

Workbook



**Aquaculture:
Emergency Management and
Quarantine of Aquaculture Facilities**



SART Training Media



Aquaculture:
Emergency Management
and Quarantine of Aquaculture Facilities
Workbook

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Other Aquaculture training units are available. All SART Training Media are available for download from the Florida SART Web site <www.flsart.org>.

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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 needs and procedures in helping an aquaculture facility respond to a man-made or natural disaster.

Learning Objectives

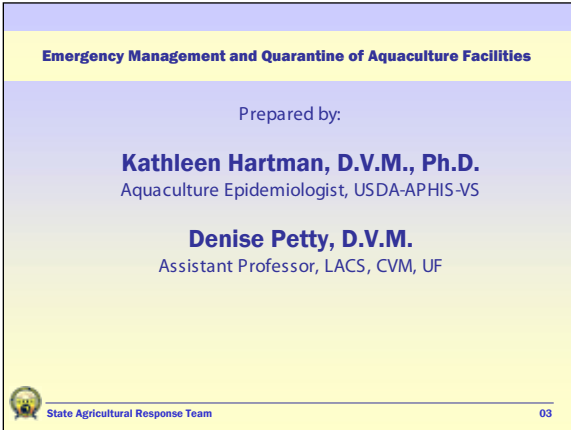
At the end of this unit, participants will be able to:

1. Identify natural and man-made disasters and disease-related emergencies that affect the aquaculture industry.
2. List and discuss an aquaculture operation's basic needs.
3. Identify and discuss risk factors common to an aquaculture operation.
4. List and describe effective risk management techniques as applied to an aquaculture facility.
5. Identify key resources available for more information.

Slides 1-3








Slides 4-6

Learning Objectives


- Identify natural and man-made disasters and disease-related emergencies that affect aquaculture
- List and discuss an aquaculture operation's basic needs
- Identify and discuss risk factors common to an aquaculture operation
- List and describe effective risk management techniques as applied to an aquaculture facility
- Identify key resources available for more information



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Emergency Scenarios


- Natural disasters
- Man-made disasters
- Biological disasters
 - Examples: endemic and foreign aquatic animal diseases (FAAD)



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Natural Disasters

- Examples: Hurricanes, Drought, Flood, Fire
- Avoid release of nonindigenous species
 - Establish physical barriers, depopulate
- Evacuation (broodstock, high value animals)
 - Short- and long-term plans advisable
 - How to provide oxygen supply, water quality, supportive therapy?
- Euthanasia and carcass disposal plans
 - Humane practices
 - Disposal within regulatory requirements of the state



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Slides 7-9


Natural Disasters

2004 Hurricane Season

Types of damage to aquaculture facilities

- **Wind**
 - Farm structures and equipment
- **Flooding**
 - Crop losses and contamination
- **Power and water outages**
 - Operational and maintenance losses

Remember, these damages can result from other disasters, too, not just hurricanes!



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Natural Disasters

Wind Damage



Photos courtesy of: W. Stephen, FDACS Division of Aquaculture



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Natural Disasters

Flooding



Photo courtesy of: W. Stephen, FDACS Division of Aquaculture



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Slides 10-12

Emergency Scenarios

Power Outages




Photo courtesy of: W. Stephen, FDACS Division of Aquaculture

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Emergency Scenarios

Man-Made Disasters

- Examples**
 - Agroterrorism
 - Nuclear fallout
 - Chemical spill
- Food Fish**
 - Euthanasia and carcass disposal
 - Epidemiological investigation – impact of disaster
- Non-Food/Ornamental Fish**
 - Epidemiological investigation
 - Only undesired impact is consumer confidence





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Emergency Scenarios

Endemic & Foreign Aquatic Animal Disease

- FAAD examples**
 - Bonamiosis
 - Spring Viremia of Carp
 - White Spot disease
- Diagnostics/pathogen confirmation**
 - Enforce quarantine if positive
- Quarantine and biocontainment**
 - As directed by state officials
- Depopulate, dispose of carcasses**
 - As directed by state officials
- Clean and disinfect**
 - Equipment, facilities





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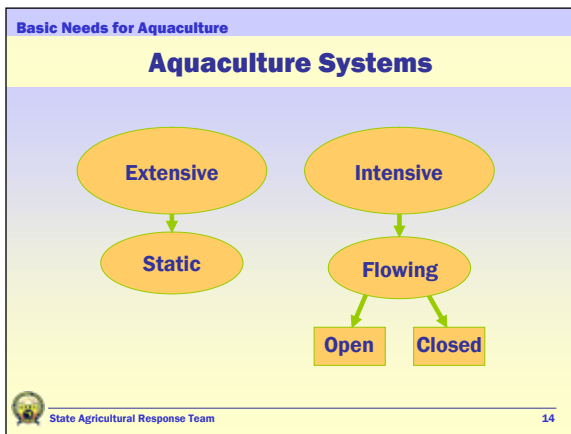
Slides 13-15

Aquaculture's Basic Needs

- Water**
 - Suitable supply
 - Quality source
 - Filtration
- Air** • Oxygen supply
- Temperature control**



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Basic Needs for Aquaculture

Aquaculture Systems

- **Defined by extensive and intensive**
 - Extensive – static water system – Lower input and lower yield
 - Intensive – flowing water system – High water volume, input higher with higher yield
- **Static water system**
 - Reliable water source, require inputs occasionally
 - Example: earthen pond
- **Flowing water system**
 - Continuous water supply
 - Defined as open or closed
 - Examples: raceways, ponds, ocean net pens, aquariums, cages, recirculating systems


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Slides 16-18

Basic Needs for Aquaculture

Open and Closed Aquaculture Systems

- **Open Water Systems – water flows through system and released into water body**
 - Excellent water quality
 - High stocking densities
 - Reliable, suitable water source
 - Examples: raceways, pens, cages
- **Closed Water Systems – water from culture chamber recycled back into system after filtration or treatment**
 - Less water input required
 - Less effluent
 - Control over water quality
 - Limited stocking densities
 - Increased cost
 - Examples: ponds, aquariums, recirculation systems

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Basic Needs for Aquaculture

Open Aquaculture Systems



Raceway
Picture courtesy aquanic.org



Net Pen

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Basic Needs for Aquaculture

Closed Aquaculture Systems



Typical glass aquariums



Larger fiberglass aquaculture system tanks

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Slides 19-21

Water Quality

The most important production component for raising fish

- **Parameters of importance:**
 - Ammonia, nitrites, DO, temperature, pH, hardness, CO₂, turbidity, chlorine, heavy metals
 - Some fish have different tolerances
- **Test kits**
 - Watch expiration dates
 - Wash after each use and between tanks
- **Reliable, safe supply source**
 - Protected source
 - Unprotected source




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Water Quality

Mechanical Filtration

- **Effective in removing suspended solids**
- **Several methods and mediums available**
 - Gravel and sand filters
 - Gravity and pressurized systems



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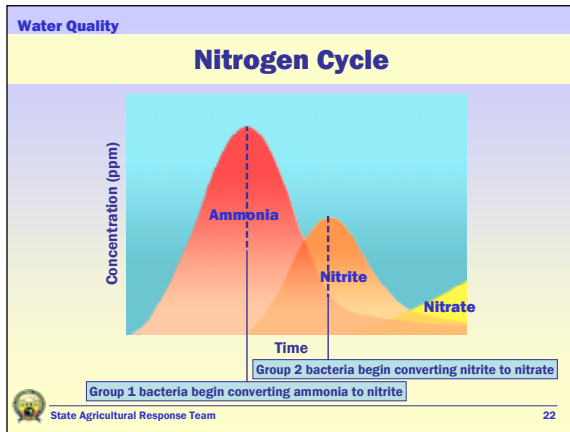
Water Quality

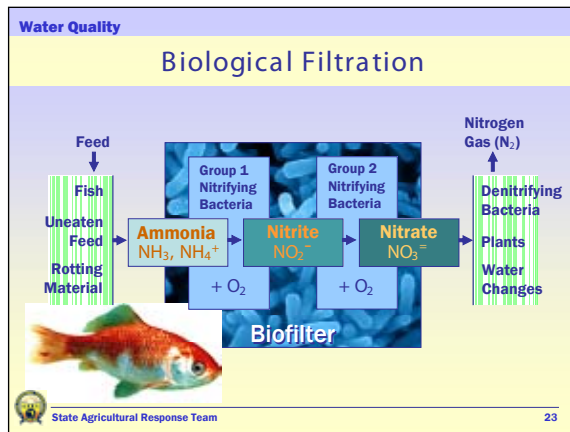
Biological Filtration

- **Primary function – nitrification of ammonia**
- **Several requirements for adequate function**
 - Surface area for bacterial colonization
 - Oxygen
 - Time
- **Size of biofilter determined by the amount of ammonia in the system and its efficiency**

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Slides 22-24





Water Quality

Chemical Filtration

- Chemical
 - Commercial products available
 - Use with caution
 - Do not fix problem of inadequate biofilter


Tanks and filtration systems for Epcot Living Seas Aquarium

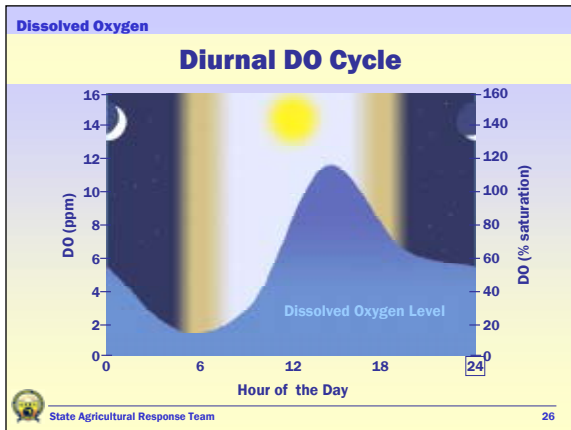
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Air – Dissolved Oxygen (DO)

- Refers to oxygen gas dissolved in water
- Sources of oxygen
 - Chemical, photosynthesis, mechanical, diffusion
 - Smaller bubble size is better due to slower rise and greater surface area for oxygen diffusion
- Depletion
 - Animal and plant respiration
 - Organic decomposition
 - Diurnal cycle of DO
- Tolerance of low DO is species specific
 - Rule of thumb – 5 ppm minimum
- Clinical signs of low DO
 - Gulping at surface, lethargy, loss of appetite, increased ventilatory effort, death


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Factors that Influence Dissolved Oxygen



More Dissolved Oxygen at <ul style="list-style-type: none">• Higher Temperature• Higher Pressure• Lower Salinity	Less Dissolved Oxygen at <ul style="list-style-type: none">• Lower Temperature• Lower Pressure• Higher Salinity
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Slides 28-30

Temperature

- **Direct effect on metabolism, feeding and survival**
- **Species-specific optimum levels**
 - Protect from heat and cold
- **Metabolism**
 - Temp ↑ leads to rapid metabolism ↑
 - Temp ↓ leads to O₂, food demand ↓
- **Acclimation**
 - Gradual changes
 - Minimizes temperature stress
- **Stress signs: Lethargy, abnormal behavior, increased ventilation, death**

Temperature has a greater impact on fish development and health than any other factor

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Tools for Aquatic Animal Emergencies

<ul style="list-style-type: none"> • Alternate emergency water source <ul style="list-style-type: none"> - Bottled water – may be missing necessary ions - Drinking water – must dechlorinate - No deionized or reverse osmosis (RO) water • Test kit <ul style="list-style-type: none"> - Evaluate water quality parameters • Diagnostic resource • Supportive therapy 	<ul style="list-style-type: none"> • Equipment <ul style="list-style-type: none"> - Thermometers, DO meter, refractometer, etc. • Back-up power source <ul style="list-style-type: none"> - Generator or power equipment • Oxygen <ul style="list-style-type: none"> - Primary or alternate oxygen supply
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Preparing for Emergencies

Identification of Risk Factors and Facility Risk Management


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Slides 31-33

Risk Factor Identification

Biological Hazard Transmission

- **Modes of pathogen transmission**
- **Aerosolization/splashing**
- **Contamination**
 - Fish, equipment, personnel, feed, water
- **Vertical and horizontal transmission**
- **Vectors**
 - Personnel, equipment, some parasites



Argulus, Fish louse

Transmission of many hazards can be prevented with proper risk management

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Risk Factor Identification

Aquaculture Risk Factors

Identify intervention points to enhance animal health by considering three groups of risk factors

- **Incoming materials**
 - Fish, equipment, people, feed, vehicles
- **On-farm management**
 - Fish, quarantine, traffic and equipment flow
- **Outgoing effluent and products**
 - Water
 - Fish

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Risk Factor Identification

Fish Husbandry

- **Risk of pathogen introduction**
 - Incoming fish can infect resident fish
 - Resident fish can infect incoming fish
- **Intervention tactics**
 - Practice quarantine and/or acclimation
 - Purchase fish from reputable source
 - Monitor environmental conditions
 - Water management
 - Feed management
 - Observe daily


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Risk Factor Identification

Equipment

- **Intervention tactic**
 - Multiple dip buckets/disinfection stations
 - Restrict net and equipment sharing
 - Separate nets for quarantine/suspect fish
 - Dip change protocol



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Risk Factor Identification

Personnel

- **Risk of pathogen introduction and dissemination from one tank to another**
- **Intervention tactics**
 - Training
 - Limit access
 - Hygiene program
 - Foot bath, hand wash
 - Clean clothes; protective clothing
 - Awareness



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Facility Risk Management

Quarantine

- **Isolated Space**
 - Separated from resident fish
 - Dedicated equipment/supplies
 - Limited visitor access
 - Managed personnel and traffic flow
- **Bag water**
 - Potential source of pathogens
 - Poor water quality (high ammonia, low pH, high CO₂)
 - Waste management

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Slides 37-39

Facility Risk Management

Quarantine

- **Length of time**
 - Pathogen life cycle dependent
 - Pathogen reproduction
 - Water temperature
 - Recommended time: = 4 weeks
- **Manipulations for pathogen expression**
- **Diagnostics/Treatments**
 - Monitor health status (non-lethal sample collection)
 - Treat for specific pathogens

Remember, the goal is to target specific pathogen elimination and/or prevention

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Facility Risk Management

Acclimation

- Defined as a method to slowly introduce fish to a new environment
- During this period, it is possible to perform therapeutic treatments



Acclimation table

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Facility Risk Management

Quarantine vs. Acclimation

Quarantine	Acclimation
<ul style="list-style-type: none"> • Requires minimum of four weeks • Isolated system and equipment • Separate species/origin • Reduce density • Diagnostics, treatment • Requires more labor and money • Optimal for pathogen control/elimination 	<ul style="list-style-type: none"> • Complete within hours • Group acclimation • Stress reduction • Bath treatment possible • Less than optimal for pathogen control/elimination


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Facility Risk Management

Collecting Fish Samples

- **Case history information**
 - General, behavioral, physical, treatments
- **Water sample**
 - Clean transport bag
 - Ship with fish
- **Collect live moribund fish**
 - 3-5; multiple species if applicable
- **If dead, wrap fish in moist paper towels and place in plastic zipper lock-type bag**
- **Do not freeze, refrigerate only**



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Facility Risk Management

Submitting Fish Samples

- **Call diagnostic lab**
- **Package live fish sample**
 - Double bag
 - 1/3 filled water
 - Oxygen source (compressed O₂, oxy tabs)
 - Heat/Cool packs if necessary
 - Styrofoam box (cardboard outer box)
 - History information (in plastic bag)
- **Ship overnight or hand-deliver**
 - Label outside box: LIVE FISH



Photo source: zfb.org




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Facility Risk Management

Euthanasia of Aquatic Animals

- **Primary methods**
 - Drug overdose (MS-222, benzocaine)
 - Expensive and impractical for large populations
 - **CO₂ (compressed gas) and rotenone**
 - USDA uses for SVC depopulation
 - More practical for large populations
- **Secondary method is stunning followed by decapitation**



CO₂ euthanized koi





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Facility Risk Management

Sanitary Precautions

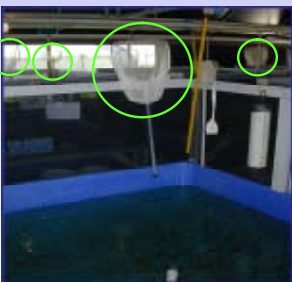


What do you notice?

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Facility Risk Management

Sanitary Precautions



What do you notice?
Every tank has its own equipment...
there is no sharing between tanks

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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) worksheets on animal health and diseases of concern**
<http://www.aphis.usda.gov/vs/ceah/cei/worksheets.htm>
- **Aquatext.com, a free, on-line aquaculture dictionary**
<http://www.pisces-aqua.co.uk/aquatext/dicframe.htm>

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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>

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Key Resources

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

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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** <http://www.cdc.gov/nasd/videos/v001401-v001500/v001433.html>

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Slides 49-51

Key Resources


- **University of Florida Institute of Food and Agricultural Sciences Electronic Data Information Source (EDIS) fact sheets for aquaculture, including diseases**
http://edis.ifas.ufl.edu/DEPARTMENT_VETERINARY_MEDICINE
http://edis.ifas.ufl.edu/DEPARTMENT_FISHERIES_AND_AQUATIC_SCIENCES
http://edis.ifas.ufl.edu/TOPIIC_Fish
- **“Aquaculture Natural Disaster Preparation and Recovery” Clemson University Cooperative Extension**
<http://www.clemson.edu/psapublishing/PAGES/AFW/AFW12.PDF>



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Key Resources

- **University of Florida IFAS Extension Disaster Handbook**
<http://disaster.ifas.ufl.edu>
- **Spawn, Spat, and Sprains by Alaska Sea Grant College Program**
http://www.uaf.edu/seagrant/Pubs_Videos/pubs/AN-17.pdf
- **Southern Regional Aquaculture Center (SRAC) fact sheets**
<http://www.msstate.edu/dept/srac/fslist.htm>
<http://srac.tamu.edu>



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Key Resources

For any biosecurity or quarantine questions, contact:

Dr. Kathleen Hartman, Aquaculture Epidemiologist

TELEPHONE : 813-671-5230 ext. 119
 E-MAIL : kathleen.h.hartman@aphis.usda.gov
 ADDRESS : 1408 24th Street, SE
 Ruskin, FL 33570




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Summary

- Natural and man-made disasters and disease-related emergencies that can affect an aquaculture facility
- The basic needs for an aquaculture operation
- Risk factors common to operating a facility
- Effective risk management techniques that can be applied to prepare for an emergency or mitigate one
- Valuable resources available for more information



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Thank You!



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Resources

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, aquatic included, are available on the World Wide Web. On-line at: <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 is a free, on-line aquaculture dictionary. <<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 Aquaculture Best Management Practices Manual. <<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. <<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
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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>

- Dr. Kathleen Hartman, an aquaculture epidemiologist, can be consulted for any questions:

Telephone: 813-671-5230, ext. 119
E-mail: kathleen.h.hartman@aphis.usda.gov
Address: 1408 24th Street, SE
Ruskin, Florida 33570

- University of Florida Institute of Food and Agricultural Sciences Electronic Data Information Source (EDIS) fact sheets for aquaculture, aquatic diseases and facility management can be found at: <http://edis.ifas.ufl.edu/DEPARTMENT_VETERINARY_MEDICINE> and <http://edis.ifas.ufl.edu/DEPARTMENT_FISHERIES_AND_AQUATIC_SCIENCES> and <http://edis.ifas.ufl.edu/TOPIC_Fish>.
 - “Aquaculture Natural Disaster Preparation and Recovery,” a Clemson University Cooperative Extension Service publication is available at: <<http://www.clemson.edu/psapublishing/PAGES/AFW/AFW12.PDF>>.
 - University of Florida IFAS Extension Disaster Handbook. <<http://disaster.ifas.ufl.edu>>
 - Southern Regional Aquaculture Center (SRAC) fact sheets on topics ranging from tanks to tilapia are available for download at: <<http://www.msstate.edu/dept/srac/fslist.htm>> or <<http://srac.tamu.edu>>.
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Notes
