

Striped Bass

AQUACULTURE CURRICULUM GUIDE

YEAR TWO SPECIES MODULE

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Diseases

A. Bacterial Diseases

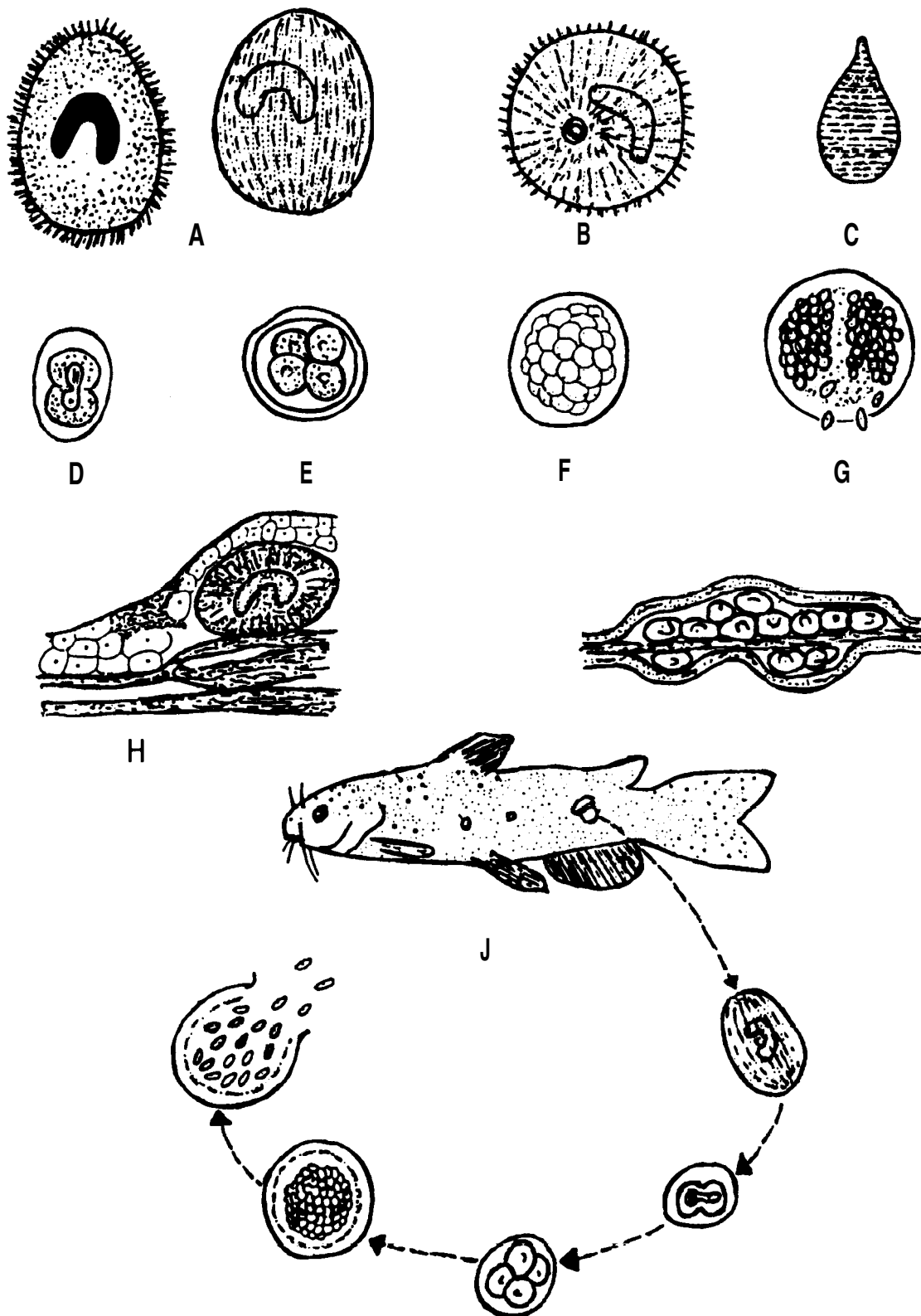
1. Columnaris
2. Aeromonas and pseudomonas
3. Vibriosis

B. Parasites

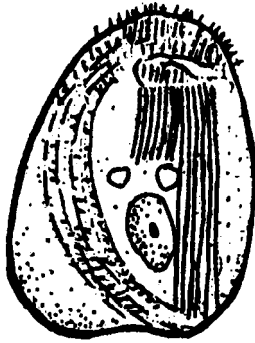
1. Ich
2. Other protists
3. Trematodes

C. Fungi (saprolognia)

Life Cycle of Ich



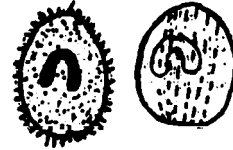
Parasites



Chilodonella



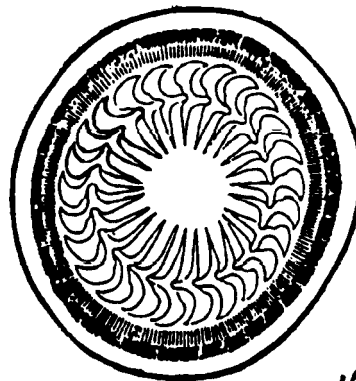
Trichophyra



Ichthyophthirius



Epistylis



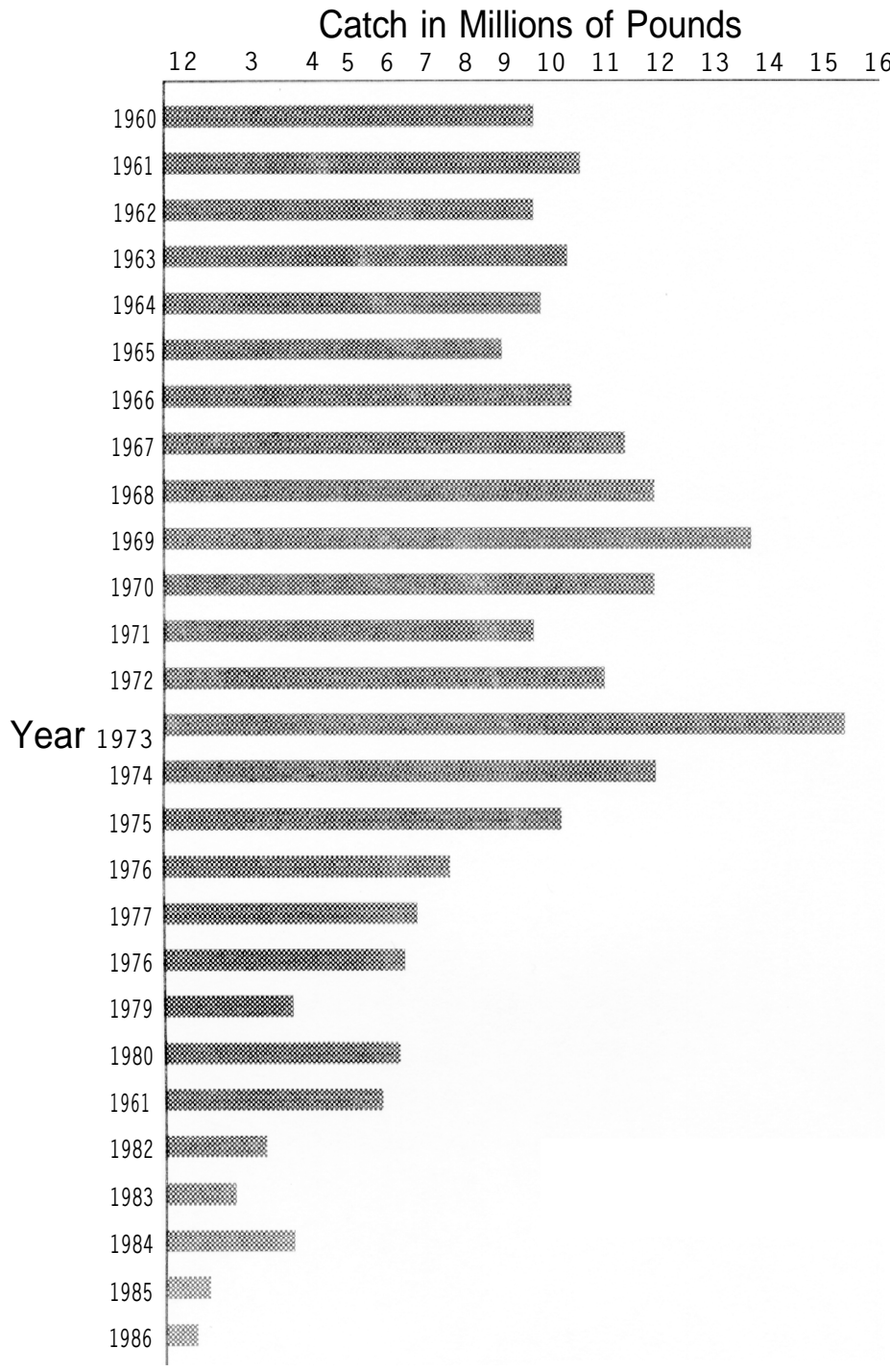
Trichodina



Ambiphyra



Wild Catch of Striped Bass 1960-1986



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

Module: Striped Bass

Problem Areas: Describing Financial Considerations of Striped Bass
Understanding the Life Cycle and Identifying Facilities for Culture of Striped Bass
Hatching and Rearing Striped Bass
Growing Striped Bass to Market Size
Feeding Striped Bass
Controlling Pests and Diseases
Harvesting, Transporting, and Marketing Striped Bass

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

- A. Describing Financial Considerations of Striped Bass
 - Explain why Striped Bass culture developed
 - Discover the profitability of Striped Bass culture
 - Identify the risks involved in Striped Bass culture
 - Examine the required investments of Striped Bass culture
 - Identify the legality of Striped Bass culture in your area
- B. Understanding the Life Cycle and Identifying Facilities for Culture of Striped Bass
 - Explain the Striped Bass life cycle
 - Discover the different types of Striped Bass and hybrids
 - Identify the varied Striped Bass culture techniques
 - Identify the type of Striped Bass which is most suitable for aquaculture
 - Identify the type of facility most suited to your production needs
 - Planning a Striped Bass culture facility.
 - Identify the biological requirements of these fish
- C. Hatching and Rearing Striped Bass
 - Discuss and/or demonstrate spawning techniques
 - Discuss and/or demonstrate techniques for incubating eggs
 - Explain the fry culture techniques of Striped Bass and their hybrids
 - Identify the methods of fingerling harvest and grading.
 - Calculate the number of fry or fingerlings on hand
 - Discuss the specific hauling requirements of fingerlings
- D. Growing Striped Bass to Market Size
 - Identify the sources of fingerlings
 - Predict the quantify of fingerlings needed
 - Identify the culture facilities
 - Discover the culture techniques of food size Striped Bass and their hybrids
 - Identify the routine management techniques involved in Striped Bass culture
 - Identify the parts of the Striped Bass industry that must be improved
- E. Feeding Striped Bass
 - Discover the types of Striped Bass feed available
 - Identify the nutritional requirements of Striped Bass and hybrids
 - Discover the feed conversion of Striped Bass

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- Identify the feeding schedule required by Striped Bass
- Identify the different feeding methods

- F. Controlling Pests and Diseases
- Discover the types of Striped Bass diseases
 - Identify a disease problem
 - Discover the prevention and treatment of Striped Bass diseases
 - Identify the different methods of pest control
- G. Harvesting, Transporting, and Marketing Striped Bass
- Identify the harvesting techniques
 - Identify the hauling equipment and technique
 - Discover the techniques of Striped Bass processing

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Teaching Plan:

Module: Striped Bass – Section A

Problem Area: Describing Financial Considerations of Striped Bass

Goal: The purpose of this problem area is to understand the financial opportunities of Striped Bass culture.

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

- explain why Striped Bass culture has developed
- discover the profitability of Striped Bass culture
- identify the risks involved in Striped Bass culture
- examine the required investments of Striped Bass culture
- identify the legality of Striped Bass culture in your area

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

Essential:

Transparencies and overhead projectors.

Third Report to the Fish Farmers

Hybrid Striped Bass a National First, Easley, J.E., National Coastal Resources Research and Development Institute News, 4(2) pp. 1-5, Newport, OR, 1989.

Culture and Propagation of Striped Bass and Its Hybrids, Harrell R.M., et al., Striped Bass Committee, Southern Division, American Fisheries Society, Bethesda, MD, 1990.

Commercial Culture of Hybrid Striped Bass: Status and Potential, Van Olst, J.C. & J.M. Carlberg, 16(1) pp. 49-59, Aquaculture Magazine, 1990.

Additional:

Hybrid Striped Bass Biology and Life History, Hodson, R.G., 1989, SRAC #300.

Culture of Striped and Hybrid Striped Bass, McVey, E. M. and N. Thomson, AquaTopics Series, National Agricultural Library, Beltsville, MD, 1990.

Striped Bass and its Hybrids, Smith, T.I.J., World Aquaculture, 20(1) pp. 32-38, 1989.

Content and Procedure

Preparation (Interest Approach):

To develop student interest in this module, explain that Striped Bass have a long history of usage in the United States and that tax on the sale of Striped Bass was used to help finance the 1st public school system in America. Then explain about the decline of the Striped Bass wild catch and get the students interested by discussing fishing for Striped Bass. Ask them to think about the long history of Striped Bass usage in the United States and speculate on where the industry might be heading.

Presentation:

A. What are the 5 reasons that Striped Bass culture has developed?

Use TM A1 or the chalkboard to show how the wild catch of Striped Bass has declined.

1. The wild catch of Striped Bass has declined since 1973 from about 15 million pounds to less than 1 million pounds today. It is, however, increasing and is competitive in Maryland and New York.
2. People in developing countries are eating more fish.
3. Fresh Striped Bass are an attractive alternative to the normal available fresh fish.
4. Growth of recreational fishing.

B. How profitable is Striped Bass culture?

Use the chalkboard to outline the law of supply and demand and discuss how the price of Bass may fluctuate both seasonally and year to year. Explain how either overproduction by aquaculturalists or a resurgence in the wild catch could drive the market price of Striped Bass down.

1. Production costs of Striped Bass are estimated to range from \$1.50 to 2.50 per pound.
2. The current selling price for Striped Bass is between \$2.25 and \$3.50 per pound live weight, but this will decline as availability increases.
3. If fish is produced at the highest estimated cost and receiving the lower price, money will be lost, but if the fish can be produced for the lower cost and obtain the higher price, then Bass production may be a profitable venture.

C. What risks are involved in Striped Bass culture?

Divide the class in half. Have the one half represent the U.S. fish industry and the other represent international competitors. Have the students discuss import quotas on foreign caught fish.

Divide the class in half. Have one half represent commercial producers and sellers and the other half represent consumer protection groups. Have the groups discuss quality and price in this context.

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Discuss the risks of any agricultural industry. Mention need for caution with fish due to the nature of the aquaculture environment. Discuss information a farmer must have about the environment and natural systems. How do these factors impact crops to make a profit?

1. Financial loss due to catastrophe.
2. The possibility that there is no cost-effective market available when fish are ready to sell.
3. Hybrid Striped Bass are a regional market, mostly in the northeast.
4. Overproduction may drive the price of market size fish below the break-even price.
5. If poor management decisions are made, the cost to raise the fish may exceed their marketable value.

D. How much money is required to start Striped Bass culture system?

1. Following is an example of a cage culture system showing how a sample production system (less than 10,000 lbs annually) can be implemented for very little capital investment if a body of water is already available. The estimated costs would be \$500 for the cages, \$750 for the fingerlings, \$400 for feed, \$300 for the necessary water quality equipment, \$450 for other miscellaneous equipment and chemicals.

The total initial investment is \$2,400. Some of this is for equipment which will last for several years and can be depreciated out 5 years.

2. A workable small farm should have a fish population of about 10,000-20,000 lbs annually. A large-scale farm would have a capability of about 500,000 to 1 million pounds per year. A large-scale production facility with the capability of producing 50 to 100,000 pounds annually will require a large capital investment which is variable upon the type of production system desired. The initial investment, including land and most of the necessary equipment for a pond production system, will be about \$8,000 per acre for a 40-acre farm and \$5,500 per acre for a 160-acre farm. These figures will vary with land price and types of machinery purchased. A rule of thumb is that initially the producer will spend at least \$5,000 per acre before the first fish is sold, and it will generally be 18-24 months between the start of construction and the first harvest.

Divide the class into several groups. Have some of them design a farm without an aquaculture system and others design a farm with a Striped Bass pond system. Have others design a farm with a tank, flow-through system.

It will cost another \$5,000 per acre to produce the first crop before the farmer gets any cash back.

3. An intensive culture system may cost as little as \$50,000 for a small operation with existing buildings and water sources to several million dollars for a large-scale tank or raceway system built from the ground up. Therefore, it is important to pay special attention to the revenue/ investment ratio.

E. What states allow the culture of Striped Bass?

Contact your state fisheries biologist or extension specialist and inquire about the legality of Striped Bass and/or hybrid Striped Bass culture in your area.

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Quiz for Section A

Name:

Date:

Quiz for Describing Financial Considerations of Striped Bass

1. T F The wild catch of Striped Bass is now over 20 million lbs per year.
2. T F The production costs of Striped Bass are \$1.50 to 2.50.
3. T F An increase in production may cause the price to fall.
4. T F A large intensive system may cause over \$1 million to construct.
5. T F In some states it is illegal to sell Striped Bass.
6. Explain the law of supply and demand.

Key for Quiz – Section A

1. F The wild catch of Striped Bass is now over 20 million lbs per year.
2. T The production costs of Striped Bass are \$1.50 to 2.50.
3. T An increase in production may cause the price to fall.
4. T A large intensive system may cause over \$1 million to construct.
5. T In some states it is illegal to sell Striped Bass.
6. Explain the law of supply and demand.
If fish are produced at a lower cost and obtained at a higher cost, then it is a profitable venture.

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Teaching Plan:

Module: Striped Bass – Section B

Problem Area: Understanding the Life Cycle and Identifying Facilities for Culture of Striped Bass

Goal: The purpose of this problem area is to understand the life cycle of the Striped Bass and to identify the facilities required for their culture.

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

- explain the Striped Bass life cycle
- discover the different types of Striped Bass and hybrids
- identify the varied Striped Bass culture techniques
- identify the type of Striped Bass which is most suitable for aquaculture
- identifying the type of facility most suited to your production needs
- planning a Striped Bass culture facility
- identify the biological requirements of these fish

Instructional Resource: The following instructional resources are needed to complete this problem area.

Essential:

Overhead projector, transparencies, water quality test kit, and SRAC video on Striped Bass culture.

Cage Culture of Striped Bass, from Purdue University and the North Central Regional Aquaculture Center.

Hybrid Striped Bass: A National First, Easley, J.E., 1989.

National Coastal Resources Research and Development Institute News, 4(2) pp. 1-5, Newport, OR.

Culture and Propagation of Striped Bass and Its Hybrids, Harrell R.M., et al., Striped Bass Committee, Southern Division, American Fisheries Society, Bethesda, MD, 1990.

Hybrid Striped Bass Biology and Life History, Hodson, R.G., SRAC #300, 1989.

Hybrid Striped Bass Pond Production of Foodfish, Hodson, R.G. and M. Hayes, SRAC #303, 1989.

Striped Bass and its Hybrids, Smith, T.I.J., World Aquaculture, 20(1) pp. 32-38, 1989.

Commercial Culture of Hybrid Striped Bass: Status and Potential, Van Olst, J.C. and J.M. Carlberg, Aquaculture Magazine, 16(1) pp. 49-59, 1990.

Content and Procedure

Preparation (Interest Approach):

To develop student interest in this module, ask them to recall the various fish production systems from the first part of the course. Compare and contrast these with other livestock production systems.

Presentation:

A. What are the life stages of the Striped Bass?

Lead a discussion on the life stages of Striped Bass.

Show the SRAC video on Striped Bass culture.

1. Egg.
 - a. Striped Bass eggs are 1.1-1.3 mm in diameter. There are roughly 900 per gram, almost clear, and are not adhesive.
 - b. White Bass eggs (used for the reciprocal hybrid White Bass female X Striped Bass male) are 0.6-0.7 mm in diameter. One gram will contain between 3,500 and 4,000 eggs. They are somewhat opaque and are adhesive.
2. Larvae.
 - a. The larvae of the Striped Bass and the original cross are 3.5-5 mm long when they hatch. They begin feeding between the 5th and 10th day post-hatch and will starve by 14 days post-hatch if not fed.
 - b. The larvae of the reciprocal cross are 2.5-3.5 mm long when they hatch, begin feeding on the 4th day post-hatch, and will starve by 10 days post-hatch if food of the right size and type, such as rotifers, is not available.
3. Juvenile (fingerling): Phases I and II.
4. Adult 1: Phase III.

B. How are pure stripers, original cross hybrids, and reciprocal cross hybrids alike and how are they different?

Use TM B1 to discuss differences of the parents and hybrids.

1. The Striped Bass (*Morone saxatilis*) are native to the eastern seaboard of the United States.
 - a. Can grow to over 100 lbs.
 - b. Have been introduced into many reservoirs and to the Pacific Coast of the United States.
 - c. Have been propagated by man since 1884.
2. The original cross (Palmetto Bass) is a female Striped Bass and a male White Bass (*Morone chrysops*).
 - a. Was first produced in 1965.
 - b. Has been widely distributed throughout the United States as a sportfish.

3. The reciprocal cross is between a female White Bass and a male Striped Bass. This has become the most available and popular among commercial aquaculturalists because the Striped Bass males cross with many females.

4. Both hybrids appear as an intermediate between Striped Bass and White Bass.
 - a. The two hybrids are indistinguishable without biochemical testing.
 - b. The horizontal stripes of the hybrids are dark like the striper, yet broken like the white.
 - c. The body shape of the hybrid is intermediate between the 2 parental species.
 - d. Pacific Coast stripers often have a broken stripe pattern.
5. There are a few other hybrids between the white perch and Striped Bass and also crosses between some of the hybrids.

C. What culture techniques can be used with each of these type of fish?

Once the fish are past the larval stage and get on feed, the culture techniques are virtually identical.

D. Which of the striper types show the most potential for aquaculture?

1. The reciprocal hybrid (White Bass female X Striped Bass male) currently shows the most promise for aquaculture because of the large size of the sexually mature Striped Bass.
2. The hybrids show faster growth rates than the straight striper for the first 2 years of culture.
3. The male Striped Bass have been domesticated, giving the producers a reliable supply of broodstock.
4. White Bass females rather than stripers are easier to work with and more available.

E. How can the producer select the proper culture technique for their situation?

Discuss hypothetical situations and differing techniques and the various advantages and disadvantages for each situation.

F. What are the steps for planning a Striped Bass culture facility?

Use TM B2 as a guide as you lead a discussion of these steps.

1. Do a thorough study of the seller's market.
2. Check the local regulations concerning Striped Bass culture.
3. Find a suitable site and test the water availability and quality (temperature, ammonia, alkalinity, etc.). Water hardness is most important.
4. Find sources of brood fish or fingerlings in the area.
5. Locate sources of feed in the area.

G. What are the specific requirements of the Striped Bass?

Use TM B3 to identify the optimum water quality ranges of the Striped Bass.

1. Temperature.
 - a. Spawning temperature is 68°F.
 - b. Optimum temperature for growth is between 78 and 82°F.
 - c. Growth slows to near zero below 55°F and above 95°F. Optimal is below 82°F.
2. Dissolved Oxygen.
 - a. Optimum growth will occur if DO is kept above 6 ppm at all times.
 - b. Supplemental aeration is required when DO falls below 4 ppm.

3. Ammonia.
 - a. Total Ammonia Nitrogen (TAN) is related to pH and the buffering capacity.
 - b. 0.5 ppm unionized ammonia will cause severe stress and may cause death.

4. pH: should be maintained between 6.5 and 8.5.
5. Nitrite.
 - a. A nitrite concentration of greater than 2 ppm may cause methemoglobin to form in the blood and reduce the blood's ability to transport O₂ to the metabolizing tissues, thereby causing stress and lost production.
 - b. A chloride to nitrite ratio of 6:1 should be maintained at all times, but this is hard to maintain economically.
6. Salinity.
 - a. Adding 100-200 ppm salt to the water when handling and transporting the fish will help to reduce stress.
 - b. Recent studies indicate levels should be significantly lower.
 - c. Raising hybrid Bass in brackish water, is advantageous
7. Alkalinity: Alkalinities of below 50 ppm are not desirable, and alkalinities of 150 ppm or more are best.
8. Hardness: Water hardness should be maintained above 50 ppm.
9. CO₂: Carbon dioxide concentrations should be held between 20 and 40 ppm to prevent stress and gas bubble disease. This is also related to pH.

Differences Between the White Bass, Hybrids, and the Striped Bass

- White Bass have a deeper body than the Striped Bass.
- White Bass horizontal lines are faint and incomplete.
- Hybrid horizontal lines are dark but incomplete.
- Striped Bass horizontal lines are dark and complete.
- Hybrids grow fastest of the 3.
- Hybrid and White Bass have smaller heads than the striper.

Steps to Follow Before Starting a Striped Bass Production Facility

- Investigate the possible markets.
- Check legality of Striped Bass culture in that area.
- Find a suitable site and check the water.
- Check the availability of brood fish or fingerlings.
- Locate the sources of feed in the area.

Water Quality Requirements of the Striped Bass

- Temperature: optimum for growth 78-82°F can survive 32-95°F. Growth slows to near zero below 55°F and above 95°F
- DO: 6 ppm or higher
- Ammonia: below 0.6 ppm TAN is optimal, 0.5 ppm un-ionized may cause severe stress or death
- pH: between 6.5 and 8.5
- Nitrite: below 2 ppm and maintain a 6:1 Cl to NO₂ ratio
- Alkalinity: above 50 ppm, above 150 ppm is best to prevent fluctuations in pH
- Hardness: best above 25 ppm
- CO₂: must be kept below 110% of saturation

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Quiz for Section B

Name:

Date:

Quiz for Understanding the Life Cycle and Identifying Facilities for Culture of Striped Bass

1. T F The Striped Bass has 4 life stages.
2. T F The original cross hybrid is a cross between the male White Bass and the female Striped Bass.
3. T F The reciprocal striper shows the most potential for aquaculture.
4. T F The male Striped Bass has been domesticated so it is a reliable broodstock.

Key for Quiz Section D

1. F The Striped Bass has 4 life stages.
2. T The original cross hybrid is a cross between the male White Bass and the female Striped Bass.
3. F The reciprocal striper shows the most potential for aquaculture.
4. F The male Striped Bass has been domesticated so it is a reliable broodstock.

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Teaching Plan:

Module: Striped Bass – Section C

Problem Area: Hatching and Rearing Striped Bass

Goal: The purpose of this problem area is to increase the student's understanding of the techniques involved in hatching and rearing Striped Bass.

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

- discuss and/or demonstrate spawning techniques
- discuss and/or demonstrate techniques for incubating eggs
- explain the fry culture techniques of Striped Bass and their hybrids
- identify the methods of fingerling harvest and grading
- calculate the number of fry or fingerlings on hand
- discuss the specific hauling requirements of fingerlings

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

Essential:

Hybrid Striped Bass Hatchery Phase, Hodson R.G. and M. Hayes, SRAC #301, 1989, transparencies, 20 gal aquarium, diesel fuel or oil, a few aquatic insects, 5-10 gal fish transport bags, oxygen cylinder, several small fish

Tank Spawning of First Generation Striped Bass X White Bass Hybrids, Harrell, R.M., Progressive Fish Culturist 46(2) pp. 75-78, 1984.

Culture and Propagation of Striped Bass and Its Hybrids, Harrell, R.M., et al., Striped Bass Committee, Southern Division, American Fisheries Society, Bethesda, MD, 1990.

Hybrid Striped Bass Biology and Life History, Hodson, R.G., SRAC #300, 1989 .

Striped Bass and its Hybrids, Smith, T.I.J., World Aquaculture, 20(1) pp. 32-38, 1989.

Commercial Culture of Hybrid Striped Bass: Status and Potential, Van Olst, J.C. & J.M. Carlberg Aquaculture Magazine, 16(1) pp. 49-59, 1990.

Content and Procedure

Preparation (Interest Approach):

To develop student interest in this module, compare the production of Striped Bass fingerlings with the production of feeder pigs, calves, and poultry. NOTE: First-time farmers should not be encouraged to spawn fish themselves. Hatchery technology requires years of experience to implement reliably and at a commercial scale. Hatchery resources may also be quite different from grow out facilities. Caution is suggested to those who would consider a hatchery and integrated production and suggest the alternative of buying fry or fingerlings from an established hatchery.

Presentation:

A. What are the spawning techniques used for Striped Bass and hybrid stripers?

1. Tank spawning.
 - a. Fish are injected with Human Chronic Gonadotropin (HCG) and placed into a tank 6-10 ft in diameter and 3 ft deep. Two males and one female are put into each tank.
 - b. HCG is collected from urine of pregnant women in developing countries, e.g., India, and imported into the United States.
 - c. Fish spawn "naturally."
 - d. Water temperature is maintained at 68°F.
 - e. The advantages of tank spawning and incubation are lowest labor intensity, not as much technical knowledge required, and less stress put onto brood fish.
 - f. The disadvantages of tank spawning and incubation: more space and water required for tanks, less control over egg and fry health. It doesn't work with reciprocal hybrid because the eggs are adhesive. It doesn't work well with the cross because it is difficult or impossible to get female Striped Bass to release eggs to White Bass males. So far, this technique has only worked for Striped Bass.
2. Manual spawning.
 - a. Fish are injected with HCG and placed into a holding tank until ready to spawn.
 - b. Females are regularly checked for signs of ovulation because their fertility window is only 30 minutes. Too much handling can also stress the female.
 - c. As ovulation occurs, the eggs are stripped into a dry pan and sperm is added from the male. Some producers add a 1% saline solution immediately after adding the sperm. Others prefer to allow fertilization to occur without adding the saline so a small amount of water must be added to activate the sperm.
 - d. After the sperm (and saline if desired) are added, the gametes are stirred with a feather or finger to allow for complete fertilization.
 - e. Fertilization will be complete within a few minutes.
 - f. White Bass eggs must be specially treated with Fuller's earth, silt, clay, starch, sodium sulfite, or tannic acid to remove the adhesive quality of the egg shell. Striped Bass eggs must be allowed to water harden; they are washed with fresh water several times.

B. How are the eggs incubated?

1. Water temperature is kept at 68°F.

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2. Jars.
 - a. 200-300 ml of eggs/jar.
 - b. Keep enough water flowing into the jar to keep the eggs rolling slowly but not so much that the eggs are pushed more than an inch up into the water column.
3. Troughs or aquaria: Incubation is generally used as a backup when tank or jar space is limited.
4. Tanks: used extensively by commercial growers.

C. How are fry transported?

Have the class bag some small fish for transport; guppies will work. Leave the fish in the bag overnight to demonstrate the efficiency of this method. Discuss how to count fry using neutrally buoyant beads of known number. Count and calculate the mean density, then total the mean number. How close did you get to the actual number? How close is this to the mean? Discuss the differences.

1. Fry are transported in 5-10 gallon clear plastic bags with 2-3 gallons of water in pure O₂.
2. Fry will live for up to 48 hours when bagged properly with pure O₂ and insulated.
3. 50,000 fry per gallon is the maximum density when the fry will remain bagged for more than 12 hours.
4. Bagging technique:
 - a. Fry and water are placed in the bags and all air is replaced with pure oxygen.
 - b. The bag top is twisted and tightly sealed with strong rubber bands.
 - c. The bags are placed into Styrofoam boxes to keep the temperature from fluctuating and shipped.
 - d. For short distances the bags can be placed into empty feed sacks to prevent puncture.

D. What is the best method for fry culture?

Use TM C1 as a guide as you discuss the techniques involved in pond culture of Bass fry.

1. Pond culture.
 - a. Spring pond preparation: drain and sterilize.
 - b. Fill with clean water. For straight stripers and original cross fry, the pond should be filled 2 to 3 weeks before stocking to allow the larger zooplankton populations to become established.
 - c. For reciprocal cross fry the pond should be filled 3 to 10 days before stocking. Timing is critical because the reciprocal fry is much smaller than the original and must eat smaller zooplankton. This food will be most abundant the first weeks after filling. **WARNING:** If the zooplankton are too large, they may eat the reciprocal fry.

Show slides of zooplankton. Set up an aquarium of filtered water in a window. Follow the development of blooms and change. Use a microscope to look at the bloom animals.

- d. Fertilizing is necessary to achieve the desired density of phytoplankton and zooplankton.

Prepare several tanks with different organic and inorganic fertilizers. Compare the differences.

- e. A combination of organic and chemical fertilizers will generally give the best results.
- f. Organic fertilizers, such as alfalfa pellets and cotton seed meal, should be spread over the pond at rates of 150 to 300 lbs/acre while the pond is being filled, and 50-100 lbs/acre should be added a few days before stocking and again each week after stocking until the fish are on feed.

- g. Chemical fertilizers, such as ammonium nitrate and phosphoric acid, can be acquired from most farm suppliers in either liquid or granular form. The granular 0-46-0 mix can be dissolved during the pond filling process by placing 10-15 lbs/acre in a mesh bag and tying it onto the inflow pipe.
- h. 2-3 gallons per acre of liquid fertilizers such as 11-37-0 should be added 2 or 3 times per week before stocking and at least once each week following stocking until the fish are on feed.
- i. Inorganic fertilizer should not be applied to the pond any time within 2 days of stocking.
- j. Predacious insects must be controlled; applying 2-5 gallons of diesel per acre will kill all air breathing insects in the pond.

Demonstrate this with a few drops of a diesel fuel mixed in a tank containing some air-breathing aquatic insects such as waterboatmen or backswimmers. Apply the diesel when a light breeze is blowing to help spread it over the entire surface of the pond. This procedure should be done 2-3 days before stocking and repeated once per week for the 3 weeks following stocking. Nonsurface breathing insects such as dragonfly larvae can be controlled by using 0.25 ppm Mastosen^R. Insecticides are toxic to zooplankton and should not be applied in the week before stocking nor should they be applied for the first 3 weeks following stocking. **WARNING:** This chemical is not labeled for use on foodfish and should not be used if any larvae or fish are present in the pond.

2. Stocking.

- a. Stocking rates of 75,000 to 200,000 fry per acre are currently used by most producers.
- b. Fry of the straight striper and original cross should be stocked by 7 days post-hatch and the reciprocal fry should be stocked at 4 days.
- c. Striper fry and original cross fry may be held in tanks until day 10 if they are fed filtered zooplankton or brine shrimp from days 5-10.
- d. Fry starve to death by day 14 if they don't get food because the yolk reserve runs out.

3. Tempering.

- a. The fry must be tempered to both temperature and pH before releasing into the pond. This is accomplished by first placing the bags containing the fry into the pond unopened, and allowing them to sit for a short period.
- b. Check the temperature and pH in both the pond and the bags. If the temperature difference is $<2^{\circ}\text{F}$. and the pH difference is <0.2 units it is safe to release the fish. If the difference is greater, add 2 l of pond water to the bags every 15 minutes until the differences are less than those stated above.
- c. It is best to add pond water to help balance all of the water parameters, i.e., Ca_{+2} , Cl^{-} , Na^{+} , etc.

4. Feeding.

- a. 7-10 days after stocking, feeding of a quality fry meal, with at least 40% protein and a large proportion of fish oil or meal, should begin, using #00 or #0 initially.
- b. 5-10 lbs/acre three times per day is plenty until the fish begin to consume the feed heavily.
- c. Once the fish come on feed, some producers like to train the fish to eat in only one corner of the pond. This makes harvest much easier because it is not necessary to seine the entire pond to catch most of the fish. **NOTE:** This practice can lead to cannibalism in larger ponds and should only be done in ponds <1 acre.
- d. When the fish reach 1.5-2 inches in length, crumble or pelleted feed should be mixed with the meal and the fish should eventually be weaned from the meal with the goal being to get them onto a small floating pellet to minimize the amount of wasted feed.

5. Sampling.

- a. Fry survival should be checked at 2-5 days post stocking, using a stocking net.
- b. 14-21 days after stocking a 1/16th inch mesh, or smaller, seine should be used to check for survival and fingerling size.

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- c. Only a small portion of the pond need be seined and care should be taken as sometimes fish this young are difficult to see in the seine.
 - d. A dip net can be used to sample for size when the fish are feeding actively.
6. Harvest: Some producers like to sell or move 75% of the fingerlings from a pond when they are between 2-3 inches. The remaining fish are then raised to 5-7 inches and sold in either late fall or winter.

D. How are fingerlings harvested and sorted to size?

1. Seining.
2. Trapping.
3. Draining.
4. Grading.
 - a. Grading is the process of sorting the fish into similar size groups.
 - b. Grading is done to help prevent cannibalism, which is often a very serious problem.
 - c. A wide variety of commercial fish graders are available. Some are small-volume, labor-intensive manual graders, while others are automated to grade large volumes of fingerlings. Most producers use bar graders for small fingerlings.
 - d. Most fish graders involve a set of aluminum bars which allow small fish to pass between them, but retain the larger fish.

E. What are the techniques for counting fry and fingerlings?

Use a known number guppies to compare and contrast various ways of estimating numbers.

1. Wet sample weight.
 - a. A container holding water is weighed. A known number of fish is added to this and it is weighed again. The weight of the fish equals the final weight minus the initial weight.
 - b. This method is often used to weigh fingerling Striped Bass. It is not as stressful on the fish because they spend almost no time out of the water.
2. Dry sample weight.
 - a. The fish are placed into a mesh or net basket. The water is drained off and then they are weighed. The weight of the basket must be subtracted from the total. Most scales can be adjusted to tare the basket.
 - b. This method can cause severe stress on small fingerlings, but is the most accurate when trying to weigh a few fish to find the average size.
3. Volumetric sample.

In this method a graduated cylinder, beaker, or marked bucket is filled to a certain level with water. The fish are added to the container and the rise in the water level is noted. The volume of the fish equals the change in the water level. Since fish have very near the same density as water, their weight equals the weight of the water they displaced.

F. What are the methods of hauling Striped Bass fingerlings?

Use TM C2 and discuss the techniques for transporting Striped Bass fingerlings.

1. Hauling densities.
 - a. With proper aeration and temperature control, the maximum density for a haul shorter than 4 hours is 0.5 lb of fish per gallon of water. On a haul longer than 4 hours, it is recommended that this be reduced to 0.25 lb/gal.
 - b. The size of fish is important; Phase II fish can be hauled at double the above weights.
2. Oxygen addition.
 - a. The DO in the hauling tank must be maintained at or slightly above saturation for the duration of the haul.
 - b. Oxygen can be added to the water as pure oxygen. The preferred way is with either a compressed oxygen or liquid oxygen system with a forced air blower system or with agitators.
3. Temperature regulation.
 - a. It is important that the temperature of the hauling water be close to the temperature that the fingerlings are being held at when loading.
 - b. When loading is complete the temperature of the hauling water may be lowered by adding block ice to the tank. This is done during hot weather and for long hauls. The fish will transport best when the water temperature is below 68°F.
4. Anesthetic.
 - a. A light dose (10-25 ppm) of MS 222 (Finquel) or Quinaldine will reduce handling and hauling stress on the fingerlings. Caution must be used as an overdose can kill the fish by stopping gill movement. If the fish are stressed before to anesthetic is applied they may experience oxygen debt and die.
 - b. Add 100-150 ppm salt during transportation.
 - c. Increase Ca hardness to 150 ppm.
5. Tempering for release.
 - a. This process insures that the fish experience as little temperature shock as possible upon release.
 - b. The temperature of the hauling water must be slowly changed to equal the temperature of the water the fish are to be released into by slowly adding the water into which the fish are to be released to the hauling tanks.
 - c. The temperature of the hauling water should not be altered more than 5°F per hour. If the temperature difference is 15°F then the tempering process should take at least 3 hours.
 - d. Another way is to unload the fish into small tanks in the hauling water using the new water to temper the fish in the small tanks.
 - e. Intensive culture facilities can decrease tempering times by changing the temperature and pH of the receiving water to match that used in transport.

Techniques for Pond Culture

- A. Pond Preparation
 - 1. Draining and sterilizing
 - 2. Filling
 - 3. Fertilizing
 - 4. Insect control

- B. Stocking – Tempering to Temperature and pH

- C. Feeding

- D. Sampling

- E. Harvest and Grading

Hauling Striped Bass Fingerlings

- Densities of 0.25-0.5 lbs per gallon of water
- Oxygen addition
- Temperature regulation
- Anesthetic
- Tempering for release

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Quiz for Section C

Name:

Date:

Quiz for Hatching and Rearing Striped Bass

1. T F Fertilization of Striped Bass eggs takes 3 hours.
2. T F It is best to transport fry in bags.
3. T F Pond preparation includes fertilization with organic material.
4. T F For the reciprocal cross fry the pond should be filled at least two weeks prior to stocking.
5. T F It is important that the temperature of the hauling water be close to that of the holding water when transferring fish.
6. Explain the tank spawning method.

Key Quiz for Section C

Name:

Date:

1. F Fertilization of Striped Bass eggs takes 3 hours.
2. T It is best to transport fry in bags.
3. T Pond preparation includes fertilization with organic material.
4. F For the reciprocal cross fry the pond should be filled at least two weeks prior to stocking.
5. T It is important that the temperature of the hauling water be close to that of the holding water when transferring fish.
6. Explain the tank spawning method.
Fish are injected with HCG. Water is maintained at 68°F. The tank should be 6-10 ft in diameter and 3 ft deep. Tanks should contain 2 males and 1 female.

Teaching Plan:

Module: Striped Bass – Section D

Problem Area: Growing Striped Bass to Market Size

Goal: The purpose of this problem area is to help students understand the techniques involved in growing Striped Bass to market size.

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

- identify the sources of fingerlings
- predict the quantity of fingerlings needed
- identify the culture facilities
- discover the culture techniques of food size Striped Bass and their hybrids
- identify the routine management techniques involved in Striped Bass culture
- identify the parts of the Striped Bass industry that must be improved

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

Essential:

Hybrid Striped Bass: Pond Production of Foodfish, Hodson, R.G. and Hayes, SRAC # 303, 1989.

Third Report to the Fish Farmers

Transparencies and overhead projector.

Additional:

Culture and Propagation of Striped Bass and its Hybrids, Harrell R.M., et al., Striped Bass Committee, Southern Division, American Fisheries Society, Bethesda, MD, 1990.

Hybrid Striped Bass: A National First, Easley, J.E., National Coastal Resources Research and Development Institute News, 4(2) pp. 1-5, Newport, OR, 1989.

Culture of Striped and Hybrid Striped Bass, McVey, E.M. & N. Thomson, AquaTopics Series, National Agricultural Library, Beltsville, MD, 1990.

Striped Bass and Its Hybrids, Smith, T.I.J., World Aquaculture, 20(1) pp. 32-38, 1989.

Commercial Culture of Hybrid Striped Bass: Status and Potential, Van Olst, J.C. & J.M. Carlberg, Aquaculture Magazine, 16(1) pp. 49-59, 1990.

Content and Procedure

Preparation (Interest Approach):

To develop student interest in this module, visit an animal finishing operation. Have the students discuss the operation. Compare and contrast growing out fish to food size with growing out swine, cattle, or poultry production.

Presentation:

A. What are the source of fingerlings available to the producer?

Use TM D1 or the chalkboard to outline the different sources of fingerlings available to the producer. Discuss the advantages and disadvantages of the various sources, paying particular attention to quality.

1. Growing them.
2. Purchase extras from another food fish producer.
3. Purchase them from a fingerling broker (live hauler).
4. Purchase them from a large-scale fingerling producer.

B. How does the producer know that he/she is getting the highest quality fingerlings available?

C. How can the producer predict the number of fingerlings needed?

Use TM D2 to go through the step-by-step procedure of determining the number of fingerlings needed. Use TM D3 to have students calculate the number needed.

1. First the producer must estimate the available space for production and estimate losses from cannibalism and other sources of mortality, e.g., disease, birds, etc.
2. The producer must decide on how intensive the production will be.
3. The producer should estimate the total number of fish that can be marketed economically.
4. How large will the fish be at market time?
5. Flow index and density index.

D. What are the different facility types for growing Striped Bass to food size?

Discuss how each system has advantages and disadvantages depending upon the farmer's situation.

1. Cages.
2. Ponds.
3. Tanks, pools, and raceways. Raceways may be circular or rectangular. These two systems differ in that large volumes of water (once through) are required for raceways, where as intensive tanks require only make up water.

Refer back to section on facilities in 1st semester and discuss the advantages and disadvantages of the various systems.

E. What are the specific techniques required for producing food-size Striped Bass?

1. Water quality management.

Review work done on water quality in 1st semester.

2. Stocking.
3. Regular feeding.
4. Monitoring for parasites and disease.
5. Predator and weed control.
6. Harvesting.
7. Record keeping.

F. What is a typical work schedule for a Striped Bass production facility?

Use the chalkboard to develop a typical weekly schedule, keeping in mind that some tasks are seasonal, variable because of demand, or a necessary daily task.

1. Regular water quality checks.
 - a. Monitor oxygen twice daily, more often if DO fluctuates greatly. The most important check is at dusk, as this is when the DO will be at its lowest. Checking every morning at sunrise will give the producer a chance to predict any future DO problems. In pond culture, if stocking density is high, fish are large and the water is warm, it will be necessary to monitor DO in the middle of the night.
 - b. Check ammonia and pH several times per week, every day if problems arise.
 - c. Check nitrites, chloride, and CO₂ weekly.
2. Regular feeding schedule: Feeding the fish two or three times per day, or using demand or automatic feeders will increase the growth of the fish.
3. Watch for sick or dead fish: Any time that sick or dead fish are found it is important to the producer to discover the cause of the problem. Even if only one or two fish are affected, this knowledge may give the producer a chance to head off any major problem.
4. Predator control: Predators, especially piscivorous birds such as grebes, herons, egrets and cormorants can cause large losses in fingerling Bass production. As the fish reach 1 lb, the problem decreases because the fish are too large for most predators and can outmaneuver many others. Fish eating birds are also an important link in the life cycle of some fish parasites.

Discuss the correct, legal procedure for predator control (especially migratory waterfowl). Ask a local fish and game officer to visit the classroom. Discuss reasons for legal restrictions concerning both wild and commercial fish.

5. Stocking, grading, and harvesting when needed.
6. Equipment maintenance and repair.

G. What must be done to improve the Striped Bass industry?

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Use TM D4 to discuss each of these changes and how they would affect the Striped Bass industry.

1. Domestication of brood stock.
2. Development of cheaper more efficient feeds.

3. Improve the disease diagnostic procedures and register more treatments for fish diseases with the FDA.
4. Develop more cost-effective production procedures.
5. The market for Striped Bass must be enlarged.
6. State laws restricting the sale of farm raised Striped Bass must be rescinded.

Sources of Fingerlings

- Growing them
- Purchase extras from another producer
- Fingerling brokers
- Large-scale fingerling producers

Determine the Number of Fingerlings Needed

- Estimate the available space
- Determine the desired density

Deciding on Number of Fingerlings

A producer needs to stock 30 acres of ponds with Striped Bass fingerlings. The average production on this farm has been 5,000 lbs per acre. The local market is strong and can handle at least 50,000 more 1.5 lbs fish than are being produced. How many fingerlings does the producer need to stock these ponds?

Needed Improvements:

- Domesticated brood stock
- Cheaper more efficient feeds
- Improved disease treatments and diagnostic techniques
- Development of more efficient production procedures
- Enlarged market
- Rescinded laws regulating culture and sale of farm raised Striped Bass

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Quiz for Section D

Name:

Date:

Quiz on Growing Striped Bass to Market Size

1. T F When estimating the number of fingerlings needed the producer should study the market.
2. T F Monitoring DO should be done weekly.
3. T F DO will reach its lowest point immediately after the fish eat.
4. T F Some birds carry parasites of fish.
5. T F To improve the Striped Bass industry the market should be enlarged.
6. List the duties a Bass producer must do.

Key for Quiz – Section D

1. T When estimating the number of fingerlings needed the producer should study the market.
2. F Monitoring DO should be done weekly.
3. F DO will reach its lowest point immediately after the fish eat.
4. T Some birds carry parasites of fish.
5. T To improve the Striped Bass industry the market should be enlarged.
6. List the duties a Bass producer must do.
Water quality checks, regular feeding, watch for sick or dead fish, predator control, stock, grade and harvest, equipment maintenance and repair

Teaching Plan:

Module: Striped Bass – Section E

Problem Area: Feeding Striped Bass

Goal: The purpose of this problem area is to understand the types of rations and feed requirements of Striped Bass.

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

- discover the types of Striped Bass feed available
- identify the nutritional requirements of Striped Bass and hybrids
- discover the feed conversion of Striped Bass
- identifying the feeding schedule required by Striped Bass
- identify the different feeding methods

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

Essential:

Transparencies and overhead projector.

Third Report to the Fish Farmers, SRAC #302

Additional:

Culture and Propagation of Striped Bass and Its Hybrids, Harrell R.M., et al., Striped Bass Committee, Southern Division, American Fisheries Society, 1990, Bethesda, MD.

Hybrid Striped Bass: A National First, Easley, J.E., National Coastal Resources Research and Development Institute News, Newport, OR, 4(2) pp. 1-5, 1989.

Striped Bass and Its Hybrids, Smith, T.I.J., World Aquaculture, 20(1) pp. 32-38, 1989.

Commercial Culture of Hybrid Striped Bass: Status and Potential, Van Olst, J.C. & J.M. Carlberg, Aquaculture Magazine, 16(1) pp. 49-59, 1990.

Content and Procedure

Preparation (Interest Approach):

To develop student interest in this module, show the class samples of various feeds if available.

Presentation:

A. What types of feed are available to the Striped Bass producer?

Feed availability depends upon geographic location. It is not economically feasible to transport large quantities of feed great distances so the local Bass producer must find a feed source within a few hundred miles. Small quantities of fry or fingerling feeds may be ordered from across country, but many times a suitable feed is produced nearby.

Call or write several local feed mills and obtain a list of feeds produced. Discuss with class and determine which feeds would be suitable for Striped Bass culture.

B. What are the nutritional requirements of the Striped Bass and their hybrids?

Use TM E1 or the chalkboard to discuss the nutritional requirements of the Striped Bass.

1. The natural foods of the Striped Bass include a variety of zooplankton, insects, crustaceans, and fish.
2. Larval diets should contain a minimum of 45% protein and more than 8% fat content.
3. Fingerling diets should remain above 35% protein and have more than 6% fat.
4. Adult diets containing more than 36% protein and 4-10% fat are suitable if they contain enough fish meal. A large portion of the protein should come from fish meal, not soybeans.

C. What kind of feed conversion can the producer expect?

Feed conversion will depend upon many factors within the facility, including stress, fish size, amount of feed wasted, temperature, and others. The producer can expect conversion rates to range from 1.5-3 lbs of feed per 1 lb of gain.

Discuss feed conversion and how it affects production costs.

D. How much and how often should Striped Bass be fed?

Use TM E2 or chalkboard to discuss feeding Striped Bass. Discuss how to keep food conversion rate low, why feed must be so available (what happens if it is not) and distributing feeds from the 1st semester material. Discuss the pros and cons of the different kinds of feeders and feeding methods.

1. Larvae in intensive culture should have feed available 24 hours per day. An automatic feeder set to feed every 5 minutes will work.
2. As the fish reach 1 inch and become more aggressive to feed they should be fed 5-10% of their body weight per day. It is best to split this ration into at least 3 feedings per day: morning, noon, and dusk.
3. Larger fingerlings (3-6 in.) should be fed 5% of their body weight per day split into at least 2 feedings.

4. Fish larger than 6 in. should be fed 3-5% of their body weight per day split into 2 feedings per day.

E. What are the 4 methods for feeding Striped Bass?

1. Hand.
2. Manual/mechanical.
3. Automatic/timer: Care must be taken when calibrating an automatic feeder to insure that no more feed than the fish will eat is being fed. There must also be enough feed provided to insure optimum growth.
4. Demand: Feeders can work with properly trained Striped Bass.

Nutritional Requirements of Striped Bass

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

Feeding Rates for Striped Bass (Manual Feeding)

- 1-3 inch fingerlings: 5-10% of body weight per day
- 3-6 inch: 5% of body weight per day
- 6 inch: + 3-5% of body weight per day

Quiz for Section E

Name:

Date:

Quiz on Feeding Striped Bass

1. T F Bass fry feed should contain at least 45% fat.
2. T F Natural foods of striped bass include crustaceans.
3. T F Larval striped bass must have a steady supply of feed.
4. T F 3 to 6 inch striped bass fingerlings can eat 15% of their body weight per day.
5. T F Feed conversion of striped bass will vary with temperature.
6. List the different methods for distributing feed.

Key for Quiz – Section E

1. F Bass fry feed should contain at least 45% fat.
2. T Natural foods of striped bass include crustaceans.
3. T Larval striped bass must have a steady supply of feed.
4. F 3 to 6 inch striped bass fingerlings can eat 15% of their body weight per day.
5. T Feed conversion of striped bass will vary with temperature.
6. List the different methods for distributing feed.
 Hand, manual/mechanical, automatic timer, demand

Teaching Plan:

Module: Striped Bass – Section F

Problem Area: Controlling Pests and Diseases

Goal: The purpose of this problem area is to identify the types of disease and predator problems faced by Striped Bass producers.

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

discover the types of Striped Bass diseases
identifying a disease problem
discovering the prevention and treatment of Striped Bass diseases
identify the different methods of pest control

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

Essential:

Transparencies and overhead projector.

Third Report to the Fish Farmers, pp. 114-116

Additional:

Slides of infected fish.

Culture and Propagation of Striped Bass and Its Hybrids, Harrell, R.M., et al., Striped Bass Committee, Southern Division, American Fisheries Society, Bethesda, MD, 1990.

Textbook of Fish Health, Post, G., TFH Publications, Inc., Neptune City, NJ, 1987.

Fish Hatchery Management, Piper, et al., U.S. Department of the Interior, Fish & Wildlife Service, Washington, DC, 1982.

Fish Pathology, Roberts, R.J., editor, Bailliere Tindall, London, 1989.

Bacterial Fish Pathogens: Disease in Farmed and Wild Fish, Austin, B. & Austin, D.A., Harwood, E., Chichester, 1987.

Fish Viruses and Fish Viral Diseases, Wolf, K., Comstock Pub. Associates, Ithaca, 1988.

Content and Procedure

Preparation (Interest Approach):

To develop student interest in this module, visit a fish disease diagnostic lab or have the local vet come in and discuss animal diseases. Get a fish grower or extension person to come in and talk about problems with the FDA and getting clearance to use chemical controls. Have class discuss the pros and cons of using different kinds of chemicals.

NOTE: Stress induced by cultural environment is the most important element in disease management. Many treatments are legal only for certain fish, not legal on food fish, or may require a withdrawal period prior to sale. All producers should exercise great care and have full knowledge of regulations and possible side effects of any treatment before using. This also extends to aquatic herbicides used for weed control.

Presentation:

A. What diseases are Striped Bass susceptible to?

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

1. Bacterial diseases: *Flexibacter columnaris*.
 - a. Columnaris is probably the most important disease of Striped Bass cultured in fresh water.
 - b. Columnaris can occur as an internal infection, an external infection, or both simultaneously.
 - c. Internal infections may cause the fish to stop eating and swim listlessly in shallow water.
 - d. 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.
 - e. Diagnosis of the disease is made by identifying the bacteria either microscopically or through isolation and biochemical testing.
 - f. Recent FDA interpretations have eliminated all therapeutants for hybrid Striped Bass, so it is illegal to use any therapeutants. Therefore, the traditional treatments are as follows: 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. The most common method of treatment is to add 2 ppm to the water every hour until the red color persists for several hours. An internal infection should be treated with Terramycin medicated feed.
2. Bacterial diseases: *Aeromonas* and *pseudomonas*.
 - a. It is common bacteria in 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.
3. Bacterial diseases: *Vibriosis*.
 - a. Similar to that caused by the aeromonads which generally occurs in brackish or salt water although it has been isolated from many freshwater facilities.

- b. Vibriosis and the aeromonad diseases can be differentiated only through isolation of the bacteria and biochemical testing.

- c. Both aeromonas and vibriosis have been treated with medicated feeds, but these are not approved by the FDA at this time.
4. Protozoan parasites: Ichthyophthirius multifiliis (Ich).

Use TM F2 to describe the life cycle of Ich.

- a. Ich can decimate a producer's stock once they become infected. Ich is the only protozoan parasite of fish that can be seen with the naked 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 1 to 3 weeks (varies with temperature) in the fish, the adult leaves the fish and attaches to the bottom or side of the tank or pond. 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.
 - d. Treatment of Ich requires multiple applications of chemicals because only the free swimming stage can be killed. NOTE: These chemicals are not approved for use on food fish at this time.
5. Protozoan parasites: Other protists.

Use TM F3 to demonstrate what some of the parasites of Striped Bass look like.

- a. There is a wide variety of protozoan parasites of Striped Bass. 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, the population of protozoan 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.
6. Trematodes.
 - a. Monogenous external parasitic flatworms are common, but generally are not a problem unless the fish are stressed and the population of flatworms increases dramatically.
 - b. Digeneous yellow grubs, white grubs, and black spot are all names for various trematodes which infect Striped Bass. Each has a specific area within the body in which it lives. There are not any known cures for these grubs and the only prevention is to break the life cycle of the parasite. This life cycle involves living as an adult in a piscivorous bird that sheds 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 an infect fish. If the fish is eaten by a bird, the parasite will finally reach the adult stage in the bird.

B. How can the producer diagnose the causative agent?

1. The best way for a producer to be sure of the causative agent of the problem is to take some of the sick fish to a diagnostic lab.
2. Review the proper techniques for selecting a sample for the diagnostic lab.

C. What are the disease prevention and treatment techniques?

1. Treatment of bacterial diseases.
 - a. Water quality maintenance. NOTE: The following treatments are not approved for use on food fish at this time.
 - b. Medicated feeds.
 - c. Chemical baths.
 - d. Chemical injection.
2. Treatment of Ich. NOTE: Chemicals may not be currently approved for use on food fish.
 - 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.
 - e. Copper A treatment of 1 ppm copper sulfate for every 100 ppm of hardness every 2 or 3 days for at least 3 treatments.
3. Treatment of external protists.
 - a. CuSO_4 .
 - b. Formalin.
 - c. KMnO_4 .
 - d. Salt.
4. Treatment of Trematodes.
 - a. Monogenous: Formalin at 25 ppm for a prolonged treatment or at 200 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.

D. What are the major pest problems and how are they controlled?

1. Snakes.
 - a. Eradication.
 - b. Removal of cover.
 - c. Barriers.
2. Birds.
 - a. Scare: Many techniques involving firecrackers, scarecrows, 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 may be 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, based on recommendations by the U.S. Department of Agriculture. NOTE: Failure to comply is grounds for imprisonment.
3. Mammals.
 - a. Removal by trapping or hunting if legal.
 - b. Prevent access.

E. How can weeds become a problem?

1. Impede harvest.
2. Cause low DO at night and prevent fish from getting to aerator.
3. Hamper feeding.

Diseases

- A. Bacterial Diseases
 - 1. Columnaris
 - 2. Aeromonas and pseudomonas
 - 3. Vibriosis

- B. Parasites
 - 1. Ich
 - 2. Other protists
 - 3. Trematodes

- C. Fungi (saprolognia)

This page is for TM F2 which will be inserted later.

This page is for TM F3 which will be inserted later.

Quiz for Section F

Name:

Date:

Quiz for Controlling Pests and Diseases

1. T F A fish may act lethargic just because it is tired.
2. T F Columnaris disease is strictly an internal disease.
3. T F Ich can be treated with medicated feed.
4. T F Yellow grubs live a portion of their life in a snail.
5. T F Treating water with formalin may kill the fish.

Aquaculture Curriculum Guide

Key for Quiz – Section F

1. F A fish may act lethargic just because it is tired.
2. F Columnaris disease is strictly an internal disease.
3. F Ich can be treated with medicated feed.
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Teaching Plan:

Module: Striped Bass – Section G

Problem Area: Harvesting, Transporting, and Marketing Striped Bass

Goal: The purpose of this problem area is to understand the techniques involved in finding markets for Striped Bass.

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

- identifying the harvesting techniques
- identifying the hauling equipment and technique
- discovering the techniques of Striped Bass processing

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

Essential:

Transparencies and overhead projector.

Hybrid Striped Bass: A National First, Easley, J.E., National Coastal Resources Research and Development Institute News, 4(2) pp. 1-5, Newport, OR, 1989.

Striped Bass and its Hybrids, Smith, T.I.J., World Aquaculture, 20(1) pp. 32-38, 1989.

Commercial Culture of Hybrid Striped Bass: Status and Potential, Van Olst, J.C. & J.M. Carlberg, Aquaculture Magazine, 16(1) pp. 49-59, 1990.

Content and Procedure

Preparation (Interest Approach):

To develop student interest in this module, have a joint class with the home economics class. Try serving fish in as many different ways as possible, e.g., fried, BBQ, baked, marinated, poached in white sauce. Discuss the various markets for fish while cooking and eating.

Presentation:

A. What are the 3 main harvest techniques for Striped Bass raised in a pond culture?

Review harvesting techniques from the first semester.

1. Crowding with seine and dipping.
2. Crowding by draining.
3. Trapping.

B. How are Striped Bass transported?

A slide show or video showing examples of transport equipment would be effective.

1. Live.
 - a. This is difficult in the summer because high temperatures make it necessary for the haulers to add large quantities of ice to the hauling boxes and stress the fish by going from high to low temperatures.
 - b. Also, fish .5 lb and larger have extremely sharp spines that puncture other fish in live transport, to the extent that an unsalable product may occur during long transport, i.e., fish with punctured eyes.
 - c. Therefore, live fish are seldom marketed today.
2. Whole, in an ice slush. This is probably the best method for hauling pond seined fish in the summer although it does create a large expense for the ice.
3. Gilled and gutted on ice.
 - a. This requires an on site processing facility.
 - b. Hauling costs are reduced because the weight of the internal organs is not being hauled.

C. How are Striped Bass processed for sale?

Use TM G1 as a guide while you discuss processing Striped Bass. If possible visit a fish processing facility.

1. Processing of food fish should be done in a facility that has been inspected by a state health department.
2. Scaled, gilled, and gutted (whole).
3. Filleted.

D. What are the main markets for Striped Bass?

Use TM G2 or the chalkboard to discuss the different market channels for Striped Bass. Have a local seafood retailer give a talk on the potential of Striped Bass sale in the area.

1. Seafood wholesalers/ fish brokers.
2. Retailers.
3. Large retail or wholesale contracts.
4. Restaurants.

Types of Processed Striped Bass:

- Whole in the round
- Whole/gilled and gutted
- Filleted

Markets for Striped Bass:

- Seafood wholesalers
- Seafood retailers
- Contracts
- Restaurants

Quiz for Section G

Name:

Date:

Quiz for Harvesting, Transporting, and Marketing Striped Bass

1. T F High summer temperatures make harvest difficult.
2. T F Hauling costs may be reduced if the fish are partially processed prior to transport.
3. T F A producer can process fish without any special permits.
4. T F Striped Bass are often cut into steaks.
5. List the markets for Striped Bass.

Aquaculture Curriculum Guide

Key for Quiz – Section G

1. T High summer temperatures make harvest difficult.
2. T Hauling costs may be reduced if the fish are partially processed prior to transport.
3. F A producer can process fish without any special permits.
4. T Striped Bass are often cut into steaks.
5. List the markets for Striped Bass.
Seafood wholesalers/fish brokers, retailers, large retail or wholesale contracts, restaurants

Final Exam – Striped Bass

Name:

Date:

1. T F Hybrid stripers grow faster than either parent for the first 2 years.
2. T F White Bass can reach weights of 100 lbs.
3. T F Striped Bass are native to the California coast.
4. T F Columnaris disease can strike both externally and internally.
5. T F Striped Bass grow best at 70°F.
6. T F A fish grader determines if the processed fish is grade A, B, or C.
7. T F Some birds carry parasites of Striped Bass.
8. T F There is no cure for Ich.
9. T F Reciprocal cross fry are larger than original cross.
10. T F The incubation temperature for Striped Bass eggs is 68°F.

11. Fry should be stocked in ponds at densities of
 - A. 10,000 to 15,000/acre
 - B. 15,000 to 30,000/acre
 - C. 30,000 to 50,000/acre
 - D. 50,000 to 75,000/acre
 - E. More than 75,000/acre

12. Striped Bass fingerlings can be hauled at densities of
 - A. 0-0.5 lb/gal
 - B. 0.5-1 lb/gal
 - C. 1-2 lb/gal
 - D. 2-3 lb/gal

13. When stocking fry they should be tempered to
 - A. pH
 - B. DO
 - C. Alkalinity
 - D. Temperature
 - E. A and D
 - F. All of the above

Key for Final Exam – Striped Bass

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6. T A fish grader determines if the processed fish is grade A, B, or C.
7. F Some birds carry parasites of Striped Bass.
8. F There is no cure for ich.
9. F Reciprocal cross fry are larger than original cross.
10. F The incubation temperature for Striped Bass eggs is 68°F.
11. Fry should be stocked in ponds at densities of
E. More than 75,000/acre
12. Striped Bass fingerlings can be hauled at densities of
A. 0-0.5 lb/gal
13. When stocking fry they should be tempered to
F. All of the above
14. List three sources of fingerlings.
Purchase them from a fingerling broker
Grow them
Purchase extras from another foodfish producer
Purchase them from a large-scale fingerling producer
15. Explain why the Striped Bass culture industry has developed.
Wild catch is increasing, people in developing countries are eating more fish, they are an attractive alternative to available fish, there is a growth of recreational fishing
16. List two ways that oxygen can be added to water.
Forced air blower and agitation