Lesson Plan

Aquaculture:

Aquatic Animal Diseases

SART Training Media

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Aquatic Animal Diseases

Lesson Plan

Prepared by: Kathleen Hartman, DVM, PhD
Aquaculture Epidemiologist, USDA-APHIS-Veterinary Services

Denise, Petty, DVM,
Assistant Professor, Large Animal Clinical Sciences,
College of Veterinary Medicine, Univ. of Florida

Charles M. Brown
Coordinator for Infomration/Publication Services
Agricultural and Biological Engineering Dept., Univ. of Florida

Carol J. Lehotla
Associate Professor
Agricultural and Biological Engineering Dept., Univ. of Florida

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About Florida SART

SART is a multiagency coordination group consisting of governmental and private entities dedicated to all-hazard disaster preparedness, planning, response, and recovery for the animal and agriculture sectors in the state of Florida.

SART operates at the local level through county SART organizations.

SART utilizes the skills and resources of many agencies, organizations and individuals with its multiagency coordination group structure.

SART supports the county, regional, and state emergency management efforts and incident management teams.

SART Mission

Empower Floridians through training and resource coordination to enhance all-hazard disaster planning and response for animals and agriculture.

SART Goals

- Promote the active engagement of each county coordinator who is responsible for animal and agricultural issues
- Provide assistance in the development and writing of county ESF-17 plans
- Promote the establishment of a county SART to work as a multiagency coordination group to support emergency management and incident management teams
- Provide training for all SART and animal and agriculture personnel
- Identify county resources available for an emergency or disaster
- Work to comply with the National Incident Management System (NIMS) document

Subject: Aquaculture may be Florida's least known, important commodity. This unit introduces participants to diseases that can affect aquatic animals in Florida's aquaculture industry.

Introduction

This lesson plan, together with a workbook and PowerPoint presentation, form a training unit entitled Aquatic Animal Diseases, which is part of the SART training module for Aquaculture. This lesson plan guides the instructor in delivering the educational portion of the workshop. For information on planning, organizing and publicizing the entire training event, consult the *Creating a County SART* Toolkit. The toolkit and other SART training materials are available on the Florida SART Web site: <www.flsart.org>.

This lesson plan is structured to provide an introductory overview of diseases that can affect aquatic animals in Florida's aquaculture industry.

Approximately 45-60 minutes should be allocated for this program.

Session Outline

Part 1—Beginning the Workshop	5 minutes
Part 2—Emerging Versus Endemic	5 minutes
Part 3—Emerging Aquatic Animal Diseases	15 minutes
Part 4—Endemic Aquatic Animal Diseases	15 minutes
Part 5—Highlight Key Resources	5 minutes
Part 6—Summary and Wrap-Up	10 minutes
Total	55 minutes

Learning Objectives

At the end of this unit, participants will be able to:

1. State the difference between an emerging and an endemic disease.
2. Provide examples and characteristics of emerging aquatic diseases affecting fish, crustaceans, and molluscs.
3. Provide examples and characteristics of endemic aquatic diseases affecting fish, crustaceans, and molluscs.
4. Identify key resources easily accessible for additional information.

Learning Environment/Aids

To complete this lesson plan, you will need:

- The PowerPoint presentation Aquatic Animal Diseases
- Optional: a companion publication, Aquatic Animal Diseases: Participant Workbook, is available. It contains copies of the PowerPoint slides and resource information

To conduct this training unit, you will need:

- A means to show the PowerPoint presentation: a computer with a projector. (Note: Master black and white copies of the slides are included at the end of this manual for use as a flipbook or, if you prefer, to make transparencies for use with an overhead projector.)
- Sufficient seating for all participants

Each participant will need:

- A pen or pencil
- Participant workbook or paper for notes

Before the Workshop

On the day of the workshop, check that all equipment needed is in place. Double-check that electronic media works on the equipment you have. Also, make certain that any materials for participants, such as paper, workbooks and pens/pencils, are available in sufficient numbers.

Part 1: Beginning the Workshop

Time: 5 minutes

Focus: Starting your training session on the right note

SLIDE 2-3

Once all participants have taken their seats and have settled down, welcome them to the Aquatic Animal Diseases workshop. Thank them for attending and congratulate them on taking the time to learn about this important Florida industry. Remind them that the best way to respond to an aquacultural emergency is to have a foundation of knowledge on which to build.

During this introduction, you may choose to administer the Pre-Test included in this manual. Make sure to explain to the participants that the pre-test is only meant to guide them; they will not be graded. Use of pre- and post-tests can help to evaluate how much knowledge participants gain during the session.

SLIDE 4

This lesson plan can be used with agricultural and non-agricultural audiences. Review the learning objectives with the participants. At the end of this training session, participants will be able to describe the difference between an emerging and endemic aquatic animal disease, provide examples and characteristics of emerging and endemic diseases affecting finfish, crustaceans and molluscs and identify key resources that can be accessed for additional information. Other SART aquaculture units are available that cover general industry overview and emergency management and quarantine.

Remind attendees that the reason they are attending the workshop is because they realize the value of being prepared by having a disaster plan in place. The information they gain in this workshop will enhance their professional performance.

This introduction should not extend past five minutes. More time may be needed if the pre-test is used. This is a time when the audience is getting comfortable

with the workshop they have decided to attend, the surroundings, and you, the presenter. At the same time, the presenter is getting comfortable with the audience, the material to be presented and being a presenter. Pay close attention to time; you may find yourself a bit nervous getting started. These "nerves" can make people ramble or talk faster or slower, while others may forget the time and forget to move on. Even if your audience is enjoying what they are doing, they will appreciate your discipline when the workshop ends on time.

Part 2: Emerging versus Endemic

Time: 5 minutes

Focus: Explain the difference between an emerging and an endemic disease

SLIDE 5

Before describing the various types of diseases affecting Florida's aquatic animals, explain the two categories into which these diseases are divided: emerging and endemic diseases.

An endemic disease is a disease that is common in a particular area or region. There are several important endemic diseases affecting fish, crustaceans and molluscs in Florida.

An emerging disease is a new disease likely to cause significant damage should it occur in Florida. An emerging disease may be an endemic disease identified in a species it was not previously known to affect, a known disease that is new in a particular area, or a previously unknown disease.

SLIDE 6-7

Some examples of emerging diseases will be described in this lesson plan, including Spring Viremia of Carp, White Spot Virus, Taura Syndrome, Yellow Head Virus and Bonamiosis. The endemic diseases to be explained in this lesson plan include Koi Herpesvirus, Largemouth Bass Virus, Perkinsosis and Multinucleate Sphere X.

The list of emerging and endemic diseases for Florida aquaculture used in this publication is based on the World Organisation for Animal Health's (OIE)

list of notifiable diseases. The OIE maintains a list of diseases considered the greatest threats to animals and livestock worldwide. (Prior to 2005, the OIE list was divided into two categories, List A and List B; they are now grouped together as "Diseases Notifiable to the OIE" and often referred to as "reportable diseases." To view the current list, visit the OIE Web site: <www.oie.int>.)

It is also important to note that aquatic animal diseases stem from various causes (etiologies) such as parasites, fungi, bacteria, or viruses. Diseases are also transmitted in different ways. Some are transmitted through contaminated water or mud while others are passed from generation to generation (for example, from broodstock to fry). Etiologies and modes of transmission are indicated for each of the diseases covered in this lesson plan. [This might be a good time to start interacting with your audience by asking them to name ways that diseases can be transmitted. This interaction can help them connect to the presentation.]

Part 3: Emerging Aquatic Animal Diseases

Time: 15 minutes

Focus: Provide examples and characteristics of emerging aquatic diseases affecting finfish, crustaceans and molluscs

SLIDE 8-9

Note: In this lesson, we will occasionally use the word "finfish." This word is used to distinguish "true" fish with fins and permanent gills from other aquatic animals that have the word "fish" in their names, like crayfish and jellyfish, but are not actually fish.

Finfish and Emerging Diseases

There are many kinds of finfish. Some are sport fish, like largemouth or smallmouth bass (Centrarchid group). Others are used as food fish or aquatic plant control, such as bighead and grass carps (Cyprinid group). Many fish are captured in the wild, but many species of finfish are cultivated in aquacultural facilities, including the common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*) and largemouth bass (*Micropterus salmoides*). [Get the audience involved by asking them to name a few examples of finfish they are familiar with.]

Aquaculture is an important industry in Florida, and because of its climate, Florida is home to the largest tropical fish culture operations in the world. Aquaculture requires scrupulous care to prevent infection of ponds and tanks. An outbreak of a significant disease can wipe out an entire operation.

Spring Viremia of Carp

SLIDE 10-14

Spring Viremia of Carp (SVC) is an OIE-notifiable, viral disease affecting finfish. It first occurred in the United States during the spring season of 2002 in farmed koi in North Carolina and Virginia and some wild carp in Wisconsin. More recent outbreaks have been confirmed in Washington state and Missouri. SVC is known to cause death in younger fish of up to 70%.

SVC is one of several fish diseases caused by Rhabdoviruses. It is a disease affecting aquaculture worldwide, and it has been reported in Europe, the Middle East, Russia, North and South America and Asia. Koi/Common carp, grass carp, bighead carp, silver carp, crucian carp and goldfish are affected by this disease. The common carp is the most susceptible to SVC.

Clinical signs of SVC are observable when water temperatures are 54-68°F (12-20°C). If temperatures are above or below this range, clinical signs are not expressed and infection may not be evident. The age of the fish, temperature fluctuations, immune status and other stressors are also important factors. SVC is transmitted through gills, feces, fish lice, birds, equipment, water and mud. The SVC virus is infective in mud for up to 42 days.

There is no treatment available for Spring Viremia of Carp. Infected fish must be destroyed and infected tanks or ponds must be thoroughly disinfected. Four techniques can be used to disinfect tanks and ponds that held SVC-infected fish stock: gamma/UV radiation; chlorine (500 parts per million (ppm) for ten minutes); maintaining pH less than 4.0 or above 10.0; and heating to 140°F (60°C) for 15 minutes.

You can prevent SVC by purchasing fish from an SVC-free source; find a reputable dealer for importation, wholesale purchase or retail purchase. USDA-APHIS has established an interim rule (effective October 30, 2006) under which importers of SVC-susceptible fish must obtain an import permit and a health certificate from the shipment's region of origin certifying that the live fish, fertilized eggs or gametes originated in an SVC-free zone. More details are available by contacting USDA-APHIS.

It is important to establish and follow quarantine and biosecurity measures.

Keep shipments of fish separate, keep species separate, and refrain from participating in or purchasing from any fish shows where the fish are commingled. Several baitfish, koi, and goldfish facilities in the United States are now tested routinely for SVC.

Crustaceans and Emerging Diseases

SLIDE 15

Crustaceans are invertebrates with hard outer shells and jointed appendages and bodies. There are two major classes of crustaceans, the Malacostracans and Entomostracans. The Malacostracan class is composed of aquatic animals like crab, shrimp and lobster. Examples of Entomostracans are barnacles, fairy shrimp and water fleas.

Some examples of crustaceans in culture or wild-harvested include the Pacific White shrimp (*Litopenaeus vannamei*), Blue shrimp (*Litopenaeus stylirostris*) and Giant Tiger shrimp (*Penaeus monodon*). [This is another opportunity to ask for audience members to name examples of crustaceans. Remember to continue to ask for the audience's input to prevent them from "tuning out."]

White Spot Disease

SLIDES 16

White Spot Disease is caused by a particular kind of virus called a baculovirus. The disease gets its name from the white spots of various sizes that appear on the victim (OIE Aquatic Animal Health Manual, 2003). WSD generally has a high mortality rate, but it is especially deadly for the Pacific White shrimp. White Spot Disease can be found in Asia and North, Central and South America. A similar virus has been seen in native Florida shrimp. The most recent outbreak occurred in Kaua'i, Hawaii in April 2004. White Spot Disease is listed in the Florida Division of Aquaculture Best Management Practices (BMP) document.

Taura Syndrome Virus

SLIDES 17-18

Taura Syndrome Virus is another emerging disease that affects Pacific White shrimp in their post-larval, juvenile and sub-adult life stages. The mortality rate for these life stages is between 40% and 90%. Any shrimp surviving the disease may become a carrier for life. This disease has been found in Asia and North, Central and South America. Infected Central and South American shrimp introduced the disease to Asian shrimp. Outbreaks in Texas and South Carolina have been documented in the late 1990s. One way that this virus can be spread is when seagulls feed on infected dead shrimp. These seagulls then become mechanical vectors for the disease by carrying the virus from pond

to pond, and farm to farm. As with White Spot Disease, Taura Syndrome is a listed disease in the Florida Division of Aquaculture Best Management Practices (BMP) document.

Yellow Head Virus

SLIDE 19

Yellow Head Virus (YHV) is an emerging disease that affects Giant Tiger shrimp, especially in the early and late juvenile life stages. These two life stages have the highest mortality to the disease. Shrimp with YHV show signs of yellowing of the cephalothorax. The disease has been reported in Asia, but it has not yet been seen in the Americas. Information about Yellow Head Virus can be found in the Florida Division of Aquaculture's Best Management Practices (BMP) document.

Other Noteworthy Crustacean Diseases

Three other diseases not listed as emerging, but worth mentioning, are Infectious Hypodermal and Haematopoietic Necrosis (IHHNV), Spherical baculovirus, and Spawner-isolated Mortality Virus Disease.

IHHNV most seriously affects juvenile and sub-adult Blue shrimp (*L. stylirostris*) with mortality rates upt to 90%. This disease is progressive and causes clinical signs in young shrimp related to poor growth and poor feed conversion. The Pacific White shrimp is also affected by IHHNV, but has a lower mortality rate. This disease can be found worldwide, but especially on the Pacific coast of the Americas and Asia. IHHNV-resistant stock has been developed to help prevent the spread of the disease. Any survivors of IHHNV may carry the virus for life and pass it on to future generations via vertical (parents deposit infected eggs) or horizontal transmission (fry contract the disease from infected adults).

Spherical baculovirus is a serious pathogen found worldwide that affects the larval, postlarval and early juvenile stages of Giant Tiger shrimp (*Penaeus monodon*). Disease transmission is generally oral by ingestion of contaminated material, but vertical transmission may also occur. Crowded living conditions are a risk factor for the spread of this virus.

Spawner-isolated Mortality Virus Disease affects the Giant Tiger Shrimp. The disease has been documented in Australia and the Philippines.

Molluscs and Emerging Diseases

SLIDES 20

Molluscs are invertebrate animals with soft unsegmented bodies, a muscular foot, and a body enclosed in a mantle. The mollusc groups include cephalopods like squid and octopus, gastropods like abalone, and bivalves like clams, mussels and oysters. Species currently harvested or cultured include the Eastern oyster (*Crassostrea virginica*), Pacific oyster (*Crassostrea gigas*), Flat oyster (*Ostrea equestris*) and hard clams (*Mercenaria mercenaria*). [Take a moment here to see if the audience can name any additional molluscs.]

Many of the mollusc diseases we will encounter in this unit are caused by one-celled parasites. These tiny creatures reproduce inside their host by producing spores, but they also go through a life phase called during which the one-celled creatures cluster together and form a slimy mass; this phase is called a "plasmodium." Different parasites take up residence in different tissues in the host animal.

Bonamiosis

SLIDE 21

Bonamiosis is the disease caused by a microscopic one-celled animal, Bonamia ostrea (a haplosporidian protozoan for any biologists in the group). This parasite infects Flat oysters. Two new species of Bonamia affect the Asian oyster (*Crassostrea ariakensis*) in addition to the Flat oyster.

Bonamiosis is more prevalent during the month of September and incubates during a three- to five-month period. Most oysters diagnosed with Bonamiosis appear normal. The disease has caused catastrophic losses in the European oyster industry, especially during the 1980s. It is also known in the United States (California, Maine and Washington) with confirmed cases in Virginia and North Carolina in 2003 and 2004.

Seaside Organism Disease

SLIDE 22

Seaside Organism disease (SSO) is also caused by a microscopic one-celled animal, *Haplosporidium costale*. It affects the Eastern oyster seasonally. *H. costale* goes through a plasmodial stage that appears in May or June and spores are developed in late June and July. During this time, SSO is difficult to detect in affected oysters until the following spring after the spores have developed. The production of spores kills the oyster host. Seaside Organism disease can be found on the east coast of the United States and Canada (from Virginia to Nova Scotia) in areas of water where the salinity is high, generally over 25 parts per thousand (ppt). Serious outbreaks have occurred along the upper

east coast of the U.S., and as recently as 2003, SSO outbreaks in Canada have been documented.

Quahog Parasite X

SLIDE 23

Quahog Parasite X (QPX) is an emerging disease affecting hard clams from Virginia's east coast to Canada. QPX has recently shown up in Massachusetts. QPX is caused by a net slime mold in the phylum Labyrinthulomycota and causes the highest mortality rates in market-size clams. The Florida Division of Aquaculture has listed this disease in the Best Management Practices (BMP) Manual and requires that all clams entering Florida be free from Quahog Parasite X.

Other Noteworthy Mollusc Diseases

Two other diseases not listed as emerging diseases of molluscs but of importance are Marteiliosis and Mikrocytosis.

Marteiliosis, caused by *Marteilia* spp., affects the Pacific and Eastern oysters, especially when water temperatures are above 62.6° F (17° C). The disease can be found in France, Greece, Italy, Morocco, Spain and Portugal. Florida has a non-specified *Marteilia* which affects the calico scallop (*Argopecten gibbus*).

Mikrocytosis affects the Pacific oyster and other species of oyster although the Pacific oyster appears to be the most resistant species of oyster to the disease. Mikrocytosis occurs most often in the months of April and May. Mortality for older oysters at low-tide water levels is approximately 40%. Affected oysters can be found on the southwest coast of Canada and Washington state. The OIE's Aquatic Animal Health manual (2003) states that "harvesting or moving large oysters to locations high in the intertidal zone prior to March and not planting oysters at lower tide levels before June have been successfully implemented to control the disease."

Part 4: Endemic Aquatic Animal Diseases

Time: 15 minutes

Focus: Provide examples and characteristics of endemic aquatic diseases affecting finfish, crustaceans and molluscs

SLIDE 24-27

Koi Herpesvirus (KHV) is a highly contagious herpesvirus found in koi and common carp. Recent information indicates that goldfish and other fish species can carry the virus if they have cohabited with KHV infected fish. These carriers do not show clinical signs of disease. The disease is transmitted from infected fish, water and/or mud. The virus can live in water for up to three days, but is much less stable outside of a fish than a virus like Spring Viremia of Carp (SVC). Water temperature between 64 and 81°F (17.8–27.2°C) is important to this disease as clinical signs of KHV are more prevalent within this temperature range. Other factors like fish age, immune status and other stressors also contribute to KHV clinical signs being exhibited. KHV causes mortalities between 80% and 100%, closer to 100% in younger fish. Mortality can occur within 24 to 48 hours after onset of symptoms. This virus is found in Europe, the United States and Asia.

There is no treatment for KHV. Should it infect any aquatic stock, depopulation of the stock and subsequent disinfection of holding areas are recommended to prevent further spread of the disease. One disinfection technique is application of chlorine at 200 ppm for one hour. For disinfection of nets, application of quaternary ammonium compounds at 500 ppm for one hour is effective. Chlorine is a harsh treatment for nets, but may also be used for disinfection.

Koi Herpesvirus can be prevented by keeping shipments of fish separate, keeping species separate, and refraining from participating in or purchasing from fish shows where the fish are commingled together, as in many Japanese style shows. It is also recommended that one find a reputable dealer for import, wholesale purchase, or retail purchase of fish.

SLIDE 28

Largemouth Bass Virus (LMBV) is an endemic disease affecting largemouth bass. LMBV is an iridovirus frequently present in healthy largemouth bass. Many adult bass test positive for the virus, but show no clinical signs of infection. LMBV was first discovered in Lake Weir, Florida in 1991, and is now known in waters in many states ranging from the Southeast and into the upper Midwest. LMBV has not resulted in any diseased fish in Florida, however it has caused kills in other states. Other species of fish are known to carry the virus.

SLIDE 29

Other endemic diseases affecting finfish come from numerous etiologies like parasites, bacteria, viruses and fungi among others. They are commonly associated with poor management of the aquaculture systems and/or water quality issues. The relationship between fish health (host), the environment and primary and secondary pathogens has been described by the triad circle model. When the factors all coincide, where all three circles overlap, is when disease commonly occurs. [The triad circle model described in this paragraph is included on the slide presentation.]

One endemic disease affecting crustaceans is *Baculovirus penaei* (BP). BP is a tetrahedral baculovirus affecting shrimp. The larval through juvenile life stages of shrimp are the ones affected by the BP virus. Principle routes of infection are via cannibalism and fecal-oral transmission. Vertical transmission can also occur through fecal contamination of the eggs laid. The BP virus is found worldwide with many strains known to infect shrimp.

Other disease-causing entities known to affect crustaceans are fungal, bacterial, parasitic and non-infectious in nature. Two fungal pathogens, *Lagendium* and *Fusarium*, affect larval and adult shrimp, respectively. *Vibrio*, *Aeromonas* and *Flavobacterium* are bacterial agents that can cause shell rot or Black Spot disease in crustaceans. Microsporidia, parasites of arthropods and fishes that invade and destroy host cells, can cause diseases like Cotton disease in juvenile and adult shrimp. Diseases like Black Spot, Gas Bubble, Spontaneous Necrosis, barnacles and blisters are all considered non-infectious in nature.

SLIDE 30

Perkinsosis is an endemic disease affecting the molluscs, the Eastern oyster (*C. virginica*) and the Pacific oyster (*C. gigas*), that has the potential to affect other bivalves as asymptomatic carriers. Perkinsosis is caused by *Perkinsus marinus* ("dermo disease") and *Perkinsus olseni/atlanticus* with all of the complex life stages of each appearing to be infective. This disease can occur within the Gulf of Mexico and the east coast of the United States from Maine to Florida. The Florida Division of Aquaculture has listed Perkinsosis in the Best Management Practices (BMP) Manual.

SLIDE 31

Multinucleate Sphere X (MSX) is a disease caused by the protist, *Haplosporidium nelsoni*. MSX is known to affect the Eastern (*C. virginica*) and Pacific oysters (*C. gigas*) as aberrant hosts. *H. nelsoni* does not survive in low salinity waters. MSX has been seen on the east coast of North America, California, France, Korea and Japan. Like Perkinsosis, the Florida Division of Aquaculture has listed MSX in the BMP Manual.

Other diseases affecting molluscs include bacterial diseases caused by *Vibrio*

and *Nocardia* and viral diseases from retroviruses and iridoviruses, such as Oyster Velar Virus Disease. Sponges and snails are considered parasites and pests. An example of a disease with unknown etiology is Juvenile Oyster Disease (JOD). JOD affects seed oysters during the nursery phase of production. The disease seems to infect only the Eastern oyster. Clinical signs of JOD resemble lesions from a bacterial infection called Brown Ring Disease, which affects clams.

The following points apply to all the material covered in this unit and may help participants better understand diseases of finfish, crustaceans and molluscs.

SLIDE 32-33

- Survivors of viral diseases may become lifelong carriers.
- Transmission vectors for any disease can include the fish themselves, birds, parasites, equipment and YOU!
- Viral diseases do not have treatments, and they cannot be treated with antibiotics.
- Make biosecurity and quarantine practices a habit now. Personnel and/or equipment may be sources of disease and/or modes of transmission. Prevention may be the only treatment available for many diseases.
- Some diseases have zoonotic potential. People with compromised immune systems are most susceptible to any zoonotic illness. Some examples of zoonotic illnesses include:
- Atypical mycobacteriosis – Some of these rod-shaped acid-fast positive bacteria can infect humans through open cuts and/or abrasions.
- *Streptococcus iniae* – This bacterium can infect humans. Food handlers are especially susceptible.
- *Erysipelothrix* – This parasite can cause a skin infection known as “fish rose.”
- Vibriosis – A number of *Vibrio* bacteria are capable of infecting humans. These infections are especially risky for those with liver disease.
- *Edwardsiella tarda* – An uncommon bacterium which can cause human illness.
- Improper cooking practices can contribute to the transmission of disease from food to human. Remember to cook all foods to proper temperature. Keep hot foods hot and cold foods cold. Refrigerate all foods as soon as possible after eating or after preparation if cooking will not commence immediately.

Part 5: Highlight Resources

Time: 5 minutes

Focus: Identify key resources that participants can easily access for additional information

SLIDE 34-38

The following are sources of additional information about the agencies, manuals and documents mentioned in this module. Others listed, but not mentioned in this module, may be helpful resources as well. [Note that Web addresses on the PowerPoint slides are hyperlinked to allow you to visit these sites during the presentation to show the audience anything you find particularly noteworthy.]

- USDA-APHIS fact sheets for various animal diseases, including aquatic animals. On-line at: <http://www.aphis.usda.gov/lpa/pubs/fsheet_faq_notice/fsfaqnot_animalhealth.html>
- APHIS Center for Emerging Issues (CEI) has various worksheets available on animal health and diseases of concern as well. <http://www.aphis.usda.gov/vs/ceah/cei/worksheets.htm>
- Aquatext is an on-line aquaculture dictionary. Available at: <http://www.aquatext.com>
- Florida Department of Community Affairs, Division of Emergency Management. <http://www.floridadisaster.org>
- United States Department of Agriculture (USDA). <http://www.usda.gov>
- Florida Department of Agriculture and Consumer Services (FDACS). <http://www.doacs.state.fl.us>
- FDACS Division of Aquaculture. <http://www.floridaaquaculture.com>
- The Division of Aquaculture's Best Management Practices Manual can be accessed at: <http://www.floridaaquaculture.com/BAD/BMP%20Rule%20-%20Manual%206-9-04.pdf>.
- Aquaculture Network Information Center. <http://aquanic.org>

- USDA Animal and Plant Health Inspection Service (USDA-APHIS). <http://www.aphis.usda.gov>

- World Organisation for Animal Health (OIE). <http://www.oie.int>

- Safety for Fish Farm Workers video on the National Ag Safety Database (NASD), English and Spanish versions. Available at: <http://www.cdc.gov/nasd/videos/v001401-v001500/v001433.html>.

- *Spawn, Spat, and Sprains,* produced by the Alaska Sea Grant College Program, describes the dangers faced by shellfish farmers and salmon hatchery workers at the aquaculture worksite. It also tells how to reduce the chance of injury. Chapters include physical and chemical hazards, proper lifting techniques, airplane and boat safety, basic first aid, electrical hazards, fire fighting, cold water survival, and coping with bears. The entire book can be downloaded from: <http://www.uaf.edu/seagrant/Pubs_Videos/pubs/AN-17.pdf>.

- University of Florida Institute of Food and Agricultural Sciences Electronic Data Information Source (EDIS) fact sheets for aquaculture and diseases can be found at <http://edis.ifas.ufl.edu/DEPARTMENT_VETERINARY_MEDICINE>, and <http://edis.ifas.ufl.edu/DEPARTMENT_FISHERIES_AND_AQUATIC_SCIENCES>.

Part 6: Summary and Wrap-Up

Time: 10 minutes

Focus: Review the learning objectives that have been accomplished and encourage a commitment to SART

SLIDE 39

You and your audience have had a stimulating and practical 40 - 50 minutes, but it is almost over. Prior to answering any audience questions or comments, provide a summary to the participants of what they just learned:

- The difference between an emerging and an endemic disease
- Examples and characteristics of some emerging aquatic diseases affecting finfish, crustaceans and molluscs
- Examples and characteristics of some endemic aquatic diseases affecting finfish and molluscs
- Valuable resources available for more information

SLIDE 40

Thank the audience for their attention and participation. Congratulate them for their commitment to the SART endeavor and on their desire to be part of the solution.

At this point, you may elect to have the participants take the Post-Test provided in the Resources section of this manual. Remember to review the answers to the test questions after all participants complete the test.

A content-specific evaluation is provided in the Resources section of the manual. The generic evaluation available in the SART unit *Creating a County SART* can be utilized as well. Please have participants complete this item at the conclusion of the session. Encourage participants to be as honest and forthright as possible as it helps you, the presenter, make adjustments for future presentations ,which in turn benefits future participants.

Notes

Participant's Evaluation of *Aquatic Animal Diseases*

Please circle the number that best expresses your opinions about the following statements.

		FULLY DISAGREE	DISAGREE	NEUTRAL	AGREE	FULLY AGREE
1.	The training unit's format was appropriate.	1	2	3	4	5
2.	The information presented was useful to me.	1	2	3	4	5
3.	The time it took to complete this unit was acceptable.	1	2	3	4	5
4.	The difference between an *emerging* disease and an *endemic* disease was clearly explained.	1	2	3	4	5
5.	Examples of *emerging* diseases affecting finfish, crustaceans and molluscs were clearly outlined.	1	2	3	4	5
6.	Examples of *endemic* diseases affecting finfish, crustaceans and molluscs were clearly outlined.	1	2	3	4	5
7.	Steps for preventing the introduction and spread of aquatic animal diseases were clearly explained.	1	2	3	4	5
8.	Available up-to-date resources were clearly outlined.	1	2	3	4	5

9. We welcome your comments about this program:

_____

_____

_____

_____

_____

Please use the back of this sheet for any further comments.

Thank you for your time!

Aquatic Animal Diseases Participant Pre-Test

This pre-test is intended to gauge the level of knowledge that you have before participating in the *Aquatic Animal Diseases* training. Please answer all the following questions to the best of your ability.

1. Define “emerging disease.”

   _____

   _____

2. A disease is called _____ when it is common to a geographical area.

3. A “true” fish with fins and permanent gills is called a _____.

4. Name three species of “true” fish.

   _____

   _____

5. Provide one emerging and one endemic disease that affect finfish in Florida.

   _____

   _____

6. A crustacean is an invertebrate characterized by a hard outer shell and jointed appendages and body. True or False? _____

7. Name two emerging diseases that can affect the Pacific White shrimp.

   _____

   _____

8. A _____ is an invertebrate animal with a soft unsegmented body, a muscular foot and a mantle.

9. Multinucleate Sphere X is a disease affecting the Eastern and Pacific oysters, which are aberrant hosts. True or False? _____

10. List three resources useful for aquatic animal disease information.

    _____

    _____

    _____

Aquatic Animal Diseases Participant Post-Test

This post-test is intended to gauge the level of knowledge that you have after participating in the *Aquatic Animal Diseases* training. Please answer all the following questions to the best of your ability.

1. Define “emerging disease.”

   _____

   _____

2. A disease is called _____ when it is common to a geographical area.

3. A “true” fish with fins and permanent gills is called a _____.

4. Name three species of “true” fish.

   _____

   _____

5. Provide one emerging and one endemic disease that affect finfish in Florida.

   _____

   _____

6. A crustacean is an invertebrate characterized by a hard outer shell and jointed appendages and body. True or False? _____

7. Name two emerging diseases that can affect the Pacific White shrimp.

   _____

   _____

8. A _____ is an invertebrate animal with a soft unsegmented body, a muscular foot and a mantle.

9. Multinucleate Sphere X is a disease affecting the Eastern and Pacific oysters, which are aberrant hosts. True or False? _____

10. List three resources useful for aquatic animal disease information.

    _____

    _____

    _____

Answer Key to *Aquatic Animal Diseases* Pre- and Post-Tests

1. Define "emerging disease." **An emerging disease is a new and/or exotic disease with potential significant impact. It is also acceptable to define it as a common disease identified in a new species or a previously unidentified disease or pathogen.**

2. A disease is called **endemic** when it is common to a geographical area.

3. A "true" fish with fins and permanent gills is called a **finfish**.

4. Name three species of "true" fish. **Answers will vary: Common carp; Crucian carp; goldfish; Largemouth bass; Smallmouth bass; Grass carp; Bighead carp; Silver carp; koi; or any others that qualify.**

5. Provide one emerging and one endemic disease that affect finfish in Florida. **Answers will vary: Emerging disease choice Spring Viremia of Carp; Endemic disease choices include Koi Herpesvirus (KHV) and Largemouth Bass Virus (LMBV).**

6. A crustacean is an invertebrate characterized by a hard outer shell and jointed appendages and body. **True**.

7. Name two emerging diseases that can affect the Pacific White Shrimp. **Taura Syndrome Virus and White Spot disease.**

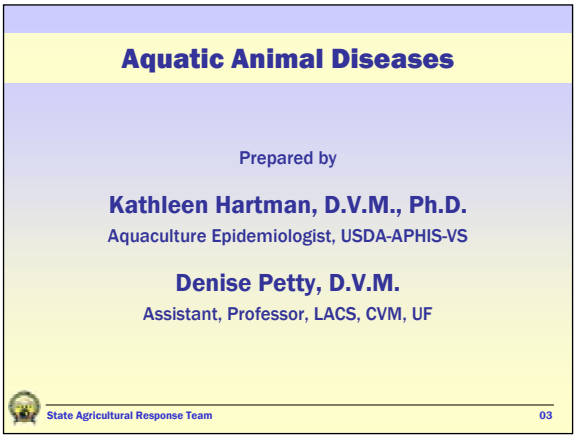
8. A **mollusc** is an invertebrate animal with a soft unsegmented body, a muscular foot and a mantle.

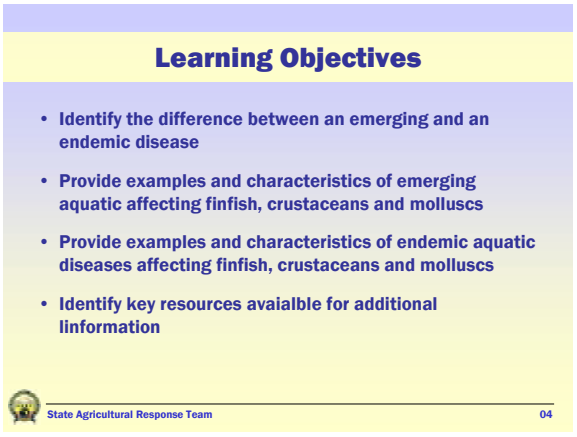
9. Multinucleate Sphere X is a disease affecting the Eastern and Pacific oysters who are aberrant hosts. **True**.

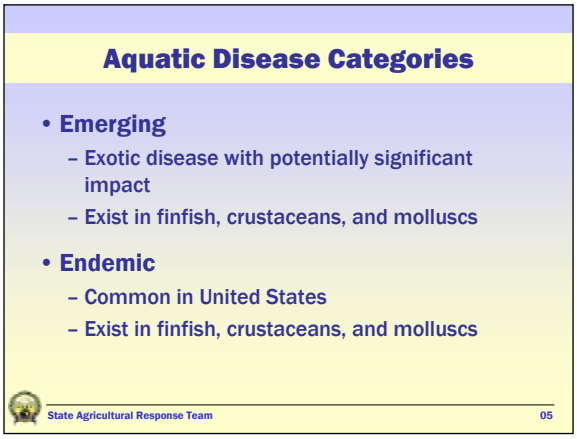
10. List three resources useful for aquatic animal disease information. **Answers will vary: USDA-APHIS fact sheet Web site; APHIS Center for Emerging Issues worksheet Web site; Aquatext.com; Florida Division of Emergency Management CERT Web site; USDA Web site; FDACS Web site; Florida Division of Aquaculture Web site; Aquaculture Network Information Center Web site; APHIS Web site; World Organisation for Animal Health Web site; etc.**

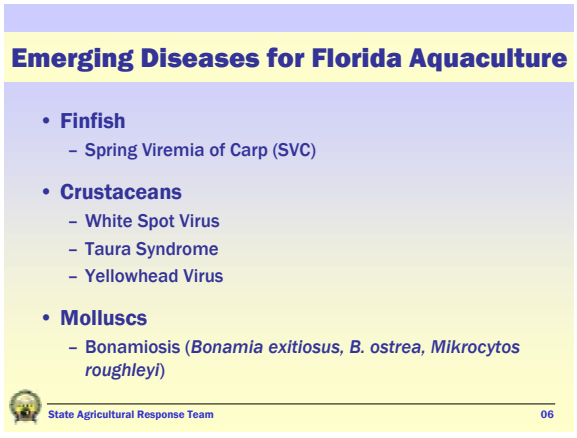
PowerPoint Slides

Slides 1-6









PowerPoint Slides

Slides 7-12

Endemic Diseases for Florida Aquaculture

- **Finfish**
  - Koi Herpesvirus (KHV)
  - Largemouth Bass Virus (LMBV)
  - Other parasitic, fungal and bacterial diseases
- **Molluscs**
  - Perkinsosis
  - Multinucleate Sphere X (MSX)

Emerging Diseases

Finfish

- **"True" fish with fins and permament gills**
  - Term distinguishes true fish from cray*fish*, jelly*fish*, star*fish*, etc.
- **Groups include**
  - Cyprinids (e.g., common grass and bighead carps)
  - Centrarchids (e.g., largemouth and smallmouth bass)
- **Species harvested or in culture include**
  - Common carp (*Cyprinus carpio*)
  - Goldfish (*Carassius auratus*)
  - Largemouth bass (*Micropterus salmoides*)

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

- **OIE notifiable disease**
- **Caused by a virus**
- **First official U.S. report in spring 2002**
  - **Farmed koi in NC, VA**
  - **Wild carp in WI**
  - **Recent outbreaks in WA, MO**
- **Major industry concern**
- **Can cause mortalities up to 70% in younger fish**

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

General Facts

- **One of several Rhabdoviruses that cause diseases in fish**
- **Distribution – Reported in Europe, Middle East, Russia, North and South America, Asia**
- **Species affected – Koi/Common carp, Grass carp, Bighead carp, Silver carp, Crucian carp, goldfish (*C. auratus*)**

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

Disease Risk Factors

- Water temperature very important – 54-68°F (12-28°C)
- Fish age, other stressors, temperature fluctuation and immune status are also factors
- Transmitted through gills, feces, fish lice, birds, equipment, water and mud

PowerPoint Slides

Slides 13-18

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

- **Treatment**
  - No treatment available
  - Virus infective in mud for up to 42 days
- **Depopulate infected fish, then disinfect tank/pond**
- **Disinfection agents/techniques**
  - Gamma/UV radiation
  - Chlorination at 500 ppm for 10 minutes
  - pH less than 4.0 or greater than 10.0
  - Heating to 140°F (60°C) for 15 minutes

State Agricultural Response Team 13

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

Prevention

- Buy from SVC-free source
- Quarantine/Biosecurity
  - Keep shipments separate
  - Keep species separate (e.g., koi separate from goldfish)
  - Refrain from Japanese-style shows where fish are commingled
- Reputation of fish supplier

State Agricultural Response Team 14

Crustaceans

- **Invertebrates characterized by a hard outer shell and jointed appendages and bodies**
- **Two major classes**
  - Malacostracans (i.e., crab, shrimp, lobster)
  - Entomostracans (i.e., fairy shrimp, water fleas, barnacles)
- **Species harvested or in culture include**
  - Pacific White shrimp (*Litopenaeus vannamei*)
  - Blue shrimp (*Litopenaeus stylirostris*)
  - Giant Tiger shrimp (*Penaeus monodon*)

State Agricultural Response Team 15

Crustacean Emerging Disease

White Spot Disease

- **Baculovirus affecting mostly juvenile Pacific White shrimp with high mortality**
- **Distribution**
  - Asia, North, Central and South America
  - Native Florida shrimp may harbor similar virus
- **Recent outbreak in Kaua'i, HI in April 2004**
- **Listed disease in the Florida Division of Aquaculture's Best Management Practices (BMP)**

White spot disease in giant black tiger shrimp, showing classic white spots

State Agricultural Response Team 16

Crustacean Emerging Disease

Taura Syndrome Virus

- **Affects the Pacific White shrimp**
  - Affects post-larval, juvenile, sub-adult life stages
    - Mortality rate for these life stages 40 to 90%
    - Survivors may become carrier for life
- **Distribution**
  - Asia, Central, South and North America
  - Infected Central and South American shrimp introduced disease into Asia
  - Outbreaks in Texas and South Carolina in late 1990s

State Agricultural Response Team 17

Crustacean Emerging Disease

Taura Syndrome Virus

- **Risk factors**
  - Seagulls feeding on infected/dead shrimp may carry virus pond to pond, farm to farm
- **Listed disease in the Florida Division of Aquaculture's BMP**

State Agricultural Response Team 18

PowerPoint Slides

Slides 19-24

Crustacean Emerging Disease

Yellow Head Virus

- Affects juvenile Giant Tiger shrimp
  - High mortality in early and late juvenile life stages
- Afflicted shrimp show signs of gross yellowing of the cephalothorax
- Distribution
  - Asia
  - Americas – Possible, however not yet documented
- Listed disease in the Florida Division of Aquaculture's BMP

State Agricultural Response Team 19

Molluscs

- Invertebrate animals with soft unsegmented bodies, a muscular foot and a body enclosed in a mantle
- Groups include
  - Cephalopods (e.g., squid, octopus)
  - Gastropods (e.g., abalone)
  - Bivalves (e.g., clams, mussels, oysters)
- Species harvested or in culture include
  - Eastern oyster (*Crassostrea virginica*)
  - Pacific oyster (*Crassostrea gigas*)
  - Flat oyster (*Ostrea equestris*)
  - Hard clams (*Mercenaria mercenaria*)

State Agricultural Response Team 20

Mollusc Emerging Disease

Bonamiosis

- Caused by *Bonamia ostrea* (Northern hemisphere), a protozoan parasite
- Affects flat oysters
  - 2 new species affect the Asian oyster (*Crassostrea ariakensis*) and Flat oysters
  - Most infected oysters appear normal
- Distribution
  - France, Ireland, Italy, the Netherlands, Spain, the united Kingdom (excluding Scotland), and the United States (CA, ME and WA)
  - Confirmed cases in VA and NC in 2003 and 2004

State Agricultural Response Team 21

Mollusc Emerging Disease

Seaside Organism Disease (SSO)

- Caused by the protist, *Haplosporidium costale*
- Affects the Eastern oyster
- Seasonal, complex life cycle ending in final sporulation killing the host
- Distribution on east coast of United States and Canada (from Virginia to Nova Scotia) in water with a salinity over 25 ppt
  - Outbreaks in Canada in 2003

State Agricultural Response Team 22

Mollusc Emerging Disease

Quahog Parasite X (QPX)

- Net slime mold in phylum, Labyrinthulomycota
- Affects Hard clams
- Can be found from Virginia's east coast to Canada
  - Recent outbreaks in Massachusetts
- Clams entering Florida must be QPX free
- Listed disease in the Florida Division of Aquaculture's BMP document

State Agricultural Response Team 23

Endemic Diseases

State Agricultural Response Team 24

PowerPoint Slides

Slides 25-30

Finfish Endemic Disease

Koi Herpesvirus (KHV)

- Highly contagious
  - Transmitted from infected fish, water and/or mud
  - Water temperature important 64 - 81°F (17 - 27°C)
- High mortalities
  - 80 to 100% mortality (higher in younger fish)
  - Can occur as soon as 24 to 48 hours after signs of disease onset
- Not transmissible to humans
  - Affects koi and common carp
- Worldwide distribution
  - Reported in Europe, United States and Asia
- Not reportable to OIE

State Agricultural Response Team 25

Finfish Endemic Disease

Koi Herpesvirus (KHV)

Operculum removed to show gill with patchy white tips

Severe gill necrosis and discoloring

State Agricultural Response Team 26

Finfish Endemic Disease

Koi Herpesvirus (KHV)

Treatment
- None – Virus can live in water for up to four hours
- Depopulation, then disinfect
- Disinfection techniques
  - Chlorine at 200 ppm for one hour
  - Quaternary ammonium compounds at 500 ppm for one hour (for nets)

Prevention
- Quarantine/Biosecurity
  - Keep shipments separate
  - Keep species separate
  - Avoid Japanese-style shows where fish are commingled
  - Reputation of fish supplier

State Agricultural Response Team 27

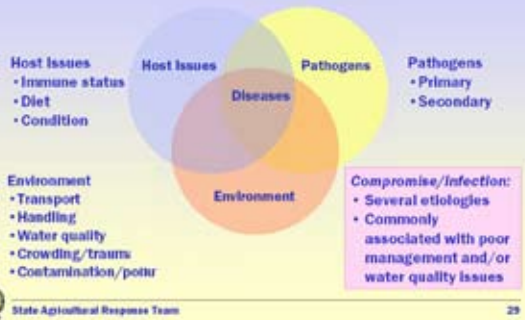
Finfish Endemic Disease

Largemouth Bass Virus (LMBV)

- Iridovirus frequently present in healthy largemouth bass
  - Bass test positive, but show no clinical signs of infection
  - No LMBV infected fish in Florida

State Agricultural Response Team 28

Finfish: Other Diseases

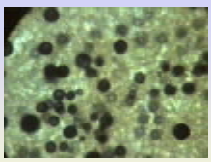


State Agricultural Response Team 29

Mollusc Endemic Disease

Perkinsosis

- Also called "dermo" disease
- Caused by *Perkinsus marinus, P. olseni/atlanticus*
- Complex life cycle; all stages appear to be infective
- Affects *Crassostrea virginica, C. gigas*
  - Could infect other bivalves
- Distribution – U.S. East coast (ME to FL) and Gulf of Mexico
- Listed disease in the Florida Division of Aquaculture's BMP



State Agricultural Response Team 30

PowerPoint Slides

Slides 31-36

Mollusc Endemic Disease

Multinucleate Sphere X (MSX)

- Caused by protist, *Haplosporidium nelsoni*
  - Does not survive low salinities
- Affects *Crassostrea virginica, Crassostrea gigas*
  - Oysters are aberrant hosts
- Distribution
  - East coast of North America, California, France, Korea and Japan
- Listed disease in the Florida Division of Aquaculture's BMP

State Agricultural Response Team 31

Things to Remember...

- Carriers and vectors
  - Survivors of viral diseases may be life-long carriers
  - Vectors can include fish, birds, parasites, equipment and personnel (i.e., YOU!)
- Viral diseases do not have treatments
- Make biosecurity/quarantine a habit
  - Personnel and equipment may be sources of disease and/or modes of transmission
  - Prevention is the best treatment in many cases

State Agricultural Response Team 32

Things to Remember...

Zoonotic potential

- People with compromised immune systems are most susceptible
- Examples:
  - Atypical mycobacteriosis – bacterial infection
  - *Streptococcus iniae* – food handlers infected from handling live fish
  - *Erysipelothrix* – parasite, "fish rose"
  - Vibriosis – bacterial infection, especially risky for those with liver disease
  - *Edwardsiella tarda* – bacteria
  - Improper cooking practices can pass on infection

State Agricultural Response Team 33

Key Resources

- USDA-APHIS fact sheets for various animal diseases
  http://www.aphis.usda.gov/lpa/pubs/fsheet_faq_notice/fsfaqnot_animalhealth.html
- APHIS's Center for Emerging Issues (CEI) has various worksheets available on animal health and diseases of concern
  http://www.aphis.usda.gov/vs/ceah/cei/worksheets.htm
- Aquatext.com -- a free, online aquaculture dictionary
  http://www.pisces-aqua.co.uk/aquatext/dicframe.htm

State Agricultural Response Team 34

Key Resources

- Florida Department of Community Affairs, Division of Emergency Management
  http://www.floridadisaster.org
- United States Department of Agriculture (USDA)
  http://www.usda.gov
- Florida Department of Agriculture and Consumer Services (FDACS)
  http://www.doacs.state.fl.us

State Agricultural Response Team 35

Key Resources

- Florida Division of Aquaculture home page
  http://www.floridaaquaculture.com
- *Aquaculture Best Management Practices* manual can be accessed directly at
  http://www.floridaaquaculture.com/BAD/BMP%20Rule%20-%20Manual%206-9-04.pdf
- Aquaculture Network Information Center
  http://aquanic.org

State Agricultural Response Team 36

PowerPoint Slides

Slides 37-40

Key Resources

- USDA Animal and Plant Health Inspection Service (APHIS)
  http://www.aphis.usda.gov
- World Organisation for Animal Health (OIE)
  http://www.oie.int
- Safety for Fish Farm Workers video on the National Ag Safety Database (NASD), English and Spanish versions available from the following link
  http://www.cdc.gov/nasd/videos/v001401-v001500/v001433.html

State Agricultural Response Team 37

Key Resources

- Spawn, Spat, and Sprains book produced by the Alaska Sea Grant College Program. The entire book can be downloaded from the following link
  http://www.uaf.edu/seagrant/Pubs_Videos/pubs/AN-17.pdf
- University of Florida Institute of Food and Agricultural Sciences Electronic Data Information Source (EDIS) fact sheets for aquaculture, including diseases, can be found at the following links
  http://edis.ifas.ufl.edu/DEPARTMENT_VETERINARY_MEDICINE
  http://edis.ifas.ufl.edu/DEPARTMENT_FISHERIES_AND_AQUATIC_SCIENCES

State Agricultural Response Team 38

Summary

- Identified the two categories of diseases in Florida
- Provided examples and characteristics of emerging diseases affecting finfish, crustaceans and molluscs
- Provided examples and characteristics of endemic diseases affecting finfish and molluscs
- Listed key resources available for additional information on aquatic animal health and disease

State Agricultural Response Team 39

Thank You!

State Agricultural Response Team 40

PowerPoint Slides — Handout Pages

The *Aquatic Animal Diseases* PowerPoint slides are reproduced on the following pages at reduced size with space for participant notes.

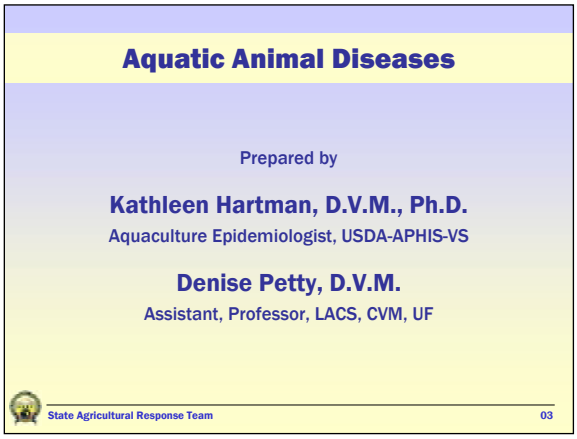
(Also included in the participant workbook for *Aquatic Animal Diseases*, available on the SART Web site:

<www.flsart.org>

Slides 1-3


STATE AGRICULTURAL RESPONSE TEAM
S. A. R. T.
FLORIDA


Aquatic Animal Diseases
State Agricultural Response Team
02


Aquatic Animal Diseases
Prepared by
Kathleen Hartman, D.V.M., Ph.D.
Aquaculture Epidemiologist, USDA-APHIS-VS
Denise Petty, D.V.M.
Assistant, Professor, LACS, CVM, UF
State Agricultural Response Team
03

Slides 4-6

Learning Objectives

- Identify the difference between an emerging and an endemic disease
- Provide examples and characteristics of emerging aquatic affecting finfish, crustaceans and molluscs
- Provide examples and characteristics of endemic aquatic diseases affecting finfish, crustaceans and molluscs
- Identify key resources avaialble for additional linformation

State Agricultural Response Team 04

Aquatic Disease Categories

- **Emerging**
  - Exotic disease with potentially significant impact
  - Exist in finfish, crustaceans, and molluscs
- **Endemic**
  - Common in United States
  - Exist in finfish, crustaceans, and molluscs

State Agricultural Response Team 05

Emerging Diseases for Florida Aquaculture

- **Finfish**
  - Spring Viremia of Carp (SVC)
- **Crustaceans**
  - White Spot Virus
  - Taura Syndrome
  - Yellowhead Virus
- **Molluscs**
  - Bonamiosis (*Bonamia exitiosus, B. ostrea, Mikrocytos roughleyi*)

State Agricultural Response Team 06

Slides 7-9

Endemic Diseases for Florida Aquaculture

- **Finfish**
  - Koi Herpesvirus (KHV)
  - Largemouth Bass Virus (LMBV)
  - Other parasitic, fungal and bacterial diseases
- **Molluscs**
  - Perkinsosis
  - Multinucleate Sphere X (MSX)


State Agricultural Response Team 07

Emerging Diseases


State Agricultural Response Team 08

Finfish

- **"True" fish with fins and permament gills**
  - Term distinguishes true fish from cray*fish*, jelly*fish*, star*fish*, etc.
- **Groups include**
  - Cyprinids (e.g., common grass and bighead carps)
  - Centrarchids (e.g., largemouth and smallmouth bass)
- **Species harvested or in culture include**
  - Common carp (*Cyprinus carpio*)
  - Goldfish (*Carassius auratus*)
  - Largemouth bass (*Micropterus salmoides*)


State Agricultural Response Team 09

Slides 10-12

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

- OIE notifiable disease
- Caused by a virus
- First official U.S. report in spring 2002
  - Farmed koi in NC, VA
  - Wild carp in WI
  - Recent outbreaks in WA, MO
- Major industry concern
- Can cause mortalities up to 70% in younger fish

State Agricultural Response Team 10

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

General Facts

- One of several Rhabdoviruses that cause diseases in fish
- Distribution – Reported in Europe, Middle East, Russia, North and South America, Asia
- Species affected – Koi/Common carp, Grass carp, Bighead carp, Silver carp, Crucian carp, goldfish (*C. auratus*)

State Agricultural Response Team 11

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

Disease Risk Factors

- Water temperature very important – 54-68°F (12-28°C)
- Fish age, other stressors, temperature fluctuation and immune status are also factors
- Transmitted through gills, feces, fish lice, birds, equipment, water and mud

State Agricultural Response Team 12

Slides 13-15

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

- **Treatment**
  - No treatment available
  - Virus infective in mud for up to 42 days
- **Depopulate infected fish, then disinfect tank/pond**
- **Disinfection agents/techniques**
  - Gamma/UV radiation
  - Chlorination at 500 ppm for 10 minutes
  - pH less than 4.0 or greater than 10.0
  - Heating to 140°F (60°C) for 15 minutes

Finfish Emerging Disease

Spring Viremia of Carp (SVC)

Prevention

- Buy from SVC-free source
- Quarantine/Biosecurity
  - Keep shipments separate
  - Keep species separate (e.g., koi separate from goldfish)
  - Refrain from Japanese-style shows where fish are commingled
- Reputation of fish supplier

Crustaceans

- **Invertebrates characterized by a hard outer shell and jointed appendages and bodies**
- **Two major classes**
  - Malacostracans (i.e., crab, shrimp, lobster)
  - Entomostracans (i.e., fairy shrimp, water fleas, barnacles)
- **Species harvested or in culture include**
  - Pacific White shrimp (*Litopenaeus vannamei*)
  - Blue shrimp (*Litopenaeus stylirostris*)
  - Giant Tiger shrimp (*Penaeus monodon*)

Slides 16-18

Crustacean Emerging Disease

White Spot Disease

- Baculovirus affecting mostly juvenile Pacific White shrimp with high mortality
- Distribution
  - Asia, North, Central and South America
  - Native Florida shrimp may harbor similar virus
- Recent outbreak in Kaua'i, HI in April 2004
- Listed disease in the Florida Division of Aquaculture's Best Management Practices (BMP)

White spot disease in giant black tiger shrimp, showing classic white spots

State Agricultural Response Team 16

Crustacean Emerging Disease

Taura Syndrome Virus

- Affects the Pacific White shrimp
  - Affects post-larval, juvenile, sub-adult life stages
    - Mortality rate for these life stages 40 to 90%
    - Survivors may become carrier for life
- Distribution
  - Asia, Central, South and North America
  - Infected Central and South American shrimp introduced disease into Asia
  - Outbreaks in Texas and South Carolina in late 1990s

State Agricultural Response Team 17

Crustacean Emerging Disease

Taura Syndrome Virus

- Risk factors
  - Seagulls feeding on infected/dead shrimp may carry virus pond to pond, farm to farm
- Listed disease in the Florida Division of Aquaculture's BMP

State Agricultural Response Team 18

Slides 19-21

Crustacean Emerging Disease

Yellow Head Virus

- **Affects juvenile Giant Tiger shrimp**
  - High mortality in early and late juvenile life stages
- **Afflicted shrimp show signs of gross yellowing of the cephalothorax**
- **Distribution**
  - Asia
  - Americas – Possible, however not yet documented
- **Listed disease in the Florida Division of Aquaculture's BMP**

State Agricultural Response Team 19

Molluscs

- **Invertebrate animals with soft unsegmented bodies, a muscular foot and a body enclosed in a mantle**
- **Groups include**
  - Cephalopods (e.g., squid, octopus)
  - Gastropods (e.g., abalone)
  - Bivalves (e.g., clams, mussels, oysters)
- **Species harvested or in culture include**
  - Eastern oyster (*Crassostrea virginica*)
  - Pacific oyster (*Crassostrea gigas*)
  - Flat oyster (*Ostrea equestris*)
  - Hard clams (*Mercenaria mercenaria*)

State Agricultural Response Team 20

Mollusc Emerging Disease

Bonamiosis

- **Caused by *Bonamia ostrea* (Northern hemisphere), a protozoan parasite**
- **Affects flat oysters**
  - 2 new species affect the Asian oyster (*Crassostrea ariakensis*) and Flat oysters
  - Most infected oysters appear normal
- **Distribution**
  - France, Ireland, Italy, the Netherlands, Spain, the united Kingdom (excluding Scotland), and the United States (CA, ME and WA)
  - Confirmed cases in VA and NC in 2003 and 2004

State Agricultural Response Team 21

Slides 22-24

Mollusc Emerging Disease

Seaside Organism Disease (SSO)

- Caused by the protist, *Haplosporidium costale*
- Affects the Eastern oyster
- Seasonal, complex life cycle ending in final sporulation killing the host
- Distribution on east coast of United States and Canada (from Virginia to Nova Scotia) in water with a salinity over 25 ppt
  - Outbreaks in Canada in 2003

State Agricultural Response Team 22

Mollusc Emerging Disease

Quahog Parasite X (QPX)

- Net slime mold in phylum, Labyrinthulomycota
- Affects Hard clams
- Can be found from Virginia's east coast to Canada
  - Recent outbreaks in Massachusetts
- Clams entering Florida must be QPX free
- Listed disease in the Florida Division of Aquaculture's BMP document

State Agricultural Response Team 23

Endemic Diseases

State Agricultural Response Team 24

Slides 25-27

Finfish Endemic Disease

Koi Herpesvirus (KHV)

- **Highly contagious**
  - Transmitted from infected fish, water and/or mud
  - Water temperature important 64 - 81°F (17 - 27°C)
- **High mortalities**
  - 80 to 100% mortality (higher in younger fish)
  - Can occur as soon as 24 to 48 hours after signs of disease onset
- **Not transmissible to humans**
  - Affects koi and common carp
- **Worldwide distribution**
  - Reported in Europe, United States and Asia
- **Not reportable to OIE**

State Agricultural Response Team 25

Finfish Endemic Disease

Koi Herpesvirus (KHV)

Operculum removed to show gill with patchy white tips

Severe gill necrosis and discoloring

State Agricultural Response Team 26

Finfish Endemic Disease

Koi Herpesvirus (KHV)

Treatment
- **None – Virus can live in water for up to four hours**
- **Depopulation, then disinfect**
- **Disinfection techniques**
  - Chlorine at 200 ppm for one hour
  - Quaternary ammonium compounds at 500 ppm for one hour (for nets)

Prevention
- **Quarantine/Biosecurity**
  - Keep shipments separate
  - Keep species separate
  - Avoid Japanese-style shows where fish are commingled
  - Reputation of fish supplier

State Agricultural Response Team 27

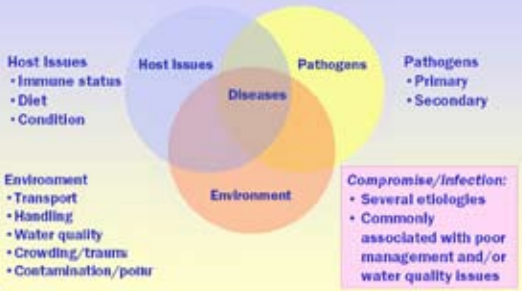
Slides 28-30

Finfish Endemic Disease

Largemouth Bass Virus (LMBV)

- Iridovirus frequently present in healthy largemouth bass
  - Bass test positive, but show no clinical signs of infection
  - No LMBV infected fish in Florida

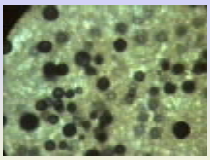
Finfish: Other Diseases



Mollusc Endemic Disease

Perkinsosis

- Also called “dermo” disease
- Caused by *Perkinsus marinus, P. olseni/atlanticus*
- Complex life cycle; all stages appear to be infective
- Affects *Crassostrea virginica, C. gigas*
  - Could infect other bivalves
- Distribution – U.S. East coast (ME to FL) and Gulf of Mexico
- Listed disease in the Florida Division of Aquaculture’s BMP



Slides 31-33

Mollusc Endemic Disease

Multinucleate Sphere X (MSX)

- Caused by protist, *Haplosporidium nelsoni*
  - Does not survive low salinities
- Affects *Crassostrea virginica, Crassostrea gigas*
  - Oysters are aberrant hosts
- Distribution
  - East coast of North America, California, France, Korea and Japan
- Listed disease in the Florida Division of Aquaculture's BMP

State Agricultural Response Team 31

Things to Remember…

- Carriers and vectors
  - Survivors of viral diseases may be life-long carriers
  - Vectors can include fish, birds, parasites, equipment and personnel (i.e., YOU!)
- Viral diseases do not have treatments
- Make biosecurity/quarantine a habit
  - Personnel and equipment may be sources of disease and/or modes of transmission
  - Prevention is the best treatment in many cases

State Agricultural Response Team 32

Things to Remember…

Zoonotic potential

- People with compromised immune systems are most susceptible
- Examples:
  - Atypical mycobacteriosis – bacterial infection
  - *Streptococcus iniae* – food handlers infected from handling live fish
  - *Erysipelothrix* – parasite, "fish rose"
  - Vibriosis – bacterial infection, especially risky for those with liver disease
  - *Edwardsiella tarda* – bacteria
  - Improper cooking practices can pass on infection

State Agricultural Response Team 33

Slides 34-36

Key Resources

- USDA-APHIS fact sheets for various animal diseases
  http://www.aphis.usda.gov/lpa/pubs/fsheet_faq_notice/fsfaqnot_animalhealth.html
- APHIS's Center for Emerging Issues (CEI) has various worksheets available on animal health and diseases of concern
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Key Resources

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Slides 37-39

Key Resources

- USDA Animal and Plant Health Inspection Service (APHIS)
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- Safety for Fish Farm Workers video on the National Ag Safety Database (NASD), English and Spanish versions available from the following link
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Summary

- Identified the two categories of diseases in Florida
- Provided examples and characteristics of emerging diseases affecting finfish, crustaceans and molluscs
- Provided examples and characteristics of endemic diseases affecting finfish and molluscs
- Listed key resources available for additional information on aquatic animal health and disease

Slides 40-42

Notes

PowerPoint Slides

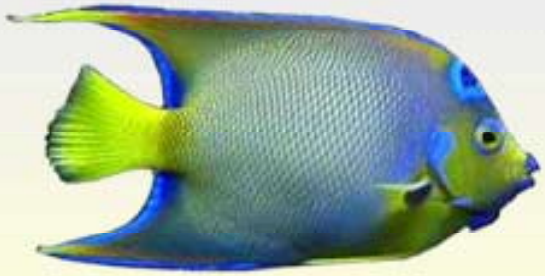
The *Aquatic Animal Diseases* PowerPoint slides are reproduced full-size on the following pages. You can use these pages as a display or photocopy them onto plastic overhead sheets for use with an overhead projector.

Color versions of these slides can be downloaded at the SART Web site:

<www.flsart.org>.


STATE AGRICULTURAL RESPONSE TEAM
S.A.R.T.
FLORIDA

Aquatic Animal Diseases



Aquatic Animal Diseases

Prepared by

Kathleen Hartman, D.V.M., Ph.D.

Aquaculture Epidemiologist, USDA-APHIS-VS

Denise Petty, D.V.M.

Assistant, Professor, LACS, CVM, UF

Learning Objectives

- Identify the difference between an emerging and an endemic disease
- Provide examples and characteristics of emerging aquatic affecting finfish, crustaceans and molluscs
- Provide examples and characteristics of endemic aquatic diseases affecting finfish, crustaceans and molluscs
- Identify key resources avaialble for additional linformation

Aquatic Disease Categories

- **Emerging**
  - Exotic disease with potentially significant impact
  - Exist in finfish, crustaceans, and molluscs
- **Endemic**
  - Common in United States
  - Exist in finfish, crustaceans, and molluscs

Emerging Diseases for Florida Aquaculture

- **Finfish**
  - Spring Viremia of Carp (SVC)
- **Crustaceans**
  - White Spot Virus
  - Taura Syndrome
  - Yellowhead Virus
- **Molluscs**
  - Bonamiosis (*Bonamia exitiosus, B. ostrea, Mikrocytos roughleyi*)

Endemic Diseases for Florida Aquaculture

- **Finfish**
  - Koi Herpesvirus (KHV)
  - Largemouth Bass Virus (LMBV)
  - Other parasitic, fungal and bacterial diseases
- **Molluscs**
  - Perkinsosis
  - Multinucleate Sphere X (MSX)

Emerging Diseases

Finfish

- **"True" fish with fins and permament gills**
  - Term distinguishes true fish from cray*fish*, jelly*fish*, star*fish*, etc.
- **Groups include**
  - Cyprinids (e.g., common grass and bighead carps)
  - Centrarchids (e.g., largemouth and smallmouth bass)
- **Species harvested or in culture include**
  - Common carp (*Cyprinus carpio*)
  - Goldfish (*Carassius auratus*)
  - Largemouth bass (*Micropterus salmoides*)

Spring Viremia of Carp (SVC)

- OIE notifiable disease
- Caused by a virus
- First official U.S. report in spring 2002
  - Farmed koi in NC, VA
  - Wild carp in WI
  - Recent outbreaks in WA, MO
- Major industry concern
- Can cause mortalities up to 70% in younger fish

Spring Viremia of Carp (SVC)

General Facts

- One of several Rhabdoviruses that cause diseases in fish
- Distribution – Reported in Europe, Middle East, Russia, North and South America, Asia
- Species affected – Koi/Common carp, Grass carp, Bighead carp, Silver carp, Crucian carp, goldfish (*C. auratus*)

Spring Viremia of Carp (SVC)

Disease Risk Factors

- Water temperature very important – 54-68°F (12-28°C)
- Fish age, other stressors, temperature fluctuation and immune status are also factors
- Transmitted through gills, feces, fish lice, birds, equipment, water and mud

Spring Viremia of Carp (SVC)

- **Treatment**
  - No treatment available
  - Virus infective in mud for up to 42 days
- **Depopulate infected fish, then disinfect tank/pond**
- **Disinfection agents/techniques**
  - Gamma/UV radiation
  - Chlorination at 500 ppm for 10 minutes
  - pH less than 4.0 or greater than 10.0
  - Heating to 140°F (60°C) for 15 minutes

Spring Viremia of Carp (SVC)

Prevention

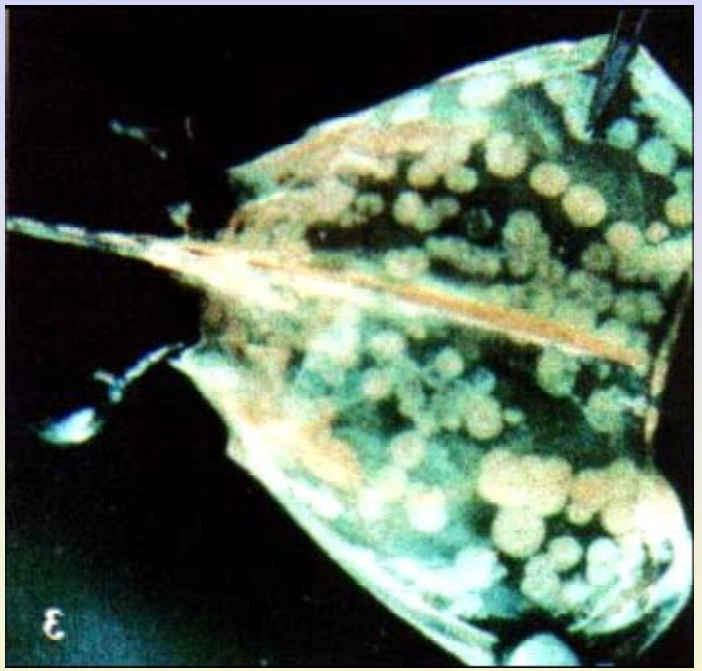
- Buy from SVC-free source
- Quarantine/Biosecurity
  - Keep shipments separate
  - Keep species separate (e.g., koi separate from goldfish)
  - Refrain from Japanese-style shows where fish are commingled
- Reputation of fish supplier

Crustaceans

- **Invertebrates characterized by a hard outer shell and jointed appendages and bodies**
- **Two major classes**
  - Malacostracans (i.e., crab, shrimp, lobster)
  - Entomostracans (i.e., fairy shrimp, water fleas, barnacles)
- **Species harvested or in culture include**
  - Pacific White shrimp (*Litopenaeus vannamei*)
  - Blue shrimp (*Litopenaeus stylirostris*)
  - Giant Tiger shrimp (*Penaeus monodon*)

White Spot Disease

- Baculovirus affecting mostly juvenile Pacific White shrimp with high mortality
- Distribution
  - Asia, North, Central and South America
  - Native Florida shrimp may harbor similar virus
- Recent outbreak in Kaua'i, HI in April 2004
- Listed disease in the Florida Division of Aquaculture's Best Management Practices (BMP)



White spot disease in giant black tiger shrimp, showing classic white spots

Taura Syndrome Virus

- **Affects the Pacific White shrimp**
  - Affects post-larval, juvenile, sub-adult life stages
    - Mortality rate for these life stages 40 to 90%
    - Survivors may become carrier for life
- **Distribution**
  - Asia, Central, South and North America
  - Infected Central and South American shrimp introduced disease into Asia
  - Outbreaks in Texas and South Carolina in late 1990s

Taura Syndrome Virus

- **Risk factors**
  - Seagulls feeding on infected/dead shrimp may carry virus pond to pond, farm to farm
- **Listed disease in the Florida Division of Aquaculture's BMP**

Yellow Head Virus

- **Affects juvenile Giant Tiger shrimp**
  - High mortality in early and late juvenile life stages
- **Afflicted shrimp show signs of gross yellowing of the cephalothorax**
- **Distribution**
  - Asia
  - Americas – Possible, however not yet documented
- **Listed disease in the Florida Division of Aquaculture's BMP**

Molluscs

- **Invertebrate animals with soft unsegmented bodies, a muscular foot and a body enclosed in a mantle**
- **Groups include**
  - Cephalopods (e.g., squid, octopus)
  - Gastropods (e.g., abalone)
  - Bivalves (e.g., clams, mussels, oysters)
- **Species harvested or in culture include**
  - Eastern oyster (*Crassostrea virginica*)
  - Pacific oyster (*Crassostrea gigas*)
  - Flat oyster (*Ostrea equestris*)
  - Hard clams (*Mercenaria mercenaria*)

Bonamiosis

- Caused by *Bonamia ostrea* (Northern hemisphere), a protozoan parasite
- Affects flat oysters
  - 2 new species affect the Asian oyster (*Crassostrea ariakensis)* and Flat oysters
  - Most infected oysters appear normal
- Distribution
  - France, Ireland, Italy, the Netherlands, Spain, the united Kingdom (excluding Scotland), and the United States (CA, ME and WA)
  - Confirmed cases in VA and NC in 2003 and 2004

Seaside Organism Disease (SSO)

- Caused by the protist, *Haplosporidium costale*
- Affects the Eastern oyster
- Seasonal, complex life cycle ending in final sporulation killing the host
- Distribution on east coast of United States and Canada (from Virginia to Nova Scotia) in water with a salinity over 25 ppt
  - Outbreaks in Canada in 2003

Quahog Parasite X (QPX)

- Net slime mold in phylum, Labyrinthulomycota
- Affects Hard clams
- Can be found from Virginia's east coast to Canada
  - Recent outbreaks in Massachusetts
- Clams entering Florida must be QPX free
- Listed disease in the Florida Division of Aquaculture's BMP document

Endemic Diseases

Koi Herpesvirus (KHV)

- **Highly contagious**
  - Transmitted from infected fish, water and/or mud
  - Water temperature important 64 - 81°F (17 - 27°C)
- **High mortalities**
  - 80 to 100% mortality (higher in younger fish)
  - Can occur as soon as 24 to 48 hours after signs of disease onset
- **Not transmissible to humans**
  - Affects koi and common carp
- **Worldwide distribution**
  - Reported in Europe, United States and Asia
- **Not reportable to OIE**

Koi Herpesvirus (KHV)

Operculum removed to show gill with patchy white tips

Severe gill necrosis and discoloring

Koi Herpesvirus (KHV)

Treatment

- None -- Virus can live in water for up to four hours
- Depopulation, then disinfect
- Disinfection techniques
  - Chlorine at 200 ppm for one hour
  - Quaternary ammonium compounds at 500 ppm for one hour (for nets)

Prevention

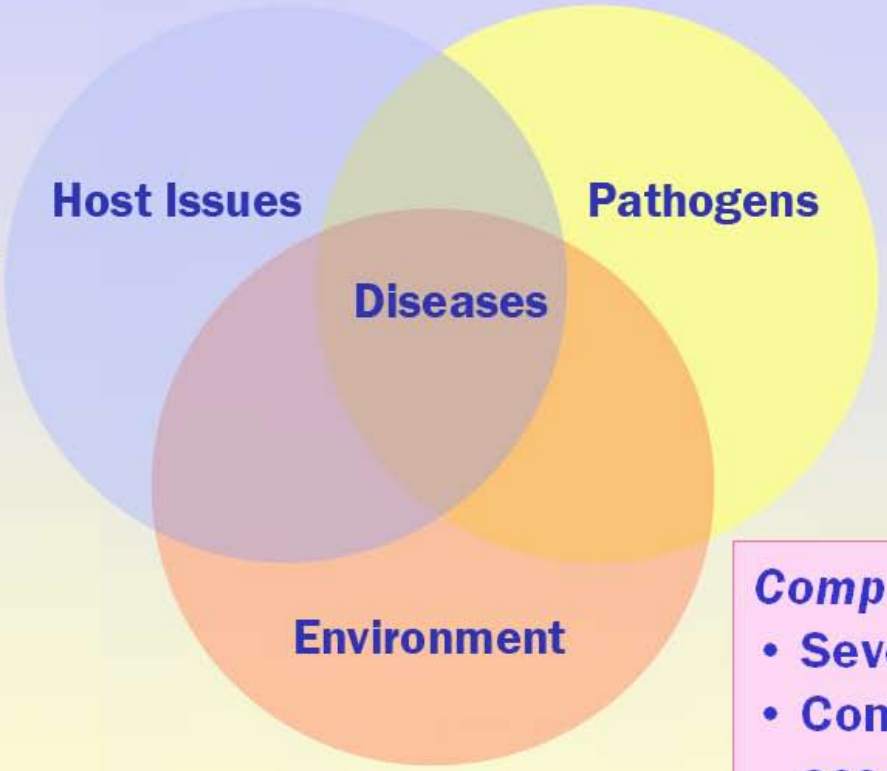
- Quarantine/Biosecurity
  - Keep shipments separate
  - Keep species separate
  - Avoid Japanese-style shows where fish are commingled
  - Reputation of fish supplier

Largemouth Bass Virus (LMBV)

- **Iridovirus frequently present in healthy largemouth bass**
  - Bass test positive, but show no clinical signs of infection
  - No LMBV infected fish in Florida

Finfish: Other Diseases

Host Issues
- Immune status
- Diet
- Condition



Pathogens
- Primary
- Secondary

Environment
- Transport
- Handling
- Water quality
- Crowding/traum
- Contamination/pollu

Compromise/Infection:
- Several etiologies
- Commonly associated with poor management and/or water quality issues

Perkinsosis

- Also called “dermo” disease
- Caused by *Perkinsus marinus, P. olseni/atlanticus*
- Complex life cycle; all stages appear to be infective
- Affects *Crassostrea virginica, C. gigas*
  - Could infect other bivalves
- Distribution – U.S. East coast (ME to FL) and Gulf of Mexico
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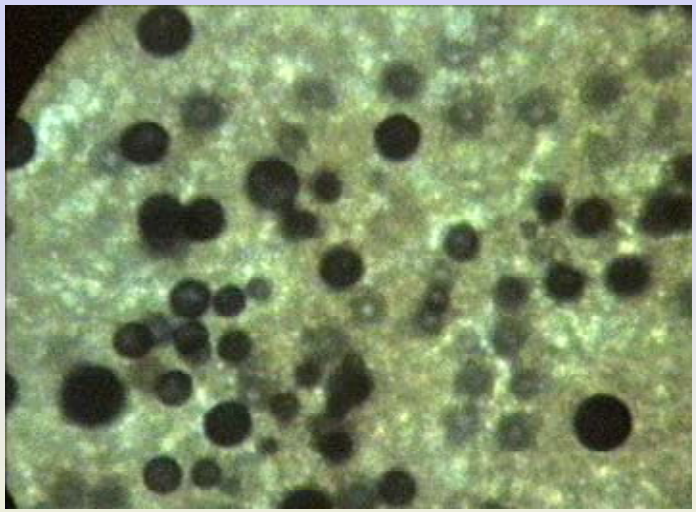

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- **Caused by protist, *Haplosporidium nelsoni***
  - Does not survive low salinities
- **Affects *Crassostrea virginica, Crassostrea gigas***
  - Oysters are aberrant hosts
- **Distribution**
  - East coast of North America, California, France, Korea and Japan
- **Listed disease in the Florida Division of Aquaculture's BMP**

Things to Remember…

- **Carriers and vectors**
  - Survivors of viral diseases may be life-long carriers
  - Vectors can include fish, birds, parasites, equipment and personnel (i.e., YOU!)
- **Viral diseases do not have treatments**
- **Make biosecurity/quarantine a habit**
  - Personnel and equipment may be sources of disease and/or modes of transmission
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Things to Remember…

Zoonotic potential

- **People with compromised immune systems are most susceptible**
- **Examples:**
  - Atypical mycobacteriosis – bacterial infection
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  - *Erysipelothrix* – parasite, “fish rose”
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  - Improper cooking practices can pass on infection

Key Resources

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Thank You!