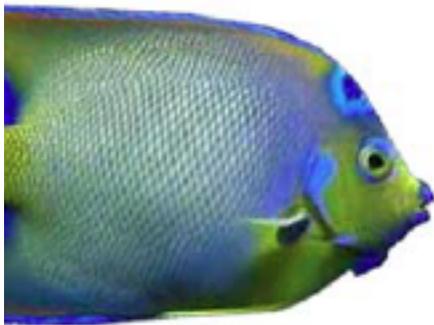




# Emergency Management and Quarantine of Aquaculture Facilities

## Training Guide



**SART Training Media**



# Emergency Management and Quarantine of Aquaculture Facilities Training Guide

**Prepared in 2006 by:**

**Kathleen Hartman, DVM, PhD**  
Aquaculture Epidemiologist  
USDA - APHIS - Veterinary Services

**Denise Petty, DVM**

Assistant Professor, Large Animal Clinical Sciences  
College of Veterinary Medicine  
University of Florida, Gainesville

**Charles M. Brown**

Coordinator for Information/Publication Services  
Agriculture and Biological Engineering Department  
University of Florida, Gainesville

**Carol J. Lehtola**

Associate Professor  
Agriculture and Biological Engineering Department  
University of Florida, Gainesville

**Updated in 2018 by:**

**Kathleen Hartman, D.V.M., Ph.D.**  
Aquaculture Program Leader  
USDA-APHIS-Veterinary Services

**Denise Petty, D.V.M.**

Assistant Professor  
University of Florida, College of Veterinary Medicine-LACS  
Owner of North Florida Aquatic Veterinary Services

**Katharine Starzel, D.V.M.**

Field Operations (FiOps), District 1 (D1)  
USDA-APHIS- Veterinary Services

Copyright by Florida Department of Agriculture and Consumer  
Services Published December 2006

**SART Training Media** are available for download from the Florida  
SART Web site <[www.flsart.org](http://www.flsart.org)>.

---

## **Contents**

<b>About Florida SART</b>	<b>1</b>
<b>Specific Learning Objectives</b>	<b>2</b>
<b>Resources</b>	<b>3</b>
<b>Training Slides</b>	<b>Appendix A</b>

---

## **About Florida SART**

- SART is a multi-agency coordination group.
- SART is made up of over 25 partner agencies (state, federal and non-governmental organizations).
- SART provides preparedness and response resources for Emergency Support Function 17 [(ESF 17) Animal and Agricultural Issues].
- SART statutory authority
  - State Emergency Management Act (Section 252.3569, Florida Statutes)

### **SART Mission**

Empower Floridians through training and resource coordination to enhance all-hazard disaster planning and response for animal and agricultural issues.

### **SART Goals**

- Support the county, regional and state emergency management efforts and incident management teams.
- Identify county resources available for animal and/or agricultural issues.
- Promote the cooperation and exchange of information of interested state, county and civic agencies.

---

## Specific Learning Objectives

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

- 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

---

## Resources

The following are sources of additional information about the subjects mentioned in this introduction.

**USDA-APHIS information for aquatic animal diseases**

<https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/aquaculture/aquatic-animal-diseases/index>

**Aquatext.com, a free, on-line aquaculture dictionary**

<http://www.aquatext.com/>

**Florida 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)**

<https://www.freshfromflorida.com/>

**Florida Division of Aquaculture home page**

<https://www.freshfromflorida.com/Divisions-Offices/Aquaculture>

**Aquaculture Best Management Practices manual**

[https://www.freshfromflorida.com/content/download/64045/1520653/BMP\\_Rule\\_and\\_Manual\\_FINAL.pdf](https://www.freshfromflorida.com/content/download/64045/1520653/BMP_Rule_and_Manual_FINAL.pdf)

**eXtension Freshwater Aquaculture Community**

<https://articles.extension.org/pages/58798/freshwater-aquaculture-community-page>

**USDA Animal and Plant Health Inspection Service (APHIS)**

<https://www.aphis.usda.gov/aphis/home/>

**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://nasdonline.org/search.php?query=safety+for+fish+farm+workers>

---

## Resources, continued

**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_VETERINARY_MEDICINE)

[http://edis.ifas.ufl.edu/DEPARTMENT\\_FISHERIES\\_AND\\_AQUATIC\\_SCIENCES](http://edis.ifas.ufl.edu/DEPARTMENT_FISHERIES_AND_AQUATIC_SCIENCES)

[http://edis.ifas.ufl.edu/TOPIC\\_Fish](http://edis.ifas.ufl.edu/TOPIC_Fish)

**University of Florida IFAS Extension Disaster Handbook**

<http://disaster.ifas.ufl.edu>

**Spawn, Spat, and Sprains by Alaska Sea Grant College Program**

<https://seagrant.uaf.edu/bookstore/pubs/AN-17.html>

**Southern Regional Aquaculture Center (SRAC) fact sheets**

<http://srac.tamu.edu>



# Emergency Management and Quarantine of Aquaculture Facilities

## Appendix A: Training Slides



**SART Training Media**



---

---

---

---

---

---

---

---

**Emergency Management and  
Quarantine of  
Aquaculture Facilities**



 State Agricultural Response Team 2

---

---

---

---

---

---

---

---

**Emergency Management and Quarantine of Aquaculture Facilities**

<p><b>Prepared by:</b></p> <p><b>Kathleen Hartman, D.V.M., Ph.D.</b> Aquaculture Program Leader, USDA-APHIS-VS</p> <p><b>Denise Petty, D.V.M.</b> Courtesy Assistant Professor, LACS, CVM, UF</p> <p><b>Katharine Starzel, D.V.M.</b> Aquaculture Liaison - Florida, USDA-APHIS-VS</p>	<p><b>Updated December 2018 by:</b></p> <p><b>Kathleen Hartman, D.V.M., Ph.D.</b> Aquaculture Program Leader USDA-APHIS-Veterinary Services</p> <p><b>Denise Petty, D.V.M.</b> Assistant Professor University of Florida, College of Veterinary Medicine- LACS Owner of North Florida Aquatic Veterinary Services</p> <p><b>Katharine Starzel, D.V.M.</b> Field Operations (FIOps), District 1 (D1) USDA-APHIS- Veterinary Services</p>
--	---

 State Agricultural Response Team 3

---

---

---

---

---

---

---

---

## 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



---

---

---

---

---

---

---

---

## Emergency Scenarios

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



---

---

---

---

---

---

---

---

## 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



---

---

---

---

---

---

---

---

## 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!*



---

---

---

---

---

---

---

---

---

---

## Wind Damage



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



---

---

---

---

---

---

---

---

---

---

## Flooding



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



---

---

---

---

---

---

---

---

---

---

## Power Outages



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



---

---

---

---

---

---

---

---

---

---

## 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

**Aquatic deaths may be first effects of Carp gizzard spill**

Photo: Mike Yonke/USFWS

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.

USFWS photo of a dead carp in a tank at the University of Florida's Aquaculture Laboratory.



---

---

---

---

---

---

---

---

---

---

## 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



---

---

---

---

---

---

---

---

---

---

## Aquaculture's Basic Needs



**Water**

- Suitable supply
- Quality source
- Filtration



**Air** • Oxygen supply



**Temperature control**



---

---

---

---

---

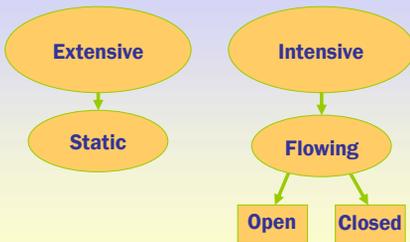
---

---

---

### Basic Needs for Aquaculture

## Aquaculture Systems



---

---

---

---

---

---

---

---

### Basic Needs for Aquaculture

## Aquaculture Systems

- Defined as 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, aquarlums, cages, recirculating systems



---

---

---

---

---

---

---

---

## 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



---

---

---

---

---

---

---

---

---

---

## Open Aquaculture Systems



Raceway  
Picture courtesy aquanlc.org



Net Pen



---

---

---

---

---

---

---

---

---

---

## Closed Aquaculture Systems



Typical glass aquariums



Larger fiberglass aquaculture system tanks



---

---

---

---

---

---

---

---

---

---

## Water Quality

The most important production component for raising fish

- Parameters of importance:

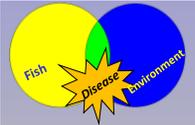
- Ammonia, nitrites, DO, temperature, pH, hardness, CO<sub>2</sub>, turbidity, chlorine, heavy metals
- Some fish have different tolerances

- Test kits

- Watch expiration dates
- Wash after each use and between tanks

- Reliable, safe supply source

- Protected source
- Unprotected source



---

---

---

---

---

---

---

---

---

---

### Water Quality

## Mechanical Filtration

- Effective in removing suspended solids

- Several methods and mediums available

- Gravel and sand filters
- Gravity and pressurized systems



---

---

---

---

---

---

---

---

---

---

### Water Quality

## Biological Filtration

- Primary function – *nitrification* of ammonia

- Several requirements for adequate function

- Surface area for bacterial colonization
- Oxygen
- Carbon, usually in the form of sodium bicarbonate or calcium carbonate (agricultural limestone)
- Time

- Size of biofilter determined by the amount of ammonia in the system and its efficiency



---

---

---

---

---

---

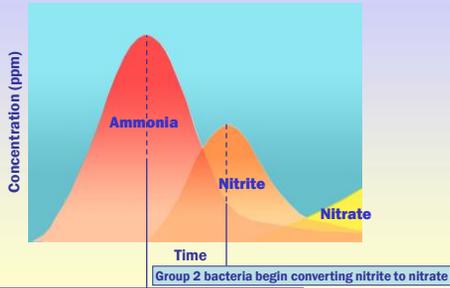
---

---

---

---

### Nitrogen Cycle




---

---

---

---

---

---

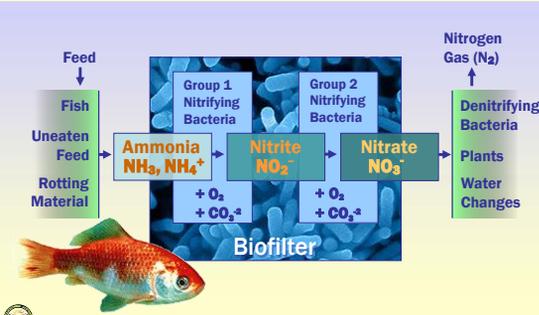
---

---

---

---

### Biological Filtration




---

---

---

---

---

---

---

---

---

---

### Chemical Filtration

- **Chemical**
  - Commercial products available
  - Use with caution
  - Do not fix problem of inadequate biofilter
  - Most often used in combination with non-chemical processes



Tanks and filtration systems for Epcot Living Seas Aquarium




---

---

---

---

---

---

---

---

---

---

## 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, but as close to saturation (7-8 ppm or 90-100%) as possible is preferred
- Clinical signs of low DO
  - Gulping at surface, lethargy, loss of appetite, increased ventilatory effort, death




---

---

---

---

---

---

---

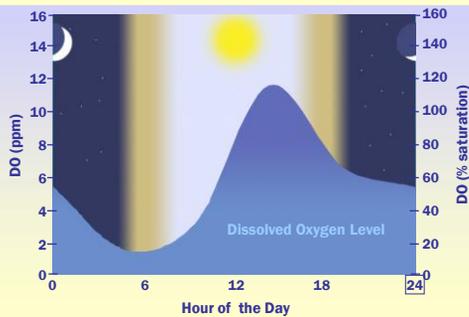
---

---

---

## Dissolved Oxygen

### Diurnal DO Cycle




---

---

---

---

---

---

---

---

---

---

## Factors that Influence Dissolved Oxygen



More Dissolved Oxygen at

- **Lower** Temperature
- **Higher** Pressure
- **Lower** Salinity
- **Lower** density stocking rate

Less Dissolved Oxygen at

- **Higher** Temperature
- **Lower** Pressure
- **Higher** Salinity
- **Higher** density stocking rate

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




---

---

---

---

---

---

---

---

---

---

## Temperature

- Direct effect on metabolism, feeding and survival
- Species-specific optimum levels
  - Protect from heat and cold
- Metabolism
  - Temp ↑ leads to rapid metabolism ↑ and O<sub>2</sub> ↓
  - Temp ↓ leads to O<sub>2</sub> ↑ food demand ↓
- Acclimation
  - Gradual changes
  - Minimizes temperature stress
- Stress signs: Lethargy, abnormal behavior, increased ventilation, death



---

---

---

---

---

---

---

---

## Tools for Aquatic Animal Emergencies

- Alternate emergency water source
  - Bottled water – may be missing necessary ions
  - Drinking water – must dechlorinate
  - No deionized or reverse osmosis (RO) water
- Test kit
  - Evaluate water quality parameters
- Diagnostic resource
- Supportive therapy
- Equipment
  - Thermometers, DO meter, refractometer, etc.
- Back-up power source
  - Generator or power equipment
- Oxygen
  - Primary oxygen supply (pump, gas)
  - Alternate oxygen supply / aeration (paddlewheel)



---

---

---

---

---

---

---

---

## Preparing for Emergencies

### Identification of Risk Factors and Facility Risk Management



---

---

---

---

---

---

---

---

## Biological Agent 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 pathogens can be prevented with proper risk management**



---

---

---

---

---

---

---

---

---

---

## Aquaculture Risk Factors

Identify intervention points to enhance farm animal health and environmental 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



---

---

---

---

---

---

---

---

---

---

## 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



---

---

---

---

---

---

---

---

---

---

## Equipment

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



---

---

---

---

---

---

---

---

## 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



---

---

---

---

---

---

---

---

## Quarantine

- **Isolated Space**
  - Separated from resident fish
  - Dedicated equipment/supplies
  - Limited visitor access
  - Managed personnel and traffic flow
- **Transport water**
  - Potential source of pathogens
  - Poor water quality (high ammonia, low pH, high CO<sub>2</sub>)
  - Waste management



---

---

---

---

---

---

---

---

## Quarantine

- Length of time
  - Recommended time:  $\geq 4$  weeks
    - However, may require longer time depending on pathogen life cycle
      - Pathogen reproduction
      - Water temperature
- 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



---

---

---

---

---

---

---

---

## Acclimation

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



Acclimation table



---

---

---

---

---

---

---

---

## Quarantine vs. Acclimation

### Quarantine

- 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

### Acclimation

- Complete within hours
- Group acclimation
- Stress reduction
- Bath treatment possible
- Less effective pathogen control/elimination



---

---

---

---

---

---

---

---

### Collecting Fish Samples

- Case history information
  - General, behavioral, physical, treatments
- Water sample
  - Clean transport bag or container
    - Air bubbles must be removed before bag closed or container capped
  - Submit along with fish
- Collect live moribund fish
  - 3-5; multiple species if applicable
- If dead, place fish in plastic zipper lock-type bag without water.
- Do not freeze, refrigerate only




---

---

---

---

---

---

---

---

---

---

### Submitting Fish Samples

- Call diagnostic lab
- Package live fish sample
  - Double bag
  - 1/3 filled water
  - Oxygen source (compressed O<sub>2</sub>, oxy tabs)
  - Heat/Cool packs if necessary
  - Styrofoam box (cardboard outer box)
  - History Information (In plastic bag)
- Include separate water sample
- Ship overnight or hand-deliver
  - Label outside box: LIVE FISH



Photo source: zfm.org




---

---

---

---

---

---

---

---

---

---

### Euthanasia of Aquatic Animals

- Primary methods
  - Drug overdose (MS-222, benzocaine)
    - Expensive and Impractical for large populations
  - CO<sub>2</sub> (compressed gas) and rotenone
    - USDA uses for SVC depopulation
    - More practical for large populations
- Secondary method is stunning followed by decapitation



CO<sub>2</sub> euthanized kol




---

---

---

---

---

---

---

---

---

---

## Sanitary Precautions



What do you notice?



---

---

---

---

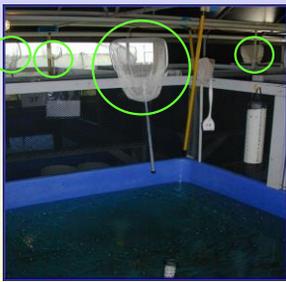
---

---

---

---

## Sanitary Precautions



What do you notice?

Every tank has its own equipment... there is no sharing between tanks



---

---

---

---

---

---

---

---

## Key Resources

- **USDA-APHIS information for aquatic animal diseases**  
<https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/animal-disease-information/aquaculture/aquatic-animal-diseases/index>
- **Aquatext.com, a free, on-line aquaculture dictionary**  
<http://www.aquatext.com/>



---

---

---

---

---

---

---

---

## 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)**  
<https://www.freshfromflorida.com/>



---

---

---

---

---

---

---

---

## Key Resources

- **Florida Division of Aquaculture home page**  
<https://www.freshfromflorida.com/Divisions-Offices/Aquaculture>
- **Aquaculture Best Management Practices manual**  
[https://www.freshfromflorida.com/content/download/64045/15206/53/BMP\\_Rule\\_and\\_Manual\\_FINAL.pdf](https://www.freshfromflorida.com/content/download/64045/15206/53/BMP_Rule_and_Manual_FINAL.pdf)
- **eXtension Freshwater Aquaculture Community**  
<https://articles.extension.org/pages/58798/freshwater-aquaculture-community-page>



---

---

---

---

---

---

---

---

## Key Resources

- **USDA Animal and Plant Health Inspection Service (APHIS)**  
<https://www.aphis.usda.gov/aphis/home/>
- **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://nasdonline.org/search.php?query=safety+for+fish+farm+workers>



---

---

---

---

---

---

---

---

## 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_VETERINARY_MEDICINE)

[http://edis.ifas.ufl.edu/DEPARTMENT\\_FISHERIES\\_AND\\_AQUATIC\\_SCIENCES](http://edis.ifas.ufl.edu/DEPARTMENT_FISHERIES_AND_AQUATIC_SCIENCES)

[http://edis.ifas.ufl.edu/TOPIC\\_Fish](http://edis.ifas.ufl.edu/TOPIC_Fish)



---

---

---

---

---

---

---

---

---

---

## Key Resources

- **University of Florida IFAS Extension Disaster Handbook**

<http://disaster.ifas.ufl.edu>

- **Spawn, Spat, and Sprains by Alaska Sea Grant College Program**

<https://seagrant.uaf.edu/bookstore/pubs/AN-17.html>

- **Southern Regional Aquaculture Center (SRAC) fact sheets**

<http://srac.tamu.edu>



---

---

---

---

---

---

---

---

---

---

## Key Resources

For any biosecurity or quarantine questions, contact:

**Dr. Kathleen Hartman**  
**Aquaculture Program Coordinator**

TELEPHONE: **813-671-5230 ext. 119**

E-MAIL: [kathleen.h.hartman@aphis.usda.gov](mailto:kathleen.h.hartman@aphis.usda.gov)

ADDRESS: **1408 24th Street, SE**  
**Ruskin, FL 33570**



---

---

---

---

---

---

---

---

---

---

## 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



---

---

---

---

---

---

---

---

**Thank You!**



---

---

---

---

---

---

---

---