Effect of Regulations on Harvest in Florida's Spiny Lobster Fishery

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The State of Florida implemented two regulations to reduce the mortality of lobsters used as live attractants in lobster traps. First, beginning in the 1987-88 fishing season, sublegal-sized lobsters retained aboard commercial fishing vessels were required to be in live wells. Secondly, the Lobster Trap Certificate Program was implemented beginning with the 1993 - 1994 fishing season, and the number of traps in the fishery declined from a peak of approximately 939,000 in 1991-92 to approximately 533,000 in 1998/99. Prior to implementation of these two regulations, from 1977 - 1978 to 1986 - 1987, an average of 2,717 metric tons were landed each fishing season. Between the time that live wells were introduced in 1987-88 until 1992-93, landings increased to an average of 2,871 metric tons each fishing season. Between the 1993-94 fishing season, the implementation of the Lobster Trap Certificate Program, and the 1998 - 1999 fishing season, average landings increased to 3,048 metric tons each fishing season. Although these increases in landings is not significant, current landings approach Lyons and Hunt's (1992) estimate of the potential gain to the fishery expected from live well usage. The Lobster Trap Certificate Program has not yet reduced the number of traps below the level first identified as detrimental to the lobster population, and the fishery's impact on lobsters used as attractants remains high.

KEY WORDS: *Panulirus argus*, spiny lobster, Lobster Trap Certificate Program, live wells

INTRODUCTION

The spiny lobster fishery is consistently one of Florida's most valuable fisheries. The high commercial value of lobsters promotes intense competition among fishers resulting in a heavily capitalized fishery (Lyons 1986, Hunt 1994) that is dependent upon wooden-slat traps for more than 90% of the commercial landings (Hunt et al. 1999). Despite this overcapitalization, spiny lobster landings remain cyclically stable (Hunt et al. 1999). The stability of the landings is hypothesized to result from a combination of natural factors, including sustained larval recruitment (Lyons 1981, Butler and Herrnkind 1992;

Acosta et al., 1997) and expansive lobster nursery areas (Lyons et al. 1981, Davis and Dodrill 1989).

In 1977, the State of Florida legalized the possession of sublegal-sized lobsters onboard commercial fishing vessels for use as live attractants in lobster traps. Traps baited with attractants catch on average three times as many lobsters as non-lobster-baited traps (Heatwole et al. 1988). However, this practice also resulted in increased mortality rates of attractants because they were subjected to extended periods of exposure to the air during transport (Kennedy 1982, Hunt et al. 1986, Hunt and Lyons 1986, Vermeer 1987). Additional mortality and reductions in growth occurred due to handling and confinement of lobsters in traps (Kennedy 1982, Hunt and Lyons 1986, Hunt et al. 1986). Attractants may be confined in traps for extended periods of time based on observations that less than 2% of lobsters escape from traps each day (Yang and Obert 1978, Davis and Dodrill 1980, Lyons and Kennedy 1981). Some researchers have hypothesized that "within the Florida Bay nursery area, ...fishery-induced damage to sublegal lobsters probably exceeded legal catch" in the 1970s (Lyons et al. 1981) and that the potential landings from this area should be 103% greater than realized landings (Austin et al. 1980).

In response to the overcapitalization of the fishery and the fishery-related mortality of attractants, two regulations were implemented in the lobster fishery. These regulations were implemented during the modern fishery era, when the stock was considered fully exploited and no additional changes occurred in the fishery (Labisky et al. 1980, Simmons 1980, Moe 1991, Hunt 1994, Muller et al. 1997). In 1987, live wells were required in order to legally transport sublegal-sized lobsters onboard fishing vessels. In 1993, the Lobster Trap Certificate Program (LTC) was implemented. Here in we report on the relationship between these two regulations and subsequent fishery yield.

LIVE WELL USE

Retention of sublegal-sized lobsters in live wells was mandated in 1987 to mitigate the exposure-related mortality of lobsters while they are retained aboard commercial fishing vessels (Florida Administrative Code, 1999). Live-well use is well accepted by most fishermen and many live wells currently include an aeration system in addition to providing the minimum water-flow levels required by law. Mandated live-well usage was followed by a 5.7% increase in commercial landings - from an average 2,717 ± 405 (SD) metric tons landed each season during the pre-live well period of 1977 - 1978 to 1986 - 1987, to an average 2,871 ± 423 (SD) metric tons landed each season from 1987 - 1988 to 1992 - 1993, after live wells were required (Figure 1). Despite the trend towards increased landings, these differences are statistically insignificant because of the small number of observations (ANOVA, $\alpha = 0.486$).

Lyons and Hunt (1992) estimated that landings could increase by 17.5% if live wells were used effectively and if the practice of using sublegal-sized lobsters for bait did not change. Although the effects are unmeasured, we would expect that the addition of several hundred thousand traps to the fishery after the implementation of live wells almost certainly resulted in more sublegal-sized lobsters being confined in traps and may have obscured the benefits of live wells. During the ten years prior to the implementation of live wells, 1977 - 1978 to 1986 - 1987, the average number of traps fished each season was 576,000. During the period 1987-88 to 1992-93 after the introduction of live wells, the average number of traps fished each season was 854,000. However, the average number of traps fished during recent seasons, 605,000 traps from 1993 - 1994 to 1998 - 1999, is similar to that fished during the pre-live well period, 576,000 (Figure 2), making a comparison of landings from the pre- and selected post-live well fishing seasons possible. Average landings per fishing season from 1993 - 1994 to 1998 - 1999 were 3,048 ± 489 (SD) metric tons per season, which is 12.2% above the 2,717 ± 405 (SD) metric tons average during the pre-live-well period (Figure 1). Landings for these periods are statistically similar (ANOVA, $\alpha = 0.168$), but do approach Lyons and Hunt's (1992) prediction of a 17.5% increase in yield for the fishery.

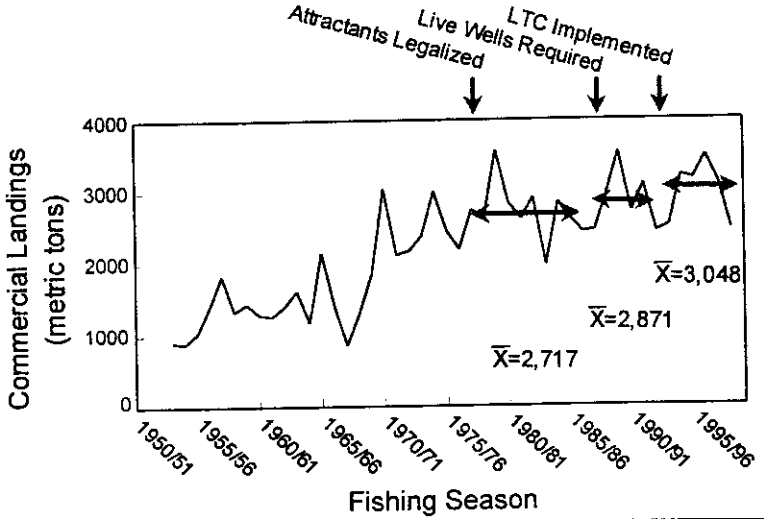

Figure 1. Commercial landings of spiny lobster from Florida. Average landings are reported for fishing seasons with comparable regulations: a) possession of sublegal-sized lobster legalized, 1977/1978 through 1986/1987, b) live wells required, 1987/1988 through 1992/1993, and c) the Lobster Trap Certificate Program Implemented, 1993/1994 through 1998/1999.

FISHING EFFORT AND THE LOBSTER TRAP CERTIFICATE PROGRAM

The number of traps used in the fishery has varied considerably during the modern fishing era (Figure 2). In the mid-1970s, the Bahamian government closed its waters to foreign fishermen, and many of these fishermen moved their fishing operations to Florida. This increased the number of traps in Florida by approximately 300,000 during the next three years. A second rapid increase in the number of traps began in 1987, resulting in an estimated 939,000 traps by 1991, the peak number of traps in the fishery (Harper 1995). This second increase was not prompted by any single event but was more likely the realization of Hardin's (1968) "Tragedy of the Commons" whereby individual fishermen tried to increase or at least maintain their historic levels of harvest by using more traps to mitigate the decline in trap efficiency, which ultimately contributed to that very decline. The estimated number of traps in the fishery was reduced to 704,000 in August 1993, with the implementation and first 10% trap reduction prescribed by the Lobster Trap Certificate Program (LTC). The LTC also includes a mechanism to reduce the number of traps used in the fishery by up to 10% annually to the lowest number that will maintain or increase overall catch levels, promote economic efficiency in the fishery, and conserve natural resources (Florida Administrative Code 1999). The Florida Fish and Wildlife Conservation Commission (FWC, formerly the Florida Marine Fisheries Commission) reviews the implementation of trap reductions annually. Four 10% reductions have occurred reducing the number of traps to 533,000 for the 1998 - 1999 fishing season (Figure 2).

Since the State of Florida implemented the LTC in 1993, fishery landings have remained statistically unchanged (ANOVA, $\alpha = 0.522$) from those during the 6-year period after the introduction of live wells, but there is a slight trend towards increased landings (Figure 1). Average seasonal landings from 1993-94 to 1998-99 were 3,048 ± 489 (SD) metric tons per season which were 6.2% above the 2,871 ± 423 (SD) metric ton seasonal average for the 6 years preceding the LTC.

Significant increases in landings following implementation of the LTC were not observed, but this may be because the overall number of attractants utilized by the fishery did not change between the 1993-94 and 1998-99 fishing seasons ($r = 0.522$; $\alpha = 0.230$; $n = 7$). Although the average number of traps declined by 29% (Figure 2), the number of attractants/trap increased by 39% during this period, a significant correlation ($r = 0.804$; $\alpha = 0.029$; $n = 7$) (Figure 3). Observations of the number of sublegal-sized lobsters in traps are available from the fishery only since the onset of the LTC, when the number of traps declined from 704,000 to 533,000. The relationship between the number of traps in the fishery and the number of attractants for greater than 704,000 or fewer than 533,000 traps remains unknown. Continued monitoring of the

number of attractants per trap should help clarify the relationship between increases in the lobster population attributed to reductions in attractant mortality and increases in trap efficiency attributed to increased number of attractants.

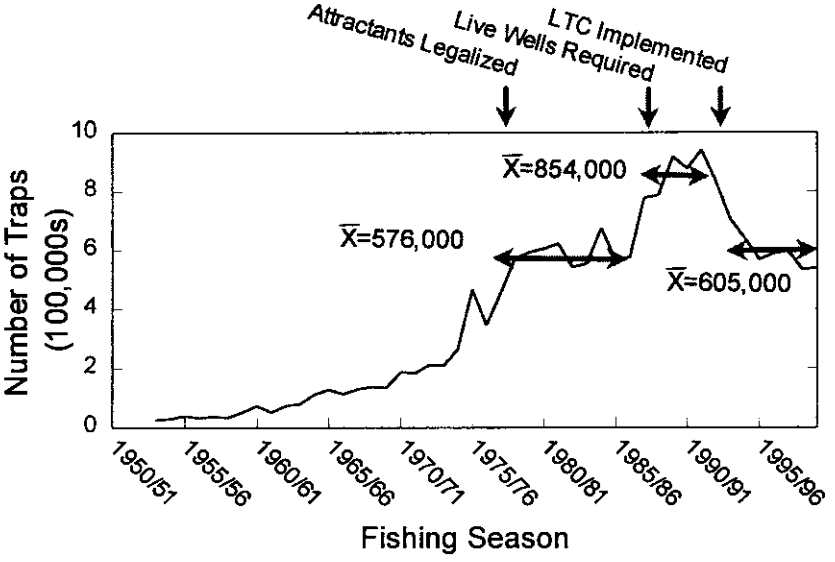

Figure 2. Number of spiny lobster traps in Florida.. Average numbers of traps are reported for fishing seasons with comparable regulations: a) possession of sublegal-sized lobster legalized, 1977/1978 through 1986/1987, b) live wells required, 1987/1988 through 1992/1993, and c) the Lobster Trap Certificate Program implemented, 1993/1994 through 1998/1999. Estimates of the number of traps prior 1993/1994 are provided by the National Marine Fisheries Service General Canvas database, subsequent estimates are the number of active lobster trap tags.

DISCUSSION

The Florida spiny lobster fishery is currently hampered with the same problems that were identified in the early 1980s: 'To increase legal catches, injury and death to juvenile [sublegal-sized lobster] stocks must be curtailed' (Lyons and Kennedy 1981). Recent regulations addressing fishery-induced effects on attractants, live wells, and trap reductions have cumulatively resulted in 331

additional metric tons of lobster being harvested each season. But recent trap reductions have only reversed the effects of increased numbers of traps since 1987 and the number of traps remains similar to the number that initially raised concerns over the fishery's impact on sublegal-sized lobsters and overcapitalization. The only practical difference between today's fishery and that of the 1980s is that live wells have reduced the mortality associated with transporting sublegal-sized lobsters. However, the critical difference between today's fishery and the 1980s is the potential for the LTC to reduce the number of traps further which will likely result in reductions in:

i) confinement-induced mortality of sublegal-sized lobsters,
ii) the cost of building additional traps, and
iii) the environmental impact of traps.

The overall reduction in confinement-induced mortality of sublegal-sized lobsters is dependent upon reducing the number of attractants used as live bait. Current observations suggest that recent reductions in the number of traps have not reduced the number of attractants confined, because the number of attractants per trap is increasing. This number of attractants per trap may peak at some point as the number of traps is reduced, but additional observations will be required to understand this relationship when fewer traps are in the fishery.

The most effective method of reducing impacts to sublegal-sized lobsters would be to minimize contact with them. Escape gaps, depending on gap size, could reduce or virtually eliminate damage to sublegal stock (Lyons and Hunt 1992) and measurably increase yield from the commercial fishery (Powers and Sutherland 1989). Increased self-baiting of traps, which may be partially inferred by the increased number of sublegal-sized lobsters per trap with fewer traps in the fishery (Figure 3), may alleviate any decline in trap efficiency associated with escape gaps (Ehrhardt et al. 1991). The importance of actively transporting sublegal-sized lobsters for use as live bait may diminish if the natural abundance of these lobsters in traps continues to increase as the number of traps in the fishery decreases.

The Lobster Trap Certificate Program has not yet reduced the number of traps below the level first identified as detrimental to the lobster population, and the fishery's impact on lobsters used as attractants remains high. Further protection of sublegal-sized lobsters used as live bait in traps may result in greater future harvest levels.

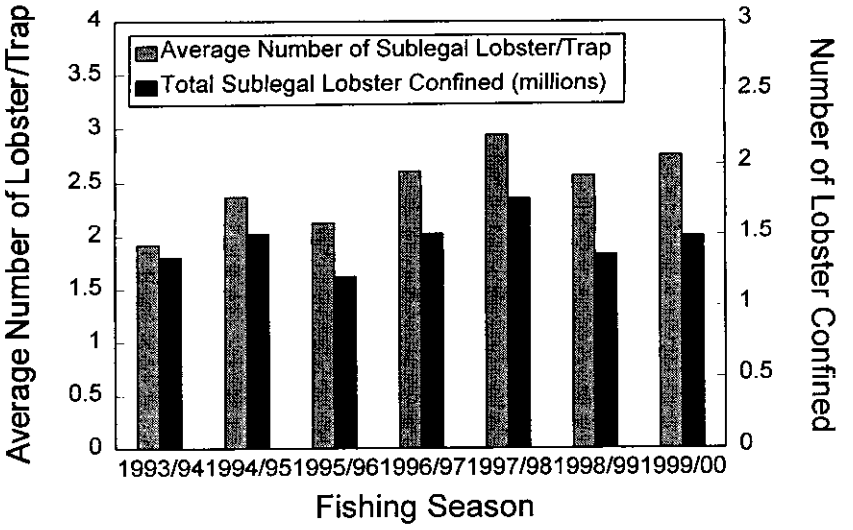

Figure 3. The average number of sublegal-sized lobsters (60 to 76.1 mm carapace length) per trap and the total number of sublegal-sized lobster confined at any point in time. A total of 191,377 lobsters were observed.

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