F/NER/2003/01177

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: U.S. Army Corps of Engineers – Philadelphia District

Activity Considered: Emergency Repairs to the Morrisville Levy, Morrisville, Pennsylvania

Conducted by: National Marine Fisheries Service
Northeast Region

Date Issued: APRIL 19, 2004

Approved by: Patricia A. Kurkul

This constitutes the National Marine Fisheries Service's (NOAA Fisheries) biological opinion based on our review of the emergency repairs to the Morrisville Levy in Morrisville, New Jersey and the emergency consultation on the effects of that action on threatened and endangered species in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). This biological opinion (BO) is based on information provided in the NOAA Fisheries October 25, 1996 BO on dredging in the Philadelphia District of the Army Corps of Engineers, a May 25, 1999 supplement to that BO, the February 2, 2001 BO on the Delaware River Main Channel Blasting Project, the biological assessment (BA) of the impacts of the emergency repairs to the Morrisville Levy on shortnose sturgeon, correspondence with Mr. James Boyer of the ACOE, and other sources of information. A complete administrative record of this consultation will be kept at the NOAA Fisheries Northeast Regional Office. Formal consultation was initiated on December 1, 2003.

CONSULTATION HISTORY

The Morrisville flood control levy is located on the west bank of the Delaware River in the Borough of Morrisville, Pennsylvania. Informal consultation on repairs to the Morrisville Flood Protection Levee began on June 4, 2002. Consultation between the ACOE and NOAA Fisheries staff resulted in a determination that the proposed project was not likely to adversely affect the federally endangered shortnose sturgeon (*Acipenser brevirostrum*) provided that no in-water work occurred from March 15 through July 15. This determination was communicated to the ACOE in a letter from NOAA Fisheries dated June 20, 2002. This time of year restriction was incorporated into the permit issued by the ACOE to the Borough of Morrisville.

During the winter of 2003, a storm sewer pipe that penetrated the levy collapsed during a high river flow event. The pipe collapse caused the earth and stone riprap over the pipe to settle into two large riverside sinkholes exposing the underlying earthen levy to river erosion. The sinkholes and collapsed pipe created a life-safety issue for the residents of Morrisville due to the possibility of flooding caused by failure of the levy or the backing up of stormwater during heavy rains.

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On February 26, 2003, the ACOE received a request from the Borough of Morrisville to amend the time of year restriction based on the urgent need to repair a collapsed pipe. On February 28, 2003, the ACOE contacted NOAA Fisheries and requested that the time of year restriction be modified so that the applicant could replace a section of the levee that contained a collapsed storm sewer pipe. The ACOE indicated that icing conditions in the river had prevented work from being accomplished, and the contractor anticipated that the March 15 deadline for completion of in-water work could not be met. Based on water temperatures in the river during March, 2003, NOAA Fisheries was able to concur with the ACOE's determination that extending the work window to April 15 or when water temperatures in the river in the vicinity of the proposed action reached 8°C (when adult shortnose sturgeon would be expected to be in the action area) was not likely to adversely affect shortnose sturgeon. Due to high river flows, the repair work was not accomplished before the water temperatures reached 8°C (which occurred on April 13, 2003). The ACOE informed NOAA Fisheries on April 18, 2003 that an emergency situation existed as a high water event could result in the failure of the levee, which would in turn, put residents of the Borough at risk. As such, in a letter dated May 1, 2003, the ACOE requested the initiation of an emergency consultation pursuant to Section 7 of the ESA and the subsequent approval to suspend the time of year restriction and allow the emergency repairs to the storm sewer pipe to proceed. Accompanying this letter was a description of the proposed action that indicated that the contractor for the project would construct a cofferdam and all work would be completed within the dewatered cofferdam.

In a letter dated May 9, 2003, NOAA Fisheries concurred with the request for emergency consultation and provided a list of recommended actions to reduce the likelihood of take and to document any take that occurred. The emergency repairs began with the installation of the cofferdam on May 27, 2003 and the emergency repair work was completed on August 29, 2003. The terms and conditions recommended by NOAA Fisheries included completing all work in the dry behind a cofferdam and using a pump with adequate clearance to ensure that any shortnose sturgeon larvae that entered the area could be returned to the river.

In a letter dated December 1, 2003, the ACOE submitted a request for initiation of formal consultation to assess the effects of the emergency repairs. As NOAA Fisheries had all the information necessary to initiate formal consultation, the date of the December 1, 2003 letter serves as the date of initiation of formal consultation.

DESCRIPTION OF THE PROPOSED ACTION

The objective of the project was the replacement of the collapsed storm sewer pipe and pressure grouting of the area around the pipe. Pressure grouting involved the injection of liquefied concrete to fill void areas in and around the pipe. In-river work was performed in the dry behind a small cofferdam (approximately 3 x 6.1m). The cofferdam consisted of plastic sheeting over a metal frame, reinforced as necessary with sandbags and sand-filled jersey type barriers. Water behind the cofferdam was pumped back to the river using a 4-inch submersible pump. Water that seeped into the cofferdam area through the riverbed was pumped out again the next workday. Dewatering the cofferdam area took approximately 1.5-2 hours at the start of each workday, and the pump was left on during the day to remove seepage. The cofferdam was installed on May 27, 2003 and the emergency repair work was completed on August 29, 2003.

The cofferdam, sandbags, and jersey barriers were removed at the completion of the project.

Action Area
The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation includes the area of the Delaware River within the cofferdam but also the Scudders Falls to Morrisville section of the Delaware River.

STATUS OF AFFECTED SPECIES

This section will focus on the status of the species that are present within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action.

The only endangered or threatened species under NOAA Fisheries' jurisdiction in the action area is the endangered shortnose sturgeon (*Acipenser brevirostrum*). No critical habitat has been designated for shortnose sturgeon and therefore none will be affected by the proposed action.

Shortnose Sturgeon
Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. A shortnose sturgeon recovery plan was published in December 1998 to promote the conservation and recovery of the species (see NOAA Fisheries 1998).

Although shortnose sturgeon are listed as endangered range-wide, in the final recovery plan NOAA Fisheries recognized 19 separate populations occurring throughout the range of the species. These populations are in New Brunswick Canada (1); Maine (2); Massachusetts (1); Connecticut (1); New York (1); New Jersey/Delaware (1); Maryland and Virginia (1); North Carolina (1); South Carolina (4); Georgia (4); and Florida (2). NOAA Fisheries has not formally recognized distinct population segments (DPS)[1] of shortnose sturgeon under the ESA. Although genetic information within and among shortnose sturgeon occurring in different river systems is largely unknown, life history studies indicate that shortnose sturgeon populations from different river systems are substantially reproductively isolated (Kynard 1997) and, therefore, should be considered discrete. While genetic information may reveal that interbreeding does not occur between rivers that drain into a common estuary, at this time, such river systems are considered a single population compromised of breeding subpopulations (NOAA Fisheries 1998). Consequently, this BO will treat the nineteen separate populations of shortnose sturgeon as subpopulations (one of which occurs in the action area) for the purposes of this analysis.

Shortnose sturgeon occur in large rivers along the western Atlantic coast from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. Shortnose sturgeon are large, long lived fish species. The species is anadromous in the

1 The definition of species under the ESA includes any subspecies of fish, wildlife, or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature. To be considered a DPS, a population segment must meet two criteria under NOAA Fisheries policy. First, it must be discrete, or separated, from other populations of its species or subspecies. Second, it must be significant, or essential, to the long-term conservation status of its species or subspecies. This formal legal procedure to designate DPSs for shortnose sturgeon has not been undertaken.

southern portion of its range (i.e., south of Chesapeake Bay), while northern populations are amphidromous (NOAA Fisheries 1998). Population sizes vary across the species' range. From available estimates, the smallest populations occur in the Cape Fear (~8 adults; Moser and Ross 1995) and Merrimack Rivers (~100 adults; M. Kieffer, United States Geological Survey, personal communication), while the largest populations are found in the Saint John (~100,000; Dadswell 1979) and Hudson Rivers (~61,000; Bain et al. 1998). No reliable estimate of the size of neither the total species nor the shortnose sturgeon population in the Northeastern United States exists. Shortnose sturgeon are benthic fish that mainly occupy the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including molluscs, crustaceans (amphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979 *in* NOAA Fisheries 1998). Shortnose sturgeon are long-lived (30-40 years) and, particularly in the northern extent of their range, mature at late ages. In the north, males reach maturity at 5 to 10 years, while females mature between 7 and 13 years.

Shortnose sturgeon have similar lengths at maturity (45-55 cm fork length) throughout their range, but, because sturgeon in southern rivers grow faster than those in northern rivers, southern sturgeon mature at younger ages (Dadswell et al. 1984). Shortnose sturgeon reach sexual maturity between approximately 6 and 10 years of age. Based on limited data, females spawn every three to five years while males spawn approximately every two years. The spawning period is estimated to last from a few days to several weeks. Spawning begins from late winter/early spring (southern rivers) to mid to late spring (northern rivers) when the freshwater temperatures increase to 8-9°C. Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse et al. 1987; Crowder et al. 1994; Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes.

Total instantaneous mortality rates (Z) are available for the Saint John River (0.12 - 0.15; ages 14-55; Dadswell 1979), Upper Connecticut River (0.12; Taubert 1980b), and Pee Dee-Winyah River (0.08-0.12; Dadswell et al. 1984). Total instantaneous natural mortality (M) for shortnose sturgeon in the lower Connecticut River was estimated to be 0.13 (T. Savoy, Connecticut Department of Environmental Protection, personal communication). There is no recruitment information available for shortnose sturgeon because there are no commercial fisheries for the species. Estimates of annual egg production for this species are difficult to calculate because females do not spawn every year (Dadswell et al. 1984). Further, females may abort spawning attempts, possibly due to interrupted migrations or unsuitable environmental conditions (NOAA Fisheries 1998). Thus, annual egg production is likely to vary greatly in this species.

At hatching, shortnose sturgeon are blackish-colored, 7-11mm long and resemble tadpoles (Buckley and Kynard 1981). In 9-12 days, the yolk sac is absorbed and the sturgeon develops into larvae which are about 15mm total length (TL; Buckley and Kynard 1981). Sturgeon larvae are believed to begin downstream migrations at about 20mm TL. Laboratory studies suggest that young sturgeon move downstream in a 2-step migration; a 2 to 3-day migration by larvae followed by a residency period by young of the year (YOY), then a resumption of migration by yearlings in the second summer of life (Kynard 1997). Juvenile shortnose sturgeon (3-10 years

old) reside in the interface between saltwater and freshwater in most rivers (NOAA Fisheries 1998).

In populations that have free access to the total length of a river (e.g., no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware and Merrimack Rivers), spawning areas are located at the farthest upstream reach of the river (NOAA Fisheries 1998). Sturgeon spawn in upper, freshwater areas and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon spawning migrations are characterized by rapid, directed and often extensive upstream movement (NOAA Fisheries 1998). Shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge.

Juvenile shortnose sturgeon generally move upstream in spring and summer and move back downstream in fall and winter; however, these movements usually occur in the region above the saltwater/freshwater interface (Dadswell et al. 1984; Hall et al. 1991). The species appears to be estuarine anadromous in the southern part of its range, but in some northern rivers, it is "freshwater amphidromous" (i.e., adults spawn in freshwater but regularly enter saltwater habitats throughout their life; Kieffer and Kynard 1993). Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total length (Buckley and Kynard 1985). Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adult and juvenile shortnose sturgeon congregate (Flourney et al. 1992; Rogers and Weber 1994; Rogers and Weber 1995; Weber 1996). While shortnose sturgeon are occasionally collected near the mouths of rivers and often spend time in estuaries, they are not known to participate in coastal migrations (Dadswell et al. 1984).

In the northern extent of their range, shortnose sturgeon exhibit three distinct movement patterns. These migratory movements are associated with spawning, feeding, and overwintering activities. In spring, as water temperatures rise above 8°C, pre-spawning shortnose sturgeon move from overwintering grounds to spawning areas. Spawning occurs from mid/late March to mid/late May depending upon location. In populations that have free access to the total length of a river (e.g., no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware, and Merrimack Rivers), spawning areas are located at the farthest accessible upstream reach of the river, often just below the fall line (NOAA Fisheries 1998). Shortnose sturgeon spawn in upper, freshwater sections of rivers and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon are believed to spawn at discrete sites within the river (Kieffer and Kynard 1996). In the Merrimack River, males returned to only one reach during the four years of the telemetry study (Kieffer and Kynard 1996). Squires (1982) found that during the three years of the study in the Androscoggin River, adults returned to a 1-km reach below the Brunswick Dam and Kieffer and Kynard (1996) found that adults spawned within a 2-km reach in the Connecticut River for three consecutive years. Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (Dadswell et al. 1984; NOAA Fisheries 1998). Additional environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 8 - 12° C, and bottom water velocities of 0.4 to 0.7 m/sec (Dadswell et al. 1984; NOAA Fisheries

1998). The eggs are separate when spawned but become adhesive within approximately 20 minutes of fertilization (Dadswell et al. 1984). Between 8° and 12°C, eggs generally hatch after approximately 13 days. The larvae are photonegative, remaining on the bottom for several days. Buckley and Kynard (1981) found week old larvae to be photonegative and form aggregations with other larvae in concealment.

Adult shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in spring and localized, wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (Dovel 1981) but remain within freshwater habitats. Older juveniles tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes. Juveniles move upstream in spring and feed mostly in freshwater reaches during summer.

The temperature preference for shortnose sturgeon is not known (Dadswell et al. 1984) but shortnose sturgeon have been found in waters with temperatures as low as 2 to 3°C (Dadswell et al. 1984) and as high as 34°C (Heidt and Gilbert 1978). However, temperatures above 28°C are thought to adversely affect shortnose sturgeon. In the Atlamaha River, temperatures of 28-30°C during summer months create unsuitable conditions and shortnose sturgeon are found in deep cool water refuges.

Shortnose sturgeon are also known to occur at a wide range of depths. A minimum depth of 0.6m is necessary for the unimpeded swimming by adults. Shortnose sturgeon are known to occur at depths of up to 30m but are generally found in waters less than 20m (Dadswell et al. 1984; Dadswell 1979). Shortnose sturgeon have also demonstrated tolerance to a wide range of salinities. Shortnose sturgeon have been documented in freshwater (Taubert 1980; Taubert and Dadswell 1980) and in waters with salinity of 30 parts-per-thousand (ppt) (Holland and Yeverton 1973; Saunders and Smith 1978). Mcleave et al. (1977) reported adults moving freely through a wide range of salinities, crossing waters with differences of up to 10ppt within a two hour period. The tolerance of shortnose sturgeon to increasing salinity is thought to increase with age (Kynard 1996). Shortnose sturgeon typically occur in the deepest parts of rivers or estuaries where suitable oxygen and salinity values are present (Gilbert 1989).

The Shortnose Sturgeon Recovery Plan (NOAA Fisheries 1998) identifies habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges) and mortality (resulting, for example, from impingement on cooling water intake screens, dredging and incidental capture in other fisheries) as principal threats to the species' survival. The recovery goal is identified as delisting shortnose sturgeon populations throughout their range, and the recovery objective is to ensure that a minimum population size is provided such that genetic diversity is maintained and extinction is avoided.

Anthropogenic impacts

The major known sources of anthropogenic mortality and injury of shortnose sturgeon include entrainment in dredges and entanglement in fishing gear. Injury and mortality can also occur at

power plant cooling water intakes and structures associated with dams in rivers inhabited by this species. Shortnose sturgeon may also be adversely affected by habitat degradation or exclusion associated with riverine maintenance and construction activities and operation of power plants. Entanglement could include incidental catch in commercial or recreational gear as well as directed poaching activities. Shortnose sturgeon are most likely to interact with fisheries in and around the mouths of rivers where they are found. Thus, interactions are likely to occur in state or unregulated fisheries. Interactions are also most likely to occur during the spring migration (NOAA Fisheries 1998b). According to information summarized by NOAA Fisheries (1998b), operation of gillnet fisheries for shad may result in lethal takes of as many as 20 shortnose sturgeon per year in northern rivers. Shortnose sturgeon may be taken in ocean fisheries near rivers inhabited by this species. No comprehensive analysis of entanglement patterns is available at this time, in part due to the difficulty of distinguishing between shortnose and Atlantic sturgeon with the similarity in appearance of these two species. For example, several thousand pounds of "sturgeon" were reported taken in the squid/mackerel/butterfish fishery in 1992. However, this information is not broken down by species.

ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this BO includes the effects of several activities that may affect the survival and recovery of the endangered species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, water quality, scientific research, and fisheries, and recovery activities associated with reducing those impacts. An additional environmental impact to be addressed is the effects of discharges into the river on shortnose sturgeon.

Status of Shortnose Sturgeon in the Delaware River

Shortnose sturgeon occur in the Delaware River from the lower bay upstream to at least Lambertville, New Jersey (river mile 148). Hastings et al. (1987) used Floy T-anchor tags in a tag-and-recapture experiment from 1981 to 1984 to estimate the size of the Delaware River population in the Trenton to Florence reach. Population sizes by three estimation procedures ranged from 6,408 to 14,080 adult sturgeon. These estimates compare favorably with those based upon similar methods in similar river systems. This is the best available information on population size, but because the recruitment and migration rates between the population segment studied and the total population in the river are unknown, model assumptions may have been violated.

Tagging studies by O'Herron et al. (1993) found that the most heavily used portion of the river appears to be between river mile 118 below Burlington Island and river mile 137 at the Trenton Rapids. From November through March, adult sturgeon overwinter in dense sedentary aggregations in the upper tidal reaches of the Delaware between river mile 118 and 131. The areas around Duck Island and Newbold Island seem to be regions of intense overwintering concentrations. However, unlike sturgeon in other river systems, shortnose sturgeon in the

Delaware do not appear to remain as stationary during overwintering periods. Overwintering fish have been found to be generally active, appearing at the surface and even breaching through the skim ice (O'Herron 1993). Due to the relatively active nature of these fish, the use of the river during the winter is difficult to predict. However, O'Herron et al. (1993) found that the typical overwintering movements are fairly localized and sturgeon appear to remain within 1.24 river miles of the aggregation site (O'Herron and Able 1986). The overwintering location of juvenile shortnose sturgeon is not known but believed to be on the freshwater side of the oligohaline/fresh water interface (O'Herron 1990). In the Delaware River, the oligohaline/freshwater interface occurs in the area between Wilmington, Delaware and Marcus Hook, Pennsylvania (O'Herron 1990).

Spawning in the Delaware River may occur from late March through early May dependent on weather conditions. While actual spawning has not been documented in this area, the concentrated use of the Scudders Falls region in the spring by large numbers of mature male and female shortnose sturgeon indicate that this is a major spawning area (O'Herron et al. 1993). The same area was identified as a likely spawning area based on the collection of two ripe females in the spring (Hoff 1965). During the spawning period, the males remain on the spawning grounds for approximately a week while females only stay for a few days (O'Herron and Hastings 1985). After spawning, shortnose sturgeon move rapidly downstream to the Philadelphia area.

Historically, sturgeon were relatively rare below Philadelphia due to poor water quality. In the past decade, the water quality in the Philadelphia area has improved leading to an increased use of the lower river by shortnose sturgeon. After adult sturgeon migrate to the area around Philadelphia, many adults return upriver to between river mile 127 and 134 within a few weeks, while others gradually move to the same area over the course of the summer (O'Herron 1993). By November, adult sturgeon have returned to the overwintering grounds around Duck Island and Newbold Island. These patterns are generally supported by the movement of radio-tagged fish in the region between river mile 125 and river mile 148 as presented by Brundage (1986).

It is likely that the area above Philadelphia is of primary importance to shortnose sturgeon in the Delaware River, but fish have been documented below Philadelphia. Brundage and Meadows (1982) have reported incidental captures in commercial gillnets in the lower Delaware. During a study focusing on Atlantic sturgeon, Shirey et al. (1999) captured 9 shortnose sturgeon in 1998. During the June through September study period, Atlantic and shortnose sturgeon were found to use the area on the west side of the shipping channel between Deep Water Point, New Jersey and the Delaware-Pennsylvania line. The most frequently utilized areas within this section were off the northern and southern ends of Cherry Island Flats in the vicinity of the Marcus Hook Bar. While the available information does not identify the area below Philadelphia as a concentration area for adult shortnose sturgeon, it is apparent that this species does occur in the lower Delaware River.

Due to limited information on juvenile shortnose sturgeon, it is difficult to ascertain their distribution and nursery habitat (O'Herron 2000, pers. comm.). In other river systems, juvenile young-of-the-year sturgeon move downstream to tidal areas and concentrate at, or just upstream of, the salt front during the summer months (June through August). However, there is no

evidence that this population moves into the region of the freshwater-saltwater interface during the summer. In the Delaware River the oligohaline/fresh interface can range from as far south as Wilmington, Delaware, north to Philadelphia, Pennsylvania, depending upon meteorological conditions such as excessive rainfall or drought. As a result, it is possible that in the Delaware River, juveniles could range from Artificial Island (river mile 54) to the Schuylkill River (river mile 92) (O'Herron 2000, pers. comm.). O'Herron believes that if juveniles are present within this range they would likely aggregate closer to the downstream boundary in the winter when freshwater input is normally greater (O'Herron 2000, pers. comm.). However, exact status of juvenile shortnose sturgeon in the Delaware River has yet to be determined due to lack of data. Hypotheses constructed about juvenile shortnose sturgeon distribution in the Delaware River have been based on comparisons in sturgeon of other river systems.

According to Dadswell (1984), shortnose sturgeon appear to be strictly benthic feeders. Adults eat mollusks, insects, crustaceans and small fish. Juveniles eat crustaceans and insects. While shortnose sturgeon forage on a variety of organisms, in the Delaware River, sturgeon primarily feed on the Asiatic river clam (*Corbicula manilensis*). *Corbicula* is widely distributed at all depths in the upper tidal Delaware River, but it is considerably more numerous in the shallows on both sides of the river than in the navigation channels. Foraging is heaviest immediately after spawning in the spring and during the summer and fall, and lighter in the winter. Juvenile sturgeon primarily feed in 10 to 20 meter deep river channels, over sand-mud or gravel-mud bottoms (Pottle and Dadswell 1979). However, little is known about the specific feeding habits of juvenile shortnose sturgeon in the Delaware River.

Dredging

The construction and maintenance of Federal navigation channels have been identified as a source of sturgeon mortality. The Delaware River Federal Navigation Channel is maintained by the ACOE, and the ACOE works in the Delaware River under the constraints of a general BO issued in 1996 and supplemented in 1999. The Delaware Main Channel is dredged using a hopper dredge, but the other smaller channels in the Delaware River usually employ a hydraulic pipeline dredge. The 1996 BO found that shortnose sturgeon may be adversely affected by entrainment and harassment during dredging projects that occur in the Delaware River. This BO outlined terms and conditions that would minimize potential impacts, but dredging projects could have caused shortnose sturgeon mortality or injury, and likely affected shortnose sturgeon distribution and foraging habitat.

Dredging in the Delaware River has resulted in the mortality of several shortnose sturgeon. In mid-March 1996, three subadult shortnose sturgeon were found in a dredge discharge pool on Money Island, near Newbold Island. The dead sturgeon were found on the side of the spill area into which the hydraulic pipeline dredge was pumping, and the presence of large amounts of roe in two specimens (i.e., fish were in breeding condition) would infer that the fish were alive and in good condition prior to entrainment. In January 1998, three shortnose sturgeon were discovered in the hydraulic maintenance dredge spoil in the Florence to Trenton section of the upper Delaware River. Recent actions in the Kennebec River in Maine indicate that shortnose sturgeon can also be killed by mechanical dredges. While mechanical dredging takes place in the Delaware River, no takes have been attributed to this dredge type in this river.

Since dredging involves removing the bottom material down to a specified depth, the benthic environment could be severely impacted by dredging operations. As shortnose sturgeon are benthic species, the alteration of the benthic habitat could have affected sturgeon prey distribution and/or foraging ability.

Contaminants and Water Quality

Historically, shortnose sturgeon were rare in the area below Philadelphia, likely as a result of poor water quality precluding migration further downstream. However, in the past 20 to 30 years, the water quality has improved and sturgeon have been found farther downstream. It is likely that contaminants remain in the water and in the action area, albeit to reduced levels. Sewage, industrial pollutants and waterfront development has likely decreased the water quality in the action area.

Contaminants including heavy metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs), can have serious, deleterious effects on aquatic life and are associated with the production of acute lesions, growth retardation, and reproductive impairment (Ruelle and Keenlyne 1993). Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable.

Several characteristics of shortnose sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term, repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979). In the Connecticut River, coal tar leachate was suspected of impairing sturgeon reproductive success. Kocan (1993) conducted a laboratory study to investigate the survival of sturgeon eggs and larvae exposed to PAHs, a by-product of coal distillation. Only approximately 5% of sturgeon embryos and larvae survived after 18 days of exposure to Connecticut River coal-tar (i.e., PAH) demonstrating that contaminated sediment is toxic to shortnose sturgeon embryos and larvae under laboratory exposure conditions (NOAA Fisheries 1998).

Although there is scant information available on the levels of contaminants in shortnose sturgeon tissues, some research on other related species indicates that concern about the effects of contaminants on the health of sturgeon populations is warranted. Detectable levels of chlordane, DDE (1,1-dichloro-2, 2-bis(p-chlorophenyl)ethylene), DDT (dichlorodiphenyl-trichloroethane), and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (Ruelle and Henry 1994). These compounds were found in high enough levels to suggest they may be causing reproductive failure and/or increased physiological stress (Ruelle and Henry 1994). In addition to compiling data on contaminant levels, Ruelle and Henry (1994) also determined that heavy metals and organochlorine compounds (i.e., PCBs) accumulate in fat tissues. Although the long term effects of the accumulation of contaminants in fat tissues is not yet known, some speculate that lipophilic toxins could be transferred to eggs and potentially inhibit egg viability. PCBs may also contribute to a decreased immunity to fin rot. In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has

been made between fish weight, fish fork length, and DDE concentration in pallid sturgeon livers indicates that DDE increase proportionally with fish size (NOAA Fisheries 1998).

Point source discharges (i.e., municipal wastewater, paper mill effluent, industrial or power plant cooling water or waste water) and compounds associated with discharges (i.e., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon populations. The compounds associated with discharges can alter the pH or receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival.

Contaminants have been detected in Delaware River fish. PCB's have been detected in elevated levels in other species of fish besides shortnose sturgeon. In addition to PCB's, large portions of the Delaware River is bordered by highly industrialized waterfront development. Sewage treatment facilities, refineries, manufacturing plants and power generating facilities all intake and discharge water directly from the Delaware River. This results in large temperature variations, heavy metals, dioxin, dissolved solids, phenols and hydrocarbons which may alter the pH of the water eventually leading to fish mortality. Industrialized development, especially the presence of refineries, has also resulted in storage and leakage of hazardous material into the Delaware River. Presently 13 superfund sites have been identified in Marcus Hook and one dumpsite has yet to be labeled as a superfund site, but does contain hazardous waste. It is possible that the presence of contaminants in the action area may have adversely affected shortnose sturgeon abundance, reproductive success and survival.

Contaminant analysis was conducted on two shortnose sturgeon from the Delaware River in the fall of 2002. Muscle, liver, and gonad tissue were analyzed for contaminants (ERC 2002). Sixteen metals, two semivolatile compounds, three organochlorine pesticides, one PCB Aroclor, as well as polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) were detected in one or more of the tissue samples. Levels of aluminum, cadmium, PCDDs, PCDFs, PCBs, DDE (an organochlorine pesticide) were detected in the "adverse affect" range. It is of particular concern that of the above chemicals, PCDDs, DDE, PCBs and cadmium, were detected as these have been identified as endocrine disrupting chemicals. While no directed studies of chemical contamination in shortnose sturgeon in the Delaware River have been undertaken, it is evident that the heavy industrialization of the Delaware River is likely adversely affecting this population.

Scientific Studies

Shortnose sturgeon in this region have been the focus of a prolonged history of scientific research, beginning in approximately 1962. As a result of techniques associated with these sampling studies, shortnose sturgeon have been subjected to capturing, handling, and tagging. It is possible that research in the action area may have influenced and/or altered the migration patterns, reproductive success, foraging behavior, and survival of shortnose sturgeon. Several mortalities have been attributed to various scientific studies in this river.

Fisheries

Shortnose sturgeon are taken incidentally in other anadromous fisheries along the East Coast and may be targeted by poachers (NOAA Fisheries 1998). However, the incidental take of shortnose

sturgeon in the river has not been well documented due to confusion over distinguishing between Atlantic sturgeon and shortnose sturgeon. Direct take of shortnose sturgeon is prohibited by the ESA. However, shortnose sturgeon are taken incidentally in other anadromous fisheries along the East Coast and are probably targeted by poachers (NOAA Fisheries 1998). The incidental take of shortnose sturgeon on the Hudson River has been documented in both commercial shad fisheries as well as recreational hook and line fisheries. Although, commercial fisheries are prohibited in Pennsylvania state waters, New Jersey and Delaware do permit commercial fisheries to operate in designated portions of the Delaware River (Miller 2000, pers. Comm.; Boriek 2000, pers. comm.). American shad, eel, and blue crab are the species targeted by commercial fisherman, however, in the action area the level of commercial fishing is very minimal (Miller 2000, pers. Comm.; Boriek 2000, pers. comm.). Recreational hook and line fisheries, that target largemouth bass, striped bass, white catfish and channel catfish, are permitted throughout the River (Coughman 2000, pers. comm.; Boriek 2000, pers. comm.). While there have been few documented incidental takes of shortnose sturgeon in fisheries in the Delaware River, it is possible that unreported incidental takes have occurred in recreational hook and line fisheries and commercial fisheries operating in the action area. (Coughman 2000, pers. comm.).

Cumulative threats from other federally regulated activities
Cumulative impacts from federal actions occurring in the Delaware River have the potential to impact shortnose sturgeon. These include the introduction of pollutants from sewers and industrial sources. Pollution has been a major problem for this river system, which continues to receive discharges from sewer treatment facilities and industrial facilities.

Status of shortnose sturgeon in the action area
Adult shortnose sturgeon are expected to be in the action area during the spring of each year when water temperatures are between 8 and 15°C, although some adults may still be present when water temperatures are as high as 18°C. The adult shortnose sturgeon that are present are expected to spawn in the Scudders Falls area and return rapidly downstream into the tidal river after spawning. While eggs are expected to be restricted to the Scudders Falls area due to their demersal and adhesive qualities, larval shortnose sturgeon are expected to occur throughout the action area for several weeks following the spawning period. No estimates on the number of shortnose sturgeon that typically spawn in the Scudders Falls area is known and therefore no estimate of the number of larval sturgeon expected in the action area can be made.

EFFECTS OF THE ACTION

This section of a BO assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

Shortnose sturgeon are present in the action area from early spring through early summer. Adult

shortnose sturgeon are expected to leave the downstream overwintering areas when water temperatures reach 8°C. The shortnose sturgeon spawning period is estimated to last from a few days to several weeks (Buckley and Kynard 1985; Kynard 1997; Hall et al. 1991; NOAA Fisheries 1998). Estimates from the Delaware River indicate that spawning typically lasted 5-17 days (O'Herron et al. 1993). The majority of spawning is expected to take place in the Scudder's Falls area (approximately 9.5km upstream of the project area) when water temperatures are 10-14°C (Brundage 1986; ERC 2000, 2001).

Based on US Geological Survey (USGS) water temperature data for the Delaware River at the Trenton gage (USGS gage 01463500; the site closest to the Scudders Falls area), water temperature reached 10°C on April 14, 2003. Mean water temperatures at Trenton reached 15°C on April 30, 2003. Based on this information, the majority of shortnose sturgeon spawning occurred between April 14 and April 30 in 2003. Shortnose sturgeon spawning has been reported at water temperatures as high as 18°C. Water temperatures reached 18°C on May 2, 2003. This suggests that May 2 was the last possible date that shortnose sturgeon may have been spawning in the Delaware River in 2003; however, most spawning was likely completed between April 14 and April 30 in 2003. This time period (16-18 days) is consistent with the spawning period reported in the literature (see above). Post-spawned adults are expected to leave the spawning grounds rapidly after spawning. As such, no shortnose sturgeon adults were expected to be in the action area when the cofferdam was erected (May 27) or when the pump was operational (through August 2003). On June 2, 2003, Hal Brundage, a shortnose sturgeon researcher, scanned the Morrisville area with an ultrasonic receiver and hydrophone in order to detect the presence of any tagged shortnose sturgeon in the project area. No tagged shortnose sturgeon were detected in the Morrisville to Scudders Falls segment of the Delaware River.

Shortnose sturgeon eggs generally hatch after approximately 9-12 days (Buckley and Kynard 1981). The larvae are photonegative, remaining on the bottom for several days. Buckley and Kynard (1981) found week old larvae to be photonegative and form aggregations with other larvae in concealment. Larvae are expected to begin swimming downstream (against the current) at 9-14 days old (Richmond and Kynard 1995). Larvae are expected to be less than 20mm TL at this time (Richmond and Kynard 1995). This initial downstream migration generally lasts two to three days (Richmond and Kynard 1995). Studies (Kynard and Horgan 2002) suggest that larvae move approximately 7.5km/day during this initial 2 to 3 day migration. In the Delaware River, this would bring larvae into the tidal river and they are likely dispersed downstream throughout the tidal river after this migration. If, based on the assumptions outlined above, all shortnose sturgeon spawning was complete by May 2, 2003, all eggs would have hatched by May 14, 2003. All larvae should have begun swimming downstream by May 28, 2003. Based on the swimming rate of approximately 7.5km/day, some shortnose sturgeon larvae were present in the Morrisville area from May 4 - May 30 in 2003.

No adult or older juveniles were present in the project area during the time of the action and therefore no adult or juvenile shortnose sturgeon were affected by this project. In addition, no shortnose sturgeon eggs or early larvae (less than 2 weeks old) were likely present in the project area. As such, the only life stage of shortnose sturgeon to be affected by this project was approximately 2 week old larvae. Based on the best available information, shortnose sturgeon larvae were only present in the Morrisville area through May 30, 2003. Therefore, the project

likely only affected shortnose sturgeon from May 27, 2003 through May 30, 2003.

On May 27, 2003, the cofferdam was constructed. The cofferdam was located on the on the West bank of the Delaware River and the in-water work area comprised only 18.3m^2 (200 ft^2) of river edge habitat. A 4-inch submersible pump was used to de-water the area behind the cofferdam. This pump ran continuously throughout the duration of the project as water seeped into the cofferdam. The majority of shortnose sturgeon larvae are expected to migrate downstream in the main channel. However, larvae are likely to be dispersed throughout the width of the River and some larvae may have been present in the area behind the cofferdam on May 27 when the cofferdam was erected. Larvae may also have entered the cofferdam area when water seeped into the area. As indicated above, larvae were likely only in the area through May 30.

It is impossible to quantify the number of shortnose sturgeon larvae that may have been affected by this action as the number of shortnose sturgeon that spawned in 2003 and the exact dates that spawning, hatching, and migration took place are unknowable. The majority of spawning is expected to have been completed by April 30, 2003 with any larvae that were spawned on that date migrating past the Morrisville area on May 27 at the latest. Most larvae had likely migrated past the Morrisville area and entered the tidal river and dispersed further downstream by the time the cofferdam was erected. However, as spawning may have continued through May 2, it is possible that some small number of larvae was present in the area behind the cofferdam through May 30. Any shortnose sturgeon that were present behind the cofferdam entered the pump and were discharged back into the river. The pump used had a 3" (76mm) clearance between any moving parts and was designed to pump small solids. Shortnose sturgeon larvae in the project area were approximately 20mm TL (.79"). Based on analysis done by Taft *et al.* on alewife and yellow perch larvae (which are of similar size to shortnose sturgeon larvae), approximately 10% of the shortnose sturgeon larvae that went through the pump were likely killed. Thus, most (90%) larvae likely passed safely through the pump and were discharged back into the River.

The number of older shortnose sturgeon larvae that were directly affected by the emergency action (i.e., entrained in the pump) was a relatively small percentage of the total number of larvae spawned in 2003. Shortnose sturgeon are expected to have migrated past the Morrisville area during a 26 day period. The cofferdam was only present in the last 4 days of this migration. The majority of larvae are expected to have migrated past the Morrisville area before May 27. Further, most shortnose sturgeon larvae are expected to have migrated past the area in the channel, away from the river bank where the action took place. As such, only a small percentage of the total larvae spawned in 2003 were present in the Morrisville area while the action was ongoing. Further, ninety-percent of the larvae that passed through the pump likely returned to the river unharmed. As only a small area of the river was affected by this action and there was minimal disturbance to the benthic environment, there are no significant indirect effects anticipated as a result of this action.

CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.

Dredging
The Delaware River is an essential waterway that links the city of Philadelphia with ports all over the world. Last year over 3000 ships traveled in and out of Philadelphia, making it one of the busiest ports in the U.S. Atlantic (website of The Port of Philadelphia and Camden). With a 1997 estimated population growth rate of 0.89%, increasing demands of global markets, and a deeper channel resulting from the Delaware River Deepening Project, it is predicted that the number and size of ships traveling in and out of Philadelphia will continue to grow (website of City of Philadelphia). As a result, it is evident that continued dredging of the Delaware River will be necessary to maintain channel depths for the movement of a greater number and larger ships to and from Philadelphia.

Continued dredging of the Delaware River would mean further removal of bottom material, which would have significant impacts on the benthic environment. Shortnose sturgeon are benthic omnivores, thus, benthic disruption directly impacts their foraging and/or distribution. In addition to habitat disruption, shortnose sturgeon are particularly susceptible to entrainment, especially in hopper dredges. Entrainment occurs when the faster moving draghead overtakes the slower moving sturgeon. Usually upon entrainment, shortnose sturgeon are then sucked into the draghead, pumped through the intake pipe and ultimately killed as they travel through the centrifugal pump and into the hopper. Hydraulic pipeline dredges may also cause sturgeon mortality or injury. If dredging of the Delaware River continues in the future, takes of shortnose sturgeon may occur and their foraging and/or distribution may be affected.

Scientific Studies
It is likely that additional scientific studies will be conducted on shortnose sturgeon in the action area. Continued capturing, handling, tagging, and tracking of shortnose sturgeon may affect their migration, reproduction, foraging, and survival.

Contaminants and Water Quality
Contaminants associated with the action area are directly linked to industrial development along the waterfront. PCB's, heavy metals, and waste associated with point source discharges and refineries are likely to be present in the future due to continued operation of industrial facilities. In addition many contaminants such as PCB's remain present in the environment for prolonged periods of time and thus would not disappear even if contaminant input were to decrease. It is likely that shortnose sturgeon will continue to be affected by contaminants in the action area in the future.

Industrialized waterfront development will continue to impact the water quality in and around the action area. Refineries, sewage treatment facilities, manufacturing plants, and generating facilities present in the action area are likely to continue to operate. Excessive water turbidity, water temperature variations and increased shipping traffic are likely with continued future operation of these facilities. As a result, shortnose sturgeon foraging and/or distribution in the action area may be adversely affected.

Fisheries
Incidental take of shortnose sturgeon is likely with the continued operation of hook and line and

commercial fisheries in the Delaware River. There have been no documented takes in the action area, however, there is always the potential for this to occur when fisheries are known to operate in the presence of shortnose sturgeon. Thus, the operation of these hook and line fisheries and commercial fisheries could result in future shortnose sturgeon mortality and/or injury.

Impacts to shortnose sturgeon from non-federal activities are unknown in this river. It is possible that occasional recreational and commercial fishing for anadromous fish species may result in incidental takes of shortnose sturgeon. However, positive identification and distinction between Atlantic sturgeon and shortnose sturgeon are difficult and therefore, historically, takes have not been quantified. Pollution from point and non-point sources has been a major problem in this river system, which continues to receive discharges from sewer treatment facilities and industrial facilities. Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable.

INTEGRATION AND SYNTHESIS OF EFFECTS

The shortnose sturgeon is endangered throughout its entire range and can be divided into nineteen separate populations (NOAA Fisheries 1998). The shortnose sturgeon residing in the Delaware River form one of the nineteen sturgeon populations.

The estimated population of adult shortnose sturgeon in the Delaware River is 6,408 individuals (NOAA Fisheries 1998). Very little is known about the juvenile population of shortnose sturgeon in the Delaware. However, since the Morrisville area is below the spawning grounds and within the distance that larvae may be reasonably expected to be found, larvae are likely to be found in the action area for several weeks each year.

As no adult or older juvenile were likely to be present in the project area during the time of the action, no adult or juvenile shortnose sturgeon were likely affected by this project. In addition, no shortnose sturgeon eggs were likely present in the project area as spawning took place approximately 9.5km upstream of the project area. It is impossible to quantify the number of shortnose sturgeon larvae that may have been affected by this action as the number of shortnose sturgeon that spawned in 2003 and the exact dates that spawning, hatching, and migration took place are unknown. Most larvae had likely migrated past the Morrisville area and entered the tidal river and dispersed further downstream by the time the cofferdam was erected. However, as spawning may have continued through May 2, it is likely that some small number of larvae was present in the area behind the cofferdam and thus entrained in the pump and returned to the River. As indicated above, approximately 10% of the larvae that entered the pump likely died. Based on the timing of spawning, the likely dates that the majority of larvae had left the action area, the location of the project (i.e., on the river bank), the number of shortnose sturgeon larvae that were directly affected by the emergency action was a very small percentage of the total number of larvae spawned in 2003. Further, only 10% of the affected larvae likely died. As only a small area of the river was affected by this action and there was minimal disturbance to the benthic environment, there are no significant indirect effects anticipated as a result of this action.

CONCLUSION

Based on the evaluation of current information on the Delaware River shortnose sturgeon population, and considering the likely level of take from this action, NOAA Fisheries concludes that the emergency repairs conducted from May through August 2003 adversely affected the Delaware River population of shortnose sturgeon. Based on the timing of spawning, the likely dates that the majority of larvae had left the action area, the location of the project (i.e., on the river bank), the number of shortnose sturgeon larvae that were directly affected by the emergency action was a very small percentage of the total number of larvae spawned in 2003. Further, only 10% of the affected larvae likely died. While the emergency action reduced the number of larvae in the Delaware River in 2003, NOAA Fisheries believes that the emergency action did not reduce the reproduction, numbers and distribution of the Delaware River shortnose sturgeon population in a way that appreciably reduces their likelihood of survival and recovery in the wild or that of the species as a whole. It is the opinion of NOAA Fisheries that the emergency repairs to the Morrisville Levee in the Delaware River from May through August 2003 adversely affected but likely did not jeopardize the continued existence of either the Delaware River shortnose sturgeon population or the species as a whole. The number of shortnose sturgeon likely directly affected by the action represents a very small percentage of the Delaware River population and the species as a whole. This determination is based on the small number of shortnose sturgeon likely affected by this action as well as the lack of any indirect effects expected as a result of this action.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. NOAA Fisheries interprets the term "harm" as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering (50 CFR §222.102). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Reasonable and prudent measures are non-discretionary, and must be undertaken by the ACOE so that they become binding conditions for the exemption in section 7(o)(2) to apply. The ACOE had a continuing duty to regulate the activity covered by this Incidental Take Statement. If the ACOE (1) failed to assume and implement the terms and conditions or (2) failed to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the ACOE was required to report the progress of the action and its impact on the species to NOAA Fisheries as specified in the Incidental Take Statement [50 CFR §402.14(I)(3)].

Extent of take

As outlined in the accompanying biological opinion, shortnose sturgeon larvae were the only life stage that was affected by this action. It is impossible to quantify the number of shortnose

sturgeon larvae that may have been affected by this action as the number of shortnose sturgeon that spawned in 2003 and the exact dates that spawning, hatching, and migration took place are unknown. The majority of spawning was likely to be complete by April 30, 2003 with any larvae that were spawned on that date migrating past the Morrisville area on May 27 at the latest. Most larvae had likely migrated past the Morrisville area and entered the tidal river and dispersed further downstream by the time the cofferdam was erected. However, as spawning may have continued through May 2, it is likely that some small number of larvae was present in the area behind the cofferdam and thus entrained in the pump and returned to the River. Shortnose sturgeon larvae were reasonably certain to be present in the Morrisville area from May 4 – May 30. As such, shortnose sturgeon larvae were likely present behind the cofferdam from May 27 – May 30. Any shortnose sturgeon that were present behind the cofferdam entered the pump. The pump used had a 3" (76mm) clearance between any moving parts and was designed to pump small solids. Shortnose sturgeon larvae in the project area were approximately 20mm TL (.79"). Thus, larvae likely passed safely through the pump and were discharged back into the River. However, as outlined in the BO, 10% of shortnose sturgeon larvae that entered the pump likely died.

Shortnose sturgeon are expected to have migrated past the Morrisville area during a 26 day period. The cofferdam was only present in the last 4 days of this migration. Also, the majority of larvae are expected to have migrated past the Morrisville area by May 27. Further, most shortnose sturgeon larvae are expected to have migrated past the area in the channel, away from the river bank where the action took place. As such, only a small percentage of the total larvae spawned in 2003 were present in the Morrisville area while the action was ongoing. Based on the timing of spawning, the likely dates that the majority of larvae had left the action area, the location of the project (i.e., on the river bank), the number of shortnose sturgeon larvae that were directly affected by the emergency action was likely a very small percentage of the total number of larvae spawned in 2003. Take consisted of shortnose sturgeon larvae and occurred in the form of harassment (successful passage through the pump) and mortality (resulting from passage through the pump). As such, an unquantifiable but very small percentage of the total number of shortnose sturgeon larvae spawned in 2003 were taken by this action, and only 10% of the take incidental to this emergency action was lethal.

Reasonable and prudent measures

Several conditions were agreed to by the ACOE prior to initiation of the emergency action and are listed in the BO (see p. 2). These conditions (i.e., working behind a cofferdam and using a submersible pump to return any larvae to the River) were implemented throughout the project. These conditions were designed to minimize incidental take that might otherwise have resulted from implementation of the repair work at the Morrisville Levee. The use of the cofferdam likely minimized the number of shortnose sturgeon larvae that were affected by the project and the use of a pump with adequate clearance between moving parts ensured the safe passage of approximately 90% of the larvae passed through the pump.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to

minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NOAA Fisheries has determined that, the repairs to the Morrisville Levee did not likely jeopardize the continued existence of endangered shortnose sturgeon. NOAA Fisheries recommends that ACOE implement the following conservation recommendations:

1. ACOE should support future research to identify the occurrence, distribution, and the ecology of shortnose sturgeon in the portion of the Delaware River below Philadelphia. Of particular concern is the distribution of juveniles. Very little information is known about the abundance, distribution, and ecology of juvenile shortnose sturgeon in the Delaware River, and a project addressing these data deficiencies would promulgate effective future management. The Delaware River is the site of intense human activity, and dredging (and potentially similar blasting activities) will most likely be needed in the future. Knowledge of the distribution of adult sturgeon below Philadelphia and juvenile sturgeon throughout the system will assist the ACOE in planning future dredging projects by predicting where, when, and if shortnose sturgeon inhabit these waters. A more accurate assessment of shortnose sturgeon abundance within the Delaware River would also help to adequately protect this species.

2. To facilitate future management decisions on listed species occurring in the action area, ACOE should maintain a database mapping system to: 1) create a history of use of the geographic areas affected; and, 2) document endangered/threatened species presence/interactions with project operations.

3. ACOE should support future biological monitoring to determine the composition and/or density of benthic fauna. The ACOE would be able to use the data on the benthic environment to establish the recolonization rate of the disturbed areas, and the functional use of the area by higher-trophic level populations. This biological monitoring data could be used to help predict the habitat suitability of a particular area for shortnose sturgeon and other fish species. Benthic data for the area would also provide a baseline for evaluating the recovery of the benthic community after disturbances such as blasting or dredging.

REINITIATION OF CONSULTATION

This concludes formal consultation on the emergency repairs to the Morrisville Flood Protection Levee that occurred from May through August 2003. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, Section 7 consultation must be reinitiated immediately.

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