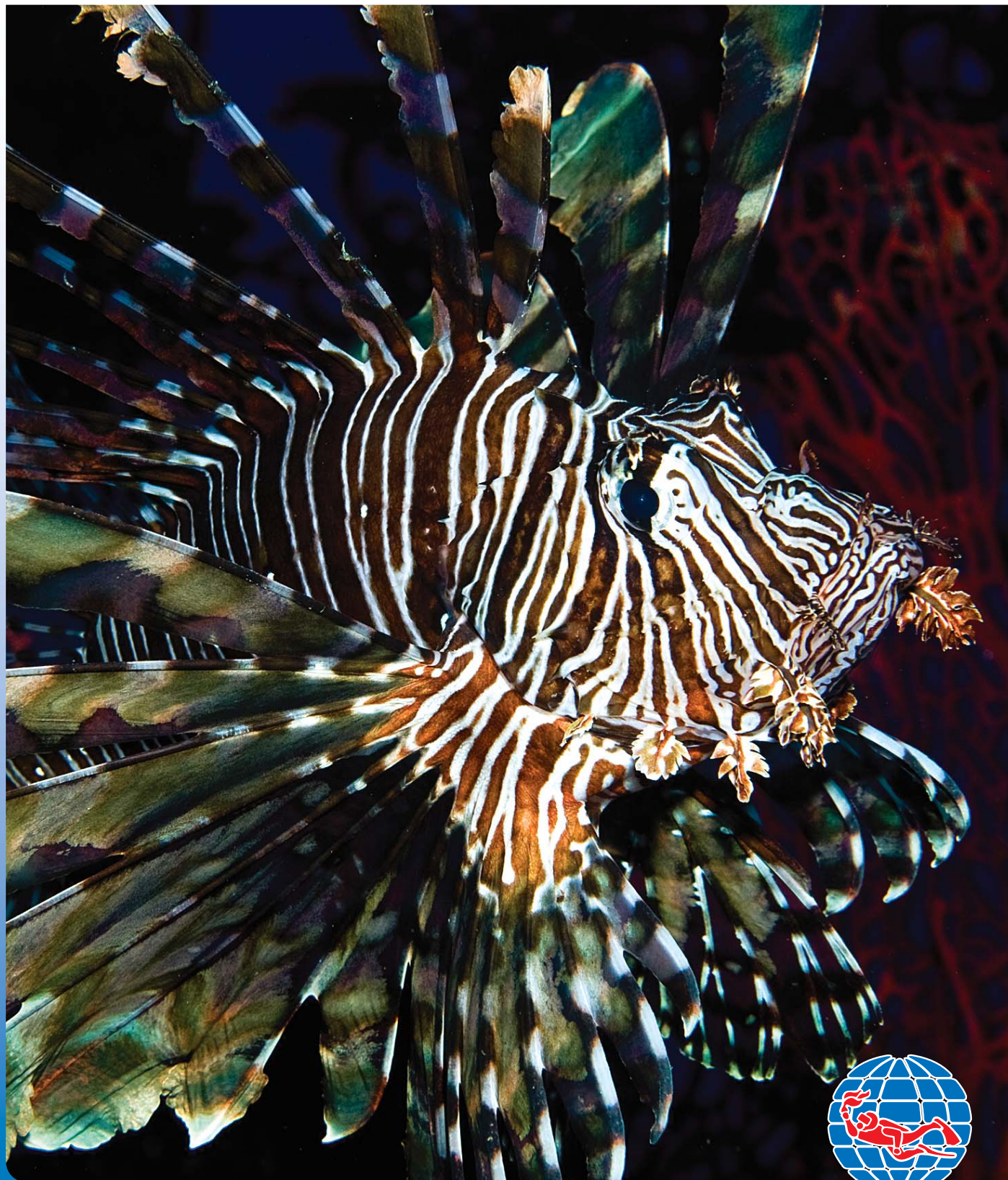


# Invasive Lionfish Tracker





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## **Invasive Lionfish Tracker**

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**Stephanie Wallwork, PADI IDC Staff Instructor and PADI Member since 2004,** for her role in the authorship of this Distinctive Specialty Course Outline and her interest in the non-native lionfish invasion that is growing in the North Western Atlantic and throughout the Caribbean.

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## *Introduction*

The Lionfish invasion in the Northwestern Atlantic and the Caribbean has been stated in the proceedings of the 61<sup>st</sup> Gulf and Caribbean Fisheries Institute as representing one of the most rapid finfish invasions in history.

## How to Use this Guide

This guide speaks to you, the Invasive Lionfish Tracker Distinctive Specialty Instructor. The guide contains three sections – the first contains standards specific to this course, the second contains knowledge development presentations and the third details the open water dives.

All required standards, learning objectives, activities, and performance requirements specific to the Invasive Lionfish Tracker course appear in boldface print. The boldface assists you in easily identifying those requirements that you must adhere to when you conduct the course. Items not in boldface print are recommendations for your information and consideration. General course standards applicable to all PADI courses are located in the General Standards and Procedures section of your PADI Instructor Manual.

## Course Philosophy and Goals

This specialty is an introduction to invasive Lionfish tracking, to familiarize divers with the skills, knowledge, planning, organization, procedures, techniques, problems, hazards and enjoyment of invasive Lionfish management diving. It's intended to serve as a safe and supervised introduction to invasive Lionfish tracking. Training should emphasize safety and fun.

The Invasive Lionfish Tracker Distinctive Specialty Course allows PADI Instructors to educate divers about invasive Lionfish, including the essential Lionfish facts and their progressive invasion of the North-western Atlantic and the Caribbean.

The course also explains why action is required now to endeavor to control the population and describes the practical way to safely and humanely capture and euthanize these fish, along with behavioral characteristics.

## Course Flow Options

Participants begin the course by reading Chapters Four and Five of the A.W.A.R.E – Our World, Our Water manual (if available in a language they understand). Students also read and keep a copy of the student handout (Appendix A) for this course. Learning continues with an Instructor led knowledge development session. By then completing and reviewing the program's Knowledge Review and completing two dives, participants may earn the Invasive Lionfish Tracker Distinctive Specialty.

There are two open water dives to complete. You may rearrange skill sequences within each dive; however, the sequence of dives must stay intact. You may add more dives as necessary to meet student divers' needs. Organize your course to incorporate environment friendly techniques throughout each dive, to accommodate student diver learning style, logistical needs, and your sequencing preferences.



## Section One

### Course Standards

This section includes the course standards, recommendations, and suggestions for conducting the PADI Invasive Lionfish Tracker course.

### Standards at a Glance

#### Course Standards

**Minimum Instructor Rating:** PADI Invasive Lionfish Tracker Distinctive Specialty Instructor

**Prerequisites:** PADI Open Water Diver, or qualifying prerequisite

**Minimum Age:** 15 years

**Ratios:** Open Water: 4:1

**Depth:** Maximum Depth:

- Open Water Diver: 18 metres/60 feet

- Advanced Open Water Diver: 30 metres/100 feet

**Hours:** Recommended: 10

**Minimum Open Water Dives:** 2

#### Materials and Equipment

##### **Instructor and Student Materials**

- Invasive Lionfish Tracker Distinctive Specialty Instructor Outline (Instructor Only)
- A.W.A.R.E – Our World, Our Water manual (free download from [www.projectaware.org](http://www.projectaware.org))
- Invasive Lionfish Tracker Participant Handout (Appendix A)
- Invasive Lionfish Tracker Knowledge Review
- Logbook

##### **Instructor and Student Equipment**

- Student and instructor equipment as outlined in the PADI Instructor Manual, General Standards and Procedures
- Two Underwater hand nets
- Waterproof goody bag (to hold captured fish)
- Pair of puncture proof protective gloves
- “Teaser” stick

### **Instructor Equipment**

- Euthanization equipment including:
  - Ice box or other suitable storage container
  - Ice
  - Clove oil
  - Rubbing alcohol
- Safety Equipment
  - Hot water
  - Any form of appropriate heat product available (ex. “Hot Hands” packages)
  - First aid equipment, including tweezers

### **Instructor Prerequisites**

To qualify to teach the Invasive Lionfish Tracker course, an individual must be a Teaching status PADI Open Water Scuba Instructor or higher. PADI Instructors may apply for the Invasive Lionfish Tracker Distinctive Specialty Instructor rating after completing a Specialty Instructor Training course with a PADI Course Director, or by providing proof of experience and applying directly to PADI. For further detail, reference Professional Membership section of your PADI Instructor Manual.

### **Student Diver Prerequisites**

By the start of the course, a diver must be:

1. Certified as a PADI Open Water Diver or have a qualifying certification from another training organization. In this case, a qualifying certification is defined as proof of entry-level scuba certification with a minimum of four open water training dives. Verify student diver prerequisite skills and provide remediation as necessary.
2. Be at least 15 years old.

### **Supervision and Ratios**

#### **Open Water Dives**

A Teaching status PADI Invasive Lionfish Tracker Distinctive Specialty Instructor must be present and in direct supervision of all activities and must ensure that all performance requirements are met. After all student divers have successfully demonstrated the required skills, the Instructor may exercise indirect supervision for the balance of the dive.

The ratio for confined and open water dives is four student divers per instructor (4:1), with a certified assistant for every two additional students (2:1), up to a maximum of eight student divers.

## **Site, Depths, and Hours**

### **Site**

Choose sites with conditions and environments suitable for completing requirements. Shallow dives will provide divers with more time to complete tasks. Use different open water dive sites, if possible, to give students divers experience in dealing with a variety of environmental conditions (incorporate environment friendly techniques throughout each dive) and logistical challenges.

### **Depths**

- Open Water Divers – 18 metres/60 feet maximum
- Advanced Open Water Divers – 30 metres/100 feet maximum

### **Hours**

The PADI Invasive Lionfish Tracker course includes two open water dives. Conduct dives during daylight hours between sunrise and sunset. The minimum number of recommended hours is 10.

## **Administrative Requirements**

### **Required**

Continuing Education Administrative Document (10038)

### **Assessment Standards**

The student diver must demonstrate accurate and adequate knowledge during the open water dives and must perform all skills (procedures and motor skills) fluidly, with little difficulty, in a manner that demonstrates minimal or no stress.

### **Certification Requirements and Procedures**

By the completion of the course, student divers must complete all performance requirements for Invasive Lionfish Tracker Open Water Dives One and Two. The instructor certifying the student diver must ensure that all certification requirements have been met. The certifying instructor submits a completed, signed PIC to the appropriate PADI Office to issue the student an Invasive Lionfish Tracker specialty certification.

## Section Two

### Knowledge Development

#### **Conduct**

Use the following teaching outline as a road map of the conduct, content, sequence and structure for the course. The result should be student divers with theoretical knowledge and pragmatic experience who can adapt what they have learned to safely and humanely capture and euthanize invasive Lionfish. Student divers will be able to explain the following learning objectives.

#### *Knowledge Development*

##### **Learning Objectives**

By the end of knowledge development, student divers will be able to explain:

- The correct Family, Genus and Species names for Lionfish
- Their morphology and lifespan
- Their habitat preference and behavior
- Their reproduction and growth facts
- The hunting methods of Lionfish and identification of its prey
- Whether Lionfish are venomous
- Whether Lionfish are dangerous to humans
- Known Lionfish predators
- The various theories relating to Lionfish introduction
- The negative effects on native species resulting from Lionfish introduction
- The procedure for reporting Lionfish sightings
- The Lionfish Tissue Repository
- The correct capturing and euthanizing techniques

##### **Knowledge Development Teaching Outline**

###### **A. Course Introduction**

1. Staff and student diver introductions

###### *Note:*

Introduce yourself and assistants. Explain your background with non-native Lionfish diving if your student divers aren't familiar with you.  
Give times, dates and locations as appropriate for classroom presentations, and open water dives.

2. Course goals –
  - a. To develop and increase your knowledge of invasive Lionfish facts and useful information.
  - b. To enable you to organize and safely conduct no-decompression dives to locate and humanely capture invasive Lionfish in depths up to 30 metres/100 feet.
  - c. To be able to humanely euthanize any invasive Lionfish captured on dives.
  - d. To improve your diving skills and provide you with additional supervised experience.
  - e. To encourage you to participate in other specialty training.
3. Course overview
  - a. The topics we will be covering are:
    1. Essential Lionfish facts
    2. Means of Lionfish introduction
    3. Effect of Lionfish introduction
    4. Lionfish Reporting
    5. Capturing techniques and practice with nets.
  - b. Open water dives. There will be two open water dives.
4. Certification
  - a. Upon successfully completing the course, you will receive the PADI Invasive Lionfish Tracker Specialty certification.
  - b. Certification means that you will be qualified to plan, organize and make dives in conditions generally comparable to, or better than those in which you are trained.

*Note:*

Use the Continuing Education Administrative Document. Explain all course costs and materials, and what the costs do and do not cover, including equipment use, dive site fees, etc. Explain what equipment student divers must have for the course, and what you will provide. Cover and review points about scheduling and attendance.

5. Class requirements
  - a. Complete paperwork.
  - b. Course costs.
  - c. Equipment needs.
  - d. Schedule and attendance.



### B. Course Content

- **What are the correct Family, Genus and Species names for Lionfish?**

1. Family name – Scorpaenidae – Scorpion fishes.
2. Genus – Pterois
3. Species

- a. volitans – Red Lionfish
- b. miles – Devil Firefish

Also known as Turkeyfish and Zebrafish (due to the distinct red and white stripes).

- **What is their morphology and lifespan?**

1. The body is white or cream colored with red to reddish brown vertical stripes with the stripes alternating from wide to very thin and sometimes even merging along the flank to form a V.
2. The Lionfish has elongated venomous dorsal and anal fin spines. There are 13 dorsal spines, 10 to 11 dorsal soft rays, 3 anal spines, 6 to 7 anal soft rays and 2 pelvic spines. The fin membranes are often spotted or have small holes.
3. In their natural habitat they are commonly found to be between 320mm – 350mm/12.6 -13.8 inches in size, but they have been found as big as 474mm/18.7 inches.
4. In recent research conducted by REEF (see Appendix A) of non-native Lionfish, the average size found was 188mm/7.4 inches with the size range 25mm – 389mm/1 - 15.3 inches.
5. The largest Pterois volitans specimen collected on the U.S. east coast, caught via hook and line off North Carolina in 2004, was over 430 mm/16.9 inches long and weighed approximately 1.1 kg/2.4 pounds.
6. The lifespan in the wild is up to 15 years, but as yet the lifespan in non-native waters has not been determined.

- **What is their habitat preference and behavior?**

1. Lionfish exhibit high site fidelity, i.e. they do not move much, and they are commonly seen in a nearly motionless posture with the head tilted slightly down.
2. Lionfish have been sighted in a wide variety of habitat types including; artificial sites, canals, harbors, estuaries, mangroves and shallow and deep reefs. From observations they appear to be at home and fully adapted to all these differing habitats.
3. Lionfish have been observed in water as cold as 13°C/56°F off the southern coast of Long Island, New York and as warm as 27°C/81°F in areas such as Turks and Caicos Islands, showing a tolerance to a wide range of temperatures.
4. It has been revealed that Lionfish stop feeding at temperatures of 16°C/61°F and below and that the average lethal low temperature is 10°C/50°F.
5. Lionfish are now being found in a large depth range from 0.6 metres/2 feet to 175 metres/574 feet, well beyond recreational dive depth limits.

- **What are their reproduction and growth facts?**

1. As juveniles Lionfish live in small groups, but as adults they typically occur alone with individuals being relatively inactive during the day, typically sheltering in reef crevices.
2. Lionfish are reaching sexual maturity and reproducing as young as one to two years old and data collected to date (REEF) suggests that the Lionfish appear to be reproducing year round in Bahamian and other Caribbean waters.
3. As stated, Lionfish are generally solitary fish but during courtship males will aggregate with multiple females to form groups of three to eight fish, with the males using their spines and fins in an aggressive visual display.
4. Following complex courting and mating behaviors, the females release a pair of mucus coated clusters of eggs approximately every 30 days, which are then fertilized by the males. On average, these clusters contain between 2,000 and 15,000 eggs, although this number can be as high as 30,000 eggs.
5. The eggs are then freed by environmental micro bacteria, which break down the egg mass.
6. The larvae hatch after approximately four days and become competent swimmers two to three days after that. At this stage in their development Lionfish are already able to capture and consume ciliates and other small zooplankton.
7. The larvae metamorphose into adults at approximately 10-12 mm/0.4 – 0.5 inches in size, which is in the range of 20-40 days. The time period it takes Lionfish to reach their adult stage is long enough for eggs released in the Caribbean, i.e. Cuba, Jamaica or the Cayman Islands to disperse into the Gulf of Mexico.

- **What are the hunting methods of the Lionfish and what is the prey?**

1. Given the tendency of the Lionfish to retreat to areas of hiding by day, this species was thought to be mostly nocturnal. However, recent studies have now shown that Lionfish have been observed feeding during the day.
2. Hunting behaviour includes the Lionfish hiding in unexposed places during the day, with its head down practically immobile, to stalking and cornering its prey by use of the outstretched and expanded pectoral fins when in full ambush mode. Lionfish prey is ultimately obtained with a lightning-quick snap of the jaws and swallowed whole.
3. The Lionfish is an undiscerning predator of small fish, shrimps, crabs and similarly sized animals and research has shown that of analyzed stomach contents, 70% was comprised of fish and 30% were crustaceans. Cannibalism has also been observed for this species in the wild as well as in captivity.
5. The most abundantly found prey in the Lionfish stomachs included basslets, shrimp and gobies and other cleaner fish. Other stomach contents included whole crabs, whole sand divers, jawfish with the eggs still in its mouth, and even juvenile groupers.
6. When consuming a large meal the Lionfish is capable of expanding its stomach over 30 times in volume, it is also capable of long term fasting and can go without food for periods of over 12 weeks without dying.

7. In its native range the Lionfish consumes 2.5% - 6% of its body weight per day.

- **Are Lionfish venomous?**

1. Scorpion fishes get their common name from their ability to defend themselves with a venomous “sting” or stab.
2. Thirteen of the long dorsal spines, two pelvic and three of the anal spines are venomous, with the venom being produced by glands located in grooves on the spines covered with skin.
3. Lionfish have venomous spines from birth and these spines are used by the Lionfish both to capture their prey and deter predators.

- **Are Lionfish dangerous to humans?**

1. The Lionfish can be aggressive and has been known to engage potential threats by moving towards them with a spines forward approach. However, observations in the field show that Lionfish will avoid confrontation with humans underwater, i.e. divers, wherever possible. However, this species should be treated with care at all times.
2. Worldwide, scorpion fishes rank second only to stingrays in total number of envenomations, with an estimated occurrence of approximately 40,000 - 50,000 cases annually.
3. The venomous nature of Lionfish can be substantial and a sting from the Lionfish can be serious. The severity of sting reactions in humans is dependant upon a number of factors which include the location of the sting, the amount of venom delivered and the strength of the immune system of the victim.
4. It should be noted that there is a higher chance of envenomation from the smaller sized Lionfish as the spine tip is smaller and sharper and the glandular venom tissue is closer to the tip of the spine.
5. Localized symptoms of envenomation by the Lionfish are the most common and include but are not limited to:
  - a. Persistent, intense throbbing; radiating, sharp pain at the site of envenomation;
  - b. Tingling sensations
  - c. Sweating
  - d. Blistering
6. The worst cases of envenomation may cause the following;
  - a. Headache
  - b. Nausea
  - c. Vomiting
  - d. Abdominal pain
  - e. Delirium
  - f. Seizures
  - g. Paralysis of limbs
  - h. A rise or drop in blood pressure
  - i. Respiratory distress
  - j. Heart complications including congestive heart failure
  - k. Pulmonary edema

- l. Tremors
    - m. Muscle weakness
    - n. Loss of consciousness
  7. Basic treatment for Lionfish envenomations includes immersing the afflicted area in hot water (38 to 43° C/100 to 110° F) for 15 – 20 minutes as this helps inactivate the venom. It is important not to burn the skin. Where hot water is not available other products such as “Hot Hands” heating pads can be used.
  8. Professional medical attention should be sought in any case of Lionfish envenomation.
  9. Calls can be made to the Aquatic Toxins Hotline at Florida Poison Information Center in Miami, Florida where medical experts will provide immediate advice. This hotline is available 24/7 and the number is (outside the US 011, not toll free) 888-232-8635.
  10. The anti-venom of the related stonefish (*Synanceia ssp.*) is also highly effective in neutralizing Lionfish venom activity.
- **Name three known Lionfish predators**
    1. Published records of natural predators of adult Lionfish are unknown but studies indicate that the Cornet fish, *Fistularia commersoni*, appears to be a predator.
    2. It is concluded that the Cornet fish in the Red Sea may utilize their ambush tactics to seize Lionfish safely from the rear, consuming them tail first. As Cornet fish are widespread and effective piscivores, they may turn out to be predators wherever Lionfish are found.
    3. Larger Lionfish are known to consume smaller members of their species.
    4. A few Lionfish have been found in the stomachs of native Groupers in the Bahamas and in the Cayman Islands. Lionfish are now being fed to Groupers in the hope that these fish will become part of their diet.
    5. Other as yet undocumented predators of the Lionfish might include sharks, as many sharks are known to consume noxious or venomous organisms with no obvious ill effects.
    6. Encouraging observations from the field indicate that both Nassau Groupers and Caribbean Reef Sharks show a high level of interest when Lionfish are being captured.

### Means of Lionfish introduction.

- **What are the various theories relating to Lionfish introduction?**

1. There are various theories as to how Lionfish were introduced into non-native waters. One popular school of thought believed that ballast water of large ocean going vessels was responsible for the Lionfish having been transported from their natural waters.
2. Another school of thought, which is the most popular, argued that the species may owe its presence in non-native waters to the deliberate or accidental release of captive specimens and, as the Lionfish increased in popularity as an aquarium fish this is not an unreasonable assumption.

This argument is supported by a paper published in 1995 (Courtenay Jr 1995) which indicated that there was an accidental release of six individual Lionfish in 1992 as a result of the Hurricane Andrew-related destruction of a large private aquarium located on a porch at the edge of Biscayne Bay, Florida. These fish were observed alive in the adjacent habitat several days later.

The above initial conclusion has recently been amended and as a result of further research, it is now believed that there were at least 11 females involved in the original foundling population released from the aquarium in question.

3. Lionfish have been documented off Palm Beach, Boca Raton, and Miami, Florida beginning in 1992.
4. In 2001 a single adult individual was captured off Georgia and two juveniles off Long Island, New York. Since then, there have been further collections and observations of live Lionfish occurring in natural habitats off Florida, Georgia, the Carolinas, New Jersey, and New York.
5. In April 2001, a Lionfish was confiscated from an Agricultural Exhibition in Bermuda and in October 2001, divers provided photo documentation of another Lionfish off the south shore of Bermuda. Since 2001, Lionfish have been sighted at numerous locations around Bermuda.
6. In 2004, a Lionfish was seen in an area east of New Providence Island in the Bahamas. In 2005, the species was reported from 16 different locations in the Bahamas around Andros Island, Eleuthera Island, Great Abaco Island, Little San Salvador and New Providence Island. Since 2005, Lionfish have spread throughout the Bahamian Islands.
7. In the second half of 2007, Lionfish spread to Cuba and the Turks and Caicos. In May 2008 a Lionfish was photographed in the National Submarine Park of Monte Cristi in the Dominican Republic. In early 2008, a juvenile Lionfish was caught in a marine park off Little Cayman in the Cayman Islands and there have been several reports of sightings in Jamaica.
8. In June 2008, both juvenile and adult Lionfish were photographed on two dive sites on the north coast of St. Croix, U.S. Virgin Islands and in July 2008 a Lionfish was photographed in Haiti. The first confirmed report of Lionfish in Puerto Rico was received in November, 2008. In December 2008, a Lionfish was photographed on a reef in Belize and another near Sea Manta City just south of Isla de Providencia in the Seaflower Biosphere Reserve, an atoll belonging to Colombia.



9. In January 2009 a specimen was photographed off the island of Cozumel, Mexico at Palancar Gardens Reef. And a Lionfish was collected on a reef just off Key Largo, Florida and a second specimen was collected in March; these are the first documented Lionfish in the Florida Keys.
10. In May 2009 Lionfish were spotted in Panama and Honduras and in September 2009 the first reported sighting in Aruba was made. By December 2009 sightings of Lionfish on the Pachareta Reef, north of the Yucatan Peninsula were made.

Regardless of the actual method of introduction, it is clear that the Lionfish is now established along the East Coast of the United States, the British West Indies and a large portion of the Caribbean, as evidenced by its distribution and the presence of juveniles.

It has also been indicated that, based upon how quickly the Lionfish established itself along the East Coast of the US and the Bahamas, it is highly likely that within a few years or less the Lionfish will have established itself along the southern edges of Central America (Nicaragua and Costa Rica), the Yucatan Peninsula and the Gulf of Mexico.

### Effects of Lionfish introduction

- **What are the negative effects on native species resulting from Lionfish introduction?**
  1. The first assessment of Lionfish densities was carried out in 2004 over 17 locations off the coast of North Carolina. It was determined that the average number of Lionfish per hectare was 21. This average continues to rise.
  2. Recent assessments off New Providence, Bahamas show that the Lionfish densities are more than 18 times higher than the 2004 North Carolina estimates. This is more than eight times higher than estimates carried out in the natural range of the Lionfish.
  3. Research provides the first evidence of negative effects of Lionfish on native Atlantic coral-reef fishes. The accumulation of new juvenile coral-reef fishes via the settlement of larvae, known as recruitment, was studied in the Bahamas during the 2007 recruitment period (July-August) on small patch of reefs. The study was conducted on reefs with and without a single Lionfish.
  4. Over the five week period, net recruitment was reduced by 79% on reefs with Lionfish compared to reefs without Lionfish, with the reduction almost certainly due to predation by Lionfish.
  5. The concern is that the Lionfish are not only depleting commercial fisheries but also destroying herbivorous species that are important in keeping coral reefs clean and free of seaweed.
  6. It has been hypothesized that the Lionfish will continue to expand along the Eastern coast of South America until it cannot tolerate the low water temperatures. "Lionfish are eating their way through the reefs like a plague of locusts," said Dr. Hixon (a marine ecology expert at Oregon State University). "This may well become the most devastating marine invasion in history."

### Lionfish Reporting

- **What are the procedures for reporting Lionfish sightings?**
  1. Lionfish sightings should be reported to the United States Geological Service Non-indigenous Aquatic Species (USGS NAS) website:  
<http://nas.er.usgs.gov/taxgroup/fish/lionfishdistribution.asp>.
  2. When information is reported, it should include as much detail as possible, including exact location (such as GPS information), behavior information, habitat, images, etc.
  3. To learn more the USGS website is the focal point for information regarding Lionfish sightings and population control efforts in the Atlantic and the Caribbean. In addition, USGS has developed mapping tools and maintains an early warning system to alert users about non-native species sightings in new areas. (<http://nas.er.usgs.gov/AlertSystem/about.asp> ) It also provides additional info on the status of the invasion <http://nas.er.usgs.gov/queries/FactSheet.asp?speciesID=963> and links to other resources.
  4. Some areas restrict Lionfish collection to trained volunteers, i.e. Bonaire. Please be sure to check local regulations before collecting Lionfish.
  
- **What is the Lionfish Tissue Repository?**
  1. Tissue samples should be forwarded to the Lionfish Tissue Repository (LTR) – <http://lionfish-invasion.blogspot.com/> – a project jointly managed by NOAA (Center for Coastal Fisheries and Habitat Research) and the Reef Environmental Education Foundation (REEF).
  2. Dr. James Morris ([James.Morris@noaa.gov](mailto:James.Morris@noaa.gov)) coordinates the LTR, and is the point of contact for inquires and contributions.
  3. According to Dr. Morris, “The LTR is a large, multi-national collaborative effort intended to maintain tissue samples for research into the ecological and evolutionary processes driving the ongoing invasion of Lionfish (*Pterois* spp.) in the Caribbean and western Atlantic.”
  4. In order to improve the value of the LTR, broad spatial and temporal coverage of Lionfish tissue samples throughout the invaded range is needed. If you have Lionfish tissue samples, or can get them, you may be able to contribute substantially to this critical research effort; this is particularly true if you have access to samples from regions not currently represented in the LTR. To contribute to the LTR, or to keep abreast of the latest news and research, please visit the LTR blog (<http://lionfish-invasion.blogspot.com/>).

## Capturing techniques.

- **What are the correct capturing and euthanizing techniques? (Practice with nets)**
  1. In an attempt to manage the Lionfish population, various countries have devised action plans.
    - a. In the Bahamas a Lionfish kill order was issued to fishermen in 2007. Education seminars, adopt a reef and removal by spear fishing/hand nets in tourist hotspots is carried out.
    - b. In Bermuda a Lionfish culling program was initiated in 2008 that included a training program, collecting license and a special dive flag allowing commercial and recreational fishers to spear Lionfish along near-shore reefs.
    - c. In the Turks and Caicos Islands, the DECR (Department of Environment and Coastal Resources) have training programs, issued collecting licenses and a special dive flag allowing commercial fishers to spear and dive centres to capture Lionfish with nets.
    - d. In October 2009 the DECR started a campaign to encourage local restaurants to put Lionfish on their menu and a Lionfish tournament lasting a year started in October 2009 with first prize being \$3,000. There is also a Lionfish Derby day in the summer.

[Insert local information here]

- e. Also NOAA (National Oceanic & Atmospheric Administration) researchers have developed techniques to trap Lionfish from deeper waters and larger areas that are impractical for removal by divers.
  - f. An early detection and rapid response program has also been developed by a collaborative effort by NOAA, REEF (Reef Environmental Education Foundation) and USGS (United States Geological Survey) in South Florida.
2. Overview of Correct Capturing Techniques
    - a. The aim is to corner the fish with nets, Lad Atkins of REEF states, "... then grab it by its bony head and place it carefully in a water-filled bag, a procedure that causes the least amount of distress to the marine animal."
    - b. It is important that when attempting to capture Lionfish that the netter is both patient and has clear communication with the dive buddy(s). These are some of the most important skills required.
  3. Overview of Correct Euthanization techniques
    - a. Once on the surface, the fish are placed into a container and euthanized using a mixture of clove oil and alcohol. This mixture is basically a narcotic that euthanizes the fish in a humane way, causing as little distress as possible.
    - b. If the fish are to be eaten then placing them in a chest full of ice has the effect of sending them to sleep and then ultimately death while not tainting the taste of the fish itself. Lionfish are very tasty and the cooking process denatures the spine venom. When handling Lionfish be very careful to avoid contact with the spines.

4. Detailed Procedures – Capturing Techniques.
  - a. Once a Lionfish is located the first step is to assess the area and determine the possible escape routes for the fish.
  - b. Working in teams of at least two, one diver has two underwater nets which are held arms length apart as they approach the Lionfish. One net should be placed behind the fish while the net in front of the fish should be used as the “decoy.”
  - c. One of the prime purposes of the decoy net is to persuade the Lionfish it does not want to come towards the net, thus encouraging it to turn and flee in the opposite direction, into the net placed at the rear.
  - d. The buddy diver may carry a teaser stick which is gently waved from side to side to help deter a Lionfish from taking an alternative escape route.
  - e. Once the Lionfish has swum into a net the two nets should rapidly be brought together, thereby preventing the Lionfish from escaping.
  - f. The Lionfish must then be grabbed by its bony head, between the eyes and the gills, in a firm grip by a diver wearing a protective puncture-proof glove. No attempt should be made to grab a Lionfish without a protective puncture-proof glove.
  - g. Once grabbed, the net is inverted so that the Lionfish is now sticking out of the net except for the head portion, which is being held.
  - h. The dive buddy opens the bag fully to allow water to enter and then the Lionfish is to be placed into the bag tail first. Once the Lionfish is a safe distance inside the bag the fish is released and the bag is sealed.
  - i. If this is not the first Lionfish to be captured and placed in the bag it is helpful for the dive buddy to place the bag on a surface (without damaging or injuring the marine life) and use their teaser stick to split the bag in two sections, while carefully avoiding any venomous spines.
  - j. This technique should be practiced on dry land before attempting this procedure underwater.
5. Detailed Procedures – Euthanization Techniques
  - a. Euthanization should be carried out as soon as possible to prevent any unnecessary distress to the Lionfish. The correct procedure is to make up a 50ml/1.7 fluid ounces mixture which is 1 part Clove Oil (5ml/0.2 fluid ounces clove oil) to 10 parts rubbing alcohol (45ml/1.5 fluid ounces alcohol). This mixture can then be diluted in approximately 11-15 litres/3-4 gallons of seawater and then the Lionfish are placed in this mixture. It is important this mixture is disposed of carefully once the Lionfish are euthanized.

### *Note*

Proper disposal is extremely important. In some areas, gray water is not treated and is piped directly into storm drains, fresh water or the ocean. It is your responsibility as an Invasive Lionfish Tracker specialist to ensure disposal that does not adversely impact the environment. Improper disposal could lead to indiscriminate euthanization of the very fish, reef and creatures that we are trying to protect from predation by Lionfish.

- b. Lionfish typically expire within 30-45 seconds, but it is best to leave them in the solution until all apparent movement has ceased, i.e. for at least 10 minutes.
- c. As the spines remain venomous up to 8 hours post death it is important to dispose of the Lionfish bodies with care to avoid accidental envenomation.
- d. Where the Lionfish are to be consumed they should be placed in a chest of ice and left until all apparent movement has ceased i.e. for at least 10 minutes.

*Note*

Colder fish – those on ice will have viable venom for longer than warmer fish.

- e. Should an envenomation occur the affected area should be immediately soaked in hot water (as hot as possible) to help the toxin break down and medical evaluation should be sought.



## Section Three

### Open Water Dives

#### General Open Water Considerations

1. Involve student divers in dive-planning activities. Give special attention to student diver anxiety and stress levels, in addition to student diver equipment preparedness.
2. Conduct a thorough briefing. The better the briefing, the more smoothly the dive will proceed. Assign buddy teams and establish a check-in/check-out procedure.
3. Assign logistical duties to staff and review emergency protocols.
4. Remind divers to familiarize themselves with their buddy's equipment.
5. Evaluate diver's thermal protection for appropriateness for the dive site and expected conditions.
6. Make yourself available to answer questions during equipment assembly, buddy pre-dive safety checks and gear-up.

#### Performance Requirements

By the end of the open water dives, student divers will be able to:

- Identify the type of capture equipment needed for the dive.
- Carry the necessary capture equipment without impeding the dive.
- Successfully capture a Lionfish without incident or injury.
- Successfully transfer a Lionfish to a collection bag without incident or injury.
- Successfully transport a Lionfish to the surface following a dive.
- Successfully euthanize any captured Lionfish without incident or injury.

### Dive One

- Buoyancy check
- Each buddy pair or team adheres to the dive plan, maximum limits and time.
- Assist in carrying the necessary equipment on the dive including nets, bag, gloves and "teaser" stick, without impeding the dive.
- Each buddy pair or team to carry out underwater exploration, while searching for Lionfish. When a Lionfish is spotted, the appropriate signal is to be given to the other team members.
- Observe the Lionfish capture by the instructor, including the use of the various techniques practiced.
- Once a Lionfish is captured, assist in the transfer to the collection bag.

#### **A. Briefing**

1. Evaluation of conditions
2. Facilities at dive site

3. Entry technique to be used – location dependent
4. Exit technique to be used – location dependent
5. Bottom composition and topography around training site
6. Depth range on bottom, planned depth and maximum depth
7. Ending tank pressure – when to terminate the dive
8. Interesting and helpful facts about the dive site
9. Sequence of training dive – review Dive One tasks
  - a. Suiting up
  - b. Pre-dive safety check
  - c. Buoyancy check at the surface
  - d. Observe dive plan, maximum limits and time
  - e. Carry assigned Lionfish capturing equipment
  - f. Search for Lionfish
  - g. Observe techniques of Lionfish capture by instructor
  - h. Assist with transfer of Lionfish to collection bag
  - i. Transport any captured Lionfish to the surface
  - j. Tour for fun and pleasure
  - k. Ascent

**B. Pre-dive procedures**

1. Prepare personal diving equipment and Lionfish capturing equipment.

**C. Descent****D. Dive One tasks****E. Ascent****F. Post-dive procedures (ethanize any captured Lionfish)****G. Debriefing****H. Log dive (instructor signs logbook)**

## Dive Two

- Buoyancy check
- Each buddy pair or team adheres to the dive plan, maximum limits and time.
- Assist in carrying the necessary equipment on the dive including nets, bag, gloves and "teaser" stick without impeding the dive.
- Each buddy pair or team to carry out underwater exploration, while searching for Lionfish. When a Lionfish is spotted, the appropriate signal is to be given to the other team members.
- Assist with the Lionfish capture, including the use of the various techniques practiced.
- Once a Lionfish is captured, assist in the transfer to the collection bag.
- Bring captured Lionfish to the surface at the end of the dive.

### A. Briefing

1. Evaluation of conditions
2. Facilities at dive site
3. Entry technique to be used – location dependent
4. Exit technique to be used – location dependent
5. Bottom composition and topography around training site
6. Depth range on bottom, planned depth and maximum depth
7. Ending tank pressure – when to terminate the dive
8. Interesting and helpful facts about the dive site
9. Sequence of training dive – review Dive Two tasks
  - a. Suiting up
  - b. Pre-dive safety check
  - c. Buoyancy check at the surface
  - d. Observe dive plan, maximum limits and time
  - e. Carry assigned Lionfish capturing equipment
  - f. Search for Lionfish
  - g. Assist with Lionfish capture
  - h. Assist with transfer of Lionfish to collection bag
  - i. Transport any captured Lionfish to the surface
  - j. Tour for fun and pleasure
  - k. Ascent

### B. Pre-dive procedures

### C. Descent

### D. Dive Two tasks

### E. Ascent

### F. Post-dive procedures (euthanize any captured Lionfish)

### G. Debriefing

### H. Log dive (instructor signs logbook)

## *Knowledge Review* – Invasive Lionfish Tracker

Answer the following questions. Your instructor will review your answers with you.

1. **What family, genus and two species do Lionfish come from?**
  
2. **In what type of habitats are Lionfish being found?**
  - a. Shallow and deep reefs.
  - b. Mangroves.
  - c. Wrecks and other artificial sites.
  - d. All of the above.
  
3. **On average, how many eggs are released per egg sac?**
  - a. 20 – 150 eggs
  - b. 200 – 1,500 eggs
  - c. 2,000 – 15,000 eggs.
  - d. 20,000 – 150,000 eggs.
  
4. **What are the known prey of Lionfish? (Choose all that apply)**
  - a. Fairy Basslets
  - b. Turtles
  - c. Shrimps
  - d. Garden Eels
  - e. Crabs
  - f. Sand divers
  - g. Jawfish
  - h. Reef sharks
  
5. **True or False. The spines of a Lionfish do not become venomous until the fish reaches sexual maturity.**
  - True
  - False
  
6. **Which and how many of the Lionfish spines are venomous?**
  - a. 13 dorsal, 3 pelvic and 2 anal.
  - b. 11 dorsal, 2 pelvic and 3 anal.
  - c. 13 dorsal, 2 pelvic and 3 anal
  - d. 11 dorsal, 3 pelvic and 2 anal.
  
7. **True or False. Lionfish are cannibalistic.**
  - True
  - False

**8. What are some of the symptoms of envenomation? (Choose all that apply)**

- a. Headache
- b. Cherry red lips
- c. Tingling sensations
- d. Delirium

**9. How is it thought that Lionfish may have been introduced into non-native waters? (Choose all that apply)**

- a. The destruction of an aquarium in hurricane Arthur.
- b. Ballast water of large ocean going vessels.
- c. The destruction of an aquarium in hurricane Andrew.
- d. Natural evolution.

**10. In what year was the first Lionfish spotted in Bahamian waters?**

**11. What is the correct balance of the euthanization mixture?**

- a. 1 part clove oil to 10 parts rubbing alcohol.
- b. 10 parts clove oil to 4 parts rubbing alcohol.
- c. 15 parts clove oil to 3 parts rubbing alcohol.
- d. 11 parts clove oil to 1 part rubbing alcohol.
- f. 5 parts clove oil to 6 parts rubbing alcohol.



## *Knowledge Review* – Invasive Lionfish Tracker

### ANSWER KEY

1. What family, genus and two species do Lionfish come from?

Family: Scorpaenidae – Scorpionfishes

Genus: *Pterois*

Species (2): *volitans* – Red Lionfish and *miles* – Devil Firefish

2. In what type of habitats are Lionfish being found?

- a. Shallow and deep reefs.                       b. Mangroves.  
 c. Wrecks and other artificial sites.            d. All of the above.

3. On average, how many eggs are released per egg sac?

- a. 20 – 150 eggs                                       b. 200 – 1,500 eggs  
 c. 2,000 – 15,000 eggs.                            d. 20,000 – 150,000 eggs.

4. What are the known prey of Lionfish? (Choose all that apply)

- a. Fairy Basslets                                       b. Turtles  
 c. Shrimps     d. Garden Eels  
 e. Crabs     f. Sand divers  
 g. Jawfish      h. Reef sharks

5. True or False. The spines of a Lionfish do not become venomous until the fish reaches sexual maturity.

- True  
 False

6. Which and how many of the Lionfish spines are venomous?

- a. 13 dorsal, 3 pelvic and 2 anal.  
 b. 11 dorsal, 2 pelvic and 3 anal.  
 c. 13 dorsal, 2 pelvic and 3 anal  
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7. True or False. Lionfish are cannibalistic.

- True  
 False

8. What are some of the symptoms of envenomation? (Choose all that apply)

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10. In what year was the first Lionfish spotted in Bahamian waters?

2004

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- b. 10 parts clove oil to 4 parts rubbing alcohol.
- c. 15 parts clove oil to 3 parts rubbing alcohol.
- d. 11 parts clove oil to 1 part rubbing alcohol.
- f. 5 parts clove oil to 6 parts rubbing alcohol.

## Appendix A

Published on Reef Environmental Education Foundation (REEF) (<http://www.reef.org>)



### **About REEF**

Protecting Marine Life Through Education, Service, and Research

REEF was founded in 1990, out of growing concern about the health of the marine environment, and the desire to provide the SCUBA diving community a way to contribute to the understanding and protection of marine populations. REEF achieves this goal primarily through its volunteer fish monitoring program, the REEF Fish Survey Project. Participants in the Project not only learn about the environment they are diving in, but they also produce valuable information. Scientists, marine park staff, and the general public use the data that are collected by REEF volunteers.

### **REEF Details**

Since 1994, REEF has maintained an on-line educational section on non-native species as well as an on-line Exotic Species Reporting page. Divers are encouraged to submit any sightings of non-native species via this sightings reporting form. Beginning in January of 2007, REEF has partnered with local dive operators to help document Lionfish sightings and collect Lionfish samples for NOAA and Bahamian researchers from five Bahamian projects. This information is being used to help determine the range and extent of the Lionfish invasion, as well as to address key questions on age/growth, reproduction, genetics, parasites and habitat preference.

As of August 2007, over 400 fish have been collected and shipped to the NOAA research in Beaufort NC and more than 500 sightings have been documented in the Bahamas. Data on length, plumage and stomach contents have been gathered in the field, and samples for genetics and age/growth studies have been shipped to researchers. REEF has worked in close partnership with the College of the Bahamas, researchers at UNCW and Salisbury University and local dive operators in gathering and analyzing the data.

To aid in this effort, REEF is enlisting interested divers and snorkelers to join in on organized Lionfish projects. These projects are led by REEF staff, national aquarium staff, and/or scientific researchers and include educational lectures on current Lionfish research as well as daily diving opportunities.

### **How can you help?**

- If you are conducting a REEF survey and encounter a Lionfish (or any non-native species), please report the species as a write in species on the back of the REEF scan sheet. Whenever possible, please include an extra sheet of paper with extended details about habitat the fish was in, behaviors noted, other species it was hanging out with, and approximate size. Also indicate if you have photo/video of the fish. Please also report your sighting through our exotic species online reporting form.
- If you see a Lionfish when you are not surveying, please use our Exotic Species Sighting Form to submit your information.

For more information go to <http://www.reef.org/programs/exotic/Lionfish> How can you help?