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DIVISION OF FISH AND WILDLIFE

MARINE FISHERIES

Division of Fish and Wildlife rules;

Horseshoe Crabs

Proposed Amendment: N.J.A.C. 7:25-18.16

Authorized By: Lisa P. Jackson, Commissioner, Department of Environmental Protection

Authority: N.J.S.A. 23:2B-6, 23:2B-14, 13:1B-3, 13:1D-9, 23:2A-1 et seq., and 23:2B-1 et seq.

Calendar Reference: See Summary below for explanation of exception to calendar requirement.

DEP Docket Number: 25-07-10/664

Proposal Number: PRN 2007-___

Submit written comments by February 1, 2008 to:

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Attn: DEP Docket Number: 25-07-10/664
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The Department of Environmental Protection (Department) requests that commenters submit comments on disk or CDs as well as on paper. Submission of a disk or a CD is not a requirement. The Department prefers Microsoft Word 6.0 or above. MacIntosh formats should not be used. Each comment should be identified by the applicable N.J.A.C. citation, with the commenter's name and affiliation following the comment.

The agency proposal follows:

Summary

As the Department has provided a 60-day comment period on this notice of proposal, this notice is excepted from the rulemaking calendar requirement pursuant to N.J.A.C. 1:30-3.3(a)5.

The Division of Fish and Wildlife (Division) is proposing an amendment to N.J.A.C. 7:25-18.16 in order to continue the moratorium on the horseshoe crab commercial bait fishery. A moratorium was previously implemented on the horseshoe crab commercial bait fishery, effective May 15, 2006 at 38 N.J.R. 2139(a) for the calendar years 2006 and 2007 with the provision that the adopted amendment would be effective from May 15, 2006 to December 31, 2007. The purpose of the two-year moratorium on the harvesting of horseshoe crabs was to improve conditions immediately for the red knot (*Calidris canutus rufa*), as well as other migratory shorebirds whose survival depends upon an abundant supply of horseshoe crab eggs in Delaware Bay. Recent analysis of the affect of the two-year moratorium of crab harvest has shown conditions have not yet improved for the red knot and other migrant shorebirds whose survival depends upon an abundant supply of horseshoe crab eggs. However, given a decade of intensive harvest focused exclusively on large, breeding-age crabs, two years is not long enough to assess the success of a moratorium on recruitment of new crabs into the population. It is, therefore, necessary to continue a moratorium until crab egg densities and shorebird abundances

begin to respond to the increase in the number of younger-aged crabs coming into the breeding population.

The interstate management of the horseshoe crab resource is accomplished through the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC was formed by the 15 Atlantic coastal states in 1942 for the promotion and protection of coastal fishery resources. The ASMFC serves as a deliberative body of the Atlantic coastal states, coordinating the conservation and management of near shore fishery resources. In 1998, the ASMFC adopted the Interstate Fishery Management Plan for Horseshoe Crab (Plan) to conserve and protect the horseshoe crab resource to ensure its role in the ecology of coastal ecosystems. The goal of the Plan includes management of horseshoe crab populations for their continued use by current and future generations of the fishing and non-fishing public, migratory shorebirds, and other dependent wildlife, including Federally listed sea turtles. The Plan recognizes that the commercial horseshoe crab fishery competes with fish and wildlife resource needs, particularly shorebirds and sea turtles. The plan further recognizes that identifying and maintaining optimal sustainable yield may not be adequate to meet the needs of both fish and wildlife resources and the commercial fishery. Since shorebirds primarily feed on horseshoe crab eggs exposed on the beach surfaces, adequate horseshoe crab spawning densities must be maintained to ensure availability of horseshoe crab eggs for shorebirds during their spring migration (May through mid-June). Since the Plan recognizes the horseshoe crab as an important component of the ecosystem, objectives within the Plan require maintaining sufficient horseshoe crab spawning biomass to sustain the horseshoe crab resource as well as adequate spawning stocks to supply the needs of migratory shorebirds.

The Plan has recognized from its development and implementation that the Delaware Bay population of horseshoe crabs is by far the largest population of horseshoe crabs on the Atlantic coast and serves a critical ecological role in the Delaware Bay because, among other things, it is a source of food for migratory shorebirds each spring. Because of the horseshoe crab's critical ecological role in the Delaware Bay, the 1998 Plan

and three addenda implemented in following years have always placed more restrictive management measures on states where harvesting would negatively impact the Delaware Bay population of horseshoe crabs. Consequently, New Jersey, Delaware, and Maryland have always had the most restrictive horseshoe crab management measures of all Atlantic coastal states, including more severe quota reductions, a springtime seasonal closure during the migratory bird feeding stopover, and many more resource monitoring requirements to assess the biological condition of the horseshoe crab resource.

The ASMFC also recognized that, due to the unique ecological role the horseshoe crab serves for other dependent fish and wildlife resources, a Shorebird Technical Committee needed to be formed to advise the ASMFC Horseshoe Crab Management Board (Board) on how existing horseshoe crab management measures were meeting the needs of the shorebirds. While the ASMFC relies upon its own Horseshoe Crab Technical Committee and Horseshoe Crab Stock Assessment Subcommittee to advise the Board on the biological condition of the horseshoe crab resource in sustaining the horseshoe crab itself, neither of these committees could advise the Board on horseshoe crab egg production in meeting the needs of the migratory shorebirds. Hence, the United States Fish and Wildlife Service formed a Shorebird Technical Committee comprised of worldwide shorebird experts to advise the ASMFC Board on the ability of existing horseshoe crab spawning biomass to meet the needs of feeding migratory shorebirds.

The Shorebird Technical Committee has met for several years and completed many studies to assess horseshoe crab egg availability on Delaware Bay beaches in meeting the needs of migratory shorebirds. In May 2004, as reported in Addendum III to the Plan, the Shorebird Technical Committee reported to the Board that a lesser proportion of red knots was achieving minimal departure weights, which suggests that food resources in Delaware Bay may not be adequate. A departure weight of 180 grams is the minimum weight necessary to cover the energetic cost of migration to Arctic breeding grounds and survive an initial period (<1 to 2 weeks) of snow cover after which insect food starts to become available. In November 2005, the Shorebird Technical Committee reported to the Board

that the red knot, one of many shorebird species that feed upon horseshoe crab eggs, is at low population levels. Red knots have shown no sign of recovery over the years despite a four-fold reduction in horseshoe crab landings since 1998. The Shorebird Technical Committee concluded a moratorium of horseshoe crab harvest could provide more horseshoe crab eggs for the birds to feed upon.

Consequently, at its November 1, 2005 meeting, the ASMFC's Horseshoe Crab Management Board authorized the development of an addendum to the Interstate Fishery Management Plan for Horseshoe Crab to reduce or eliminate harvest of the Delaware Bay population of horseshoe crabs. Addendum IV was adopted in May 2006 to prohibit directed harvest and landing of all horseshoe crabs in New Jersey and Delaware from January 1 through June 7, and female horseshoe crabs in New Jersey and Delaware from June 8 through December 31. New Jersey and Delaware harvest quotas were reduced to 100,000 male horseshoe crabs per state per year. These provisions would be in place for two years from October 1, 2006 through September 30, 2008. States required to comply with the minimum requirements of an ASMFC Plan or Addenda under the threat of a Federally imposed moratorium, may implement more restrictive management measures if that state determines that the minimum requirements of the Plan or Addenda are not adequate in meeting the individual state's regional resource management requirements.

New Jersey implemented a complete moratorium on the horseshoe crab commercial bait fishery even before the adoption of Addendum IV because the Department recognized that horseshoe crab egg production had not been sufficient to allow migratory shorebirds to achieve their minimal departure weights.

While Addendum IV would allow both New Jersey and Delaware to maintain an annual harvest quota of no more than 100,000 male horseshoe crabs, the Department proposes to continue the moratorium on the commercial horseshoe crab bait fishery. The allowance of a 100,000 male horseshoe crab harvest is predicated on two assumptions: 1) only one male crab attached to a spawning female is required to fertilize eggs, and 2) harvest of "satellite" males during spawning, and harvest of males offshore, is not expected

to impact the breeding population size or structure (e.g., sex ratio) Satellite males are breeding males that do not attached to a female but come ashore, surround a spawning pair, and compete for a favorable position from which to release sperm (and fertilize eggs) as the female is laying eggs. Although information on horseshoe crab reproduction is not completely understood, there is adequate information with which to make a reasonable biological assessment of potential impacts caused by removal of males (satellite or other) from the breeding population. First, the male-biased sex ratio observed during spawning (~ 4 - 8 males per female) is not a true reflection of the population sex ratio observed during nonbreeding, thus the assumption that there are "surplus" males in the breeding population is not likely to be valid. The observation of more spawning males than females is explained by a greater proportion of males gathering along shore, and remaining there through several tidal cycles, to come ashore with females ready to spawn. Once eggs are laid, typically during one tidal cycle, females move offshore, thus there are fewer females present. New Jersey and Delaware trawl surveys, performed during the nonbreeding season, show a population sex ratio which hovers around 1 male to 1 female[1,2].With an even sex ratio, it is unlikely that a surplus of males exists in the population and, further, this suggests that increased harvest of males would have a negative impact on the breeding population. Second, satellite males fertilize a significant proportion of an individual female's eggs and make a significant contribution to the breeding population both in terms of the quantity of eggs fertilized and genetic variability. When one satellite male is present during spawning, the satellite fathers on average 40 percent of the offspring and the attached male fathers 51 percent; paternity of the remainder were unresolved. When two to four satellites males are present, they father an average of 75 percent of the offspring[3]. In

[1] Himchak, P., Pers Comm., October 2, 2007, NJ Division of Fish and Wildlife, Bureau of Marine Fisheries.
[2] Michels, S., Pers Comm. October 16, 2007, DE Division of Fish and Wildlife, Fisheries Section.
[3] Brockmann, H. T., C. Nguyen, and W. Potts. 2000. Paternity in horseshoe crabs when spawning in multiple-male groups. Anim. Behav. 60:837-849.

other species with external fertilization, where paternity has been studied (fish), the success rate of satellite males was much lower, 5 to 17 percent. This clearly indicates that satellite males, especially those that successfully compete for the best positions proximate to a spawning female, make a significant contribution to the breeding population. Moreover, increased genetic variability is adaptive in a population because it confers advantage to some proportion of individuals that allows them to survive novel environmental conditions, diseases and random (stochastic) events, and pass on their genes to the next generation.[4] It is well-known that reduced genetic variability can lead to deleterious genetic mutation in a population causing reduced survival, greater vulnerability to stochastic environmental events (e.g., such those predicted to accompany global warming) or, in the worst case, can cause direct mortality.

Finally, in states where harvest of males is allowed, males are taken both by hand-harvest during breeding season (all of these males are mature) and during non-breeding season (including both mature and immature males). It is unclear what proportion of males are removed from breeding and pre-breeding age classes and how this could affect the sex ratio and size of the breeding population over time.

Based on the preponderance of current biological knowledge: 1) there does not appear to be a large surplus of males in the breeding population, 2) a male-only harvest could decrease the ratio of males in the population to a level lower than necessary to support a stable or increasing crab population, and 3) satellite males fertilize a large proportion of eggs and make a large genetic contribution to the breeding population. It is, therefore, reasonable to expect that the harvest of male horseshoe crabs (satellites and other age classes) will have an impact on the breeding population. To stabilize and recover migratory shorebird populations, particularly the red knot population, it is estimated that a minimum of 50,000 horseshoe crab eggs per square meter, in the top 5 cm

[4] Pianka, E. R. Rules of Inheritance for Life on Earth, Pgs. 121-130, in: E. R. Pianka. Evolutionary Ecology, 5th Ed., Harper Collins College Publishers, New York, NY, 1994.

of the beach surface, are necessary. The existing breeding crab population that spawns in New Jersey now produces only approximately 2,000 eggs per square meter. Without an immediate and substantial increase in egg densities on Delaware Bay beaches, red knot and other shorebird populations will continue to decline. For these reasons, the Department believes that a more conservative, risk averse management policy that will provide the best chance of immediate increase in horseshoe crab numbers and overall egg production is necessary to reduce the risk of extinction of the red knot population and assure the needs of all migratory shorebirds are met.

In August 2006, Department biologists completed and submitted a status assessment for the red knot[5]. This assessment of the current status of the red knot population in the Western Hemisphere was commissioned by the US Fish and Wildlife Service and consisted of all extant published research and unpublished information for red knots in the Hemisphere. In October 2006, the US Fish and Wildlife Service announced that the red knot was designated a candidate for federal listing but precluded listing for lack of resources. The findings in the status assessment were the basis upon which USFWS designated the red knot as a candidate for federal listing. In April 2007, the red knot was recommended for Endangered Status by Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

The number of horseshoe crab eggs available to red knots and all migrating shorebirds has declined to a level that is insufficient to support this migration of birds. Evidence for this is found in the condition of shorebirds prior to leaving Delaware Bay to continue their migration, and in the recent population trends of these bird populations.

[5] Niles, L. J., H. P. Sitters, A. D. Dey, P. W. Atkinson, A. J. Baker, K. A. Bennett, K. E. Clark, N. A. Clark, C. Espoz, P. M. Gonzalez, B. A. Harrington, D. E. Hernandez, K. S. Kalasz, R. Matus N., C. D. T. Minton, R. I. G. Morrison, M. K. Peck, I. L. Serrano. 2007. Status of the Red Knot (*Calidris canutus rufa*) in the Western Hemisphere. Prepared for U.S. Fish and Wildlife Service, Ecological Services, Region 5, New Jersey Field Office, 927 North Main Street, Pleasantville, New Jersey 08232. 287 Pgs.

The red knot population in Delaware Bay declined from counts exceeding 95,000 in the 1980's (as late as 1989) to 15,345 in 2005, and further to 12,375 in 2007. In the face of this drastic decline in the threatened red knot, the Department reduced the quota and harvest season of horseshoe crabs in 2003-2005 and initiated a two-year moratorium on harvest in 2006-2007. However, there has been continued decline of the red knot population, and no improvement in their condition in Delaware Bay, indicating that the harvest reductions and subsequent moratorium were inadequate.

The red knot population that passes through Delaware Bay winters in Patagonia, South America. The South American wintering population has also declined, from 67,500 in 1985 to 17,653 in 2005, a 74 percent drop. As of 2007, the wintering population size has not increased and remains low at 17,360 individuals. In 1985, the red knot wintering range extended approximately 800 miles northward from the island of Tierra del Fuego along the Argentinian coast as far as Río Negro province[6]. In 1985, 80 percent of the red knot wintering population (53,232 individuals) was located on Tierra del Fuego. The remaining 20 percent (15,314) wintered in smaller groups spreading northward along the coast of Argentina. Recent surveys have shown that red knot range has contracted so that nearly the entire population (97 percent in 2004) is now confined to Tierra del Fuego. In addition to range contraction, the wintering population on Tierra del Feugo, which was stable during the period 1985 (53,232) to 2000 (51,255), suffered a 43 percent decline in 2001 (29,335 individuals), another 42 percent decline in 2005 (17,653 individuals) and remains low in 2007 (17,630). These declines occurred on the heels of the peak harvests of horseshoe crabs in the mid- to late-1990's

Demographic studies[7] show that the reason the Tierra del Fuego population fell by almost 50 percent between 2000 and 2002[8] was because annual adult survival -- the

[6] Morrison, R.I.G., R.W. Butler, F.S. Delgado, and R.K. Ross. 1998. *Atlas of Nearctic shorebirds and other waterbirds on the coast of Panama*. Canadian Wildlife Service Special Publication. Environment Canada. 112 pp.

[7] Baker, A. J., P. M. González, T. Piersma, L. J. Niles, I. L. S. do Nascimento, P. W. Atkinson, N. A. Clark, C. D. T. Minton, M. K. Peck, and G. Aarts. 2004. Rapid

likelihood of surviving to the following year -- declined from 85 percent to an average of only 56 percent during 1999-2001. There are predictable trends in the population that could be expected if adult survival either recovered to 85 percent or remained at 56 percent. If the adult survival rate returned to 85 percent, the population would remain fairly constant at the year 2000 level. If, however, the adult survival rate remained at 56 percent, the population would approach extinction as early as the year 2010. Subsequent counts in 2003-2005 showed that although population size remained steady in 2003-2004, the sudden drop to only 17,653 in 2005 substantiated the lower survival rate and an increased risk of extinction, possibly by 2010. Tierra del Fuego counts in 2006 (17,211) and 2007 (17,360) remain low and closely track the predicted extinction curve[8]. At this lower population size and current survival rate estimate, the continued existence of the red knot is in jeopardy.

Conditions in other parts of the red knot's range have not changed significantly, and other shorebird populations within the same range using the same habitat, but not dependent on horseshoe crab eggs, have remained steady or increased in the period red knots have declined. Concurrently, the red knot's food resource of horseshoe crab eggs in Delaware Bay has declined significantly, from a high of 50,000 eggs per square meter in the early 1990's to 4,181 eggs per square meter in 2000. By 2007, horseshoe crab egg densities reached the lowest ever recorded, 2,060 eggs per square meter. Demographic studies[8] have shown that red knots need to reach at least 180 grams to successfully complete migration, survive < 1 to 2 weeks until snow melt, and commence breeding. The decline in horseshoe crab eggs has resulted in fewer red knots leaving Delaware Bay in adequate body condition to complete the migration to Arctic nesting grounds and carry out successful nesting. Between 1997 and 2001, the proportion of red knots that reached 180

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population decline in red knot: fitness consequences of decreased refueling rates and late arrival in Delaware Bay. Proceedings of the Royal Society B 25:125-129.

[8] Morrison, R. I. G., R. K. Ross, and L. J. Niles. 2004. Declines in wintering populations of red knots in southern South America. Condor 106: 60-70.

grams averaged 49 percent, translating to 21,758 red knots based on the total number of red knots in the Bay. Between 2002 and 2007, only 27 percent of red knots reached 180 grams, that is 4,585 red knots based on the Baywide population. Consequently, there was a decline in both adult survivorship and productivity, leading to a severe and abrupt population decline. Without action to improve survival and productivity of the red knot population, this species faces the possibility of extinction within this decade. The proposed amendment is the single most important action for increasing the number of horseshoe crab eggs available to red knots in Delaware Bay. This action is necessary to improve the red knot's survival prospects for the short and long terms.

The Delaware Bay is unique because it is the center of the Western Hemisphere's only horseshoe crab population, and it is the last stop for migrating shorebird before they reach frozen arctic breeding grounds. The red knot's northbound Arctic flight to the breeding grounds is physically demanding. After shorter flights along the South American coast, the birds make a single, non-stop flight to Delaware Bay. Many birds arrive in depleted condition with no fat reserves and, at the extreme, having lost muscle during their flight causing them to weigh up to 30 percent less than normal fat-free weight. The red knots stop over for about two weeks in Delaware Bay, where they feed on horseshoe crab eggs and roughly double their body weight. Horseshoe crab eggs are a unique and critical food resource because eggs can be quickly metabolized by shorebirds into body fat allowing large weight gains in very brief period[9]. At the end of May, red knots prepare to depart for the Arctic by nearly ceasing to feed and undergoing physiological changes, including reduction of their digestive organs and increasing the size of their flight muscles[10]. The birds leave Delaware Bay heading along a route across the boreal forest

[9] Haramis M. G., W. A. Link, P. C. Osenton, D. B. Carter, R. G. Weber, N. A. Clark, M. A. Teece, D. S. Mizrahi. 2007. Stable isotope and pen feeding trial studies confirm the value of horseshoe crab *Limulus polyphemus* eggs to spring migrant shorebirds in Delaware Bay. Journal of Avian Biology 38 (3), 367–376.

[10] Piersma, T. and R. E. Gill Jr. 1998. Guts don't fly: Small digestive organs in obese bar-

and low tundra of Canada, which in early spring remains frozen and unsuitable for shorebirds.

Upon arrival at their breeding grounds in the Arctic, the red knot's digestive systems recover, but there is very little food available for one to three weeks until snow and ice melt, so their survival depends on surplus fat resources gained in Delaware Bay. Shorebirds lay eggs in a shallow scrape created in a patch of arctic grass. Throughout the three weeks of incubation, the parents take turns to brood the clutch, and each brooding session can last for up to 24 hours at a time. The off-duty parent may fly as much as 10 km in search of unfrozen wetlands in which to find food (L. Niles unpubl. data). Without sufficient fat reserves gained during the stopover in the Delaware Bay, the red knot's ability to survive as well as their ability to establish nests during the first one to three weeks in the Arctic will be impacted. By the time the young hatch, the weather is usually warmer and an abundance of invertebrate food becomes available to sustain the chicks.

Numerous studies have shown that of all the sites visited by the *rufa* subspecies of the red knot, Delaware Bay is the most critical[8, 11, 12.] Without the ability to gain weight rapidly in Delaware Bay, both the survival of the adult birds and their productivity will decline[8].

Other shorebird species that rely on horseshoe crab eggs, such as ruddy turnstone (*Arenaria interpres*), semipalmated sandpiper (*Calidris pusilla*) and sanderling (*Calidris alba*), dunlin (*Calidris alpina*) and short-billed dowitcher (*Limnodromus griseus*) have also declined in number on the Delaware Bay migratory stopover. During the period 1998 to 2007, all of these species declined by approximately 64%. Ruddy turnstone, sanderling and short-billed dowitchers suffered the most severe declines; 84%, 61%, and 74%,

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tailed godwits. Auk 115: 196-203.

[11] Myers, J. P. 1986. Sex and gluttony on Delaware Bay. Natural History 95(5): 68-77.

[12] Harrington, B. and C. Flowers. 1996. *The flight of the red knot.* W.W. Norton and Company. New York. 192pp.

respectively[13]. The breeding populations of these three species, as well as Delaware Bay migrants dunlin (*Calidris alpine*) and short-billed dowitcher (*Limnodromus griseus*), have declined according to the Canadian Wildlife Service's breeding bird surveys [14, 15]. These species and red knots make up 99 percent of the shorebird concentration in Delaware Bay. All are dependent upon horseshoe crab eggs for all or most of their diet during the stopover, and all have declined in population.

The Department has taken other actions to improve conditions for migrating shorebirds on Delaware Bay. In 2003-2007 selected beaches have been closed to people for portions of May and early June to minimize disturbance, allowing birds to feed undisturbed on the available horseshoe crab eggs. These beach closures have been enforced by conservation officers assisted by volunteer shorebird stewards trained by the New Jersey Division of Fish and Wildlife. In 2005 the beach at Stone Harbor Point was closed to prevent human disturbance to roosting flocks of shorebirds. In May 2005-2007, division personnel experimented with physical barriers to limit the number of laughing gulls on Delaware Bay beaches, to make more beach area and horseshoe crab eggs available to red knots; those efforts will continue in 2008. These measures will only be effective if there is an adequate supply of horseshoe crab eggs in the Delaware Bay beaches.

[13] NJ DEP Division of Fish and Wildlife, Delaware Bay aerial survey, peak counts.

[14] Morrison, R. I. G., and P. Hicklin. 2001. Recent trends in shorebird populations in the Atlantic Provinces. Bird Trends 8:16-18.

[15] Morrision, R. I. G., B. J. McCaffery, R. E. Gill, S. K. Skagen, S. L. Jones, G. W. Page, C. L. Gratto-Trevor, and B. A. Andres. 2006. Population estimates of North American shorebirds, 2006. Wader Study Group Bulletin 111:67-85

Social Impact

The proposed amendment to N.J.A.C. 7:25-18.16 will have a positive social impact on tourists and residents who travel to Delaware Bay specifically to observe the shorebird migration and horseshoe crab spawning. According to a 1998 study, 6,000 to 10,000 people visited Delaware Bay in spring to see the concentration of shorebirds and horseshoe crabs[16]. Positive impacts are also expected in educational programs for children and families conducted by several environmental institutions in Cape May and Cumberland counties. Some of those educational programs focus on horseshoe crabs and include field trips to see horseshoe crab spawning. Shorebird and horseshoe crab ecotourist operators are also likely to benefit from a continued closure of the horseshoe crab harvest.

The Delaware Bay is the center of the Western Hemisphere's only horseshoe crab population. The uniqueness of Delaware Bay's ecosystem, because of horseshoe crabs and the marine and terrestrial wildlife that depend on them, has intrinsic value to future generations from natural, cultural and economic perspectives.

The proposed amendment to N.J.A.C. 7:25-18.16, however, will have a negative social impact on horseshoe crab permittees who will not be able to harvest horseshoe crabs during the continuing moratorium, as well as the other commercial fisheries that rely on horseshoe crabs as bait. These other commercial fisheries include, but are not limited to, the American eel pot fishery, the conch pot fishery, and the minnow pot fishery. Other negative social impacts are likely to be experienced in many recreational fisheries that rely on eels and minnows for bait, such as the striped bass sportfishery, if sufficient bait is not available for recreational fishermen to pursue their fishing activities. In these instances, the recreational fishermen would have to resort to an alternative bait.

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[16] Eubanks, T. L., Jr., J. R. Stoll, and P. Kerlinger. 2000. Wildlife-associated recreation on the New Jersey Delaware Bayshore: The economic impact of tourism based on the horseshoe crab-shorebird migration in New Jersey. Report prepared for the NJ DEP Division of Fish and Wildlife. 91p.

Economic Impact

The proposed amendment to N.J.A.C. 7:25-18.16 will have a positive economic impact on tourism associated with the horseshoe crab and shorebird concentration in Delaware Bay. An economic study conducted in 1998[17] estimated the gross economic value of this tourism to New Jersey's Delaware Bay region to be between $25 and $41 million annually, based on 1998 visitation levels. Alternatively, taking no action would risk a substantial decline in the size of this shorebird concentration and many of the related benefits to the local economies. The 1998 economic survey asked visitors what amount of decline in shorebirds and horseshoe crabs would cause them to cancel their trip to the region, and the answer was 50 percent. Thus the trends observed in recent years are likely to already be affecting local shorebird-related tourism. The Division of Fish and Wildlife is currently seeking funding to repeat this survey.

The proposed amendment to N.J.A.C. 7:25-18.16 will have a negative economic impact on horseshoe crab permittees who will lose income from not being able to harvest horseshoe crabs during the moratorium. According to the National Marine Fisheries Service (NMFS), horseshoe crab landings in New Jersey in 2005, the last complete year that commercial horseshoe crab harvesting was allowed in New Jersey, amounting to 330,714 pounds had a dockside value of $120,782.

Additionally, the lack of horseshoe crabs as bait in other commercial fisheries could have a negative economic impact on these fisheries, as well. For example, horseshoe crabs are one of the types of bait used for American eel and conch. NMFS reported landings for American eel in 2006, the most recent year with complete commercial landings, of 158,917 pounds had a dockside value of $333,843 and for conch landings of 199,625 pounds, with a dockside value of $578,928. Because horseshoe crabs are only one of the types of bait used in these fisheries and it is likely those who utilize horseshoe crabs as bait will switch to using one of the other available alternate types of bait, it is not

possible to provide an exact estimate of the impact, if any, on the landings of these fisheries or the costs incurred by those engaged in the fisheries.

The moratorium on the harvest of horseshoe crabs may also have some impact on the surf clam fishery since horseshoe crabs that otherwise would have been harvested may feed on juvenile surf clams. The New Jersey surf clam landings of 43,643,726 pounds in 2006 according to the NMFS had a dockside value of $25,106,785. However, given the magnitude of the ocean's surf clam resources and the relatively small increase in the number of horseshoe crabs resulting from the moratorium that may feed on juvenile surf clams, the impact on the surf clam resource should not pose a serious threat to the sustainability of the ocean's surf clam resources.

The potential decrease in the availability of American eels may result in an increase in prices for these bait fish as supplies become limited. The striped bass sport fishery, in particular, utilizes American eels as bait.

Environmental Impact

The proposed amendment to N.J.A.C. 7:25-18.16 will have major positive environmental impacts on red knots and all shorebirds that rely on the Delaware Bay stopover in the spring migration. Recent results of Delaware Bay spawning survey indicated a statistically-significant increase in spawning activity in New Jersey during the period 1999 to 2006, particularly 2005 and 2006, while spawning activity in Delaware significantly declined during the same period[17]. In light of the fact that there is moratorium in New Jersey and not in Delaware, these results indicate that the New Jersey moratorium is likely having a positive effect and is allowing more crabs to spawn.

[17] Michaels, S., D. Smith, S. Bennett. Horseshoe Crab Spawning Activity in Delaware Bay: 1999-2006. Report to the Atlantic States Marine Fisheries Commission's Horseshoe Crab Technical Committee. January 16, 2007. 15 pgs.

While a coast-wide moratorium on horseshoe crab harvest in the Mid-Atlantic region (NJ, DE, MD, VA, NY, PA) would provide the most immediate relief and fastest recovery of horseshoe crab egg densities, the continued closure of New Jersey's horseshoe crab harvest will result in 100,000 additional adult crabs surviving to spawn annually. More horseshoe crab eggs would be available creating better feeding conditions for red knots and other shorebirds. A larger spawning population of adults would at some point cause crabs to compete for space on the beach and would result in horseshoe crabs reoccupying more of their former range along bay beaches.

A larger area of occupied shoreline and higher density of horseshoe crab eggs would improve feeding conditions for red knots and other shorebirds. A greater number of red knots would be able to make adequate take-off weight to successfully reach the Arctic, nest and raise young. Improved productivity and increased adult survival will increase the red knot population, and slow down and reverse the trend toward extinction of this population.

Other shorebird species that rely on horseshoe crab eggs, such as semipalmated sandpiper (*Calidris pusilla*), sanderling (*Calidris alba*) and ruddy turnstone (*Arenaria interpres*) have declined in number on the Delaware Bay migratory stopover and would also benefit from an increased number of horseshoe crabs. The smaller species (sanderling and semipalmated sandpiper) often get out-competed for foraging space when horseshoe crab egg density is suboptimal. Improved feeding conditions resulting from a greater number of spawning horseshoe crabs over a greater area of beaches would improve the ability of shorebirds to gain weight and depart Delaware Bay in good condition.

More adult horseshoe crabs available to spawn in future years as a result of a moratorium on horseshoe crab commercial harvesting would also result in more crab eggs available for fish in the estuary, particularly the back bays where fish nursery areas are critical to maintain and enhance fish populations. Under these conditions, natural fish production would be expected to increase. Some Federal and State endangered sea turtles

found in Delaware Bay in low numbers (e.g., loggerhead, Kemp's ridley) also eat horseshoe crabs and might be expected to benefit from a larger horseshoe crab population.

The proposed amendment to N.J.A.C. 7:25-18.16 could have a negative environmental impact on the surf clam resource since horseshoe crabs are major predators on juvenile surf clams and the increased abundance of horseshoe crabs in coastal marine waters could increase predation on the surf clam resource. However, the surf clam population has coexisted with horseshoe crabs at current and higher levels, thus this is not a significant concern, particularly in light of the unstable red knot population. The positive environmental impacts on migratory shorebirds, particularly the red knot, outweigh any potential negative environmental impact on the surf clam resource.

Federal Standard Analysis

Executive Order No. 24 (1994) and N.J.S.A. 52:14B-1 et seq. require State agencies which adopt, readopt or amend State regulations that exceed Federal standards or requirements to include in the rulemaking document a comparison with Federal law.

Federal regulations do not currently address horseshoe crabs outside the Carl N. Shuster, Jr. Horseshoe Crab Reserve where harvesting is prohibited. The Department has determined that regulations in the area outside the Carl N. Shuster Jr. Horseshoe Crab Reserve are essential for the management, conservation and protection of migratory shorebirds. The survival of these shorebirds depends on horseshoe crab eggs available in Delaware Bay beaches and marshes. The density of horseshoe crab eggs, as the shorebird food resource, has declined to a level inadequate to sustain the shorebird migration. The proposed amendment is necessary to increase the number of horseshoe crabs spawning in Delaware Bay habitats, thus improve conditions therein for migratory shorebirds, and reverse declining trends of red knots and other Delaware Bay shorebirds. Without such action, the red knot has an increased likelihood of extinction within five years.

The proposed amendment to N.J.A.C. 7:25-18.16 continuing the moratorium on the harvesting of horseshoe crabs is more stringent than the required management measures of the ASMFC interstate fishery management plan for horseshoe crabs on the harvesting of horseshoe crabs. The ASMFC is not a Federal agency but rather a compact of the 15 Atlantic coastal states coordinating the conservation and management of nearshore fishery resources. While Addendum IV allows for a limited commercial bait fishery, New Jersey may implement more restrictive management measures if it determines that the minimum compliance management measures of the Addendum do not meet the regional resource needs within the State.

This regulatory proposal's moratorium on horseshoe crab harvesting is consistent with Department policies in the management of natural resources and the proposed moratorium is achievable under current technology. The Department has conducted an appropriate cost/benefit analysis, as explained in the Economic Impact section of this regulatory proposal, and has determined that the proposed amendment should be adopted.

Jobs Impact

The proposed amendment to N.J.A.C. 7:25-18.16 will directly impact the currently eligible participants in the commercial horseshoe crab bait fishery since none of these fishermen will be allowed to harvest horseshoe crabs during the moratorium. For the period 1998 through 2005, on average, 35 horseshoe crab permits have been issued annually to eligible participants. The average number of horseshoe crabs harvested by each permittee varies from year to year. There are generally three levels of magnitude of harvesting horseshoe crabs in any one year, high, medium, and low levels of harvesting. Thus there is considerable variability in harvesting among permittees. Horseshoe crab permittees rely to varying degrees on the harvest of horseshoe crabs for their livelihood; many participate in other fisheries or have jobs outside the commercial fishing industry. To what degree these permittees can find alternate bait or redirect their effort into other

fisheries or other jobs would dictate whether any jobs are lost as a result of this regulatory proposal. Additional jobs impacts may be experienced by commercial fishermen in the American eel pot fishery, the conch pot fishery, and the minnow pot fishery, as these fishermen rely, to some extent, on the availability of horseshoe crabs as bait in their commercial fishing activities. In 2006, 250 lobster and fish pot licenses were issued, most are issued to conch pot fishermen. Additionally, in 2006, 177 licenses were issued for miniature fykes and pots which allow for the commercial harvesting of eels. It is impossible to predict exactly the impact on jobs in these commercial fisheries that currently utilize horseshoe crabs as bait. However, the impact appears to have been offset to some extent by the use of alternate baits in these other commercial fisheries as evidenced by the fact that, while New Jersey horseshoe crab landings have been steadily decreasing from 1996, the landings of conch, eels, and minnows have not declined to any noticeable extent.

Positive benefits will be expected for those who operate ecotourism-based tours on water and land. Other Cape May and Cumberland county businesses would benefit, including those that rely on tourism in the early spring, such as hotels, motels and other renters, and restaurants and stores.

Agriculture Industry Impact

Pursuant to N.J.S.A. 52:14B-4(a)2, the Department has evaluated this rulemaking to determine the nature and extent of the proposed amendment on the agriculture industry. The proposed amendment applies solely to the marine fishing industry and will have no impact upon the agriculture industry.

Regulatory Flexibility Analysis

In accordance with the New Jersey Regulatory Flexibility Act, N.J.S.A. 52:14B-16 et seq., the Department has reviewed the proposed amendment for reporting, recordkeeping, or other compliance requirements on small businesses. The proposed amendment applies to commercial fishermen eligible to obtain horseshoe crab permits to commercially harvest horseshoe crabs. The proposed amendment will require no reporting, recordkeeping or other compliance requirements because the fishery will be closed and no permits will be issued during the two-year period. Previously, all permitted fishermen were required to report weekly and monthly during the open horseshoe crab season.

The proposed amendment may impact small businesses engaged in the horseshoe crab fishery and fisheries that use horseshoe crabs as bait. In proposing these amendments, the Department has balanced the expected economic impacts of the rules upon small businesses against the need to protect the environment and public health. The Department has determined that any attempt to relax the requirements for small businesses would endanger the environment. Therefore, no exemption from the rule is provided for small businesses.

Smart Growth Impact

Executive Order No. 4(2002) requires State agencies which adopt, amend or repeal any rule adopted pursuant to N.J.S.A. 52:14B-4(a) of the Administrative Procedure Act to describe the impact of the proposed rule on the achievement of smart growth and implementation of the New Jersey State Development and Redevelopment Plan (State Plan). The Department has evaluated this rulemaking to determine the nature and extent of the proposed amendment's impact on smart growth and the implementation of the State

Plan. The proposed amendment concerns various marine fisheries provisions at N.J.A.C. 7:25-18.16 and does not involve land use policies or infrastructure development and, therefore, will not have any impact on the achievement of smart growth. The amendment is intended to conserve the State's natural resources, which is one of the overall goals of the State Plan. Accordingly, the conservation of the shorebird resources is supportive of the goals of the State Plan.

Full text of the proposal follows (additions indicated in boldface **thus**; deletions indicated in brackets [thus]):

7:25-18.16 Horseshoe crab (Limulus polyphemus)

(a) – (c) (No Change.)

(d) The annual horseshoe crab harvest quota for New Jersey [from May 15, 2006 to December 31, 2007] shall be zero or as modified by the Commissioner pursuant to (h) below. [Thereafter, the annual horseshoe crab harvest quota for New Jersey shall be no more than 150,000 or as modified by the Commissioner pursuant to (h) below.] All landings of horseshoe crabs in New Jersey shall be applied to the New Jersey annual horseshoe crab quota.

1. through 5. (No change).

(e) – (j) (No Change.)