stop moving downstream.

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4. Newly hatched larvae become dispersed over lake by wind action.
5. When the fins become fully developed, they are said to have reached the fry stage.
6. At fry stage, fish migrate to inshore waters.

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 them to explain the content that goes with each objective.

Evaluation:

Class participation, quizzes, and a final exam.

Energy Requirements

Some research indicates that:

- Females use about 87% of their energy to produce eggs.
- Males use only 10% of their energy to produce milt.

Sexual Development

- Differentiation begins when fish reach 10-12 mm.
- Oogenesis begins at 35 mm.
- Vitellogenesis and spermatogenesis begin at 85 mm.

Reproductive Stages

Gametogenesis

- A. Females
 - 1. Liberation of gametes
 - 2. Meiosis resumption
 - 3. Oocyte maturation
 - 4. Ovulation
 - 5. Oviposition

- B. Males
 - 1. Spermiation
 - 2. Sperm release

Spawning

- From February to July
- Duration of spawn is 2 weeks
- Takes place in shallow water
- Males arrive first
- At least 2 males per female, up to 25
- No protection is given to eggs
- Female drags egg tube through milt
- Incubation temperature 0-20°C

Spawning Is Influenced by:

- Temperature
- Social interactions
- Photoperiod
- Substrate conditions
- Water temperature
- Water level and velocity

Physiology

Egg tube may be a meter long and is
accordion-like

Hormones

- Gonadotrophin Releasing Hormones (GnRH)
- Gonadotrophin Release Inhibiting Hormones (GRIF)

Development of Embryo

- Egg strand is transparent, gelatinous, and accordion-like

Eggs

- Pale amber color
- Egg membrane swells and hardens within 20 minutes of fertilization
- Hatching takes place in 10 to 25 days

Development of Larvae

- Mouths, jaws, teeth, and eyes develop.
- At 7.0 mm, they begin feeding and gills start to form.
- Fins are fully formed by 21 to 27 mm.
- Scaling is complete by 37 mm.
- Optimum temperature is 23-25°C.

Behavior of Larvae and Fry

- In post-larval stage are phototactic
- Stop moving downstream
- Become dispersed over lake by wind
- Swim bladder becomes inflated within 1 week of hatch
- Good temperature range 23-25°C
- Feeding prepared food is difficult

Size

- Newly hatched pro-larvae 4.6-6.6 mm
- Larval stage reached at 14 mm
- Called "fry" when the fins become fully developed
- At fry stage they migrate to inshore waters

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Quiz for Section C

Name:

Date:

Quiz on Describing the Reproduction and Development of Yellow Perch

For the following questions, circle a T for True statements or an F for False statements.

1. T F Females use about 10% of their energy for making eggs.
2. T F Oogenesis is when the ovum begins to form.
3. T F Vitellogenesis is when the yolk begins to form.
4. T F Meiosis is when the germ cells begin to divide.
5. T F Spawning usually takes place in the late fall.
6. T F Water level and velocity are important factors affecting spawning.
7. T F At least 2 females produce eggs for each male.
8. T F "Chill periods" are necessary for late yolk development.
9. T F It is hard to get larvae to eat commercial feeds.
10. T F Post-larvae are sensitive to the light; therefore, they stay in deep, dark pools.

Key to Quiz - Section C

1. F Females use about 87% of their energy for making eggs.
2. T Oogenesis is when the ovum begins to form.
3. T Vitellogenesis is when the yolk begins to form.
4. T Meiosis is when the germ cells begin to divide.
5. F Spawning usually takes place between February and July.
6. T Water level and velocity are important factors affecting spawning.
7. F At least 2 males produce milt for each female.
8. T "Chill periods" are necessary for late yolk development.
9. T It is hard to get larvae to eat commercial feeds.
10. F Post-larvae are attracted to light.

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Teaching Plan:

Module: Yellow Perch - Section D

Problem Area: Describing the Growth Cycle of Yellow Perch

Goal: The goal of this problem area is to understand which factors contribute to the optimum growth of Yellow Perch.

Learning Objective: Upon completing this problem area, the student will be able to:
explain how environmental factors affect the growth of Yellow Perch.
define the growth parameters of Yellow Perch maturity.

Instructional Resources:

Essential:

The Biology of Perch and Related Fish, by Craig, J.F., Croom Helms, London, 1987.

Culture of Nonsalmonid Freshwater Fishes, by Heidinger, R.C. & Kayes, T.B., CRC Press, Boca Raton, 1986

Aquarium, light, filter, etc. Fish larvae. Cardboard box

Additional:

Wisconsin Trails Magazine, "Fish Farming in Wisconsin," by Smith P., Jan/Feb, 1983.

Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, continue working with the aquarium you set up for the last section. Put it in a box with some eye holes. Try to determine if the activity of the fish is changed by the amount of light they receive. Also, try feeding with different kinds of feed, i.e., live, dry, etc. Discuss how environmental factors affect the growth of the larvae.

Presentation:

A What are the environmental factors affecting Yellow Perch development?

Show TM D1 and lead a discussion about how environmental factors affect Perch development.

1. Temperature
 - a. Affects hormone production
 - b. Affects production of enzymes: controls growth, feeding, reproduction, survival, and distribution.
 - c. Temperature tolerances: Optimum for growth is 24.7°C; maximum is 33.4°C.
2. Light
 - a. Affects feeding, growth, and reproduction.
 - b. Optimum photoperiod is approximately 16 hours.

B. How do Yellow Perch mature?

Show TM D2 and lead a discussion about maturity.

1. Males mature in 1 to 3 years; length about 108 mm.
2. In nature, females take 1 year longer to mature. This can be changed in farmed cultures; length about 158 mm.
3. Time of maturation takes longer further north.
4. Perch not subjected to predation. Fish will generally live more than 6 years and not more than 21 years.

Environmental Factors

- A. Temperature
 - 1. Affects hormone production
 - 2. Affects production of enzymes
 - 3. Tolerances: Optimum for growth is 24.7°C; maximum is 33.4°C

- B. Light
 - 1. Affects feeding
 - 2. Affects growth
 - 3. Affects reproduction

Maturity

A. Males mature in 1-3 years; length about
108 mm

B. Females mature in 1.5 years on fish farms;
length about 158 mm

- C. Time of Maturation
1. Takes longer further north
 2. Natural mortality at 6-21 years

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Quiz - Section D

Name:

Date:

Quiz on Describing the Growth Cycle of Yellow Perch

Fill in the blank(s) with the appropriate word to complete the following statements.

1. Environmental factors affect the production of _____ and _____.

2. Amounts of light affect _____, _____, and _____.

3. Time of maturation increases as one travels _____.

Key to Quiz - Section D

1. Environmental factors affect the production of **hormones** and **enzymes**.
2. Amounts of light affect **feeding, growth,** and reproduction.
3. Time of maturation increases as one travels **north**.

Yellow Perch

.Teaching Plan:

Module Yellow Perch - Section E

Problem Area: Describing Feeding Habits of Yellow Perch

Goal: The goal of this problem area is to understand the dietary requirements and feeding techniques used in raising Yellow Perch as an aquaculture crop.

Learning Objectives: Upon completion of this section, student will be able to:

describe the natural feeding characteristics of Yellow Perch
explain factors determining food selection of Yellow Perch

Instructional Resources:

Essential:

The Biology of Perch and Related Fish, by Craig, J.F., Croom Helms, London., 1987.

"Use of Animal Fat in Formulated Diets for Yellow Perch," by Heck, N.E. & Calbert, H.E., University of Wisconsin, 1977.

Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, buy two or three varieties of commercial fish food. Compare the ingredients of these foods. Experiment with the various foods to see whether the fish prefer one over the other.

Preparation:

A. What natural foods do Yellow Perch eat?

Show TM E1 and lead a discussion about the natural food diet of Yellow Perch.

1. Energy inflow/outflow is a complicated process.
2. Perch eat almost anything, but are primarily zooplankton eaters, particularly from May to September.
3. Exogenous feeding commences with immature copepods and rotifers. Feed on cladocerans when they get larger
4. Are quite cannibalistic when young are abundant.
5. Walleye feed on Perch fry.

B. How do the Yellow Perch select food?

Show TM E2 and lead a discussion about the food selection of the Yellow Perch.

1. Size of mouth determines size of prey.
2. Movement of prey is important.
3. Yellow Perch are primarily shoaling (travel in schools) predators.
4. They feed actively in day time.
5. Peak feeding is at sunrise and sunset.
6. Perch are inactive at night, spending that time on the lake bottom in shallow water.
7. Spend winter in deep water.
8. Fry are positively phototactic; they feed almost continually during the day on zooplankton.

C. How do the Yellow Perch feed?

Show TM E3 and lead a discussion about the feeding procedures for commercially raised Yellow Perch.

1. Perch display "shy feeding behavior" and must be trained to overcome this.
2. After fingerlings reach 18 mm, 80% can be trained to accept prepared diets.
3. Training procedure similar to that of striped bass.
4. Procedure includes:
 - a. Concentrating the fingerlings.

- b. Gradually removing natural food source.
 - c. Elevating the temperature to insure aggressive feeding response.
 - d. Feeding frequently.
 - e. Grading fingerlings to eliminate cannibalism.
4. Some growers initiate feeding with a soft pellet (Oregon Moist), then switch to hard pellets.
 5. Others start with hard pellets, which are cheaper.
 6. Fingerlings can consume pellets between 0.84 and 1.19 mm in diameter.

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 them to explain the content that goes with each objective.

Evaluation:

Evaluation will be based on class participation, quizzes, and a final exam.

Natural Foods Yellow Perch Eat

- Are primarily zooplankton eaters
- Exogenous feeding commences with immature copepods and rotifers
- Are cannibalistic when young
- Perch fry are food source for walleye

Food Selection of Yellow Perch

- Determined by size of mouth
- Movement of prey is important
- Perch are shoaling predators
- Fry feed almost continually during the day on zooplankton
- Peak feeding at sunrise and sunset
spend winter in deep water

Feeding Procedures for Yellow Perch

- Concentrate the fingerlings
- Remove natural food source
- Elevate the temperature
- Feed frequently
- Grade by size
- Initiate with soft pellets

Quiz for Section E

Name:

Date:

Quiz on the Feeding Habits of Yellow Perch.

Circle a T if it is a True statement or an F if it is a False statement .

1. T F Yellow Perch are daytime feeders.
2. T F Perch are individualistic and seldom travel in schools.
3. T F In switching to commercial feeds, it is best to feed Yellow Perch only occasionally.
4. T F Young Perch feed primarily on zooplankton.
5. T F Diet is determined by the size of the mouth.
6. T F When switching to commercial feeds, it is best to lower the water temperature.
7. T F Peak feeding is at sunrise and sunset.
8. T F Yellow Perch are often cannibalistic when young.

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Key for Quiz - Section E

1. T Yellow Perch are daytime feeders.
2. F Perch are **shoaling predators**.
3. F In switching to commercial feeds, it is best to feed `Yellow Perch **frequently**.
4. T Young Perch feed primarily on zooplankton.
5. T Diet is determined by the size of the mouth.
6. F When switching to commercial feeds, it is best to **raise** the water temperature.
7. T Peak feeding si at sunrise and sunset.
8. T Yellow Perch are often cannibalistic when young.

Module: Yellow Perch - Section F

Problem Area Performing Experimental Work With Yellow Perch

Goal: The goal of this problem area is to understand the current research that is going on to develop economically viable alternatives in Yellow Perch
Perch aquaculture.

Learning Objectives: Upon completing this section, the student will be able to:

explain 3 problems facing researchers in Yellow Perch aquaculture

describe the experiments being done for Yellow Perch production

Instructional Resources:

Essential:

Canadian Journal of Fisheries and Aquatic Sciences, by Malison, J.A., Kayes, T.B., Best, C.H. & Wentworth, B.C., "Sexual Differentiation and Use of Hormones to Control Sex in Yellow Perch," 43(1):26-35, 1986.

Canadian Journal of Fisheries and Aquatic Sciences, Malison, J.A., Kayes, T.B., Wentworth, B.C., & Amundson, C.H., "Growth and Feeding Responses of Male versus Female Yellow Perch Treated with Estradiol," 17B,45(1):1942-1948, 1988.

Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, write the definition of experiment on the board. Ask the students if they have ever performed an experiment. Compare and contrast experiments with scientific observations. Emphasize the problem-solving nature of scientific experimentation and the effort to achieve an unbiased test to learn something new. Ask the students to decide when it is better to use an experiment versus an observed study.

Presentation:

A. How is the experimental work with Yellow Perch divided?

Show TM F1 and discuss the major problems in farming Yellow Perch.

1. Cultural work with diet, density, etc. Some researchers believe that the biggest constraint to large-scale commercial perch aquaculture is:
 - a. reliable source of fingerlings
 - b. work being conducted on larval/feeding techniques
 - c. research on pond production of fingerlings
 - d. dietary needs, specific to Yellow Perch
 - e. density and loading of Perch in intensive systems.
2. Genetics and hormonal experiments - Experimental work with genetics and hormones to improve the productivity of Yellow Perch is actively being pursued

B. What are the major problems with raising Yellow Perch commercially?

Show TM F2 and discuss the current experiments being done to overcome the growth problems of Yellow Perch.

1. Larval perch refuse to accept commercial diet.
2. Overall growth potential is limited by small size of fish.
3. These fish have a significant reduction in growth before they reach marketable size.
4. Broodfish availability.
5. Eggs/fry are available only once a year.
6. Economical heat source.

C. What problems are related to the onset of sexual maturation?

Show TM F3 and discuss genetic and hormonal problems in the growth and reproduction of Yellow Perch.

1. It appears that growth and reproduction are antagonistic, because each competes for available nutrient resources.
2. Gonadal development also reduces amount of edible meat.

3. Therefore, stocking reproductively competent, cultured fish can be detrimental to commercial ventures.
4. Experiments show that genetic manipulation and hormonal treatments can be used for manipulation of sex, to induce sterility, and to enhance growth.

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5. Because hormonal treatments need approval by the USDA, and improperly administered hormones can cause a reduction in fish size, current experiments are focused on gene manipulation:
- a. gene insertion (growth hormone),
 - b. genetic engineering
 - c. haploid (a gamete) having the full number of chromosomes normally occurring in the mature germ cell
 - d. triploidy - having 3 times the haploid number of chromosomes
 - e. tetraploidy - having 4 times the haploid number of chromosomes

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 them to explain the content that goes with each objective.

Evaluation:

Evaluation will be based on class participation, quizzes, and a final exam.

Major Problems for Commercial Operations

- Reliable source of fingerlings
- Larvae refuse commercial diets
- Overall growth potential is small
- Reduction of growth before marketable size

Cultural Experiments

- Larval/feeding techniques
- Pond production of fingerlings
- Dietary needs
- Density and loading of Perch in intensive systems

Genetic and Hormonal Experimental Problems

- Growth and reproduction appear to be antagonistic because of competition for available nutrients.
- Gonadal development reduces amount of edible meat.
- Genetic manipulation and hormonal treatments can be used for manipulation of sex, to induce sterility, and to enhance growth.
- Hormonal treatments must be approved by USDA.
- Improperly administered hormones can cause a reduction in fish size.
- Therefore, most research is on genetic manipulation.

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Quiz for Section F

Name:

Date:

Quiz on Performing Experiments With Yellow Perch.

In two short paragraphs, explain the two major areas of Yellow Perch research that are currently being pursued and explain the kinds of research that are being done in each one.

Key to Quiz - Section F

There are two areas of research being done today: **cultural** and experimental work in **genetics and hormonal systems**. Cultural work is being done in the following areas: **larval feeding** techniques, the **pond production** of fingerlings, **dietary needs** of Yellow Perch and the **density and loading** of intensive systems.

Experiments with genetics and hormones are as follows: growth and reproduction systems compete for available nutrients. Also, development of gonads reduces the amount of edible meat. The experiments that are currently being done seek to remedy this problem. The experiments are of two kinds: treatments with hormones and the manipulation of genes. The main objectives of these experiments are to manipulate sex (create only female fish, which grow bigger), induce sterility (so the females don't go through gonadal development), and enhance growth. Because hormonal treatments require USDA approval, which takes time and money, most experimental work today concentrates on genetic manipulation.

Teaching Plan:

Module: Yellow Perch - Section G

Problem Area: Obtaining Aquaculture Information

Goal: The goal of this problem area is to understand different techniques used in raising Yellow Perch.

Learning Objectives: Upon completion of this section, the student will be able to:

- explain the procedures used in a commercial operation
- discuss the optimum growth rate of commercially raised Yellow Perch
- explain the pond culture requirements of Yellow Perch

Instructional Resources:

Essential:

The Biology of Perch and Related Fish, by Craig, J.F., Croom Helms, London, 1987.

Culture of Nonsalmonid Freshwater Fishes: Yellow Perch, by Heidinger, R.C., Kayes, T.B., CRC Press, Boca Raton, FL, 1986.

Additional:

"Genetic Manipulation of Growth and Production of Select Great Lakes Coolwater Fishes," by Kayes, T.B., & Malison, J.A., R/AQ-14, University of Wisconsin - Madison.

Aquaculture, "Harvesting Photopositive Juvenile Fish from a Pond Using a Lift Net and Light," by Mancini, W.E., Malison, J.A., Kayes, T.B. & Kuczynski, T.E., 34:157-164, 1983.

Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, ask the students if they have ever been to a livestock feed lot. Discuss the advantages and disadvantages of a feedlot system. Compare and contrast the use of feedlot systems and the use of pond cultures for grow out.

Presentation:

A. What are the difficulties in raising Yellow Perch?

Show TM G1 and lead a discussion about the procedures used in a commercial Yellow Perch operation.

1. Larvae refuse to accept commercial diets.
2. Overall growth limited by inherently small size. Rapid growth stops before fish reach marketable size of 80 to 90 g.
3. Possible solutions:
 - a. Crossbreeding often combines characteristics and results in strains superior to purebred stock.
 - b. Development of pedigree stock.
 - c. Important area of research.

B. How do the commercial procedures for raising Yellow Perch operate?

1. Optimum temperature for fast growth and weight gain is 68-78°F.
2. Need to complete "water hardening" of eggs within 15 min. of stripping.
3. Use of milt
 - a. Traditionally, when stripping eggs, sperm and eggs needed to be mixed within 20 sec. of stripping because larvae deformity takes place if sperm is more than one minute old.
 - b. Now, milt can be stored for weeks or months in a 0.5% NaCl solution.

C. What are the incubation procedures?

1. Commercial "Heath" incubators are used by some growers to incubate the eggs.
2. Other growers use floating cages with ribbons attached.
3. Hatching takes place within 24 hours after mouth and opercular movements become synchronized with regular breathing.

D. What is the growth rate of Yellow Perch?

Show TM G2 and lead a discussion about the growth rate of Yellow Perch.

1. Growth rate dependent on three major factors:
 - a. Photoperiod.
 - b. Diet.
 - c. Temperature.

2. Experiments by Calbert and Huh indicate that a marketable Yellow Perch (20 cm or 150 g) can be raised in 9 to 11 months when cultivated at:
 - a. 21°C.
 - b. 16 hours of light.
 - c. Fed 3-4% of their body weight daily.

3. Females grow faster and reach larger sizes than males. For this reason, experiments are being done to breed only females.

E. What is the pond culture for Yellow Perch?

Show TM G3 and lead a discussion about pond culture when raising Yellow Perch.

1. Obtaining eggs
 - a. From wild.
 - b. From farmed Perch 4th generation farmed Perch have much more efficient behavior and feeding habits.
 - c. By tank spawning.
 - d. By stripping.

2. Incubating
 - a. In trays.
 - b. In Heath incubator.
 - c. In nets.

3. Can be for stocking or for grow out.

4. Need to be sure there are no predators in the pond before release.

5. Important to use organic or inorganic fertilizer to insure good bloom of zooplankton.

6. To harvest fry, use:
 - a. Seines, in clean ponds. Algae and aquatic plant growth can decrease effectiveness of seining.
 - b. Draw the pond down to the harvest basin.
 - c. Use a light and a lift net. Works because the young fish are photoactive.
 - d. Small trap nets

Review:

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

Evaluation:

Evaluation will be done using class participation, quizzes, and a final exam.

Commercial Procedures

- Optimum temperature for fast growth:
68-78°F
- Milt can be stored ahead of use time
- Hand-stripping is very effective
- Eggs must be incubated
- Hatching takes place in 1-2 weeks after fertilization, depending on temperature

Experimental Commercial Yellow Perch Pond

- Experiments by Calbert & Huh and by Malison, et al.
- Raising marketable Perch apprc
 - 21°C temperature
 - 16 hours of light
 - Fed 3-4% of their body weight daily

Pond Culture

A. Obtaining Eggs

1. From wild
2. From farmed fish
3. By tank spawning
4. From hand-stripping

B. Incubating

1. In trays
2. In heath incubator
3. In nets

C. Can be for Stocking or Grow Out

D. Need to Remove Predators From Pond

E. Fertilize Pond to Insure Bloom of Zooplankton

F. Harvesting Fry

1. With seine nets
2. Drain pond
3. With light and a lift net
4. With small trap nets

Aquaculture Curriculum Guide

Quiz for Section G

Name:

Date:

Quiz on Obtaining Aquaculture Information

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

1. T F When stripping eggs, eggs and sperm should be mixed within 20 seconds.
2. T F Egg hatching takes place within 1-2 hours after fertilization.
3. T F The raising of commercial size Yellow Perch takes from 6-8 months.
4. T F Optimum temperature for raising Yellow Perch is 60-70°F.
5. T F A good way to obtain eggs is from wild perch.
6. T F Hand-stripping is a viable way to obtain Yellow Perch eggs.

Key for Quiz - Section G

1. T When stripping eggs, eggs and sperm should be mixed within 20 seconds.
2. F Egg hatching takes place within **24** hours.
3. F The raising of commercial size Yellow Perch takes from **9-11** months.
4. T Optimum temperature for raising Yellow Perch is 60-70°F.
5. T A good way to obtain eggs is from wild perch.
6. T "Heath" incubators are often used in Yellow Perch operations.

Teaching Plan:

Module: Yellow Perch - Section H

Problem Area: Describing the Health of Yellow Perch

Goal: The goal of this problem area is to understand the health care needs of Yellow Perch.

Learning Objectives: Upon completion of this section, the student will be able to:

explain the host-parasite relationship.
describe the causative agents of diseases affecting Yellow Perch.

Instructional Resources:

Essential:

The Biology of Perch and Related Fish, by Craig, J.F., Croom Helms, London, 1987.

Overhead projector, transparencies.

Content and Procedures

Preparation (Interest Approach):

To develop student interest in this module, ask the students if animals which they have at their homes or on their farms have become sick. Ask them to describe the causes of the diseases. Compare the differences between the treatments for humans and for animals. Compare the difference between treatments for farm animals and for fish. Discuss the difficulties of finding treatments for animal health problems that are safe for human consumption. Relate this to aquaculture.

Presentation:

A. What diseases do Yellow Perch get?

Show TM H1 and lead a discussion about the health problems of Yellow Perch.

NOTE: Fish diseases and parasites are endemic to wild populations. The struggle of the fish farmer is to isolate the farmed fish as much as possible from these sources of contamination in the wild, and from those pathogens that are ubiquitous in the water to keep the fish from being stressed and thereby susceptible to these fish diseases when normal immunological responses are compromised.

1. Host-parasite relationship
 - a. Perch are host to many parasites, but only a small number of them cause serious problems.
 - b. Disease is when the host-parasite relationship becomes imbalanced.
2. Outbreaks of disease related to environmental conditions.
3. Diseases also caused by viruses, bacteria and fungi.
4. Yellow Perch are subject to tumors, largely in response to environmental pollution.
5. The larger the fish, the more chance of parasites.
6. In some cases, females more susceptible to parasites than males.

B. What causes disease in Yellow Perch?

Show TM H2 and lead a discussion about the causative agents in the disease of Yellow Perch.

1. Mortality not identified with any specific virus.
2. Large "perch kill" in Windermere, England, probably caused by bacteria, *Aeromonas salmonicida*. Disease was complicated by several species of fungi.
3. Success of parasites relative to population of host. The larger the population, the better chance of success.

Review:

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

Evaluation:

Evaluation will be based on class participation, quizzes, and a final exam.

Diseases

A. Parasitic

1. Definition: Disease is when the host- parasite relationship becomes imbalanced.
2. Perch are host to many parasites, but only a small number cause problems.

B. Causes

1. Viral diseases
2. Bacterial diseases
3. Fungal diseases
4. Tumors
5. Environmental factors

Causative Agents

- Mortality has not been identified with any specific virus.
- Success of parasites is relative to the population of host.

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Quiz for Section H

Name:

Date:

Quiz on Describing the Health of Yellow Perch

For the following statements, fill in the blank to complete the statement.

1. The success of parasites is relative to the population of the _____.
2. The definition of a parasitic disease is when the _____ relationship is out of balance.
3. Outbreaks of disease are related to _____ factors.
4. The three causes of disease to Yellow Perch, other than parasites, are _____, _____, and _____.

Key for Quiz - Section H

1. The success of parasites is relative to the population of the host
2. The definition of a parasitic disease is when the **host-parasite** relationship is out of balance.
3. Outbreaks of disease are related to **environmental** factors.
4. The three causes of disease to Yellow Perch, other than parasites, are **virus, fungus, and bacteria.**