Appendix I

Delfin LNG Ichthyoplankton Report

Port Delfin LNG Project

Ichthyoplankton Impact Analysis

Response to Data Gap Question #61

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Acronyms and Abbreviations

Delfin LNG	Delfin LNG LLC
EAM	equivalent adult model
FLNGV	floating liquefied natural gas vessel
GMFMC	Gulf of Mexico Fishery Management Council
GSMFC	Gulf States Marine Fisheries Commission
lb	pound
LCL	lower confidence limit
LDWF	Louisiana Department of Wildlife and Fisheries
kg	kilogram
m^2	square meters
m^3	cubic meters
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
Port Delfin	the offshore component of the Port Delfin LNG Project consisting of the floating liquefied natural gas vessels, foundations, and underwater elements
Port Delfin LNG Project	Delfin LNG LLC's liquefied natural gas project, including all onshore and offshore components
Project	Port Delfin LNG Project
SEAMAP	Southeast Area Monitoring and Assessment Program
TYMS	tower yoke mooring system
UCL	upper confidence limit
USCG	U.S. Coast Guard
ZSIOP	Plankton Sorting and Identification Center

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1 Introduction

This Ichthyoplankton Impact Analysis describes the National Oceanic and Atmospheric Administration (NOAA) Fisheries' Southeast Area Monitoring and Assessment Program (SEAMAP) ichthyoplankton sampling, the descriptions of the source water body used to delineate the study area (see Attachment A), and the specific approaches used to analyze the SEAMAP data for fish egg and larval densities. These densities are used in conjunction with the average annual floating liquefied natural gas vessel (FLNGV) (cumulative for all four FLNGVs and the four tower yoke mooring system's [TYMS's]) estimated total annual seawater intake volume of 4.395 billion gallons (16.6 million cubic meters [m^3]) to estimate potential levels of annual impingement and entrainment losses from Delfin LNG LLC's (Delfin LNG's) Port Delfin LNG Project (Project). These losses are calculated for four target species (see Section 2.5 below for additional information):

- Red drum (*Sciaenops ocellatus*);
- Red snapper (*Lutjanus campechanus*);
- Bay anchovy (*Anchoa mitchilli*); and
- Gulf menhaden (*Brevoortia patronus*).

The base case scenario uses the average daily intake flow, the mean density estimates based on larval data from the NOAA Fisheries' SEAMAP, and the estimated life history parameters (e.g., mortality, stage duration) based on available literature.

The Delfin LNG Project has been designed to meet the purpose and need while avoiding, minimizing, and, where necessary, mitigating environmental impacts. The Project has a number of environmental objectives that were important in the site selection process, the pipeline strategy evaluation, and the LNG liquefaction process selection. Importantly, as designed, the Project has minimized the use of seawater in the liquefaction process through detailed evaluation and selection of an alternative process cooling technology.

Process cooling for floating LNG liquefaction facilities can be accomplished by open-loop, water-cooled heat exchangers or by air-cooled heat exchangers. Closed-loop water cooling for liquefaction process cooling on floating LNG liquefaction facilities was not considered a viable option due to the amount, and subsequent weight, of piping required to achieve the change of water temperature (ΔT) required for liquefaction through induction cooling from ambient seawater.

An open-loop, water-cooled system for liquefaction utilizes a once-through water-cooling system that requires a substantial volume of seawater to remove heat from the process. Cooling water intake systems can result in both impingement mortality and entrainment mortality of aquatic organisms due to high seawater intake rates needed to meet required the volumes sufficient for liquefaction process cooling. Fish and other organisms that are pinned to intake screens are "impinged," while smaller fish, eggs, and larvae that are swept through the structure with the cooling water are "entrained." The amount of cooling seawater required depends on the acceptable temperature rise between the intake and discharge temperature (ΔT of seawater). Temperature rise in seawater can be detrimental to the local marine life if the heat cannot be dispersed by the sea currents and wave action in a reasonable amount of time.

In past projects for LNG import terminals, NOAA Fisheries has expressed concern about the potential cumulative adverse effects of open-loop process cooling systems on fish populations, mainly because marine organisms (eggs and larvae that can pass through the seawater intake screens) would be

entrained and likely killed in the once-through open-loop cooling systems. An open-loop system would use between 72 and 290 million gallons of seawater per day per FLNGV, depending on the acceptable increase of ambient seawater temperature if this technology is used. Secondary biological effects from the open-loop system are fish impingement on intake screens. Delfin LNG discarded the use of open-loop heat exchangers as an option due to entrainment and mortality of ichthyoplankton, impingement mortality of larger fish, and the degree of localized seawater heating caused by open-loop systems.

For the proposed Delfin FLNGVs, air cooling was the recommended cooling medium for the following reasons:

- Insignificant impact on marine life; and
- No requirements of cooling medium (glycol and fresh water mix) storage and circulation system on board. Space requirements preclude serious consideration of freshwater cooling towers for this project.

It should be noted that small-dedicated seawater cooling would be used on an intermittent basis for cooling of engines of essential generators during intermittent or emergency testing of the FLNGVs.

For Delfin LNG, each FLNGV will use approximately 3.03 million gallons of seawater per day, or approximately 12 million gallons per day for all four FLNGVs during full operation. This represents a reduction in seawater use of over 98% as compared to an open loop process cooling system that might require 200 million gallons of seawater per day for each of the four FLNGVs. The 3.03 million gallons of seawater used per FLNGV each day equates to approximately 4.4 billion gallons of water per year for all four FLNGVs. This is the process water volume that has been used for determining impacts to ichthyoplankton and select taxa within this report.

Delfin LNG Water Usage Calculation:

Single FLNGV Water Use		*# of FLNGVs*		*# Days per Year*		*Annual Water Use for Port Delfin LNG*
3.03 mgd	x	*4*	x	*365*	=	*4,423 million gallons*

2 Data Procurement and Management

Outlined below is a description of the SEAMAP ichthyoplankton studies, the Delfin LNG study area, and the procedures used to calculate fish egg and larval densities from the SEAMAP samples taken from the defined source water body.

2.1 SEAMAP Program

Ichthyoplankton sampling has been conducted in the Gulf of Mexico as part of SEAMAP (Rester et al. 2000) since 1982. The sampling is conducted at standard stations, which are located at 30-mile (48-kilometer), or 0.5° intervals comprising a fixed, systematic grid across the Gulf of Mexico. Occasionally, samples are taken at non-standard locations, or stations are moved to avoid navigational hazards. Samples are taken upon arrival at a station, regardless of time of day. Sampling cruises are routinely made during the summer and fall (June through November). July and September are typically the focal months of these surveys. The SEAMAP data represent fish eggs and larvae only; the data do not include other taxa (e.g., shrimp or crab species).

Lyczkowski-Shultz et al. (2004) reported that the sampling gear and methodology used for SEAMAP ichthyoplankton surveys follow Kramer et al. (1972), Smith and Richardson (1977), and Posgay and Marck (1980). A 24-inch (61-centimeter) bongo net fitted with 0.333-millimeter mesh is fished in an oblique tow path to a maximum depth of 656 feet (200 meters) or to 6.56 to 16.4 feet (2 to 5 meters) off the bottom at depths less than 656 feet (200 meters). A mechanical flow meter is mounted off-center in the mouth of each bongo net to record the volume of water filtered. The volume of water filtered varies between approximately 20 to 600 m^3, but is typically 30 to 40 m^3 at the shallowest stations and 300 to 400 m^3 at the deepest stations. These data provide density estimates (i.e., the number of larvae or eggs per m^3). In addition to the bongo net sampling, a single or double 2- by 1-meter pipe-frame neuston net fitted with 0.04-inch (0.947-millimeter) mesh is towed at the surface with the frame half submerged for 10 minutes. These data yield catch-per-unit effort rather than density indices. Catches from bongo nets are standardized to account for sampling effort (i.e., volume filtered) and then expressed as number of larvae under 10 square meter (m^2) of sea surface (Lyczkowski-Shultz et al. 2004). This is accomplished by dividing the number of larvae of each taxon caught in a sample by the volume of water filtered during the tow, and then multiplying the result by the maximum depth of the tow in meters and a factor of 10. For the purposes of this ichthyoplankton assessment, the density estimate (number/m^3) is the value of interest. Initial processing of SEAMAP plankton samples is carried out at the Sea Fisheries Institute, Plankton Sorting and Identification Center (ZSIOP), in Szczecin, Poland, and the Louisiana Department of Wildlife and Fisheries (LDWF) (Lyczkowski-Shultz et al. 2004). Vials of eggs and identified larvae, plankton displacement volumes, total egg counts, and counts and length measurements of identified larvae are sent to the SEAMAP archive at the Florida Marine Research Institute in St. Petersburg, Florida. These data are entered into the SEAMAP database, and specimens are preserved and loaned to interested scientists. Data files containing specimen identifications and lengths are sent to the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) Mississippi Laboratories where these data are combined with field collection data and edited according to established SEAMAP editing routines. SEAMAP survey data are currently maintained in dBase file structures, but conversion to an Oracle-based system is underway.

2.2 Study Area – Source Water Body

Selection of the size and configuration of a study area within which SEAMAP data are considered representative of a proposed site requires careful consideration of the SEAMAP sampling station grid, the strong cross-shelf distribution of ichthyoplankton (e.g., Ditty et al. 1988; Hernandez et al. 2002; Shaw et al. 2002), and environmental factors, such as proximity to shore and depth of the study area.

The boundary polygon defining the Delfin LNG study area was developed and further refined based on comments received during the deepwater port application process. The final area selected is a block defined by the following corner coordinates, as depicted in Attachment A of this submittal: 93.27º W, 28.87º N; 93.77º W, 28.88º N; 93.23º W, 29.32º N; 93.77º W, 29.32º N.

2.3 SEAMAP Data Analyses

Detailed methods used for analyzing the SEAMAP ichthyoplankton data are provided in Attachment B. Generally, these descriptions identify the three SEAMAP data files (STAREC, ISTRWK, ISARWK) that are used together to estimate fish larvae and egg densities, and the relevant fields within each data file. The STAREC describes when and where sampling operations took place. The ISTRWK is the data file that contains gear code information, volumes filtered, and all egg data, whereas the ISARWK dataset provides data about individual taxa. STAREC and ISTRWK can be merged based on three common fields (cruise number, vessel, and station number). The sample number field is required to merge these data with the ISARWK data file.

2.4 Ichthyoplankton Densities and Taxa Composition

A description of the fish egg and larvae density calculations were obtained for the Delfin LNG site (see Section 2.1). These densities are based on samples taken during the months of June through November and the years 1983-2012.

A total of 59 samples of larval fish and eggs were analyzed from sampling stations within the Delfin LNG area. Over 1,200 taxonomic categories, including unidentified specimens, were identified from these stations. Overall, the density of fish larvae averaged 0.274 larvae/m^3, whereas the density of fish eggs averaged 4.616 eggs/m^3.

2.5 Species of Concern

Species of concern include those that are of ecological and/or economic importance, including managed species, in addition to the fact that life history data were readily available for use in the model. For the Delfin LNG area (as with other deepwater port areas), the species of concern include red drum, red snapper, Gulf menhaden, and bay anchovy. Bay anchovy have ecological value as a prey species, while Gulf menhaden have commercial as well as prey value. Red drum and red snapper are managed, high-value, recreational and/or commercial species.

Importantly, and from a very conservative perspective, data used for each species of concern included all relevant taxonomic categories for each of the four selected species. Because SEAMAP samples cannot always be identified to species level, data are also reported at genus and/or family levels and, therefore, may or may not actually be the species of concern. For example, for red drum, taxonomic search categories used in the analysis included family (Sciaenidae), genus (*Sciaenops*) and species (*ocellatus*) names. But, for all 59 stations, only Sciaenidae was reported by NOAA's contracting laboratory for the samples used in this analysis. Hoese and Moore (1998) report that croakers [F. Sciaenidae] "*are perhaps the most characteristic group of northern Gulf inshore fishes. In numbers they exceed all other families,*

and in number of individuals, or biomass, they are among the top three [*besides mullet and anchovies*]." Sciaenids include sand drum, Atlantic croaker, whiting, black drum, spotted seatrout, silver seatrout and several other ubiquitous species. Generally, red drum eggs and larvae are found near mouths and inlets of bays, and develop to post-larvae within estuarine marshes for the first several weeks after hatching. Several studies report that red drum larvae are abundant within tidal inlets during late fall periods (Holt et al. 1989). This information suggests that entrainment, and subsequently determined loss of age-1 equivalents for red drum, are likely overly conservative to unreliable, at best.

Similar taxonomic issues in the SEAMAP data were observed for red snapper. Of the 36 reported records for the three taxonomic categories, Lutjanidae, *Lutjanus* spp., and *L. campechanus*, only 33 percent (12) of the records were for 'true' red snapper; 66 percent (24) were for the other two taxonomic groups identified, which could include any of the six other *Lutjanus* species, including lane (*L. synagris*), mutton (*L. analis*), gray (*L. griseus*), dog (*L. jocu*), schoolmaster (*L. apodus*), or Cubera *(L. cyanopterus*) snapper. Again, as with red drum, the data query approach (per the U.S. Coast Guard [USCG] and Maritime Administration [MARAD] 2004) will likely result in a subsequent loss of age-1 equivalents that is overly conservative. Similarly, for anchovy, the query included *Anchoa mitchelli*, *Anchoa* spp., and Family Engraulidae. For menhaden, taxonomic categories included *Brevoortia patronus*, *Brevoortia* spp., and Family Clupeidae.

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3 Calculation of Potential Entrainment Estimates

The potential entrainment estimates for larvae and eggs were obtained by multiplying the observed densities by the daily average intake volume by the days of exposure. Net extrusion effects were accounted for by multiplying the observed densities by a factor of 3. These estimates include three assumptions, in addition to the net extrusion adjustment factor. These additional assumptions include:

1. The depth-integrated samples reflect the densities that would be encountered at the depth of the intake location;
2. The densities obtained from the summer-fall collections are considered representative of the average density over the whole year (because LNG gas transfer schedules may vary and be inconsistent over an annual period); and
3. Exposure would occur intermittently over the entire year.

However, Assumption #2 concerning densities is likely not true (see Section 2.5), and Assumption #1 likely results in an overestimate of the actual ichthyoplankton densities found at the intake location since the depth-integrated sample accounts for the density across the entire water column.

3.1 Annual Estimates

Given the above, the annual estimates of impingement and entrainment of fish eggs and larvae for the Delfin LNG area (for all four FLNGVs) are provided in Table 1.

Table 1. Projected Annual FLNGVs Estimates of Impingement and Entrainment

	Lower 95% Confidence Limit (LCL)	Annual Mean	Upper 95% Confidence Limit (UCL)
Fish Eggs	15,014,889	36,471,801	416,323,508
Fish Larvae	886,620	2,153,639	24,583,659

Expected average larval densities, along with upper and lower confidence intervals, for the four species of concern are provided in Table 2.

Table 2. Projected Annual FLNGVs Larval Entrainment Values

Species	Associated Taxa In SEAMAP Data	Annual LCL	Annual Mean	Annual UCL
Bay anchovy	F. Engraulidae, *Anchoa* spp.	800,772	1,904,146	21,464,680
Gulf menhaden	F. Clupeidae, *Brevoortia patronus*	28,109	84,231	16,215,205
Red drum	*S. ocellatus* and Sciaenids	30,325	114,349	1,574,483
Red snapper	*L. campechanus* and F. Lutjanidae	27,412	50,911	477,442

Key:
LCL = Lower confidence limit
UCL = Upper confidence limit

Because eggs were not identified to species, species-specific egg entrainment was determined by first calculating the ratio of total eggs to total larvae for the SEAMAP database. Respective densities were adjusted by a multiple of 3 for net extrusion. This yielded estimates of larvae and egg entrainment for the average, upper confidence limit (UCL), and lower confidence limit (LCL) cases from which egg/larvae ratios were determined. Egg/larvae ratios (16.9) were multiplied by annual larval entrainment for each species and each entrainment scenario (LCL, average, and UCL) to yield the projected egg entrainment for each representative species, as presented in Table 3.

Table 3. Projected Annual FLNGVs Egg Entrainment Values

Species	Associated Taxa In SEAMAP Data	Annual		
		LCL[1]	Mean	UCL[1]
Bay anchovy	F. Engraulidae, *Anchoa* spp.	13,561,065	32,246,655	363,503,693
Gulf menhaden	F. Clupeidae, *Brevoortia patronus*	476,029	1,426,464	18,070,526
Red drum	*S. ocellatus* and Sciaenids	513,563	1,936,497	26,663,822
Red snapper	*L. campechanus* and F. Lutjanidae	464,231	862,184	8,085,465

Notes:
Values are derived by multiplying larval entrainment by species from Table 2 by the egg-to-larvae ratio for each entrainment scenario.
[1] Confidence limits for the mean are an interval estimate for the mean. Interval estimates are often desirable because the estimate of the mean varies from sample to sample. Instead of a single estimate for the mean, a confidence interval generates a lower and upper limit for the mean. The interval estimate gives an indication of how much uncertainty there is in our estimate of the true mean. The narrower the interval, the more precise is our estimate. For this study, there was, generally, high variability between entrainment numbers compared to the mean, thus the large variances for both LCL and UCL for all four species. See Snedecor and Cochran (1989) for more detail on confidence limits.

4 Ichthyoplankton Assessment Model Methods

E^2M, a consultant to the USCG, developed an Ichthyoplankton Assessment Model for specific taxa in association with the formerly proposed Gulf Landing LNG facility (USCG and MARAD 2004). The USCG has instructed that this model be used without change in the assessment process for new LNG projects so that impact assessments among projects will be comparable. In this section, we apply the USCG and MARAD (2004) model as amended by USCG and MARAD (2005) to the same taxa treated in the Gulf Landing Final EIS. The model involves calculating age-1 equivalents and equivalent yield (for the taxa based on the entrainment estimates and life history characteristics of the taxa).

The equivalent yield analysis begins with the larval impacts associated with FLNGVs expressed as the number of age-1 fish eggs and larvae that would have become adults if they had not been entrained and killed. The yield that these fish would have contributed over time is estimated and expressed as an equivalent increase in fishing pressure. In other words, an equivalent yield estimate that represents 2 percent fishing pressure on the population when compared to that harvest, not a 2 percent loss of that harvest (USCG and MARAD 2004).

4.1 Life History Tables

Calculations of both age-1 equivalents and equivalent yield use stage-specific mortality rates to project the number of entrained eggs and larvae that otherwise would have been expected to survive to age-1 or would have been caught in a commercial or recreational fishery. The two critical life history values of importance for both estimates are daily, instantaneous mortality rates for identified stages and duration in days for each stage (e.g., USCG and MARAD 2004, Table G-13, as amended). Total mortality per stage is the product of daily instantaneous mortality and stage duration. Calculating total natural mortality is a prerequisite for estimating both age-1 equivalents and equivalent yield.

To address variability in recruitment, the critical life histories are determined for three separate scenarios:

1. A base mortality case;
2. A low mortality case; and
3. A high mortality case.

The base mortality case provides estimates of daily mortality and stage duration based on average values provided in the scientific literature (e.g., USCG and MARAD 2004, Table G-13, as amended). In the low mortality case, critical values are based on low or lower-end estimates of mortality provided in the scientific literature (e.g., USCG and MARAD 2004 Table G-13 as amended), whereas high mortality critical values are determined from high or higher end estimates (e.g., USCG and MARAD 2004, Table G-13, as amended).

Three additional critical life history values are required for calculating the equivalent yield of taxa that are commercially or recreationally fished:

1. Natural mortality rate per stage for individuals age-1 and older;
2. Fishing mortality rate per stage for individuals age-1 and older; and

3. Weight at median age of death per stage for individuals age-1 and older (e.g., USCG and MARAD 2004, Table G-16, as amended).

Within individual taxa, these critical values remain constant regardless of whether it is the base, low, or high mortality case for stages younger than age-1. It is assumed that fish age-1 and older are not subject to entrainment; therefore, parameter values are independent of the entrainment process.

Critical life history values used in this Ichthyoplankton Impact Analysis for Delfin LNG were taken directly from tables provided in USCG and MARAD (2004), as amended.

Red Drum

Instantaneous daily mortality and stage duration values for five initial stages of red drum are provided in USCG and MARAD 2004, Table G-13, as amended, along with the references used to determine those estimates. These data are for the base case mortality, low mortality, and high mortality scenario; they use average values of instantaneous daily mortality and stage duration. Additional critical values for individuals age-1 and older that are needed to calculate equivalent yield are provided in USCG and MARAD 2004, Table G-16, as amended.

Red Snapper

Critical life history values for four initial stages of red snapper are provided in USCG and MARAD 2004, Table G-58, as amended for the base, low, and high mortality cases. Additional critical values (natural mortality, fishing mortality, weight at median age of death) for individuals age-1 and older needed to calculate equivalent yield are provided in USCG and MARAD 2004, Table G-59, as amended.

Bay Anchovy

Critical life history values for three initial stages of bay anchovy are provided in USCG and MARAD 2004, Table G-34, as amended, for the base, low, and high mortality cases.

Gulf Menhaden

Critical life history values for three initial stages of Gulf menhaden are provided in USCG and MARAD 2004, Table G-42, as amended, for the base, low, and high mortality cases. Additional critical values for individuals age-1 and older that are needed to calculate equivalent yield are provided in USCG and MARAD 2004, Table G-43, as amended.

4.2 Age-1 Equivalent Analysis

Age-1 equivalents represent the number of individuals of each taxon that would have been expected to survive to age-1 had they not been entrained (see Attachment C). The variables and parameters used to calculate the number of age-1 equivalents are detailed in Section 3.1 of USCG and MARAD (2004). To describe the analysis, the age-1 equivalent table for the red drum base mortality case (USCG and MARAD 2004, Table A3.1 in Attachment 3) was used as an example.

As discussed above, critical values for instantaneous daily mortality and stage duration (days) were taken from the appropriate table in USCG and MARAD (2005). For the red drum base mortality case, this is Table G-13 in USCG and MARAD (2005).

The product of instantaneous daily mortality and stage duration yields total natural mortality per stage. By definition, Total Mortality is the sum of natural mortality and fishing mortality. Since fishing

mortality for fish under the age of 1 is always zero, total mortality per stage is the natural mortality per stage. The fraction of individuals surviving a stage (Fraction Surviving) is defined by Equation 6 in USCG and MARAD (2004):

Fraction Surviving = EXP (-Total Mortality) (1)

"Correction" is an adjustment factor used to account for underestimation of mortality based on the model assumption that all larvae are at the beginning of a life history stage when entrained. In fact, this may not be the actual case. The Correction represents a revised Fraction Surviving and is defined by Equation 4 in USCG and MARAD (2004):

Correction = 2 * Fraction Surviving * EXP (-log(1 + Fraction Surviving)) (2)

The Number Potentially Entrained is the estimated number of entrained red drum, expressed as the mean, 95 percent LCL, and 95 percent UCL (see Tables 1 and 2).

Fraction Surviving to Age 1 is the product of all values of Fraction Surviving for all stages remaining in the table beyond and including the stage of interest. Note that, for the stage of interest, the Correction value is used; but for all the remaining stages, the Fraction Surviving values are used. In Table A3.1 in Attachment 3 of USCG and MARAD (2004), the Fraction Surviving to Age-1 for Larvae is calculated as the Larvae Correction multiplied by the Juvenile 1 Fraction Surviving multiplied by the Juvenile 2 Fraction Surviving multiplied by the Juvenile 3 Fraction Surviving. The Number Surviving for each stage is the product of the Number Potentially Entrained and the Fraction Surviving to Age 1. These values are calculated for both the egg and larvae stages and are summed to yield the total number of age-1 equivalents.

4.3 Equivalent Yield Analysis

Equivalent yield takes the estimated larval impacts associated with the intake of seawater and adjusts those impacts forward in time to resemble a fishery yield or harvest. The equivalent yield estimate is used as a base for reasonable comparison to other fisheries to help assess potential stress or pressure on the population. Equivalent yield is in no way intended for, or capable of, predicting direct losses to fish landings or harvest.

The analysis begins with an age-1 equivalent analysis. The variables and parameters used to calculate the number of age-1 equivalents are detailed in Section 3.2 of USCG and MARAD (2004), as amended, and as summarized above. For this report, a tabular equivalent yield model is provided as Attachment D.

4.4 Sensitivity Analyses

To address variability in recruitment, low and high ranges of mortality and entrainment were compared to assess differences in extreme ranges in entrainment loss relative to the base scenario. These analyses are presented in summary tables, along with summaries of age-1 equivalent and equivalent yield analysis. The upper extreme estimate is for UCL entrainment and low mortality. Such a case in which there would be maximum entrainment and minimum natural mortality would result in the highest proportionate loss of fish due to entrainment, or the highest losses in terms of age-1 equivalents and equivalent yield. The converse is the case in which there would be low (LCL) entrainment and high natural mortality.

Under high natural mortality, most of the entrained fish would have been lost, thereby minimizing the loss attributed to entrainment. Total entrainment, age-1 equivalents, and equivalent yield under either

the UCL entrainment/low mortality or LCL entrainment/high mortality cases provide the sensitivity contrast. The results of four likely scenarios also are provided for each species:

- Low larval mortality/average entrainment;
- High larval mortality/average entrainment;
- Base larval mortality/UCL entrainment; and
- Base larval mortality/LCL entrainment.

5 Model Results

Detailed results of the age-1 equivalent and equivalent yield analyses for the four primary species of concern are provided in Attachments C and D, respectively. The following is a summary of the results by species.

5.1 Red Drum

Using the average entrainment estimates and base case life history values, it is estimated that 114,349 red drum (and F. Sciaenidae) larvae and 1,936,498 eggs would be entrained. In this case, 670 age-1 equivalents are represented and would have had an equivalent yield of 3,352 pounds (lbs) (1,520 kilograms [kg]). It should be noted that this estimate assumes that all larvae identified in the family Sciaenidae are in fact red drum, which is highly unlikely given the abundance of other sciaenids (including Atlantic croaker - *Micropogonias undulate*s, and spot croaker - *Leiostomus xanthurus*) found in the shallow continental shelf waters of the northern Gulf of Mexico.

If we assume the low mortality life history scenario and use the UCL for the entrainment estimate, 60,362 age-1 equivalents are represented with an equivalent yield of 301,899 lbs (136,939 kg). In this unlikely scenario, estimated take of age-1 equivalents and the resulting equivalent yield estimate would be more almost two orders of magnitude higher than the base case estimate. In contrast, if we use the lower confidence interval of the entrainment estimate and the high mortality life history case, age-1 equivalents is 178 fish and equivalent yield is only 889 lbs (403 kg).

5.2 Red Snapper

Using the average entrainment estimates and base case life history values, it is estimated that 50,911 red snapper larvae and 862,184 eggs would be entrained. In this case, 133 age-1 equivalents are represented and would have had an equivalent yield of 232 lbs (105 kg). If we assume the low mortality life history scenario and use the UCL for the entrainment estimate, 48,439 age-1 equivalents are represented with an equivalent yield of 79,690 lbs (36,146 kg). In this unlikely scenario, estimated take of age-1 equivalents and the resulting equivalent yield estimate would be more than two orders of magnitude higher than the base case estimate. In contrast, if we use the lower confidence interval of the entrainment estimate and the high mortality life history case, age-1 equivalents is 3 fish and equivalent yield is only 5 lbs (2.3 kg).

5.3 Gulf Menhaden

Using the average entrainment estimates and base case life history values, it is estimated that 84,232 Gulf menhaden larvae and 1,426,464 eggs would be entrained. In this case, 250 age-1 equivalents are represented and would have had an equivalent yield of 50 lbs (23 kg). If we assume the low mortality life history scenario and use the UCL for the entrainment estimate, 8,559 age-1 equivalents are represented with an equivalent yield of 1,700 lbs (771 kg). In this unlikely scenario, estimated take of age-1 equivalents and the resulting equivalent yield estimate would be 34 times higher than the base case estimate. In contrast, if we use the lower confidence interval of the entrainment estimate and the high mortality life history case, age-1 equivalents is 11 fish and equivalent yield is only 2 lbs (0.9 kg).

5.4 Bay Anchovy

As anchovies are not fished, we provide age-1 equivalent values, but do not calculate equivalent yield losses. For the average entrainment and base mortality case, total entrainment was estimated at 1,904,146 anchovy larvae and 32,246,655 eggs. In terms of age-1 equivalents, the expected loss to the system would be 5,098 anchovies in the average likelihood scenario. For the extreme low mortality/UCL entrainment scenario, age-1 equivalent losses would increase to 251,033 anchovies. At the other extreme, the high mortality/LCL entrainment case, losses would be 913 age-1 anchovies.

5.5 Summary

The FLNGVs' operations associated with the Port Delfin LNG Project could have adverse impacts on the representative species. The potential commercial and recreational fishing impacts of most concern are caused by the population decreases from impingement and entrainment from water intakes for the FLNGVs. A summary of the Project's economic impacts on commercial and recreational fishing, including potential impacts to red snapper, red drum, Gulf menhaden, and bay anchovy, is provided in Table 4 and presented below. Overall, the economic impacts to commercial and recreational fishing from the entrainment and impingement of the representative species from the operation of the Port Delfin LNG Project would not be significant for the duration of the Project.

Table 4. Summary of Annual Economic Impacts to Fishery from Delfin LNG

Species	Age-1 Equivalents Lost (average entrainment/base case mortality)	Pounds of Fish Lost	Estimated Economic Impact
Red Drum	670	3,352	$0 - $4,357.00
Red Snapper	133	232	$0 - $934.96
Gulf menhaden	250	50	$0 - $45.00
Bay anchovy	5,098	22	N/A

Key:
N/A = not applicable

Red Drum

Commercial and recreational fishing of red drum in Gulf of Mexico federal waters is illegal (Gulf of Mexico Fishery Management Council [GMFMC] 2004). Commercial harvesting of red drum is also prohibited in Louisiana state waters; however, recreational fishing is permitted with a five fish per day limit, with not more than one exceeding 27 inches. Under base-case parameters, the Port Delfin LNG Project would reduce the number of red drum age-1 equivalents by 670 individuals. If each recreational fishing trip met the current allowable limit, including the catch and release program, the loss of 670 age-1 red drum (3,352 lbs [1,520 kg]) would not affect the number of fishing trips taken. However, a decrease in the red drum population could cause a loss in the value of recreational fishing trips. The latest NOAA Fisheries report (2004) available on the price of commercially-landed red drum was $1.30/lb ($0.59/kg). Based on only this information, the Port Delfin LNG Project's economic impact from red drum entrainment and impingement from the estimated annual population reduction would range from $0.00 to no more than $4,357.20 (see Table 4 above). Based on these values, impacts to the red drum recreational fishery are not considered significant.

Red Snapper

The Port Delfin LNG Project would cause an estimated annual loss of 133 age-1 equivalents (232 lbs [105 kg]) due to entrainment and impingement from FLNGV water intake. According to the 2014 annual landings by species database (NOAA Fisheries 2015), the price of Gulf Coast red snapper is $4.03/lb. Therefore, the estimated annual economic impact from the entrainment and impingement of red snapper would range from $0.00 to no more than $934.96 (see Table 4 above). Based on this amount, the Port Delfin LNG Project's impact to the red snapper commercial and recreational fisheries would not be significant.

Gulf Menhaden

The Gulf menhaden fishery is primarily harvested commercially, with no significant recreational harvesting in the Gulf of Mexico. Federal and state regulations are focused on area and seasonal closures with few restrictions, if any, on size or total trip limits; therefore, the fishery is similar to an open access fishery (Gulf States Marine Fisheries Commission [GSMFC] 2002).

The Port Delfin LNG Project is expected to impact the Gulf menhaden population by approximately 250 individuals or 50 lbs (23 kg). This population reduction is a very small percentage of the total population in the Gulf of Mexico, and no change will occur in the standing crop. In 2014, the price per pound of Gulf menhaden was $0.90 (NOAA Fisheries 2015). The economic impact from Gulf menhaden entrainment and impingement from the annual reduction in population would be $0.00 to no more than $45.00. Therefore, the impact to the Gulf menhaden commercial fishery from the operation of the Port Delfin LNG Project would not be significant.

Bay Anchovy

The bay anchovy is not commercially or recreationally fished; however, it is an important food source for a number of commercially and recreationally harvested species. Therefore, the Port Delfin LNG Project could impact commercial and recreational fisheries by the loss of 5,098 bay anchovy, or approximately 22 lbs (10 kg). The bay anchovy, itself, would not cause an economic loss as it is not commercially or recreationally fished. Based on these values, impacts to bay anchovy from the Port Delfin LNG Project would not be significant.

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6 Conclusion

The Port Delfin LNG Project intentionally designed the LNG liquefaction process aboard each FLNGV to operate with air-cooling rather than a water-cooled process. This engineering decision increased the cost and reduced the thermal efficiency of the LNG liquefaction cooling process aboard each FLNGV, but reduced the volume of seawater required to operate each unit by more than 98% when compared to an open loop cooling system requiring 200 million gallons (or more) of seawater each day for each of the four FLNGVs.

This report concludes that the impacts to ichthyoplankton and fisheries resources from entrainment within water intakes for the Port Delfin LNG Project are insignificant. The overall daily water use expected for the four FLNGVs will be approximately 12 million gallons per day. Compared to other water intakes for various industries and vessels along the Gulf Coast, these numbers are extremely low.

The various assumptions used in the Ichthyoplankton Assessment Model, including the cumulative use of related taxonomic categories (e.g., inclusion of all taxa identified to Sciaenidae as red drum – see Section 2.5), the use of a net extrusion factor of 3 for baseline entrainment values, and use of depth-integrated SEAMAP data for surface-oriented intakes, likely results in over-estimates of entrainment, which lead to overly-conservative results for subsequent lost age-1 individuals and equivalent yield values. Importantly, the current forward-projecting equivalent adult model (EAM) used by the USCG has been critically evaluated, and its inadequacy has been demonstrated within peer-reviewed technical papers (see Gallaway et al. 2007). Gallaway et al. (2007) noted that forward-projecting EAMs are likely inappropriate and lead to gross over-estimates of predicted losses. For example, Gallaway et al. (2007) note that, based on review of seven proposed offshore LNG terminals, forward-projecting EAMs were 387 times greater than if a fecundity hindcast model would have been used. The primary issue noted by Gallaway et al. is that the EAMs do not include any density-dependent compensation; the models are strictly linear or density independent. Gallaway et al. (2007) state that this approach leads to results on population effects that over-estimate impacts.

Delfin LNG has applied USCG's forward-projecting EAM model based on its historical application during previous DWPA application proceedings, but believes that the model skews the understanding of "real world" impacts toward a much more conservative direction than is warranted by the data. This belief is supported by recent peer-reviewed scientific studies considering this topic (see Gallaway et al. 2007). However, even using the highly conservative forward-projecting EAM model, the predicted fisheries impacts from the Port Delfin LNG Project were evaluated as insignificant. Considering the high degree of uncertainty associated with the historically used USCG/MARAD model, and issues brought to bear concerning its use for estimating fisheries' population impacts, the impacts expected from entrainment and impingement for the four species of concern are considered inconsequential.

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Attachment A: Source Waterbody

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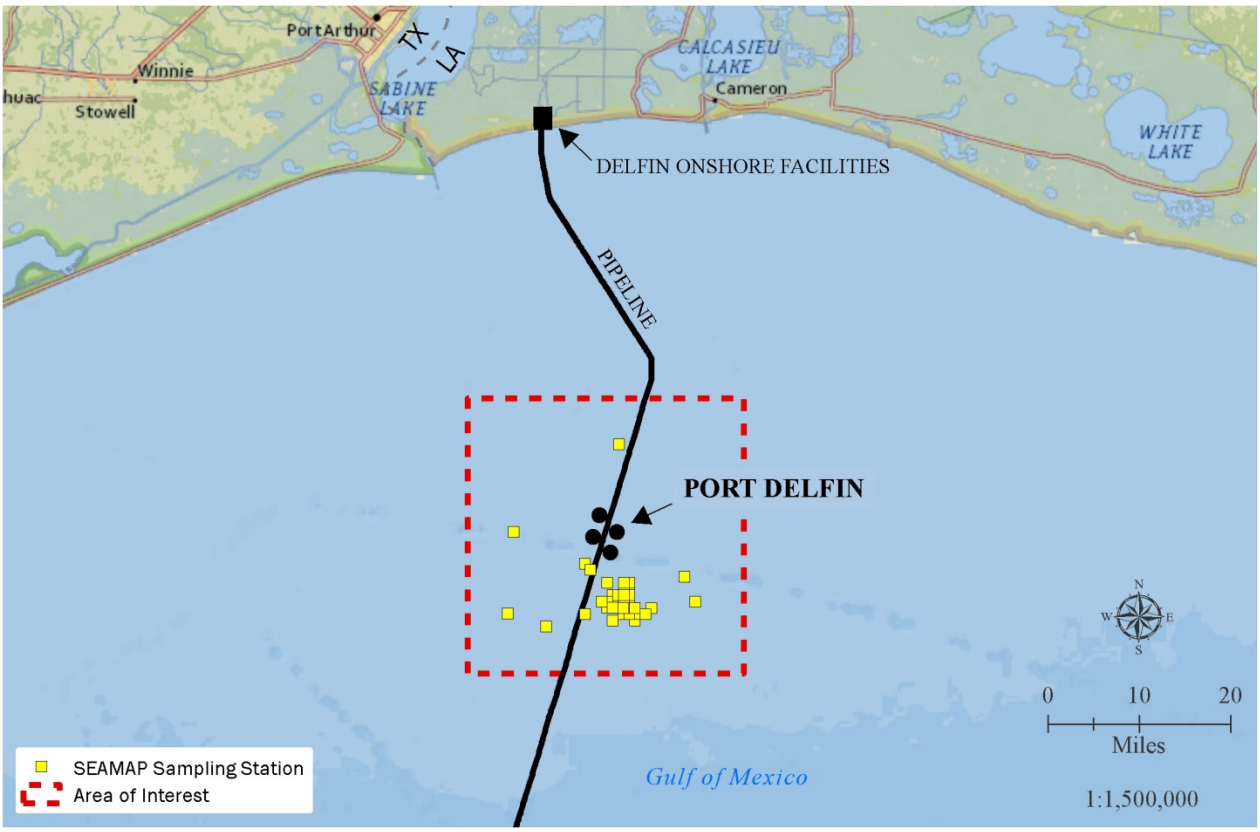
Port Arthur
TX
LA
Winnie
Stowell
SABINE LAKE
CALCASIEU LAKE
Cameron
WHITE LAKE
DELFIN ONSHORE FACILITIES
PIPELINE
PORT DELFIN
SEAMAP Sampling Station
Area of Interest
Gulf of Mexico
0
10
20
Miles
1:1,500,000

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Attachment B: SEAMAP Analysis Methods

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Data Sources

The databases used for the Ichthyoplankton Impact Analysis were obtained from the NOAA Fisheries, Pascagoula, dated 9/2/04. They were obtained from the following file transfer protocol site: ftp://ftp.mslabs.noaa.gov/pub/seamap.

The file obtained from this location is: Ichthyoplankton_9_2_04ascii.zip. This file includes 3 datasets containing different parameters of SEAMAP data. Structural relationships from these datasets were set-up in order to analyze the fish egg and larvae data. These 3 datasets include the following:

- STAREC: This dataset contains when and where sampling operations take place. Fields that were queried which were necessary to complete the analysis included:
    1. VESSEL
    2. CRUISE_NO
    3. P_STA_NO
    4. S_LATD
    5. S_LATM
    6. S_LOND
    7. S_LONM
    8. S_STA_NO
    9. MO_DAY_YR

- ISTRWK: This dataset contains information on the plankton samples taken at each station and the results of all egg data collected. Fields that were queried which were necessary to complete the analysis included:
    1. VESSEL
    2. CRUISE_NO
    3. P_STA_NO
    4. VOL_FILT
    5. NO_EGGS
    6. EGGS_ALIQU

- ISARWK: This is the individual taxa dataset which contains information on each individual fish larvae taxa collected in each sample. Fields that were queried which were necessary to complete the analysis included:
    1. VESSEL
    2. CRUISE_NO
    3. P_STA_NO
    4. TAXONOMIC
    5. TAXON
    6. MEAS
    7. NOT_MEAS
    8. ALIQUOT

Merging Datasets

Information between STAREC and ISTRWK can be linked (merged) by setting a relationship between the unique combination of the VESSEL, CRUISE_NO and P_STA_NO variables or the V_C_P variable. Information between ISTRWK and ISARWK can be linked (merged) by setting a relationship between the unique combination of VESSEL, CRUISE_NO, P_STA_NO and SAMPLE_NO variables or the V_C_P_S variable.

Data Analysis

The STAREC dataset, with its station time and place information is the core dataset for these analyses. The dataset contains latitude and longitude values which are converted to decimal degrees, and the sample date are used to create the variable for sample month and sample year which are then transferred to into a database file. Then the STAREC, ISTRWK, and ISARWK files are merged using the variables listed above in order to create a datasheet containing: VCP, MO-DAY_YR, VOL_FILT_, DEPTH_MA_, NUM_EGGS, EGGS_ALIQUOT, TAXONOMIC, TAON, MEAS, NOT_MEAS, and ALIQUOT. After the merger, the VOL_FILT is also converted from a negative value to NA, to adjust for differences in the handling of missing data.

The SEAMAP station data used in the analysis is restricted to the sample found within the Project area/source water body. All stations falling on or inside the boundaries of the project area were included.

In order to use the egg data in the analysis, the number of eggs per cubic meter of water filtered was calculated for each sample in the combined STAREC-ISTRWK dataset where the VOL_FLT variable if greater than zero. The mean egg catch per unit effort (cpue) and 2 standard errors are then calculated to produce the mean value with upper and lower confidence intervals. Where the NO_EGGS variable is equal to zero and the EGG_ALIQU variable is not a valid value, the result is changed to NA.

In order to use the fish larvae data in the analysis, the ISARWK data that is in the database is restricted to only those entries containing a value for VOL_FILT, so that the values can be used in a quantitative analysis. The variable MEAS and NOT.MEAS are adjusted to zero values where the value in the record is -9, then they are added together to create the total count variable, which is then adjusted by the ALIQUOT variable factor to represent a whole sample.

Fish larvae catch for each sample is aggregated, and divided by the sample VOL FILT parameter to create the sample catch per cubic meter of water filter, fish cpue. From that the mean fish cpue is calculated to produce the mean value with upper and lower confidence intervals, by month of sampling and the sampling period. Once that calculation is complete, catch rates for fish larvae for each individual taxa are calculated as catch per cubic meter of water filtered. Then the catch rate per cubic meter of water filtered is calculated for each taxa at each station. These were summarized to produce the mean cpue for each taxa along with standard errors, so that upper and lower confidence intervals can be calculated.

Attachment C: Age-1 Equivalent Calculations

Table C1. Age-1 equivalents for red drum (*Sciaenops ocellatus*) using base mortality estimates (i.e., base life history) for all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.7558
Larvae	0.25000	20	5.0000	0	5.0000	0.0067	0.0134
Juvenile 1	0.13650	12	1.6380	0	1.6380	0.1944	0.3255
Juvenile 2	0.00540	166	0.8964	0	0.8964	0.4080	0.5796
Juvenile 3	0.00180	166	0.2988	0	0.2988	0.7417	0.8517
	Total =	365		Total =	8.3316		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	513,564	1,936,498	26,663,822	3.00E-04	154	580	7,988
Larvae	30,326	114,349	1,574,483	7.87E-04	24	90	1,240
Juvenile 1							
Juvenile 2							
Juvenile 3							
				Total =	178	670	9,228

Table C2. Age-1 equivalents for red drum (*Sciaenops ocellatus*) using low mortality estimates (i.e., low mortality life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.7558
Larvae	0.17000	20	3.4000	0	3.4000	0.0334	0.0646
Juvenile 1	0.13400	12	1.6080	0	1.6080	0.2003	0.3337
Juvenile 2	0.00478	166	0.7942	0	0.7942	0.4520	0.6225
Juvenile 3	0.00090	166	0.1494	0	0.1494	0.8612	0.9254
	Total =	365		Total =	6.4500		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	513,564	1,936,498	26,663,822	1.97E-03	1,010	3,808	52,434
Larvae	30,326	114,349	1,574,483	5.04E-03	153	576	7,928
Juvenile 1							
Juvenile 2							
Juvenile 3							
				Total =	1,163	4,384	60,362

Table C3. Age-1 equivalents for red drum (*Sciaenops ocellatus*) using high mortality estimates (high mortality life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.4984	1	0.4984	0	0.4984	0.6075	0.75583
Larvae	0.33	20	6.6000	0	6.6000	0.0014	0.00272
Juvenile 1	0.139	20	2.7800	0	2.7800	0.0620	0.11683
Juvenile 2	0.00609	162	0.9866	0	0.9866	0.3728	0.54318
Juvenile 3	0.0018	162	0.2916	0	0.2916	0.7471	0.85522
	Total =	365		Total =	11.1566		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	513,564	1,936,498	26,663,822	0.000018	9	34	474
Larvae	30,326	114,349	1,574,483	0.000047	1	5	74
Juvenile 1							
Juvenile 2							
Juvenile 3							
				Total =	11	40	548

Table C4. Age-1 equivalents for red drum (*Sciaenops ocellatus*) using low larval mortality rates and base mortality estimates (base life history) across all other life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.7558
Larvae	0.17000	20	3.4000	0	3.4000	0.0334	0.0646
Juvenile 1	0.13650	12	1.6380	0	1.6380	0.1944	0.3255
Juvenile 2	0.00540	166	0.8964	0	0.8964	0.4080	0.5796
Juvenile 3	0.00180	166	0.2988	0	0.2988	0.7417	0.8517
	Total =	365		Total =	6.7316		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	513,564	1,936,498	26,663,822	1.48E-03	762	2,873	39,564
Larvae	30,326	114,349	1,574,483	3.80E-03	115	434	5,982
Juvenile 1							
Juvenile 2							
Juvenile 3							
				Total =	877	3,308	45,547

Table C5. Age-1 equivalents for red drum (*Sciaenops ocellatus*) using high larval mortality rates and base mortality estimates (base life history) across all other stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.7558
Larvae	0.33	20	6.6000	0	6.6000	0.0014	0.0027
Juvenile 1	0.13650	12	1.6380	0	1.6380	0.1944	0.3255
Juvenile 2	0.00540	166	0.8964	0	0.8964	0.4080	0.5796
Juvenile 3	0.00180	166	0.2988	0	0.2988	0.7417	0.8517
	Total =	365		Total =	9.9316		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	513,564	1,936,498	26,663,822	6.05E-05	31	117	1,613
Larvae	30,326	114,349	1,574,483	1.60E-04	5	18	252
Juvenile 1							
Juvenile 2							
Juvenile 3							
				Total =	36	135	1,864

Table C6. Age-1 equivalents for red snapper (*Lutjanus campechanus*) using base mortality estimates (base life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.75583
Larvae	0.20500	28	5.7400	0	5.7400	0.0032	0.00641
Juvenile 1	0.10000	24	2.4000	0	2.4000	0.0907	0.16635
Juvenile 3	0.00160	312	0.5001	0	0.5001	0.6064	0.75502
	Total =	365		Total =	9.1385		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	464,232	862,184	8,085,466	0.000134	62	115	1,081
Larvae	27,413	50,911	477,442	0.000353	10	18	168
Juvenile 1				0.100880			
Juvenile 3				0.755017			
				Total =	72	133	1,249

Table C7. Age-1 equivalents for red snapper (*Lutjanus campechanus*) using low mortality estimates (low mortality life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.75583
Larvae	0.15500	26	4.0300	0	4.0300	0.0178	0.03493
Juvenile 1	0.04500	10	0.4500	0	0.4500	0.6376	0.77872
Juvenile 3	0.00163	307	0.5004	0	0.5004	0.6063	0.75489
	Total =	344		Total =	5.4788		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	464,232	862,184	8,085,466	0.005194	2,411	4,478	41,992
Larvae	27,413	50,911	477,442	0.013502	370	687	6,447
Juvenile 1				0.472125			
Juvenile 3				0.754889			
				Total =	2,781	5,165	48,439

Table C8. Age-1 equivalents for red snapper (*Lutjanus campechanus*) using high mortality estimates (high mortality life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.75583
Larvae	0.25500	30	7.6500	0	7.6500	0.0005	0.00095
Juvenile 1	0.12000	31	3.7200	0	3.7200	0.0242	0.04732
Juvenile 3	0.00154	324	0.5000	0	0.5000	0.6065	0.75508
	Total =	386		Total =	12.3684		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	464,232	862,184	8,085,466	0.000005	2	5	43
Larvae	27,413	50,911	477,442	0.000014	0	1	7
Juvenile 1				0.028702			
Juvenile 3				0.755083			
				Total =	3	5	49

Table C9. Age-1 equivalents for red snapper (*Lutjanus campechanus*) using low larval mortality rates and base mortality estimates (base life history) across all other life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.75583
Larvae	0.15500	26	4.0300	0	4.0300	0.0178	0.03493
Juvenile 1	0.10000	24	2.4000	0	2.4000	0.0907	0.16635
Juvenile 3	0.00160	312	0.5001	0	0.5001	0.6064	0.75502
	Total =	363		Total =	7.4285		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	464,232	862,184	8,085,466	0.000739	343	637	5,976
Larvae	27,413	50,911	477,442	0.001922	53	98	917
Juvenile 1				0.100880			
Juvenile 3				0.755017			
				Total =	396	735	6,893

Table C10. Age-1 equivalents for red snapper (*Lutjanus campechanus*) using high larval mortality rates and base mortality estimates (base life history) across all other life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.49840	1	0.4984	0	0.4984	0.6075	0.75583
Larvae	0.25500	30	7.6500	0	7.6500	0.0005	0.00095
Juvenile 1	0.10000	24	2.4000	0	2.4000	0.0907	0.16635
Juvenile 3	0.00160	312	0.5001	0	0.5001	0.6064	0.75502
	Total =	367		Total =	11.0485		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	464,232	862,184	8,085,466	0.000020	9	17	160
Larvae	27,413	50,911	477,442	0.000052	1	3	25
Juvenile 1				0.100880			
Juvenile 3				0.755017			
				Total =	11	20	185

Table C11. Age-1 equivalents for Gulf menhaden (*Brevoortia patronus)* using base mortality estimates (Base life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	1.044	1.75	1.8270	0	1.8270	0.1609	0.27719
YSL	0.059	65	3.8350	0	3.8350	0.0216	0.04229
Juvenile	0.013	298.3	3.8779	0	3.8779	0.0207	
	Total =	365.05		Total =	9.5399		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	476,029	1,426,464	18,070,527	0.000124	59	177	2,239
YSL	28,109	84,232	1,067,054	0.000875	25	74	934
Juvenile							
				Period Total =	84	250	3,173

Table C12. Age-1 equivalents for Gulf menhaden *(Brevoortia patronus)* using low mortality estimates (low mortality life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	1.044	1.50	1.5660	0	1.5660	0.2089	0.34557
YSL	0.0488	60	2.9280	0	2.9280	0.0535	0.10157
Juvenile	0.013	303.5	3.9455	0	3.9455	0.0193	
	Total =	365		Total =	8.4395		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	476,029	1,426,464	18,070,527	0.000358	170	510	6,462
YSL	28,109	84,232	1,067,054	0.001965	55	165	2,096
Juvenile							
				Period Total =	225	676	8,559

Table C13. Age-1 equivalents for Gulf menhaden *(Brevoortia patronus)* using high mortality estimates (high mortality life history) across all life stages.

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	6.210	2.00	12.4200	0	12.4200	0.0000	0.00001
YSL	0.077	60	4.6200	0	4.6200	0.0099	0.01951
Juvenile	0.013	303	3.9390	0	3.9390	0.0195	
	Total =	365		Total =	20.979		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	476,029	1,426,464	18,070,527	0.000000	0	0	0
YSL	28,109	84,232	1,067,054	0.000380	11	32	405
Juvenile							
				Period Total =	11	32	405

Table C14. Age-1 equivalents for Gulf menhaden (*Brevoortia patronus*) using low larval mortality rates and base mortality estimates (Base life history) across all other life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	1.044	1.75	1.8270	0	1.8270	0.1609	0.27719
YSL	0.049	60.000	2.9280	0	2.9280	0.0535	0.10157
Juvenile	0.013	298.3	3.8779	0	3.8779	0.0207	
	Total =	360.05		Total =	8.6329		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	476,029	1,426,464	18,070,527	0.000307	146	438	5,546
YSL	28,109	84,232	1,067,054	0.002102	59	177	2,243
Juvenile							
				Period Total =	205	615	7,789

Table C15. Age-1 equivalents for Gulf menhaden (*Brevoortia patronus*) using high larval mortality rates and base mortality estimates (Base life history) across all other life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	1.044	1.75	1.8270	0	1.8270	0.1609	0.27719
YSL	0.077	60.000	4.6200	0	4.6200	0.0099	0.01951
Juvenile	0.013	298.3	3.8779	0	3.8779	0.0207	
	Total =	360.05		Total =	10.3249		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	476,029	1,426,464	18,070,527	0.000057	27	81	1,021
YSL	28,109	84,232	1,067,054	0.000404	11	34	431
Juvenile							
				Period Total =	38	115	1,452

Table C16. Age-1 equivalents for bay anchovy (*Anchoa* sp.) using base mortality estimates (Base life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	1.044	1	1.0440	0	1.0440	0.3520	0.52076
Larvae	0.2059	34	7.0006	0	7.0006	0.0009	0.00182
Juvenile	0.004	330	1.3035	0	1.3035	0.2716	
	Total =	365		Total =	9.3481		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	13,561,066	32,246,655	363,503,693	0.000129	1,748	4,156	46,851
Larvae	800,773	1,904,146	21,464,680	0.000495	396	942	10,615
Juvenile							
				Period Total =	2,144	5,098	57,466

Table C17. Age-1 equivalents for bay anchovy (*Anchoa* sp.) using low mortality estimates (low mortality life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	0.69	1	0.6900	0	0.6900	0.5016	0.66807
Larvae	0.1804	30.63	5.5257	0	5.5257	0.0040	0.00793
Juvenile	0.004	333.4	1.3336	0	1.3336	0.2635	
	Total =	365.03		Total =	7.549252		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	13,561,066	32,246,655	363,503,693	0.000701	9,510	22,614	254,914
Larvae	800,773	1,904,146	21,464,680	0.002091	1,674	3,982	44,884
Juvenile							
				Period Total =	11,184	26,595	299,798

Table C18. Age-1 equivalents for bay anchovy (*Anchoa* sp.) using high mortality estimates (high mortality life history) across all life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	1.94	1	1.9400	0	1.9400	0.1437	0.25130
Larvae	0.231	34	7.8540	0	7.8540	0.0004	0.00078
Juvenile	0.01	330	3.3000	0	3.3000	0.0369	
	Total =	365		Total =	13.094		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	13,561,066	32,246,655	363,503,693	0.000004	49	116	1,308
Larvae	800,773	1,904,146	21,464,680	0.000029	23	55	614
Juvenile							
				Period Total =	72	171	1,922

Table C19. Age-1 equivalents for bay anchovy (*Anchoa* sp.) using low larval mortality rates and base mortality estimates (Base life history) across all other life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	1.044	1	1.0440	0	1.0440	0.3520	0.52076
Larvae	0.1804	30.63	5.5257	0	5.5257	0.0040	0.00793
Juvenile	0.004	330	1.3035	0	1.3035	0.2716	
	Total =	361.63		Total =	7.873152		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	13,561,066	32,246,655	363,503,693	0.000563	7,640	18,166	204,777
Larvae	800,773	1,904,146	21,464,680	0.002155	1,726	4,103	46,256
Juvenile							
				Period Total =	9,365	22,269	251,033

Table C20. Age-1 equivalents for bay anchovy (*Anchoa* sp.) using high larval mortality rates and base mortality estimates (Base life history) across all other life stages

Stage	Instantaneous Mortality	Duration (Days)	Natural Mortality per Stage	Fishing Mortality per Stage	Total Mortality per Stage	Fraction Surviving	Correction
Egg	1.044	1	1.0440	0	1.0440	0.3520	0.52076
Larvae	0.231	34	7.8540	0	7.8540	0.0004	0.00078
Juvenile	0.004	330	1.3035	0	1.3035	0.2716	
	Total =	365		Total =	10.2015		

Stage	Number Potentially Entrained			Fraction Surviving to Age 1+	Number Surviving to Age 1+		
	LCL	Mean	UCL		LCL	Mean	UCL
Egg	13,561,066	32,246,655	363,503,693	0.000055	745	1,770	19,957
Larvae	800,773	1,904,146	21,464,680	0.000211	169	401	4,524
Juvenile							
				Period Total =	913	2,172	24,481

Attachment D: Equivalent Yield Analysis

Table D1. Base Life History (Base Mortality Rates) Table and Average Entrainment Estimate for Red Drum (*Sciaenops ocellatus*)

Note: Base life history indicate base mortality estimates and average entrainment; this corresponds to table 1 in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**1,936,498**	0.00030	**580**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	5.0000	0	1	5.00	0.01	0.01	**114,349**	0.00079	**90**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	1.6380	0	1	1.64	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.8964	0	1	0.90	0.41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 3	0.2988	0	1	0.30	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.27	0.621	1	0.89	0.41	NA	NA	NA	NA	2.59458	275	120	275	**670**	715	311	713
2	0.19	1.149	1	1.34	0.26	NA	NA	NA	NA	6.88424	174	29	72	275	1,198	198	496
3	0.16	0.324	1	0.48	0.62	NA	NA	NA	NA	10.23435	19	9	44	72	189	94	455
4	0.16	0.190	1	0.35	0.70	NA	NA	NA	NA	11.45316	7	6	31	44	82	69	358
5	0.15	0.036	1	0.19	0.83	NA	NA	NA	NA	12.62000	1	4	26	31	13	54	328
6	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	13.72648	3	3	20	26	37	44	276
7	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	14.76732	2	2	16	20	31	37	230
8	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	15.73977	2	2	12	16	25	30	189
9	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	16.64306	1	1	9	12	21	25	155
10	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	17.47794	1	1	7	9	17	20	126
11	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.24628	1	1	6	7	14	16	101
12	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.95076	1	1	4	6	11	13	81
13	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	19.59460	0	1	3	4	9	10	65
14	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.18136	0	0	3	3	7	8	52
15	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.71480	0	0	2	3	5	7	41
16	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.19871	0	0	2	2	4	5	33
17	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.63685	0	0	1	2	3	4	26
18	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.03290	0	0	1	1	3	3	20
19	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.39038	0	0	1	1	2	3	16
20	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.71262	0	0	1	1	2	2	12
									670	**Total =**	488	182	1	670	**2,387**	952	12
											Population in Numbers				**Population in Pounds**		
											Mean Weight (pounds)				4.89	5.24	22.71

Total Weight Lost	**3,352**
To Fishing Mortality	2,387
To Natural Mortality	952

Table D2. Low Larval Mortality and Base Life History (Base Mortality Rates) Across All Other Stages and Average Entrainment Estimate for Red Drum (*Sciaenops ocellatus*)

Note: This analysis used low larval mortality rates and base mortality estimates across all other stage along with average entrainment (corresponds to table 4 in Age-1 sheet).

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**1,936,498**	0.00148	**2,873**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	3.4000	0	1	3.40	0.03	0.06	**114,349**	0.00380	**434**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	1.6380	0	1	1.64	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.8964	0	1	0.90	0.41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 3	0.2988	0	1	0.30	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.27	0.621	1	0.89	0.41	NA	NA	NA	NA	2.59458	1,360	591	1,357	**3,308**	3,528	1,534	3,521
2	0.19	1.149	1	1.34	0.26	NA	NA	NA	NA	6.88424	859	142	356	1,357	5,915	978	2,449
3	0.16	0.324	1	0.48	0.62	NA	NA	NA	NA	10.23435	91	45	219	356	935	462	2,244
4	0.16	0.19	1	0.35	0.70	NA	NA	NA	NA	11.45316	35	30	154	219	403	339	1,769
5	0.15	0.036	1	0.19	0.83	NA	NA	NA	NA	12.62000	5	21	128	154	64	267	1,619
6	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	13.72648	13	16	99	128	182	217	1,362
7	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	14.76732	10	12	77	99	151	181	1,133
8	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	15.73977	8	9	59	77	125	149	934
9	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	16.64306	6	7	46	59	102	122	764
10	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	17.47794	5	6	35	46	83	99	620
11	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.24628	4	4	27	35	67	80	501
12	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.95076	3	3	21	27	54	64	402
13	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	19.59460	2	3	16	21	43	51	322
14	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.18136	2	2	13	16	34	41	256
15	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.71480	1	2	10	13	27	32	203
16	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.19871	1	1	8	10	21	26	161
17	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.63685	1	1	6	8	17	20	127
18	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.03290	1	1	5	6	13	16	100
19	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.39038	0	1	4	5	10	13	79
20	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.71262	0	0	3	4	8	10	62
									3,308	**Total =**	2,408	897	3	3,308	**11,782**	4,701	62
											Population in Numbers				Population in Pounds		
														Mean Weight (pounds)	4.89	5.24	22.71

Total Weight Lost	**16,544**
To Fishing Mortality	11,782
To Natural Mortality	4,701

Table D3. High Larval Mortality and Base Life History (Base Mortality Rates) Across All Other Life Stages and Average Entrainment Estimate for Red Drum (*Sciaenops ocellatus*)

Note: This analysis used high larval mortality rates and base mortality estimates across all other stage along with average entrainment (corresponds to table 5 in Age-1 sheet).

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**1,936,498**	0.00006	**117**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	6.6000	0	1	6.60	0.00	0.00	**114,349**	0.00016	**18**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	1.6380	0	1	1.64	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.8964	0	1	0.90	0.41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 3	0.2988	0	1	0.30	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.27	0.621	1	0.89	0.41	NA	NA	NA	NA	2.59458	56	24	56	**135**	144	63	144
2	0.19	1.149	1	1.34	0.26	NA	NA	NA	NA	6.88424	35	6	15	56	242	40	100
3	0.16	0.324	1	0.48	0.62	NA	NA	NA	NA	10.23435	4	2	9	15	38	19	92
4	0.16	0.19	1	0.35	0.70	NA	NA	NA	NA	11.45316	1	1	6	9	16	14	72
5	0.15	0.036	1	0.19	0.83	NA	NA	NA	NA	12.62000	0	1	5	6	3	11	66
6	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	13.72648	1	1	4	5	7	9	56
7	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	14.76732	0	1	3	4	6	7	46
8	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	15.73977	0	0	2	3	5	6	38
9	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	16.64306	0	0	2	2	4	5	31
10	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	17.47794	0	0	1	2	3	4	25
11	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.24628	0	0	1	1	3	3	20
12	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.95076	0	0	1	1	2	3	16
13	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	19.59460	0	0	1	1	2	2	13
14	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.18136	0	0	1	1	1	2	10
15	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.71480	0	0	0	1	1	1	8
16	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.19871	0	0	0	0	1	1	7
17	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.63685	0	0	0	0	1	1	5
18	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.03290	0	0	0	0	1	1	4
19	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.39038	0	0	0	0	0	1	3
20	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.71262	0	0	0	0	0	0	3
									135	**Total =**	99	37	0	135	**482**	192	3
											Population in Numbers				Population in Pounds		
											Mean Weight (pounds)				4.89	5.24	22.71

Total Weight Lost	**677**
To Fishing Mortality	482
To Natural Mortality	192

Table D4. Base Life History (Base Mortality Rates) Table and UCL Entrainment Estimate for Red Drum (*Sciaenops ocellatus*)

Note: This analysis uses base life history i.e. base mortality estimates and UCL; corresponds to table 1 UCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**26,663,822**	0.00030	**7,988**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	5.0000	0	1	5.00	0.01	0.01	**1,574,483**	0.00079	**1,240**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	1.6380	0	1	1.64	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.8964	0	1	0.90	0.41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 3	0.2988	0	1	0.30	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.27	0.621	1	0.89	0.41	NA	NA	NA	NA	2.59458	3,793	1,649	3,786	**9,228**	9,841	4,279	9,822
2	0.19	1.149	1	1.34	0.26	NA	NA	NA	NA	6.88424	2,397	396	992	3,786	16,502	2,729	6,831
3	0.16	0.324	1	0.48	0.62	NA	NA	NA	NA	10.23435	255	126	612	992	2,608	1,288	6,259
4	0.16	0.190	1	0.35	0.70	NA	NA	NA	NA	11.45316	98	83	431	612	1,123	946	4,936
5	0.15	0.036	1	0.19	0.83	NA	NA	NA	NA	12.62000	14	59	358	431	179	744	4,515
6	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	13.72648	37	44	277	358	507	606	3,798
7	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	14.76732	29	34	214	277	422	504	3,160
8	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	15.73977	22	26	165	214	348	416	2,605
9	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	16.64306	17	20	128	165	284	340	2,130
10	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	17.47794	13	16	99	128	231	276	1,730
11	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.24628	10	12	77	99	186	223	1,397
12	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.95076	8	9	59	77	150	179	1,122
13	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	19.59460	6	7	46	59	120	143	897
14	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.18136	5	6	35	46	95	114	715
15	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.71480	4	4	27	35	76	91	567
16	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.19871	3	3	21	27	60	72	449
17	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.63685	2	3	16	21	47	57	354
18	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.03290	2	2	13	16	37	45	279
19	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.39038	1	2	10	13	29	35	219
20	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.71262	1	1	8	10	23	27	172
									9,228	**Total =**	6,716	2,504	8	9,228	**32,866**	13,113	172

	Population in Numbers	Population in Pounds	
Mean Weight (pounds)	4.89	5.24	22.71

Total Weight Lost	**46,152**
To Fishing Mortality	32,866
To Natural Mortality	13,113

Table D5. Base Life History (Base Mortality Rates) Table and LCL Entrainment Estimate for Red Drum (*Sciaenops ocellatus*)

Note: This analysis uses base life history i.e. base mortality estimates and LCL; corresponds to table 1 LCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**513,564**	0.00030	**154**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	5.0000	0	1	5.00	0.01	0.01	**30,326**	0.00079	**24**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	1.6380	0	1	1.64	0.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.8964	0	1	0.90	0.41	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 3	0.2988	0	1	0.30	0.74	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.27	0.621	1	0.89	0.41	NA	NA	NA	NA	2.59458	73	32	73	**178**	190	82	189
2	0.19	1.149	1	1.34	0.26	NA	NA	NA	NA	6.88424	46	8	19	73	318	53	132
3	0.16	0.324	1	0.48	0.62	NA	NA	NA	NA	10.23435	5	2	12	19	50	25	121
4	0.16	0.190	1	0.35	0.70	NA	NA	NA	NA	11.45316	2	2	8	12	22	18	95
5	0.15	0.036	1	0.19	0.83	NA	NA	NA	NA	12.62000	0	1	7	8	3	14	87
6	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	13.72648	1	1	5	7	10	12	73
7	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	14.76732	1	1	4	5	8	10	61
8	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	15.73977	0	1	3	4	7	8	50
9	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	16.64306	0	0	2	3	5	7	41
10	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	17.47794	0	0	2	2	4	5	33
11	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.24628	0	0	1	2	4	4	27
12	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.95076	0	0	1	1	3	3	22
13	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	19.59460	0	0	1	1	2	3	17
14	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.18136	0	0	1	1	2	2	14
15	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.71480	0	0	1	1	1	2	11
16	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.19871	0	0	0	1	1	1	9
17	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.63685	0	0	0	0	1	1	7
18	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.03290	0	0	0	0	1	1	5
19	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.39038	0	0	0	0	1	1	4
20	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.71262	0	0	0	0	0	1	3
									178	**Total =**	129	48	0	178	**633**	253	3
											Population in Numbers				Population in Pounds		
											Mean Weight (pounds)				4.89	5.24	22.71

Total Weight Lost	**889**
To Fishing Mortality	633
To Natural Mortality	253

Table D6. Low Mortality History (Low Mortality Rates Across All Life Stages) Table and UCL Entrainment Estimate for Red Drum (*Sciaenops ocellatus*)

Note: This analysis uses low mortality estimates across all life stages and UCL; corresponds to table 2 UCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**26,663,822**	0.00197	**52,434**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	3.4000	0	1	3.40	0.03	0.06	**1,574,483**	0.00504	**7,928**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	1.6080	0	1	1.61	0.20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.7942	0	1	0.79	0.45	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 3	0.1494	0	1	0.15	0.86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.27	0.621	1	0.89	0.41	NA	NA	NA	NA	2.59458	24,811	10,787	24,763	**60,362**	64,375	27,989	64,250
2	0.19	1.149	1	1.34	0.26	NA	NA	NA	NA	6.88424	15,680	2,593	6,491	24,763	107,943	17,850	44,683
3	0.16	0.324	1	0.48	0.62	NA	NA	NA	NA	10.23435	1,667	823	4,000	6,491	17,062	8,426	40,940
4	0.16	0.19	1	0.35	0.70	NA	NA	NA	NA	11.45316	641	540	2,819	4,000	7,345	6,185	32,286
5	0.15	0.036	1	0.19	0.83	NA	NA	NA	NA	12.62000	93	386	2,340	2,819	1,169	4,869	29,537
6	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	13.72648	241	289	1,810	2,340	3,315	3,966	24,846
7	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	14.76732	187	223	1,400	1,810	2,758	3,300	20,672
8	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	15.73977	144	173	1,083	1,400	2,273	2,720	17,040
9	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	16.64306	112	134	837	1,083	1,859	2,224	13,934
10	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	17.47794	86	103	647	837	1,510	1,807	11,317
11	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.24628	67	80	501	647	1,219	1,459	9,137
12	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.95076	52	62	387	501	979	1,172	7,339
13	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	19.59460	40	48	299	387	783	937	5,869
14	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.18136	31	37	232	299	624	746	4,674
15	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.71480	24	29	179	232	495	592	3,711
16	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.19871	18	22	139	179	392	469	2,937
17	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.63685	14	17	107	139	309	370	2,318
18	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.03290	11	13	83	107	244	291	1,826
19	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.39038	9	10	64	83	191	229	1,435
20	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.71262	7	8	50	64	150	180	1,126
									60,362	**Total =**	43,935	16,377	50	60,362	**214,993**	85,780	1,126
											Population in Numbers				**Population in Pounds**		
											Mean Weight (pounds)				4.89	5.24	22.71

Total Weight Lost	**301,899**
To Fishing Mortality	214,993
To Natural Mortality	85,780

Table D7. High Mortality Life History (High Mortality Across All Life Stages) Table and LCL Entrainment Estimate for Red Drum (*Sciaenops ocellatus*)

Note: This analysis uses high mortality estimates across all life stages and LCL; corresponds to table 3 LCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**513,564**	0.00002	**9**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	6.6000	0	1	6.60	0.00	0.00	**30,326**	0.00005	**1**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	2.7800	0	1	2.78	0.06	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.9866	0	1	0.99	0.37	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 3	0.2916	0	1	0.29	0.75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.27	0.621	1	0.89	0.41	NA	NA	NA	NA	2.59458	4	2	4	**11**	11	5	11
2	0.19	1.149	1	1.34	0.26	NA	NA	NA	NA	6.88424	3	0	1	4	19	3	8
3	0.16	0.324	1	0.48	0.62	NA	NA	NA	NA	10.23435	0	0	1	1	3	1	7
4	0.16	0.19	1	0.35	0.70	NA	NA	NA	NA	11.45316	0	0	0	1	1	1	6
5	0.15	0.036	1	0.19	0.83	NA	NA	NA	NA	12.62000	0	0	0	0	0	1	5
6	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	13.72648	0	0	0	0	1	1	4
7	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	14.76732	0	0	0	0	0	1	4
8	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	15.73977	0	0	0	0	0	0	3
9	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	16.64306	0	0	0	0	0	0	2
10	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	17.47794	0	0	0	0	0	0	2
11	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.24628	0	0	0	0	0	0	2
12	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	18.95076	0	0	0	0	0	0	1
13	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	19.59460	0	0	0	0	0	0	1
14	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.18136	0	0	0	0	0	0	1
15	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	20.71480	0	0	0	0	0	0	1
16	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.19871	0	0	0	0	0	0	1
17	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	21.63685	0	0	0	0	0	0	0
18	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.03290	0	0	0	0	0	0	0
19	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.39038	0	0	0	0	0	0	0
20	0.14	0.117	1	0.26	0.77	NA	NA	NA	NA	22.71262	0	0	0	0	0	0	0
									11	**Total =**	8	3	0	11	**38**	15	0
											Population in Numbers				Population in Pounds		
										Mean Weight (pounds)					4.89	5.24	22.71

Total Weight Lost	**53**
To Fishing Mortality	38
To Natural Mortality	15

Table D8. Base Life History (Base Mortality Rates) Table and Average Entrainment Estimate for Red Snapper (*Lutjanus campechanus*)

***N**ote: **B**ase life history indicate base mortality estimates and average entrainment; this corresponds to table 6 in Age-1 sheet.*

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**862,184**	0.00013	**115**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	5.7400	0	1	5.74	0.00	0.01	**50,911**	0.00035	**18**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	2.4000	0	1	2.40	0.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.5001	0	1	0.50	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.1	1.009	1	1.11	0.33	NA	NA	NA	NA	0.312203291	81	8	44	**133**	25	3	14
2	0.1	0.073	1	0.17	0.84	NA	NA	NA	NA	1.078177702	3	4	37	44	3	4	40
3	0.1	0.288	1	0.39	0.68	NA	NA	NA	NA	2.29954469	9	3	25	37	20	7	58
4	0.1	0.537	1	0.64	0.53	NA	NA	NA	NA	3.86505456	10	2	13	25	38	7	51
5	0.1	0.434	1	0.53	0.59	NA	NA	NA	NA	5.643088548	4	1	8	13	25	6	44
6	0.1	0.289	1	0.39	0.68	NA	NA	NA	NA	7.514896779	2	1	5	8	14	5	40
7	0.1	0.199	1	0.30	0.74	NA	NA	NA	NA	9.386632383	1	0	4	5	9	4	37
8	0.1	0.147	1	0.25	0.78	NA	NA	NA	NA	11.19085368	1	0	3	4	6	4	34
9	0.1	0.116	1	0.22	0.81	NA	NA	NA	NA	12.88340238	0	0	2	3	4	4	32
10	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	14.43874938	0	0	2	2	3	3	30
11	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	15.84530904	0	0	2	2	2	3	27
12	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	17.10136025	0	0	1	2	2	3	24
13	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	18.21176751	0	0	1	1	2	2	21
14	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	19.18548284	0	0	1	1	2	2	19
15	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	20.03372138	0	0	1	1	2	2	16
									133	**Total =**	112	21	1	133	**157**	58	16
											Population in Numbers				**Population in Pounds**		
											Mean Weight (pounds)				**1.41**	**2.83**	**20.03**

Total Weight Lost	**232**
To Fishing Mortality	157
To Natural Mortality	58

Table D9. Low Larval Mortality and Base Life History (Base Mortality Rates) Across All Other Stages and Average Entrainment Estimate for Red Snapper (*Lutjanus campechanus*)

***N**ote: This analysis used low larval mortali**t**y rates and base mortality estimates acr**o**ss all other stage along with average entrainment (corresponds to table 9 in Age-1 sheet).*

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**862,184**	0.00074	**637**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	4.0300	0	1	4.03	0.02	0.03	**50,911**	0.00192	**98**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	2.4000	0	1	2.40	0.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.5001	0	1	0.50	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.1	1.009	1	1.11	0.33	NA	NA	NA	NA	0.312203291	448	44	242	**735**	140	14	76
2	0.1	0.073	1	0.17	0.84	NA	NA	NA	NA	1.078177702	16	22	204	242	18	24	220
3	0.1	0.288	1	0.39	0.68	NA	NA	NA	NA	2.29954469	49	17	138	204	112	39	318
4	0.1	0.537	1	0.64	0.53	NA	NA	NA	NA	3.86505456	55	10	73	138	212	40	283
5	0.1	0.434	1	0.53	0.59	NA	NA	NA	NA	5.643088548	25	6	43	73	139	32	242
6	0.1	0.289	1	0.39	0.68	NA	NA	NA	NA	7.514896779	10	4	29	43	77	27	219
7	0.1	0.199	1	0.30	0.74	NA	NA	NA	NA	9.386632383	5	3	22	29	47	24	202
8	0.1	0.147	1	0.25	0.78	NA	NA	NA	NA	11.19085368	3	2	17	22	31	21	188
9	0.1	0.116	1	0.22	0.81	NA	NA	NA	NA	12.88340238	2	2	14	17	23	20	175
10	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	14.43874938	1	1	11	14	15	18	163
11	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	15.84530904	1	1	9	11	14	16	149
12	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	17.10136025	1	1	8	9	12	15	134
13	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	18.21176751	1	1	7	8	11	13	118
14	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	19.18548284	0	1	5	7	10	11	104
15	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	20.03372138	0	0	4	5	8	10	90
									735	**Total =**	617	114	4	735	**869**	323	90
											Population in Numbers				Population in Pounds		
											Mean Weight (pounds)				**1.41**	**2.83**	**20.03**

Total Weight Lost	**1,282**
To Fishing Mortality	869
To Natural Mortality	323

Table D10. High Larval Mortality and Base Life History (Base Mortality Rates) Across All Other Life Stages Table and Average Entrainment Estimate for Red Snapper (*Lutjanus campechanus*)

Note: This analysis used high larval mortality rates and base mortality estimates across all other stage along with average entrainment (corresponds to table 10 in Age-1 sheet).

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**862,184**	0.00002	**17**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	7.6500	0	1	7.65	0.00	0.00	**50,911**	0.00005	**3**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	2.4000	0	1	2.40	0.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.5001	0	1	0.50	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.1	1.009	1	1.11	0.33	NA	NA	NA	NA	0.312203291	12	1	7	**20**	4	0	2
2	0.1	0.073	1	0.17	0.84	NA	NA	NA	NA	1.078177702	0	1	5	7	0	1	6
3	0.1	0.288	1	0.39	0.68	NA	NA	NA	NA	2.29954469	1	0	4	5	3	1	9
4	0.1	0.537	1	0.64	0.53	NA	NA	NA	NA	3.86505456	1	0	2	4	6	1	8
5	0.1	0.434	1	0.53	0.59	NA	NA	NA	NA	5.643088548	1	0	1	2	4	1	6
6	0.1	0.289	1	0.39	0.68	NA	NA	NA	NA	7.514896779	0	0	1	1	2	1	6
7	0.1	0.199	1	0.30	0.74	NA	NA	NA	NA	9.386632383	0	0	1	1	1	1	5
8	0.1	0.147	1	0.25	0.78	NA	NA	NA	NA	11.19085368	0	0	0	1	1	1	5
9	0.1	0.116	1	0.22	0.81	NA	NA	NA	NA	12.88340238	0	0	0	0	1	1	5
10	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	14.43874938	0	0	0	0	0	0	4
11	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	15.84530904	0	0	0	0	0	0	4
12	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	17.10136025	0	0	0	0	0	0	4
13	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	18.21176751	0	0	0	0	0	0	3
14	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	19.18548284	0	0	0	0	0	0	3
15	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	20.03372138	0	0	0	0	0	0	2
									20	**Total =**	17	3	0	20	**23**	9	2
											Population in Numbers				**Population in Pounds**		
											Mean Weight (pounds)				**1.41**	**2.83**	**20.03**

Total Weight Lost	**34**
To Fishing Mortality	23
To Natural Mortality	9

Table D11. Base Life History (Base Mortality Rates) Table and UCL Entrainment Estimate for Red Snapper (*Lutjanus campechanus*)

Note: This analysis uses base life history i.e. base mortality estimates and UCL; corresponds to table 6 UCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**8,085,466**	0.00013	**1,081**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	5.7400	0	1	5.74	0.00	0.01	**477,442**	0.00035	**168**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	2.4000	0	1	2.40	0.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.5001	0	1	0.50	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.1	1.009	1	1.11	0.33	NA	NA	NA	NA	0.312203291	762	75	412	**1,249**	238	24	129
2	0.1	0.073	1	0.17	0.84	NA	NA	NA	NA	1.078177702	28	38	347	412	30	41	374
3	0.1	0.288	1	0.39	0.68	NA	NA	NA	NA	2.29954469	83	29	235	347	190	66	541
4	0.1	0.537	1	0.64	0.53	NA	NA	NA	NA	3.86505456	93	17	124	235	361	67	481
5	0.1	0.434	1	0.53	0.59	NA	NA	NA	NA	5.643088548	42	10	73	124	236	54	411
6	0.1	0.289	1	0.39	0.68	NA	NA	NA	NA	7.514896779	17	6	49	73	131	45	371
7	0.1	0.199	1	0.30	0.74	NA	NA	NA	NA	9.386632383	8	4	37	49	80	40	344
8	0.1	0.147	1	0.25	0.78	NA	NA	NA	NA	11.19085368	5	3	29	37	53	36	320
9	0.1	0.116	1	0.22	0.81	NA	NA	NA	NA	12.88340238	3	3	23	29	38	33	297
10	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	14.43874938	2	2	19	23	26	30	277
11	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	15.84530904	1	2	16	19	23	28	253
12	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	17.10136025	1	1	13	16	21	25	227
13	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	18.21176751	1	1	11	13	19	22	201
14	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	19.18548284	1	1	9	11	16	19	176
15	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	20.03372138	1	1	8	9	14	17	153
									1,249	**Total =**	1,048	194	8	1,249	**1,476**	548	153
											Population in Numbers				**Population in Pounds**		
											Mean Weight (pounds)				**1.41**	**2.83**	**20.03**

Total Weight Lost	**2,178**
To Fishing Mortality	1,476
To Natural Mortality	548

Table D12. Base Life History (Base Mortality Rates) Table and LCL Entrainment Estimate for Red Snapper (*Lutjanus campechanus*)

Note: This analysis uses base life history i.e. base mortality estimates and LCL; corresponds to table 6 LCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**464,232**	0.00013	**62**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	5.7400	0	1	5.74	0.00	0.01	**27,413**	0.00035	**10**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	2.4000	0	1	2.40	0.09	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.5001	0	1	0.50	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.1	1.009	1	1.11	0.33	NA	NA	NA	NA	0.312203291	44	4	24	**72**	14	1	7
2	0.1	0.073	1	0.17	0.84	NA	NA	NA	NA	1.078177702	2	2	20	24	2	2	21
3	0.1	0.288	1	0.39	0.68	NA	NA	NA	NA	2.29954469	5	2	14	20	11	4	31
4	0.1	0.537	1	0.64	0.53	NA	NA	NA	NA	3.86505456	5	1	7	14	21	4	28
5	0.1	0.434	1	0.53	0.59	NA	NA	NA	NA	5.643088548	2	1	4	7	14	3	24
6	0.1	0.289	1	0.39	0.68	NA	NA	NA	NA	7.514896779	1	0	3	4	8	3	21
7	0.1	0.199	1	0.30	0.74	NA	NA	NA	NA	9.386632383	0	0	2	3	5	2	20
8	0.1	0.147	1	0.25	0.78	NA	NA	NA	NA	11.19085368	0	0	2	2	3	2	18
9	0.1	0.116	1	0.22	0.81	NA	NA	NA	NA	12.88340238	0	0	1	2	2	2	17
10	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	14.43874938	0	0	1	1	1	2	16
11	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	15.84530904	0	0	1	1	1	2	15
12	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	17.10136025	0	0	1	1	1	1	13
13	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	18.21176751	0	0	1	1	1	1	12
14	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	19.18548284	0	0	1	1	1	1	10
15	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	20.03372138	0	0	0	1	1	1	9
									72	**Total =**	60	11	0	72	**85**	31	9
											Population in Numbers				Population in Pounds		
											Mean Weight (pounds)				**1.41**	**2.83**	**20.03**

Total Weight Lost	**125**
To Fishing Mortality	85
To Natural Mortality	31

Table D13. Low Mortality History (Low Mortality Rates Across All Life Stages) Table and UCL Entrainment Estimate for Red Snapper (*Lutjanus campechanus*)

Note: This analysis uses low mortality estimates across all life stages and UCL; corresponds to table 7 UCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**8,085,466**	0.00519	**41,992**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	4.0300	0	1	4.03	0.02	0.03	**477,442**	0.01350	**6,447**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	0.4500	0	1	0.45	0.64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.5004	0	1	0.50	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.1	1.009	1	1.11	0.33	NA	NA	NA	NA	0.312203291	29,532	2,927	15,979	**48,439**	9,220	914	4,989
2	0.1	0.073	1	0.17	0.84	NA	NA	NA	NA	1.078177702	1,071	1,467	13,441	15,979	1,155	1,582	14,492
3	0.1	0.288	1	0.39	0.68	NA	NA	NA	NA	2.29954469	3,208	1,114	9,118	13,441	7,378	2,562	20,968
4	0.1	0.537	1	0.64	0.53	NA	NA	NA	NA	3.86505456	3,622	674	4,823	9,118	13,997	2,607	18,639
5	0.1	0.434	1	0.53	0.59	NA	NA	NA	NA	5.643088548	1,622	374	2,827	4,823	9,151	2,109	15,954
6	0.1	0.289	1	0.39	0.68	NA	NA	NA	NA	7.514896779	677	234	1,916	2,827	5,087	1,760	14,399
7	0.1	0.199	1	0.30	0.74	NA	NA	NA	NA	9.386632383	330	166	1,421	1,916	3,094	1,555	13,338
8	0.1	0.147	1	0.25	0.78	NA	NA	NA	NA	11.19085368	185	126	1,110	1,421	2,071	1,409	12,421
9	0.1	0.116	1	0.22	0.81	NA	NA	NA	NA	12.88340238	116	100	894	1,110	1,492	1,286	11,522
10	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	14.43874938	69	82	744	894	991	1,179	10,743
11	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	15.84530904	57	68	619	744	905	1,077	9,808
12	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	17.10136025	47	57	515	619	812	967	8,806
13	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	18.21176751	40	47	428	515	720	857	7,802
14	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	19.18548284	33	39	356	428	631	751	6,838
15	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	20.03372138	27	33	297	356	548	652	5,940
									48,439	**Total =**	8,036	1,485	59	9,579	**57,250**	21,265	1,175

	Population in Numbers	Population in Pounds	
Mean Weight (pounds)	**1.41**	**2.83**	**20.03**

Total Weight Lost	**79,690**
To Fishing Mortality	57,250
To Natural Mortality	21,265

Table D14. High Mortality History (High Mortality Rates Across All Life Stages) Table and LCL Entrainment Estimate for Red Snapper (*Lutjanus campechanus*)

Note: This analysis uses high mortality estimates across all life stages and LCL; corresponds to table 8 LCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	0.4984	0	1	0.50	0.61	0.76	**464,232**	0.00001	**2**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	7.6500	0	1	7.65	0.00	0.00	**27,413**	0.00001	**0**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	3.7200	0	1	3.72	0.02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 2	0.5000	0	1	0.50	0.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.1	1.009	1	1.11	0.33	NA	NA	NA	NA	0.312203291	2	0	1	**3**	1	0	0
2	0.1	0.073	1	0.17	0.84	NA	NA	NA	NA	1.078177702	0	0	1	1	0	0	1
3	0.1	0.288	1	0.39	0.68	NA	NA	NA	NA	2.29954469	0	0	1	1	0	0	1
4	0.1	0.537	1	0.64	0.53	NA	NA	NA	NA	3.86505456	0	0	0	1	1	0	1
5	0.1	0.434	1	0.53	0.59	NA	NA	NA	NA	5.643088548	0	0	0	0	1	0	1
6	0.1	0.289	1	0.39	0.68	NA	NA	NA	NA	7.514896779	0	0	0	0	0	0	1
7	0.1	0.199	1	0.30	0.74	NA	NA	NA	NA	9.386632383	0	0	0	0	0	0	1
8	0.1	0.147	1	0.25	0.78	NA	NA	NA	NA	11.19085368	0	0	0	0	0	0	1
9	0.1	0.116	1	0.22	0.81	NA	NA	NA	NA	12.88340238	0	0	0	0	0	0	1
10	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	14.43874938	0	0	0	0	0	0	1
11	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	15.84530904	0	0	0	0	0	0	1
12	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	17.10136025	0	0	0	0	0	0	1
13	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	18.21176751	0	0	0	0	0	0	0
14	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	19.18548284	0	0	0	0	0	0	0
15	0.1	0.084	1	0.18	0.83	NA	NA	NA	NA	20.03372138	0	0	0	0	0	0	0
									3	**Total =**	2	0	0	**3**	3	1	0
											Population in Numbers				Population in Pounds		
											Mean Weight (pounds)				**1.41**	**2.83**	**20.03**

Total Weight Lost	**5**
To Fishing Mortality	3
To Natural Mortality	1

Table D15. Base Life History (Base Mortality Rates) Table and Average Entrainment Estimate for Gulf Menhaden (*Brevoortia patronus*)

Note: Base life history indicate base mortality estimates and average entrainment; this corresponds to table 16 in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	1.8270	0	1	1.83	0.16	0.28	**1,426,464**	0.00012	**177**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	3.8350	0	1	3.84	0.02	0.04	**84,232**	0.00088	**74**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	3.8779	0	1	3.88	0.02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.131179834	100	100	51	**250**	13	13	7
2	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.241990667	20	20	10	51	5	5	2
3	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.348069196	4	4	2	10	1	1	1
4	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.437623557	1	1	0	2	0	0	0
5	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.507986545	0	0	0	0	0	0	0
									250	**Total =**	125	125	63	314	**20**	20	10
											Population in Numbers				Population in Pounds		
										Mean Weight (pounds)					**0.16**	**0.16**	**.016**

Total Weight Lost	**50**
To Fishing Mortality	20
To Natural Mortality	20

Table D16. Low Larval Mortality and Base Life History (Base Mortality Rates) Across All Other Life Stages Table and Average Entrainment Estimate for Gulf Menhaden (*Brevoortia patronus*)

Note: This analysis used low larval mortality rates and base mortality estimates across all other stage along with average entrainment (corresponds to table 19 in Age-1 sheet).

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	1.8270	0	1	1.83	0.16	0.28	**1,426,464**	0.00031	**438**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	**2.9280**	0	1	2.93	0.05	0.10	**84,232**	0.00210	**177**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	3.8779	0	1	3.88	0.02	NA	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.131179834	245	245	124	**615**	32	32	16
2	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.241990667	50	50	25	124	12	12	6
3	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.348069196	10	10	5	25	3	3	2
4	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.437623557	2	2	1	5	1	1	0
5	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.507986545	0	0	0	1	0	0	0
									615	**Total =**	307	307	155	770	**49**	49	25
											Population in Numbers				Population in Pounds		
													Mean Weight (pounds)		**0.16**	**0.16**	**.016**

Total Weight Lost	**122**
To Fishing Mortality	49
To Natural Mortality	49

Table D17. High Larval Mortality and Base Life History (Base Mortality Rates) Across All Other Life Stages Table and Average Entrainment Estimate for Gulf Menhaden (*Brevoortia patronus*)

Note: This analysis used high larval mortality rates and base mortality estimates across all other stage along with average entrainment (corresponds to table 20 in Age-1 sheet).

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	1.8270	0	1	1.83	0.16	0.28	**1,426,464**	0.00006	**81**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	**4.6200**	0	1	4.62	0.01	0.02	**84,232**	0.00040	**34**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	3.8779	0	1	3.88	0.02	NA	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.131179834	46	46	23	**115**	6	6	3
2	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.241990667	9	9	5	23	2	2	1
3	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.348069196	2	2	1	5	1	1	0
4	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.437623557	0	0	0	1	0	0	0
5	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.507986545	0	0	0	0	0	0	0
									115	**Total =**	57	57	29	144	**9**	9	5
											Population in Numbers				Population in Pounds		
										Mean Weight (pounds)					**0.16**	**0.16**	**.016**

Total Weight Lost	**23**
To Fishing Mortality	9
To Natural Mortality	9

Table D18. Base Life History (Base Mortality Rates) Table and UCL Entrainment Estimate for Gulf Menhaden (*Brevoortia patronus*)

Note: This analysis uses base life history i.e. base mortality estimates and UCL; corresponds to table 16 UCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	1.8270	0	1	1.83	0.16	0.28	**18,070,527**	0.00012	**2,239**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	3.8350	0	1	3.84	0.02	0.04	**1,067,054**	0.00088	**934**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	3.8779	0	1	3.88	0.02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.131179834	1,266	1,266	641	**3,173**	166	166	84
2	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.241990667	256	256	129	641	62	62	31
3	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.348069196	52	52	26	129	18	18	9
4	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.437623557	10	10	5	26	5	5	2
5	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.507986545	2	2	1	5	1	1	1
									3,173	**Total =**	1,586	1,586	802	3,974	**252**	252	127
											Population in Numbers				Population in Pounds		
													Mean Weight (pounds)		**0.16**	**0.16**	**.016**

Total Weight Lost	**630**
To Fishing Mortality	252
To Natural Mortality	252

Table D19. Base Life History (Base Mortality Rates) Table and LCL Entrainment Estimate for Gulf Menhaden (*Brevoortia patronus*)

Note: This analysis uses base life history i.e. base mortality estimates and LCL; corresponds to table 16 LCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	1.8270	0	1	1.83	0.16	0.28	**476,029**	0.00012	**59**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	3.8350	0	1	3.84	0.02	0.04	**28,109**	0.00088	**25**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	3.8779	0	1	3.88	0.02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.131179834	33	33	17	**84**	4	4	2
2	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.241990667	7	7	3	17	2	2	1
3	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.348069196	1	1	1	3	0	0	0
4	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.437623557	0	0	0	1	0	0	0
5	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.507986545	0	0	0	0	0	0	0
									84	**Total =**	42	42	21	105	**7**	7	3
											Population in Numbers				Population in Pounds		
										Mean Weight (pounds)					0.16	0.16	.016

Total Weight Lost	**17**
To Fishing Mortality	7
To Natural Mortality	7

Table D20. Low Mortality History (Low Mortality Rates Across All Life Stages) Table and UCL Entrainment Estimate for Gulf Menhaden (*Brevoortia patronus*)

Note: This analysis uses low mortality estimates across all life stages and UCL; corresponds to table 17 UCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	1.5660	0	1	1.57	0.21	0.35	**18,070,527**	0.00036	**6,462**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	2.9280	0	1	2.93	0.05	0.10	**1,067,054**	0.00196	**2,096**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	3.9455	0	1	3.95	0.02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.131179834	3,415	3,415	1,728	**8,559**	448	448	227
2	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.241990667	690	690	349	1,728	167	167	84
3	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.348069196	139	139	70	349	48	48	25
4	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.437623557	28	28	14	70	12	12	6
5	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.507986545	6	6	3	14	3	3	1
									8,559	**Total =**	4,278	4,278	2,164	10,720	**679**	679	343
											Population in Numbers				Population in Pounds		
													Mean Weight (pounds)		**0.16**	**0.16**	**.016**

Total Weight Lost	**1,700**
To Fishing Mortality	679
To Natural Mortality	679

Table D21. High Mortality History (High Mortality Across All Life Stages) Table and LCL Entrainment Estimate for Gulf Menhaden (*Brevoortia patronus*)

Note: This analysis uses high mortality estimates across all life stages and LCL; corresponds to table 18 LCL column in Age-1 sheet.

											Projected Fate of Age-1 Fish In the Absence of the FLNGV						
Life History Stage or Age	Natural Mortality per Stage or Age (M)	Fishing Mortality per Stage or Age (F)	% Vulnerable to Fishery	Total Mortality per Stage (Z)	Fraction Surviving at Stage or Age	Corrected Survival Fraction	Number Potentially Entrained at Stage or Age	Cumulative Survival at Stage or Age	Projected Mortality of Age-1 fish	Weight of an Individual Fish at Median Age of Death	Number Potentially Lost to Fishing Mortality	Number Potentially Lost to Natural Mortality	Number That Might Have Remained in the Population at End of Year	Total Number at Age	Weight of Fish Potentially Lost to Fishing Mortality	Weight of Fish Potentially Lost to Natural Mortality	Weight of Fish That Might Have Remained in the Population at End of Year
Egg	12.4200	0	1	12.42	0.00	0.00	**476,029**	0.00000	**0**	NA	NA	NA	NA	NA	NA	NA	NA
Larvae	4.6200	0	1	4.62	0.01	0.02	**28,109**	0.00038	**11**	NA	NA	NA	NA	NA	NA	NA	NA
Juvenile 1	3.9390	0	1	3.94	0.02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.131179834	4	4	2	**11**	1	1	0
2	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.241990667	1	1	0	2	0	0	0
3	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.348069196	0	0	0	0	0	0	0
4	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.437623557	0	0	0	0	0	0	0
5	0.8	0.8	1	1.60	0.20	NA	NA	NA	NA	0.507986545	0	0	0	0	0	0	0
									11	**Total =**	5	5	3	13	**1**	1	0
											Population in Numbers				Population in Pounds		
													Mean Weight (pounds)		**0.16**	**0.16**	**.016**

Total Weight Lost	**2**
To Fishing Mortality	1
To Natural Mortality	1