

Estimated Impacts of Trip Limits and Time/Area Closures on Dwarf Seahorse (*Hippocampus zosterae*) Commercial Harvest in Florida

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Introduction

The dwarf seahorse (*Hippocampus zosterae*) is managed as part of the Florida's marine life (tropical ornamental/aquarium) fishery. NOAA Fisheries has received a petition to list the dwarf seahorse under the Endangered Species Act (ESA) and is currently conducting a status review for this species.

Per the Florida Fish and Wildlife Conservation Commission (FWC):

“Available data suggest abundance may be low, particularly in northern portions of the state, and that this species may be slow to rebound from temporary seagrass loss. Dwarf seahorses are abundant only in peninsular Florida and, to a lesser extent, along parts of the Texas coast and Mexico's Gulf coast. The largest populations are in south Florida, especially Florida Bay. Due to the dwarf seahorse's limited geographic range, dependence on seagrass habitat, and concerns about its population status, staff believe implementing additional management measures is appropriate for this species and could prevent the need for more drastic measures, such as listing under the ESA, in the future” (FWC 2015).

FWC has proposed the following regulations to manage dwarf seahorse:

68B-42.0036 Closed Areas – The proposed rule would prohibit harvest of the dwarf seahorse north of a line extending due west from the Anclote Key State Park lighthouse near Tarpon Springs on the Gulf coast and north of a line extending due east of the Jupiter Inlet lighthouse in Palm Beach County on the Atlantic coast.

68B-42.005 Recreational Bag Limit, Recreational Closed Season – The proposed rule would:

Reduce the recreational bag limit for seahorse species from 5 of each species per person to 5 total seahorses per person (within the 20-organism aggregate limit including all Marine Life species).

Create a closed season statewide for the recreational harvest of dwarf seahorses from July – September each year.

Provide for a season closure once the dwarf seahorse commercial quota is projected to be met.

68B-42.0055 Closed Season (NEW) – The proposed rule would create a closed season statewide for the recreational and commercial harvest of dwarf seahorse from April – June each year.

68B-42.006 Commercial Season, Harvest Limits – The proposed rule would:

Reduce the daily commercial trip limit from 400 dwarf seahorses to 200 per person or per vessel (whichever is less).

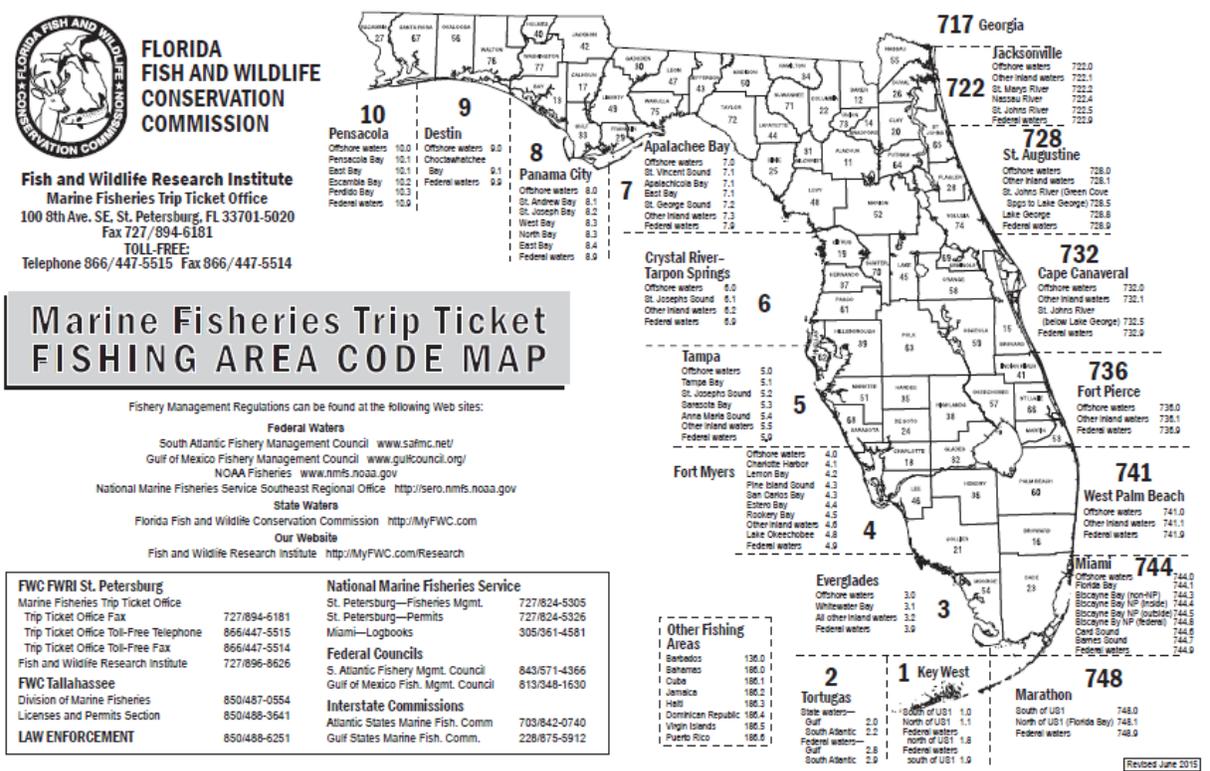
Create a closed season statewide for the commercial harvest of dwarf seahorses from July – September each year.

Create an annual commercial harvest quota of 25,000 individual dwarf seahorses. The fishery would be closed when the quota is projected to be met and remain closed until the start of the following fishing year (October 1).

Reducing or maintaining harvest may ensure the long term viability of the species and improve the condition of the population. The effectiveness of fishery regulations is an important factor that NOAA Fisheries will consider in determining whether the species needs federal protection under the ESA. This report evaluates the effectiveness of the proposed time/area closures and various trip limit alternatives at reducing commercial harvest of dwarf seahorse.

Methods and Results

Confidential commercial trip ticket data were obtained from Florida Fish and Wildlife Research Institute (S. Brown, FWRI, personal communication). Trip tickets are completed by dealers at the point of sale and contain unique identifiers for the trip, the dealer, and the Saltwater Products License number for the commercial harvester. They also contain the unloading date for the trip, the area fished (Figure 1), the county for the dealer’s location, the gear used, and the number of seahorses sold. Many trip records also have information on the depth fished and the level of effort expended to capture the number of seahorses reported.



Marine Fisheries Trip Ticket FISHING AREA CODE MAP

Fishery Management Regulations can be found at the following Web sites:
Federal Waters
 South Atlantic Fishery Management Council www.safmc.net/
 Gulf of Mexico Fishery Management Council www.gulfcouncil.org/
 NOAA Fisheries www.nmfs.noaa.gov
 National Marine Fisheries Service Southeast Regional Office <http://sero.nmfs.noaa.gov>
State Waters
 Florida Fish and Wildlife Conservation Commission <http://MyFWC.com>
Our Website
 Fish and Wildlife Research Institute <http://MyFWC.com/Research>

FWC FWRI St. Petersburg Marine Fisheries Trip Ticket Office Trip Ticket Office Fax 727/894-6181 Trip Ticket Office Toll-Free Telephone 866/447-5515 Trip Ticket Office Toll-Free Fax 866/447-5514 Fish and Wildlife Research Institute 727/896-8626	National Marine Fisheries Service St. Petersburg—Fisheries Mgmt. 727/824-5305 St. Petersburg—Permits 727/824-5326 Miami—Logbooks 305/361-4581
FWC Tallahassee Division of Marine Fisheries 850/487-0554 Licenses and Permits Section 850/488-3641	Federal Councils S. Atlantic Fishery Mgmt. Council 843/571-4366 Gulf of Mexico Fish. Mgmt. Council 813/948-1630
LAW ENFORCEMENT 850/488-6251	Interstate Commissions Atlantic States Marine Fish. Comm 703/842-0740 Gulf States Marine Fish. Comm. 228/875-5912

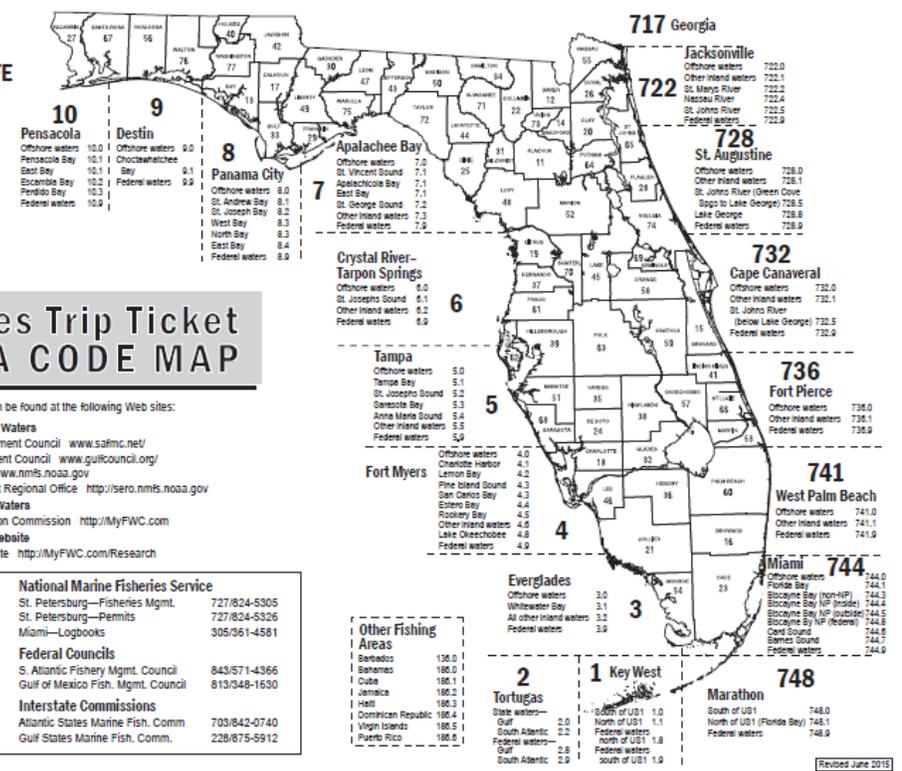


Figure 1. FWRI Marine Fisheries Trip Ticket fishing area code map.

Landings were summarized at the trip level. To compute the impacts of closed areas, trips were identified as having occurred within or outside proposed closures. Closed areas in the Gulf of Mexico were considered areas 6-10, closed areas on the Atlantic coast were considered areas 736, 732, 728,

722, and 717 (Figure 1). To determine the impacts of the proposed commercial-specific closed season, trips were noted as occurring within or outside the July-September proposed closure period. To determine the impacts of the proposed April-June commercial closed season, trips were noted as occurring within or outside the proposed closure period.

To evaluate the potential impacts of a trip limit, landings were summarized by year to examine interannual trends (Figure 2). No clear interannual trends were apparent following the 2009 implementation of a 400-seahorse commercial trip limit. Landings were primarily made by net and trawl gear in recent years. From 2011-2014, net gear accounted for 44% of reported trips; diver trips accounted for 32%, and trawl accounted for 20%. Only landings in 2013 exceeded the proposed 25,000 seahorse annual commercial harvest quota since the 2009 trip limit reduction was implemented (Figure 2). The 400-seahorse trip limit greatly reduced mean catch per trip (Figure 3). From 2011-2015, catch per trip has been relatively stable, with a mean of 114 ± 38 seahorses per trip (mean \pm SD; Figure 3).

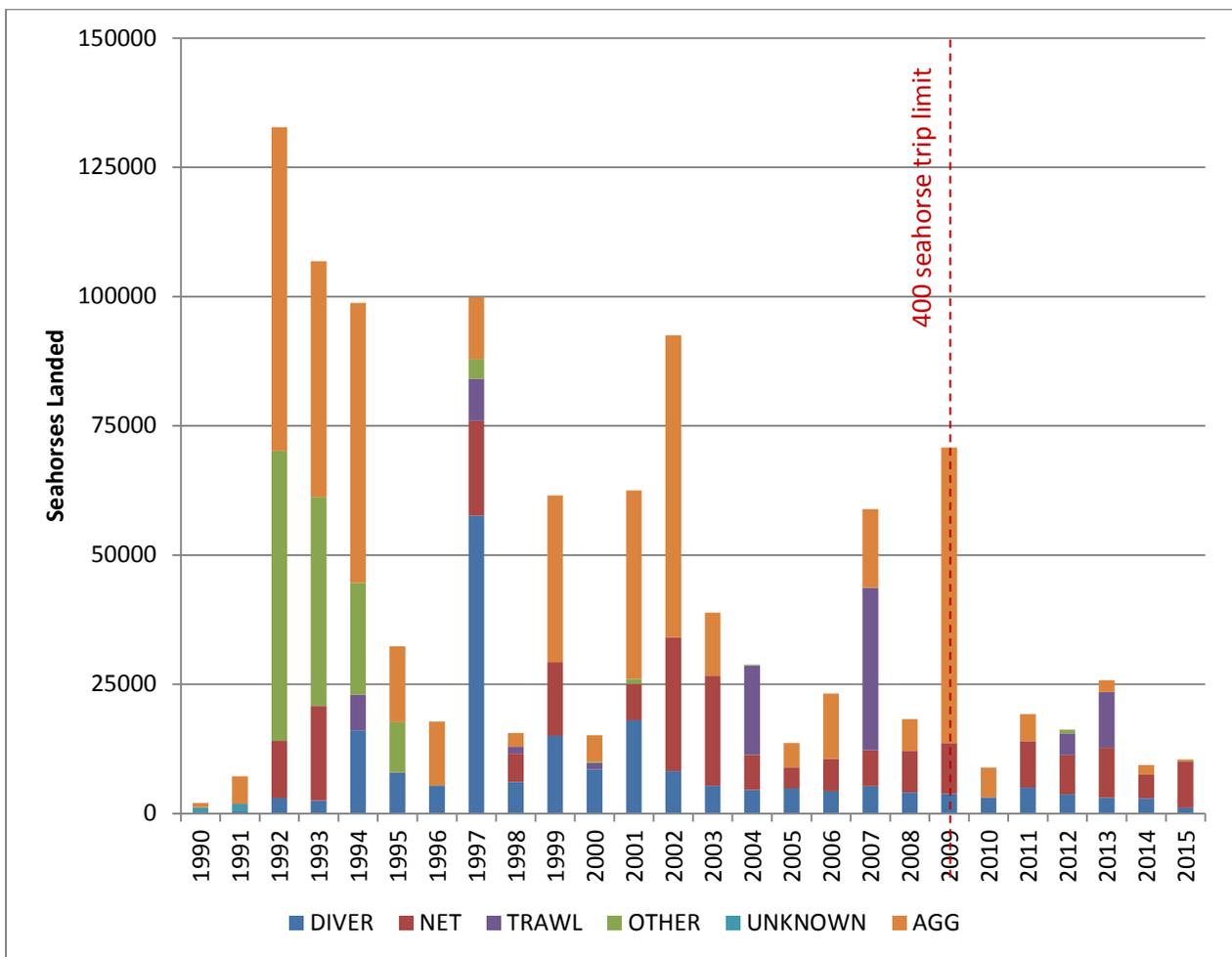


Figure 2. FWC dwarf seahorse commercial Trip Ticket reported landings by year and gear. “AGG” includes aggregated gear types when minimum confidentiality requirements were not met to provide landings by gear. Note: 2015 landings are incomplete.

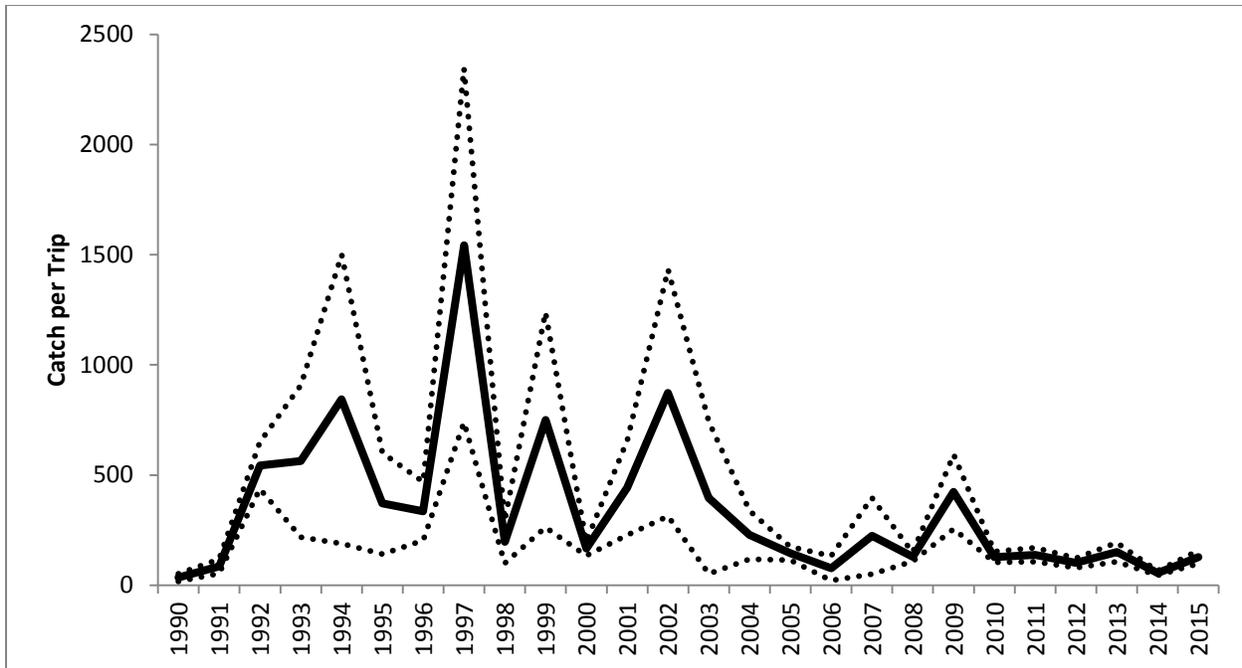


Figure 3. Dwarf seahorse mean commercial catch per trip, irrespective of gear or effort, with upper and lower 95% confidence intervals. Note: 2015 landings are incomplete.

The distribution of catch per trip has reduced in recent years, with fewer high catch trips following the 2009 implementation of the 400-seahorse trip limit (Figure 4); however, there were still trips with greater than 400 seahorses landed. Between 2010-2015, 26 trips exceeded the 400-seahorse trip limit. Harvest in excess of the trip limit totaled over 11,000 dwarf seahorses.

From 2011-2015, 49% of all reported trips landed fewer than 100 seahorses (Figure 5). Trawl trips tended to catch more seahorses per trip than diver or net trips. Mean trawl catch 2011-2014 was 150 dwarf seahorses per trip, as compared to 123 dwarf seahorses per net trip, and 71 dwarf seahorses per diver trip.

Potential trip limit impacts were evaluated with and without proposed spatial and seasonal closures. Trip limit impacts were evaluated for all fishing gear and by gear, with some gear types aggregated to protect confidentiality. Impacts of trip limits were modeled using data from 2011-2014, with a sensitivity run using only 2014 data (the last complete year of data). If landings on a trip during the simulated time period exceeded the simulated trip limit, they were converted to the simulated trip limit. Landings were summarized for the baseline condition (i.e., harvest during the 2011-2015 or 2014 periods without spatial or seasonal closures) and the trip limit alternatives. The baseline and trip limit alternative landings were summarized by year and then averaged across years. The ratio between the mean baseline historic landings and the modified trip record landings was used to determine the potential reduction in harvest associated with each trip limit alternative. To simulate spatial and seasonal closures, trips noted as occurring within the July-September period or within the closed areas were excluded from the trip limit alternative landings summaries. The baseline assumed no trips would exceed the simulated trip limit in the future.

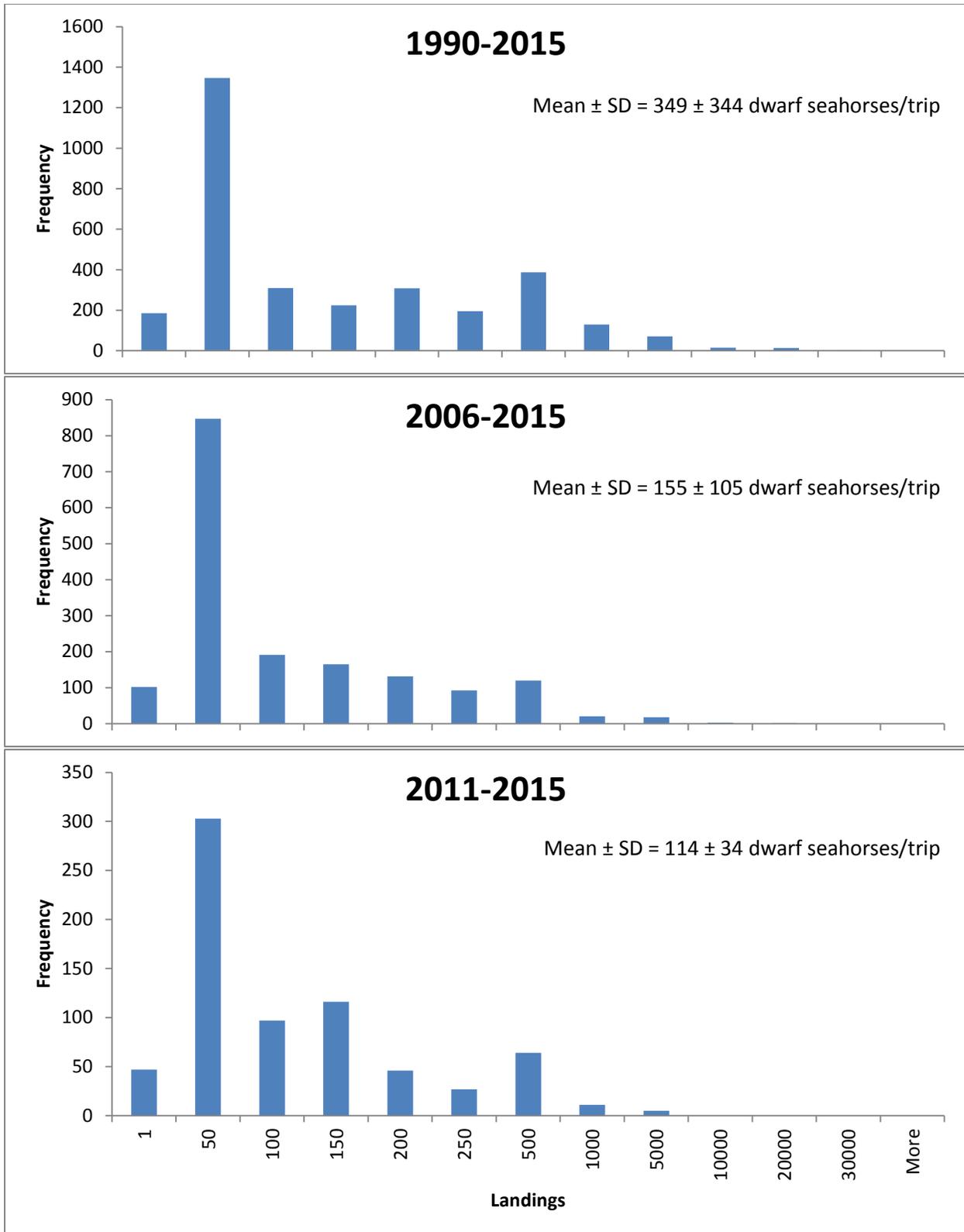


Figure 4. Histograms of dwarf seahorse commercial catch per trip, by time period.

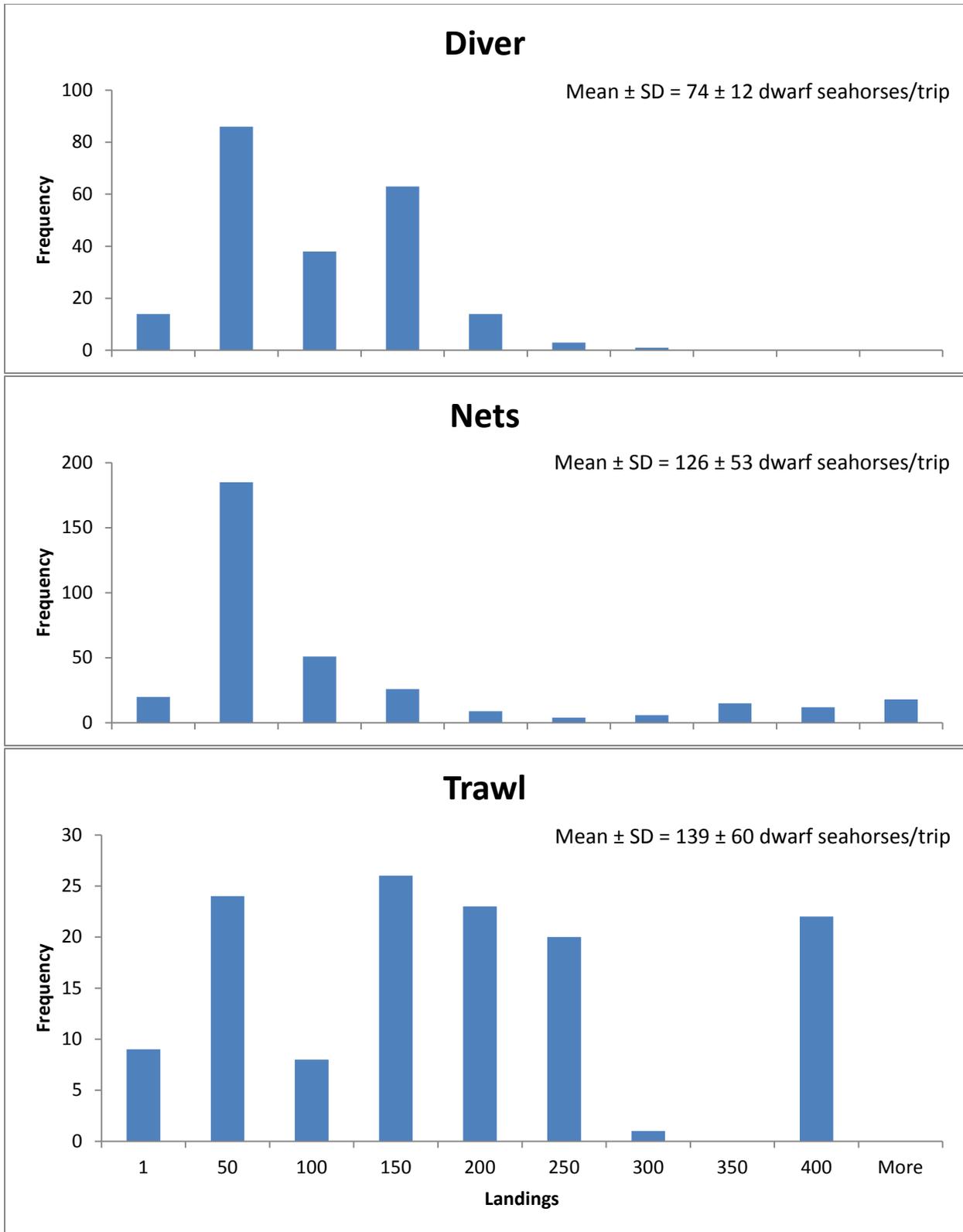


Figure 5. Histograms of dwarf seahorse commercial catch per trip, by gear, from the 2011-2015 period.

Impacts of trip limits and time-area closures are presented in Table 1. In general, trip limits had lower impacts upon diver gear than trawl and net gear (Table 1). Proposed area closures reduced harvest by an additional 3-5% (Table 1B).

Based on the mean of simulations from 2011-2014 data, at FWC's current proposed trip limit of 200 seahorses, without any time-area closures, the anticipated reduction is 18% (Table 1A). A 200 dwarf seahorse trip limit coupled with an April-June closure and area closures would reduce harvest by approximately 53% (Table 1C). A 200 dwarf seahorse trip limit coupled with a July-September closure and area closures would reduce harvest by approximately 36% (Table 1D). A 200 dwarf seahorse trip limit coupled with area closures and an April-September closed season would reduce harvest by 61% (Table 1E).

Based on the mean of simulations from 2011-2014 data, at a trip limit of 100 seahorses, without any time-area closures, the anticipated reduction is 43% (Table 1A). A 100 dwarf seahorse trip limit coupled with an April-June closure and area closures would reduce harvest by approximately 64% (Table 1C). A 100 dwarf seahorse trip limit coupled with a July-September closure and area closures would reduce harvest by approximately 55% (Table 1D). A 100 dwarf seahorse trip limit coupled with area closures and an April-September closed season would reduce harvest by 73% (Table 1E).

Based on the mean of simulations using only 2014 data, at FWC's current proposed trip limit of 200 seahorses, the overall anticipated reduction is 6%. Coupled with an April-June closure and area closures, this reduction increases to 40%. Coupled with a July-September closure and area closures, the estimated reduction is 35%. If area closures were implemented and all commercial harvest were prohibited April-Sept, the reduction is estimated at 54%.

Discussion

The dwarf seahorse fishery has dynamically changed through time. Prior to the implementation of the 2009 400-seahorse trip limit, there were many trips with extremely high landings, including a trip with 30,000 seahorses landed. It is believed that many of these sales were to the curio trade. Under the current trip limit, the fishery is more of a live specimen sales fishery for the aquaria trade. The primary gear types landing seahorses since 2010 are net, trawl, and diver gear. Table 1 shows the various gear types used to harvest dwarf seahorse, including aggregate categories. Trawl gear trips will be most heavily impacted by proposed reductions, followed by net gear trips.

Another source of uncertainty in this analysis is the spatial resolution of the available data relative to the proposed spatial closures. The closed months were rather simple to address, but the Trip Ticket data are not sufficiently resolved spatially to tell when a trip in area 6 was north of Anclote Key State Park lighthouse near Tarpon Springs on the Gulf side or when a trip in area 741 was north of the Jupiter Inlet lighthouse in Palm Beach County on the Atlantic coast. For analytical purposes, it was assumed that all trips in area 6 and north on the Gulf side and all trips in area 741 and north on the Atlantic side of Florida would be eliminated by the proposed spatial closures to dwarf seahorse harvest.

A critical question to address in any trip limit analysis is the baseline for comparison. Ideally, the baseline is the best possible representation of what would happen if no new regulations were implemented. It was assumed that the current 400-seahorse limit will be strictly abided by without new regulations being implemented. Due to the lack of a clear trend since the implementation of the 400-seahorse trip limit in 2009 and the possible influence of the BP/Deepwater Horizon oil spill upon 2010

harvest, the 2011-2014 time period was selected as a baseline to capture the range of recent trends. A sensitivity run with 2014 only was provided because 2014 was the last complete year of data available. Assuming illegal harvest is eliminated and seahorse harvest rates remain similar to those observed during the 2011-2014 time period, our analyses indicate that FWC's proposed 200-seahorse trip limit would reduce harvest by 6-18%. When coupled with the proposed area closures and an April-June closed season, this limit would reduce harvest by 40-48%. When coupled with the proposed area closures and a July-September closed season, this limit would reduce harvest by 35-36%. When coupled with the proposed area closures and an April-September closed season, this limit would reduce harvest by 54-61%.

Several additional factors should be considered when evaluating the proposed regulatory actions:

- 1) Any trip limits will need to be sufficiently enforced to prevent fishermen from exceeding daily trip limits.
- 2) Trip limits that reduce the use of trawl and net gear may reduce habitat damage or destruction (Turner et al. 2001) and impacts to marine biodiversity (Thrush & Dayton 2002).
- 3) Given the dwarf seahorse's unique monogamous (Rose et al. 2014) reproductive life cycle featuring extended courtship and paternal care (Ginsburg 1937, Breder 1940, Masonjones & Lewis 1996, Rose et al. 2014), they may be particularly vulnerable to localized depletion. Trip limits that reduce the risk of localized depletion may be desirable from a conservation perspective, as reproduction and recruitment are almost certainly density dependent.
- 4) The dwarf seahorse breeding season is from mid-February to late October/early November with a possible peak between April-September (Table 3 in Strawn 1958); thus, the current proposed partial closure of July-September would encompass at least part of this breeding season but might miss part of the protracted peak. The proposed full closure from April-September would encompass the entire breeding season. This period coincides with seasonal high water temperatures and day length, which influence dwarf seahorse reproduction and growth (Strawn 1958).
- 5) The current proposed annual commercial harvest quota of 25,000 individual dwarf seahorses is much higher than the mean annual harvest during the 2011-2014 period. If harvest in excess of the trip limit had been eliminated during this time period, mean annual harvest would have been 15,055 dwarf seahorses. Additionally, the proposed annual commercial harvest quota of 25,000 dwarf seahorses is much higher than the mean 2011-2014 harvest would have been under the proposed regulations for time-area closures and trip limits. Mean harvest with simulated area closures and an April-June closure was only 7,762 dwarf seahorses; mean harvest with simulated area closures and a July-September closure was only 9,638 dwarf seahorses. Implementation of a 25,000 individual dwarf seahorse annual commercial harvest quota would allow harvest to increase if effort increased in the future. If the intent is to reduce or maintain dwarf seahorse harvest, an annual commercial harvest quota substantially lower than 25,000 dwarf seahorses should be considered. The implementation of a restrictive annual commercial harvest quota is an important component to managing commercial harvest; without one, the harvest reductions accomplished by other means (i.e., reduced trip limit, season and area closures) may be diminished and may only shift effort temporally and spatially.

References

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Table 1A. Projected reductions in Florida commercial landings of dwarf seahorse under different conditions, assuming NO closed season (July-Sept) and NO harvest closures from ~Anclote Key Lighthouse (~Tarpon Springs) north on the west coast and north of Jupiter Lighthouse (~Palm Beach County) on the east coast. This projection excludes illegal harvest from the baseline 2011-2014 period, assuming improved enforcement.

Mean 2011-2014		Trip Limit (Number of Seahorses)					Percent Reduction under Trip Limit				
Gear	Base@400	50	100	150	200	250	50	100	150	200	250
DIVER	3,694	1,779	2,963	3,556	3,657	3,692	52%	20%	4%	1%	0%
NET	5,421	1,989	3,029	3,698	4,168	4,572	63%	44%	32%	23%	16%
TRAWL	5,445	1,263	2,461	3,482	4,212	4,618	77%	55%	36%	23%	15%
ALL	15,055	5,138	8,637	10,984	12,348	13,255	66%	43%	27%	18%	12%

Table 1B. Projected reductions in Florida commercial landings of dwarf seahorse under different conditions, assuming NO closed season, but commercial harvest closures from ~Anclote Key Lighthouse (~Tarpon Springs) north on the west coast and north of Jupiter Lighthouse (~Palm Beach County) on the east coast. This projection excludes illegal harvest from the baseline 2011-2014 period, assuming improved enforcement.

Mean 2011-2014		Trip Limit (Number of Seahorses)					Percent Reduction under Trip Limit				
Gear	Base@400	50	100	150	200	250	50	100	150	200	250
DIVER	3,694	1,649	2,730	3,290	3,390	3,425	55%	26%	11%	8%	7%
NET	5,421	1,919	2,921	3,567	4,025	4,429	65%	46%	34%	26%	18%
TRAWL	5,445	1,150	2,236	3,162	3,832	4,213	79%	59%	42%	30%	23%
ALL	15,055	4,825	8,070	10,268	11,558	12,441	68%	46%	32%	23%	17%

Table 1C. Projected reductions in Florida commercial landings of dwarf seahorse under different conditions, assuming partial closed season (April-June) and harvest closures from ~Anclote Key Lighthouse (~Tarpon Springs) north on the west coast and north of Jupiter Lighthouse (~Palm Beach County) on the east coast. This projection excludes illegal harvest from the baseline 2011-2014 period, assuming improved enforcement.

Mean 2011-2014		Trip Limit (Number of Seahorses)					Percent Reduction under Trip Limit				
Gear	Base@400	50	100	150	200	250	50	100	150	200	250
DIVER	3,694	1,242	2,068	2,500	2,598	2,633	66%	44%	32%	30%	29%
NET	5,421	1,103	1,665	2,061	2,386	2,682	80%	69%	62%	56%	51%
TRAWL	5,445	773	1,523	2,159	2,578	2,784	86%	72%	60%	53%	49%
ALL	15,055	3,189	5,378	6,882	7,762	8,336	79%	64%	54%	48%	45%

Table 1D. Projected reductions in Florida commercial landings of dwarf seahorse under different conditions, assuming partial closed season (July-Sept) and harvest closures from ~Anclote Key Lighthouse (~Tarpon Springs) north on the west coast and north of Jupiter Lighthouse (~Palm Beach County) on the east coast. This projection excludes illegal harvest from the baseline 2011-2014 period, assuming improved enforcement.

Mean 2011-2014		Trip Limit (Number of Seahorses)					Percent Reduction under Trip Limit				
Gear	Base@400	50	100	150	200	250	50	100	150	200	250
DIVER	3,694	1,387	2,270	2,708	2,795	2,830	62%	39%	27%	24%	23%
NET	5,421	1,559	2,361	2,866	3,222	3,539	71%	56%	47%	41%	35%
TRAWL	5,445	1,019	1,980	2,782	3,360	3,714	81%	64%	49%	38%	32%
ALL	15,055	4,061	6,768	8,566	9,638	10,393	73%	55%	43%	36%	31%

Table 1E. Projected reductions in Florida commercial landings of dwarf seahorse under different conditions, assuming full closed season (April-Sept) and harvest closures from ~Anclote Key Lighthouse (~Tarpon Springs) north on the west coast and north of Jupiter Lighthouse (~Palm Beach County) on the east coast. This projection excludes illegal harvest from the baseline 2011-2014 period, assuming improved enforcement.

Mean 2011-2014		Trip Limit (Number of Seahorses)					Percent Reduction under Trip Limit				
Gear	Base@400	50	100	150	200	250	50	100	150	200	250
DIVER	3,694	980	1,607	1,918	2,002	2,037	73%	56%	48%	46%	45%
NET	5,421	743	1,105	1,360	1,583	1,792	86%	80%	75%	71%	67%
TRAWL	5,445	643	1,268	1,778	2,107	2,285	88%	77%	67%	61%	58%
ALL	15,055	2,425	4,076	5,181	5,841	6,289	84%	73%	66%	61%	58%

SOURCE: FWC Trip Ticket Data (Nov 2015); mean of 2011-2014.

Gear aggregations used to protect confidentiality:

Gear	Includes
Diver	SCUBA; snorkel; hook & line, snorkel
Net	hand net; hand gear; cast net, hand net; shrimp dip net; cast net; trawl, diving (hand net); cast net, diving (snorkel)
Trawl	trawl, roller frame; trawl; trawl, SCUBA; trawl, diving (snorkel); trawl, roller; trawl, single
All	all of the above, as well as other tropicals; chemical, other; beach/haul seine; quinaldine; traps; stone crab traps; traps, trawl; lobster traps; dredge; traps, SCUBA; rod & reel; rake/shovel/pitchfork; and unidentified gear