

This document summarizes a proposed final rule for sea cucumbers, which are regulated under the Florida Fish and Wildlife Conservation Commission's (FWC) Marine Life rule, 68B-42, Florida Administrative Code (FAC). The commercial marine life fishery has requested FWC implement a commercial trip limit out of concern that the expanding market will lead to overharvest. This document includes a series of potential management options for ensuring the sustainability of the commercial fishery and staff's recommendation to implement commercial daily trip and vessel limits of 200 sea cucumbers.

Authors: Melissa Recks and Mason Smith

Report date: March 10, 2014

Cause for Concerns

- Traditional marine life fishery collects sea cucumbers to supply the live aquarium trade
- There is new potential for overharvest to meet demands of a developing food fishery
- Globally, sea cucumber food fisheries lacking regulation are often unsustainable
- Lack of commercial trip limit may allow overexploitation in Florida



Photo by Ian Haderyer



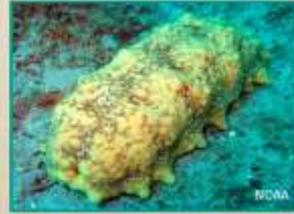
Sea cucumbers are traditionally collected in Florida for the live aquarium trade. However, with the development of a market in south Florida for sea cucumbers to supply the food fishery, there is a new potential for overharvest of this natural resource. Once harvested, sea cucumbers destined for the food market are dried and sold by the gram, with almost all of them imported into Hong Kong for further Asian distribution.

Globally, sea cucumber food fisheries lacking proper regulation are often unsustainable. Because sea cucumbers are regulated under the Commission's marine life regulations, commercial harvest is already limited to those who possess a limited access marine life endorsement (ML), in addition to a saltwater products license with a restricted species endorsement, but ML endorsement holders are not subject to any further limits on the number of sea cucumbers they can harvest.

Florida's commercial marine life fishery approached staff in 2012 with concerns that the lack of a commercial trip limit could lead to overexploitation. Based on industry concerns, staff began monitoring landings and investigating the potential for unsustainable expansion of the sea cucumber fishery in Florida. Given the global trend in unsustainable harvest of sea cucumbers, staff believes a commercial trip limit is needed and has been working with members of the fishery to develop reasonable commercial limits.

Sea Cucumbers

- Sedentary invertebrates
- Inhabit seagrass beds, lagoons, and reefs
- Vulnerable to overfishing
 - Broadcast spawners – require dense populations for successful reproduction
 - When depleted, recovery may take several decades
- Small commercial fishery in FL Keys for live aquarium trade
- Recent interest in a developing food fishery
 - Globally, highly valuable food trade in Asian markets
 - Historically a boom-and-bust fishery without proper management



Sea cucumbers are sedentary marine invertebrates that live in shallow water habitats, such as seagrass beds, lagoons, and on nearshore reefs. They are vulnerable to overfishing because of their visible and sedentary nature, which makes them easy to locate and collect. Their life history characteristics also make them prone to overfishing, due to their late reproductive age (at least 2 years), long life span (up to 15 years), and spawning behavior. Sea cucumbers are broadcast spawners, meaning they release their sperm and eggs into the water column. This spawning behavior requires dense populations (individuals occurring in close proximity to one another) in order to be successful because adequate numbers of sperm and eggs must be released in the same vicinity at the same time for sufficient levels of fertilization to occur. This spawning behavior also contributes to slow recovery times once the populations become depleted. In the case of sea cucumbers, recovery may take several decades.

Currently, there is a small commercial fishery for sea cucumbers in Florida, primarily in the Keys. Sea cucumbers are regulated as marine life species, which are traditionally collected for live display in private and public aquaria. These species are harvested by both recreational and commercial collectors using non-lethal methods, and are required to be landed alive. Marine life species collected by commercial fishermen are typically sold to wholesalers, retailers, and owners of public or private aquariums.

While the Florida fishery has traditionally targeted sea cucumbers for live sale into the aquarium trade, they are commonly harvested elsewhere in the world as a food product because of their high value in Asian markets. Without proper management, these food fisheries have historically followed boom-and-bust patterns, with overfishing occurring within just a few years and often leading to population collapse and a complete harvest ban.

Current Florida Regulations

- All marine life species must be transported and landed alive

Recreational

- Recreational fishing license required
- Bag limit: 5 of each species per day, included in the 20-organism aggregate bag limit for all marine life species

Commercial

- Commercial Saltwater Products License (SPL) with Restricted Species (RS) and Marine Life (ML) endorsements required
- **Trip limit: none**

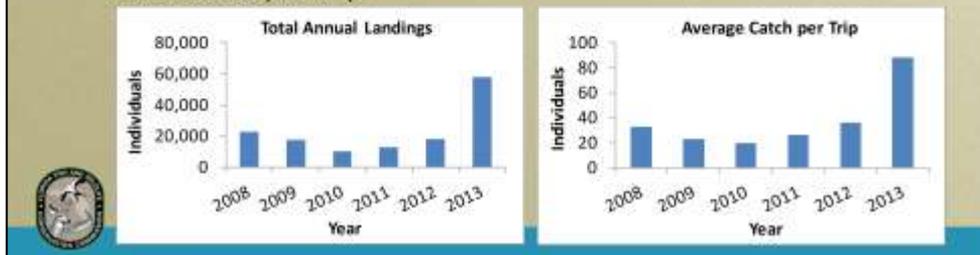


Like all marine life species, sea cucumbers harvested either commercially or recreationally must be transported and landed alive.

Current recreational regulations for sea cucumbers include a bag limit of five of each species per person per day, which is included in the marine life aggregate bag limit of 20 organisms that applies to all marine life species. Commercial harvest requires a commercial Saltwater Products License (SPL) with Restricted Species (RS) and ML endorsements. There is no commercial bag limit or trip limit for sea cucumbers.

Sea Cucumber Fishery – Florida

- Traditionally a small fishery
 - Annual landings around 16,000 sea cucumbers
 - Average catch rate of 28 sea cucumbers per trip
- Industry began expressing concern in 2012
- June 2012 Commission meeting – staff committed to monitor the fishery for changes
- Through November of 2013, annual landings tripled to nearly 58,000 sea cucumbers with an average catch rate of 88 individuals per trip



Traditionally, Florida’s sea cucumber fishery has been small, with annual landings around 16,000 sea cucumbers and an average catch rate of 28 sea cucumbers per trip. But in 2012, industry began expressing concerns about potential future overexploitation. At that time, the landings data did not indicate any increase in harvest of sea cucumbers or any discernible change in fishery practices. But because of industry concerns, staff committed to closely monitoring the fishery and to work with the industry to implement additional regulations if needed. Through November of 2013, the landings have more than tripled the previous annual average with nearly 58,000 sea cucumbers landed and a catch rate of approximately 88 sea cucumbers per trip.

Value of Sea Cucumbers

Economic Value

- Prior to 2012: \$14,000 per year
- Jumped to \$43,000 in 2013

Ecological Value

- Important for nutrient cycling in tropical reefs and seagrass habitats
- Oxygenate sediments

Nutritional and Medicinal Value

- Contain a wide variety of vitamins, minerals and essential amino acids, proteins, and fatty acids
- Contain a suite of compounds that hold promise for drug development



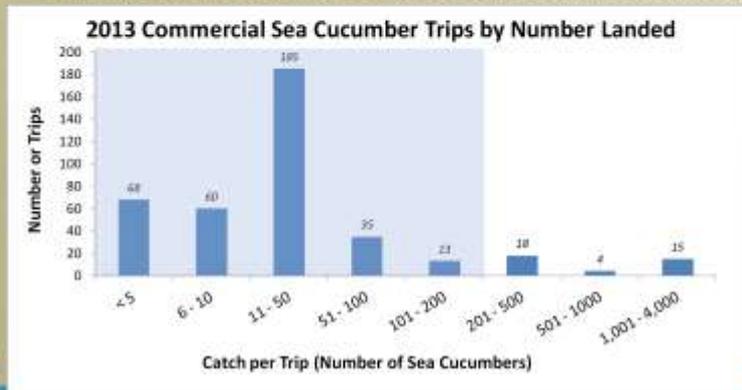
Florida's commercial sea cucumber fishery has historically been a low-value fishery, averaging \$14,000 per year for marine life endorsement (ML) holders prior to 2012. However, the value of landings during 2013 exceeded \$43,000, more than three times the previous average.

In addition to their economic value, sea cucumbers play an important role in marine ecosystems. These animals are important for nutrient cycling in otherwise nutrient-poor tropical reefs. They also make nutrients available to seagrasses by recycling nutrients that have been deposited in the sediment. Sea cucumbers also help to oxygenate the sediments for other bottom-dwelling organisms by burying themselves. Laboratory experiments have demonstrated that removing sea cucumbers can lead to the development of unwanted algal mats on the sediment, limiting the availability of oxygen.

Recent attention has also focused on the nutritional and medicinal properties of sea cucumbers. Nutritional studies have reported high levels of vitamins A, B1, B2, and B3, as well as minerals such as calcium, magnesium, and zinc. Research has also found that sea cucumbers contain essential amino acids that help regulate immune function, and important omega-3 and other essential fatty acids, which are thought to reduce heart disease, certain cancers, asthma, depression, ADHD, and rheumatoid arthritis. Several studies have also isolated compounds from sea cucumbers that may be useful for drug development. Many of these compounds have been tested and found to potentially slow the progression of or treat cancer; reduce blood clotting; treat osteoarthritis; kill viruses, bacteria, and fungi; reduce fatigue; and speed wound healing.

Commission Direction to Date

- Draft rule hearings held in Nov. (2013) and Feb. (2014)
 - Supported proposed daily commercial trip limit of 200 sea cucumbers
 - Requested staff bring back other possible management options for discussion and consideration



Draft rules proposing a commercial trip limit of 200 sea cucumbers per day were presented at the November 2013 and February 2014 Commission meetings. Of the nearly 400 commercial sea cucumber trips taken in 2013, over 90% harvested 200 or fewer sea cucumbers, with over 75% of those trips harvesting 50 or less. Based on these historical landings patterns and the information received from the industry, staff believes a commercial trip limit of 200 sea cucumbers would ensure the sustainability of sea cucumber populations and the fisheries they support.

To date, the Commission has expressed its support for moving forward with a 200 sea cucumber daily limit, but at the February hearing the Commission also directed staff to bring additional management options back at the final public hearing for Commission discussion and consideration.

Proposed Rule

68B-42.006 Commercial Season, Harvest Limits

Establish a commercial daily trip limit and vessel limit of 200 individual sea cucumbers

- Will not impede current practices of the traditional marine life fishery collecting for the aquarium trade
- Conservative limit that can be expanded later, if appropriate
- Supported by participants in the traditional fishery
- Proactive measure to ensure sustainability



Photo by Don DeMara



The proposed rule, as presented previously at the draft rule hearings, would establish a commercial trip limit of 200 individual sea cucumbers per person per day, as well as a daily vessel limit of 200 sea cucumbers, inclusive of all sea cucumber species. The proposed rule would allow the established traditional fishery that supplies sea cucumbers alive to the aquarium trade to continue to operate under its current practices and could be carefully expanded later, if appropriate, once more information is known about how the populations will respond to increased harvest. The proposed daily limit of 200 is supported by the Florida Marine Life Association (FMLA), the official industry organization for ML endorsement holders and by participants in an industry stakeholder survey.

The proposed trip limit would be a proactive measure to help ensure that the developing food fishery will be sustainable while preventing depletion of these ecologically important animals.

Management Options Considered

- FAO and NOAA Fisheries publications
 - Best strategy for new fisheries: adaptive management
 - Start with conservative harvest levels and allow for careful expansion
- Other options considered by staff:
 - Minimum size limits
 - Spawning season closure
 - Rotating area closures
 - Marine reserves
 - Annual quotas
 - Individual fishing quotas



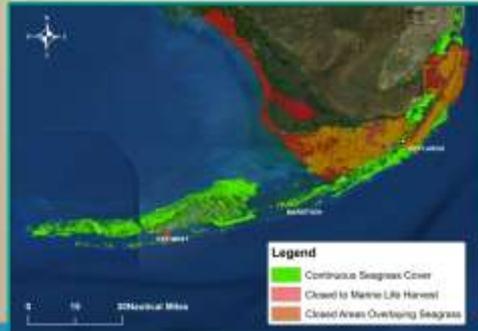
A wide variety of management measures have been applied to sea cucumber fisheries around the globe. The Food and Agriculture Organization of the United Nations (FAO) and NOAA Fisheries have also published guidelines on sea cucumber management. Harvest restrictions using an adaptive management scheme are often regarded as the best strategy for new or developing fisheries, especially when information needed to construct maximum sustainable yield (MSY) is lacking or when the fishery is new or expanding, both of which apply in Florida. Through adaptive management, fisheries managers begin with a conservative catch quota and allow the fishery to expand under close monitoring.

Several management options were reviewed by staff, but are not recommended for a variety of reasons:

- Minimum size limits are often adopted for sea cucumber fisheries, but are difficult to enforce due to the ability of sea cucumber to contract and expand, and would also limit the collection of small individuals for use in aquariums.
- Spawning season closures are also commonly used elsewhere. Closing the Florida fishery seasonally would also negatively affect the traditional live aquarium fishery that collects low numbers year round.
- Rotating areas closures and permanent marine reserves are also used in other regions. Current state and federal regulations already prohibit harvest of marine life species from Everglades National Park, Biscayne National Park, and John Pennekamp Coral Reef State Park. These areas will act as marine reserves for sea cucumbers even if harvest surrounding these areas increases. Additional area closures would be unnecessarily restrictive; thus further consideration of closed areas is not warranted.
- An annual quota was reviewed as a possible management measure, but may cause a “race to fish,” leading to the majority of the quota being met early in the year by the food export industry. This could leave limited opportunities for traditional live aquarium collectors if the season closes early.
- Individual fishing quotas (IFQs) are one solution to the “race to fish” scenario and give each fisher a designated quota. But this management strategy is very complex and is not ideal for a fishery like the marine life fishery that collects almost exclusively based on when fishers receive orders from wholesalers or retailers and thus has somewhat unpredictable variations in demand and needs to be able to operate year-round.

Development of Quota Alternative

- No population assessment available in Florida
- Stock assessment conducted in Mexico in 2001
 - Population parameters were adjusted relative to the fishable seagrass habitat in the FL Keys
- Maximum sustainable catch for the Keys estimated
 - Approximately 200,000 individuals
 - Based on best available information



Staff reviewed the possibility of implementing a quota system for commercial harvest of sea cucumbers in Florida. While there is not sufficient information available on the distribution, abundance, and other characteristics of Florida's populations of sea cucumbers to conduct an assessment or calculate MSY, sea cucumbers have been studied more thoroughly in other portions of their range and some of that information was used to estimate a sustainable level of harvest for Florida.

A stock assessment of the Florida sea cucumber (*Holothuria floridana*), which is the main target of collectors in the Florida Keys, was conducted in the Mexican Caribbean in 2001. In order to estimate a sustainable level of harvest in Florida, population parameters from this stock assessment (density, average sea cucumber size and biomass of the unfished stock) were used as a proxy for Florida-specific data and adjusted relative to the fishable area of the Florida Keys to estimate a potential quota. An MSY surplus production model (the recommended model for new sea cucumber fisheries) was used for the calculation and the fishable area was considered to be areas in the Florida Keys open to marine life harvest with continuous sea grass cover (the Florida sea cucumber's primary habitat). Areas where marine life collection is prohibited, such as Everglades National Park, Biscayne National Park, John Pennekamp Coral Reef State Park, and other closed areas in the Florida Keys National Marine Sanctuary were excluded from the analysis. Using these methods, the annual sustainable catch was estimated to be 200,000 sea cucumbers, which suggests there is room for a modest expansion of the sea cucumber fishery which harvested roughly 60,000 sea cucumbers in 2013.

Although the population parameters used here are from a stock assessment on the same species most commonly targeted in Florida, those parameters may not accurately account for variables specific to Florida populations. For that reason, staff was intentionally conservative with respect to other factors in the analysis, such as limiting the analysis to the Florida sea cucumber (even though a variety of sea cucumbers contribute to the overall harvest in Florida) and limiting the fishable area for the analysis to the primary habitat (sea grass) and the Florida Keys.

Best Management Options

Staff recommendation: *Commercial daily trip limit of 200 sea cucumbers per person and per vessel*

Additional Management Alternative

- **Step-down bag limit**
 - Commercial trip limit of 500 sea cucumbers until harvest reaches 150,000 sea cucumbers
 - Once met, decrease trip limit to 50 sea cucumbers



Photo by Stan DeMaria



This slide discusses the best management options for Florida's sea cucumber fishery. Both options are proactive measures that are expected to prevent depletion of the sea cucumber resource in Florida. The first option, and the one recommended by staff, is a commercial daily trip limit of 200 sea cucumbers per person and per vessel. This recommended option adopts the FAO recommendation to begin with a conservative initial limit and allows the traditional fishery to continue with its current practices in light of a developing food fishery, while limiting regulatory complexity.

In addition to the recommended commercial trip limit of 200 sea cucumbers, staff has developed another alternative that the Commission may wish to consider:

The second option would operate similar to a quota system, but with a step-down bag limit once the quota is reached. This system would allow for higher initial levels of harvest with a commercial trip limit of 500 sea cucumbers per day and per vessel until the annual harvest reaches 150,000 sea cucumbers (75% of the estimated sustainable harvest level), at which time the commercial trip limit would decrease to 50 sea cucumbers per day to allow collection for the live aquarium trade to persist without exceeding 200,000 total sea cucumbers harvested in a given year. This option would provide an opportunity for the food-based fishery to harvest greater numbers of sea cucumbers early in the year, but would likely close the food fishery entirely each year when the step-down bag limit goes into effect. However, the traditional fishery for the aquarium trade would likely face minimal negative effects from the implementation of the step-down bag limit because the vast majority of those trips collects 50 or less sea cucumbers. One potential side effect of the higher initial daily bag limit is that it could encourage harvesters to deplete sea cucumbers from localized areas before moving on to a new collecting location. This type of serial depletion of sea cucumbers from portions of the habitat would be difficult for staff to detect when monitoring the commercial landings and could reduce the fisheries ability to respond to the increase fishing pressure.

Staff Recommendation

Approve the proposed rule

- *Establish a commercial daily trip limit and vessel limit of 200 sea cucumbers*

If approved, make rule effective June 1, 2014



Taking into consideration the need to implement conservative initial harvest limits, the lack of Florida-specific information about sea cucumber populations and their resiliency to harvest pressure, and the desire to limit regulatory complexity, staff recommends approving the proposed draft rule establishing a commercial trip limit of 200 individual sea cucumbers per person per day, as well as a daily vessel limit of 200 sea cucumbers. These limits would be overall limits, inclusive of all sea cucumber species.

If approved, staff recommends making the rule effective on June 1, 2014. Staff has evaluated the rule under the standards of 68-1.004, FAC, and found it to be in compliance.

The following slides are considered back up material and are not anticipated to be part of the actual presentation to the Commission



Market Value of Sea Cucumbers

Live Aquarium Trade

- Market value around \$1.00 per individual for live animals



Photo by Don DeMarie

Food Trade

- Highly variable depending on species
 - \$0.05 - \$3.00 per individual
 - Florida fishers reportedly getting around \$1.00 each
- As a final processed product, some species can be sold dried for up to \$200 per pound
- Market Driving Force: exploitation and depletion near Asia driving value higher with increasing opportunities found in areas farther away



Sea cucumbers are of modest value in the live aquarium trade, with ex-vessel values in Florida averaging \$1 per sea cucumber. In the food trade however, the ex-vessel value is highly variable, and ranges from 5 cents to \$3, depending on the species. Collectors in Florida are currently receiving around \$1 per sea cucumber, the same as they receive for those sold into the aquarium trade. However, they are much more valuable once they have been dried and processed, with some species found in Japan historically bringing in up to \$200 per pound processed. According to the Food and Agriculture Organization of the United Nations (FAO), the driving force for development and expansion of sea cucumber fisheries is the exploitation and depletion of stocks near Asia, with increasing opportunities found in areas farther away where stocks have not yet been exploited.

Nutritional and Medicinal Value

Nutritional

- Rich in vitamins A, B1, B2, B3
- Rich in calcium, magnesium, and zinc
- Contain essential amino acids and protein
- Contain omega-3 and other essential fatty acids
 - Reduce inflammatory causes of cancer, asthma, depression, cardiovascular disease, ADHD, and rheumatoid arthritis



Photo by Don DeMania

Medicinal

- Isolated compounds may be useful for drug development
 - Slow or treat cancer
 - Reduce blood clotting
 - Treat osteoarthritis
 - Kill viruses
 - Kill bacteria
 - Kill fungi
 - Reduce fatigue
 - Speed wound healing



Recent attention has focused on the nutritional and medicinal properties of sea cucumbers. Nutritional studies have reported high levels of vitamins A, B1, B2, and B3, as well as minerals such as calcium, magnesium, and zinc. Research has also found that sea cucumbers contain essential amino acids that help regulate immune function, and important omega-3 and other essential fatty acids, which are thought to reduce heart disease, certain cancers, asthma, depression, ADHD, and rheumatoid arthritis.

Additionally, several studies have isolated compounds from sea cucumbers that may be useful for drug development. Many of these compounds have been tested and found to potentially slow the progression of or treat cancer; reduce blood clotting; treat osteoarthritis; kill viruses, bacteria, and fungi; reduce fatigue; and speed wound healing.

Global Food Fisheries

- Most international sea cucumber fisheries deemed unsustainable by the Food and Agriculture Organization of the United Nations (FAO)
 - Typically boom-and-bust
 - Most fisheries are either fully depleted (20%) or otherwise overexploited (52%)
 - Extinctions from overfishing reported from Indo-Pacific region
 - Complete ban on harvest implemented in many tropical fisheries due to overharvest
- Severe population crashes due to overfishing in high profile conservation sites such as the Great Barrier Reef and Galapagos Islands National Park
 - No signs of recovery at these sites



Photo by Don DeMott

Many of the sea cucumber fisheries that have developed around the world have done so in the absence of regulation, resulting in a series of boom-and-bust fisheries. The FAO has determined that most of the sea cucumber fisheries worldwide are unsustainable. Worldwide, 20% of the sea cucumber fisheries have been deemed fully depleted, with an additional 52% deemed overexploited. Extinctions of some species from overfishing have been reported from the Indo-Pacific region, and complete bans on sea cucumber harvest due to population collapse have been implemented in many tropical and subtropical fisheries including Costa Rica, Ecuador, India, France, Panama, Papua New Guinea, Solomon Islands, Tanzania, Tonga, Vanuatu, and Venezuela. There have also been severe population crashes recorded in high profile conservation sites such as the Great Barrier Reef and Galapagos Islands National Park due to overfishing, with no signs of recovery at these sites.

A food fishery that was established in Cuba in 1999 resulted in the harvest of over three million sea cucumbers during the first two years of the fishery, with only 12 boats in operation, before steep declines in the catch led to a series of management measures to ensure the sustainability of the fishery.

Nearby Sea Cucumber Food Fisheries

Export markets driving harvest of high numbers from nearby areas



Photo by Don DeMara

Mexico

- Exports over 300 tons to Hong Kong annually
- Targets many species also found in Florida
- Harvest of one species banned after just 4 years due to it becoming "endangered"

Cuba

- Millions of individuals exported to Hong Kong annually
- Targets chocolate chip sea cucumber, a common species in Florida

British Columbia

- Exports over 800 tons to Hong Kong annually

United States (Washington, Oregon, California, Alaska, and Maine)

- Total exports to China range from 4 to 10,000 tons annually



This slide summarizes the characteristics of several sea cucumber fisheries operating in regions within relatively close proximity to Florida that supply large numbers of sea cucumbers to food-based export markets.

Other Nearby Sea Cucumber Fisheries Management

- Alaska
 - Annual quota based on harvest rate of 5% of biomass
 - Spawning season closure
- British Columbia
 - Annual quota based on harvest of 4.2% of biomass
- Cuba
 - Annual quotas divided into separate regions
- Mexico
 - Annual quota equal to 30% of estimated spawning stock biomass



Photo by Don DeMena



This slide summarizes the characteristics of several sea cucumber fisheries operating in regions within relatively close proximity to Florida that supply large numbers of sea cucumbers to food-based export markets.

Additional Strategy for Monitoring the Fishery

- Staff included a question about trip ticket reporting in the email survey of ML holders earlier this year
 - Broad support for implementing species-specific reporting codes
 - FMLA requested a separate trip ticket code for sea cucumbers destined for the food market to facilitate separate management strategies for that aspect of the fishery
- Division of Marine Fisheries Management staff will work with FWC's research staff and the ML industry in the near future to implement additional reporting codes for this fishery



Photo by Don Sahlin

In addition to questions about the status of the sea cucumber fishery and support for new commercial harvest limits, staff included a question about trip ticket reporting codes for this fishery in the email survey that was distributed to ML endorsement holders earlier this year. There was broad support from individual marine life collectors and from the FMLA for additional trip ticket reporting codes for this fishery. Currently, there is only one species-specific reporting code for sea cucumbers with all other species lumped into a single reporting code. In addition to species-specific codes, the FMLA suggested additional codes for sea cucumbers supplied to the food market. There is currently a single trip ticket code for sea cucumbers harvested for this purpose, but no landings have been reported under that code in recent years.

In order to gather more information about the species composition of the harvest in the commercial fishery, Division of Marine Fisheries Management staff will work with research staff at the Fish and Wildlife Research Institute and the marine life industry to implement additional trip ticket codes for this fishery and provide the fishery with the information needed to facilitate species identification and accurate reporting.