COMMON BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*) Jacksonville Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the western North Atlantic, the coastal morphotype of common bottlenose dolphins is continuously distributed in nearshore coastal and estuarine waters along the U.S. Atlantic coast south of Long Island, New York, to the Florida peninsula. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several inshore areas of the southeastern United States (Caldwell 2001; Gubbins 2002; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Rosel *et al.* 2009; Litz *et al.* 2012), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Sellas *et al.* 2005; Balmer *et al.* 2008; Rosel *et al.* 2017).

The estuarine habitat around Jacksonville, Florida, is composed of several large brackish rivers, including St. Mary's, Amelia, Nassau, Fort George and St. Johns River (Figure 1). The St. Johns River is a deep, swift moving river with heavy boat and shipping activity (Caldwell 2001). The remainder of the area is made up of tidal marshes and riverine systems averaging 2 m in depth over sand, mud or oyster beds, and is bisected by the Intracoastal Waterway.

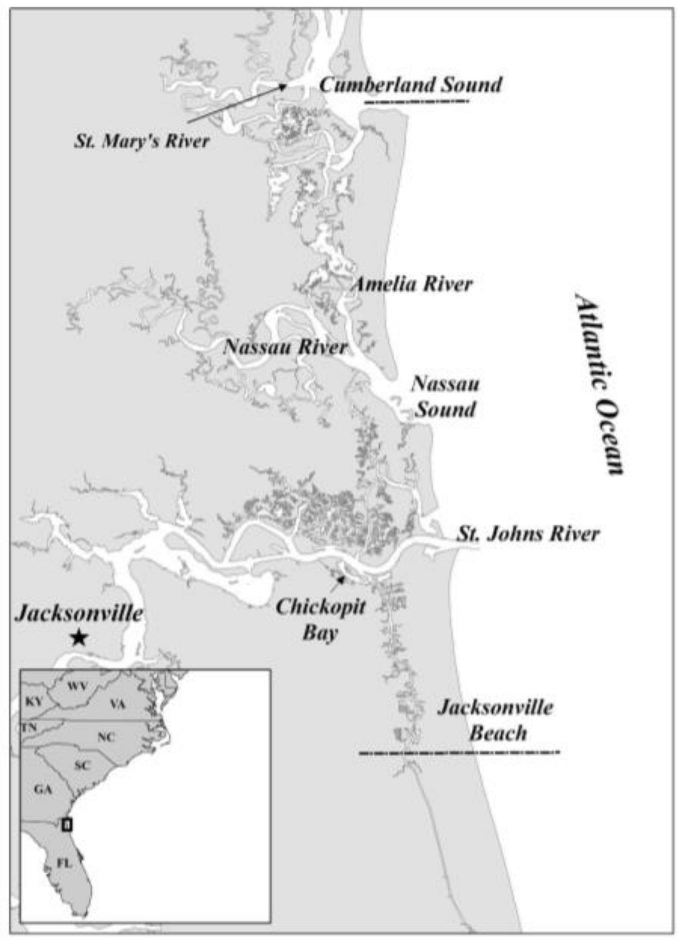

Figure 1. ***Geographic extent of the Jacksonville Estuarine System (JES) stock. Dashed lines denote the boundaries.***

Caldwell (2001; 2016a,b) investigated the social structure of common bottlenose dolphins inhabiting the estuarine waters between the St. Mary's River and Jacksonville Beach, Florida, using photo-ID and behavioral data obtained from December 1994 through December 1997. Three behaviorally different communities were identified during this study, namely the estuarine waters north of St. Johns River (termed the Northern area), the estuarine waters south of St. Johns River (the Southern area) and the coastal area, all of which differed in density, habitat fidelity and social affiliation patterns. Caldwell (2001; 2016b) found that dolphins inhabiting the Northern area were the most isolated and demonstrated strong year-round site fidelity. Cluster analyses suggested that dolphins using the Northern area did not socialize with those using the Southern area. In the Southern area, 78% of the groups were photographed only in this region but these dolphins moved into and out of the Jacksonville area each year, returning during three consecutive summers, suggesting the Southern area dolphins may show summer site fidelity as opposed to the year-round fidelity demonstrated in the Northern area (Caldwell 2001; 2016b). Caldwell (2001; 2016b) reported that dolphins found in the coastal areas were highly mobile, had fluid social affiliations, were not sighted more than eight times over the entire study and showed no long-term (> 4 months) site fidelity. Three of these dolphins were also sighted off South Carolina, behind shrimp boats. These coastal dolphins are thus considered to be members of a coastal stock. Caldwell

(2001) also examined genetic differentiation among the Northern, Southern and coastal areas of the study site using mitochondrial DNA sequences and microsatellite data. Both mitochondrial DNA haplotype and microsatellite allele frequencies differed significantly between the Northern and Southern sampling areas. Differentiation between the Southern sampling area and the coast was lower, but still significant. Rosel *et al.* (2009) also found evidence for genetic subdivision within samples collected in the Jacksonville region. These genetic data are in line with the behavioral analyses. However, sample sizes were small for these estuarine regions (n≤ 25) and genetic analyses did not account for the high number of closely related individuals within the dataset. Finally, Mazzoil *et al.* (2020) using photo-ID data further corroborated the isolation and site-fidelity of the dolphins in the northern portion of the stock area, illustrating that this pattern has temporal stability. They recommended Florida estuarine waters north of the St. Johns River (the northern Jacksonville Estuarine System (JES) stock region) be split from the JES Stock and made a separate stock whose northern border remains undetermined. These data combined suggest it is plausible there are multiple demographically independent populations of common bottlenose dolphins within the stock area. Further analyses are necessary to augment the genetic analyses, to explore the northern stock boundary of the JES Stock, and to determine whether the dolphins in the northern area exhibit demographic independence.

Gubbins *et al.* (2003) identified oscillating abundance year round for dolphins within the estuarine waters of this area, with low numbers reported in January and December. There was a positive correlation between dolphin abundance and water temperature, with peak numbers seen when water temperatures rose above 16°C.

The JES Stock has been defined as a separate estuarine stock based on the results of these photo-ID and genetic studies. It is bounded in the north by the Florida/Georgia border at Cumberland Sound, abutting the southern border of the Southern Georgia Estuarine System Stock, and extends south to Jacksonville Beach, Florida. Despite the strong fidelity to the Northern and Southern areas observed by Caldwell (2001; 2016b), some dolphins were photographed outside their preferred areas, supporting the proposal to include both these areas within the boundaries of the JES Stock. Mazzoil *et al.* (2020) identified dolphins from the southern portion of the JES Stock area utilizing the Intracoastal Waterway further south and suggested the southern boundary of the stock be extended to include estuarine waters as far south as the St. Augustine River inlet. Future analyses may provide additional information on the importance of the Southern area to the resident stock, and thus the inclusion of both areas in this stock boundary may be modified with additional data or further analyses.

Dolphins residing within estuaries south of this stock down to the northern boundary of the Indian River Lagoon Estuarine System Stock (IRLES) are currently not included in any Stock Assessment Report. There are insufficient data to determine whether animals south of the JES Stock exhibit affiliation to the JES Stock, the IRLES Stock to the south or are simply transient animals associated with coastal stocks. Further research is needed to establish affinities of dolphins in this region. It should be noted that during 2016–2020, there were 29 stranded common bottlenose dolphins in this region in estuarine waters. There was evidence of human interaction for four of the strandings, including two interactions with hook and line fishing gear, one entanglement in commercial blue crab trap/pot gear, and one entanglement in unidentified rope/line. The two interactions with hook and line gear were both mortalities for which evidence suggested the hook and line gear contributed to cause of death. The entanglement in commercial blue crab trap/pot gear was a live release for which it could not be determined if the animal was seriously injured following mitigation efforts (initial determination was seriously injured; Maze-Foley and Garrison 2022). The entanglement in unidentified rope/line involved a live animal that shed the gear on its own and was considered not seriously injured (Maze-Foley and Garrison 2022). In addition to animals included in the stranding database, in estuarine waters south of JES there was one at-sea observation of a dolphin entangled in commercial blue crab trap/pot gear. The dolphin shed the gear on its own and was considered not seriously injured (Maze-Foley and Garrison 2022).

POPULATION SIZE

The total number of common bottlenose dolphins residing within the JES Stock is unknown because previous estimates are more than 8 years old (Table 1; NMFS 2016).

Earlier abundance estimates (>8 years old)

Data collected by Caldwell (2001; 2016a,b) were incorporated into a larger study that used mark-recapture analyses to calculate abundance in four estuarine areas along the eastern U.S. coast (Gubbins *et al.* 2003). Sighting records collected only from May through October were used, as this limited time period was determined to reduce the possibility of violating the mark-recapture model's assumption of geographic closure and mark retention. Based on photo-ID data from 1994 to 1997, 334 individually identified dolphins were observed (Gubbins *et al.* 2003), which included an unspecified number of seasonal residents and transients. Mark-recapture analyses included all the 334 individually identifiable dolphins, and the population size for the JES Stock was calculated to be 412 residents (CV=0.06; Gubbins *et al.* 2003). This was an overestimate of the stock abundance in the area covered by the study because it included non-resident and seasonally resident dolphins. Caldwell (2001; 2016b) indicated that 122 dolphins were resighted at least 10 times in the JES, with 33 individuals observed primarily in the Northern area, and 89 individuals reported to use the Southern area.

Minimum Population Estimate

No current information on abundance is available to calculate a minimum population estimate for the JES Stock of common bottlenose dolphins.

Current Population Trend

One abundance estimate is available for this stock, and therefore there are insufficient data to assess population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the JES Stock is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5 because this stock is of unknown status. PBR for the JES Stock of common bottlenose dolphins is unknown (Table 1).

Table 1. Best and minimum abundance estimates (Nest and Nmin) for the Jacksonville Estuarine System Stock of common bottlenose dolphins with Maximum Productivity Rate (Rmax), Recovery Factor (Fr) and PBR.

Nest	CV Nest	Nmin	Fr	Rmax	PBR
Unknown	-	Unknown	0.5	0.04	Unknown

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury for the JES Stock during 2016–2020 is unknown. The mean annual fishery-related mortality and serious injury during 2016–2020 based on strandings and at-sea observations identified as fishery-related was 2.0. No additional mortality or serious injury was documented from other human-caused sources. The minimum total mean annual human-caused mortality and serious injury for this stock during 2016–2020 was therefore 2.0 (Table 2). This is considered a minimum because 1) not all fisheries that could interact with this stock are observed and/or observer coverage is very low, 2) stranding data are the only data used as an indicator of fishery-related interactions and not all dead animals are recovered by the stranding network (Peltier *et al.* 2012; Wells *et al.* 2015; Carretta *et al.* 2016), 3) cause of death is not (or cannot be) routinely determined for stranded carcasses, 4) the estimate of fishery-related interactions includes an actual count of verified fishery-caused deaths and serious injuries and should be considered a minimum (NMFS 2016), and 5) strandings with evidence of fishery-related interactions occurred in waters south of the JES Stock boundary that are not included within any stock, and some or all of those strandings could have been part of this stock (see Stock Definition and Geographic Range section).

Fishery Information

There are three commercial fisheries that interact, or that potentially could interact, with this stock. These include two Category II fisheries (Southeastern U.S. Atlantic, Gulf of Mexico stone crab trap/pot and Atlantic blue crab trap/pot) and one Category III fishery (Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line)). Detailed fishery information is presented in Appendix III.

Note: Animals reported in the sections to follow were ascribed to a stock or stocks of origin following methods described in Maze-Foley et al. (2019). These include strandings, observed takes (through an observer program), fisherman self-reported takes (through the Marine Mammal Authorization Program), research takes, and *opportunistic at-sea observations.*

Trap/Pot

During 2016–2020 there were eight documented entanglement interactions of common bottlenose dolphins in the JES area with trap/pot fisheries. During 2016 there was one mortality and one animal disentangled from commercial blue crab trap/pot gear and released alive. It could not be determined (CBD) whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured (Maze-Foley and Garrison 2022). During 2017 there were three live animals entangled in commercial blue crab trap/pot gear for two cases and unidentified trap/pot gear in one case. For one case, the animal disentangled itself and was not considered seriously injured. For the remaining two cases, both animals were disentangled, and one was considered seriously injured post-mitigation (commercial blue crab trap/pot gear), and for the other case it could not be determined whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured; Maze-Foley and Garrison 2022). During 2018 there was one mortality in commercial blue crab trap/pot gear. During 2020 there were two live animals disentangled from commercial blue crab trap/pot gear. One animal was considered seriously injured, and for the second animal, it could not be determined whether the animal was seriously injured following mitigation efforts (the initial determination was seriously injured (Maze-Foley and Garrison 2022). The two mortalities, two live entanglements that were seriously injured, and three live entanglements that were CBD for serious injury (CBD cases were prorated based on previous assignable injury events; NMFS 2012; Maze-Foley and Garrison 2022) are included in the annual human-caused mortality and serious injury total for this stock (Table 2), and were also documented within the stranding database (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021).

Since there is no observer program, it is not possible to estimate the total number of interactions or mortalities associated with these crab trap/pot fisheries. The documented interactions in this gear represent a minimum known count of interactions in the last five years.

Hook and Line (Rod and Reel)

During 2016–2020 within the JES area, there were five documented interactions within the stranding data of common bottlenose dolphins entangled in or with ingested hook and line fishing gear. During 2016, there were two mortalities and one live animal considered seriously injured. For one of the mortalities, it could not be determined whether the hook and line gear interaction contributed to cause of death, and for the second mortality, available evidence suggested the hook and line gear did not contribute to cause of death. During 2017, there was one mortality and one animal considered seriously injured. For the mortality, evidence suggested the hook and line gear did not contribute to cause of death. The two serious injuries are included in the annual human-caused mortality and serious injury total for this stock (Table 2; Maze-Foley and Garrison 2022). All of these cases were included in the stranding database and in the stranding totals presented in Table 3 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021).

In addition to the interactions documented within the stranding data, two live common bottlenose dolphins were observed at-sea (in 2016 and 2017) entangled in hook and line fishing gear. Both dolphins were considered seriously injured, and are also included in the annual human-caused mortality and serious injury total for this stock (Table 2; Maze-Foley and Garrison 2022).

It should be noted that, in general, it cannot be determined if rod and reel hook and line gear originated from a commercial (i.e., charter boat and headboat) or recreational angler because the gear type used by both sources is typically the same. Also, it is not possible to estimate the total number of interactions with hook and line gear because there is no observer program. The documented interactions in this gear represent a minimum known count of interactions in the last five years.

Other Mortality

There were no additional documented mortalities or serious injuries besides those described in the fisheries sections above. All mortalities and serious injuries from known sources for the JES Stock are summarized in Table 2.

Table 2. Summary of the incidental mortality and serious injury of common bottlenose dolphins (*Tursiops truncatus*) of the Jacksonville Estuarine System Stock. The fisheries do not have an ongoing, federal observer program, so counts of mortality and serious injury were based on stranding data, at-sea observations, or fisherman self-reported takes via the Marine Mammal Authorization Program (MMAP). For strandings, at-sea counts, and

fisherman self-reported takes, the number reported is a minimum because not all strandings, at-sea cases, or gear interactions are detected. See the Annual Human-Caused Mortality and Serious Injury section for biases and limitations of mortality estimates, and the Strandings section for limitations of stranding data. NA = not applicable. *Indicates the count would have been higher had it not been for mitigation efforts (see text for that specific fishery for further details).

Fishery	Years	Data Type	Mean Annual Estimated Mortality and Serious Injury Based on Observer Data	5-year Minimum Count Based on Stranding, At-Sea, and/or MMAP Data
Commercial Blue Crab Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	5.5*a
Unidentified Trap/Pot	2016–2020	Stranding Data and At-Sea Observations	NA	0.5*b
Hook and Line	2016–2020	Stranding Data and At-Sea Observations	NA	4
Mean Annual Mortality due to commercial fisheries (2016–2020)			**2.0**	
Mean Annual Mortality due to other takes (2016–2020)			**0**	
Minimum Total Mean Annual Human-Caused Mortality and Serious Injury (2016–2020)			**2.0**	

a. Includes two cases of CBD which were prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison 2022). There was one case of a non-calf entanglement in which the post-mitigation determination was CBD. The CBD was prorated as 0.46 (rounded to 0.5). There was one case of a calf entanglement in which the post-mitigation determination was a CBD, and this case was prorated as a serious injury (1 serious injury). The two CBD cases were therefore prorated as 1.5 serious injuries.

b. One case of CBD which was prorated based on previous assignable injury events (NMFS 2012; Maze-Foley and Garrison 2022). There was one non-calf entanglement in which the post-mitigation determination was CBD. The CBD was prorated as 0.46 (rounded to 0.5).

Strandings

During 2016–2020, 55 common bottlenose dolphins were reported stranded within the JES Stock area (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2021). There was evidence of human interaction for 19 of the strandings. For the remaining 36 strandings, it could not be determined if there was evidence of human interaction. Thirteen human interactions were from entanglements with trap/pot gear and hook and line gear as described above, and there was also evidence of vessel strike for two animals (one was also entangled in trap/pot gear). It should be noted that evidence of human interaction does not necessarily mean the interaction caused the animal's stranding or death. However, for any case for which it could be determined that a human interaction contributed to an animal's stranding, serious injury, or death, the case was included in the counts of mortality and serious injury in Table 2.

Stranding data underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al*. 2012; Wells *et al*. 2015; Carretta *et al.* 2016). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al*. 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

The JES Stock has been affected by two unusual mortality events (UMEs) during the past 15 years. A UME was declared for the St. Johns River area during May–September 2010, including 14 strandings assigned to the JES Stock and four strandings within estuaries to the south not currently included in any stock assessment report. The cause of this UME was undetermined. An additional UME occurred during 2013–2015 along the Atlantic coast of the U.S. and was attributed to morbillivirus (Morris et al. 2015). The total number of stranded common bottlenose dolphins from New York through North Florida (Brevard County) during the 2013–2015 UME was 1,614 (https://www.fisheries.noaa.gov/national/marine-life-distress/2013-2015-bottlenose-dolphin-unusual-mortality-event-mid-atlantic, accessed 13 November 2019). Most strandings and morbillivirus positive animals were recovered from the ocean side beaches rather than from within the estuaries, suggesting that coastal stocks may have been more impacted by this UME than estuarine stocks (Morris et al. 2015). However, several confirmed morbillivirus positive animals were recovered from within the JES Stock area.

Table 3. Common bottlenose dolphin strandings occurring in the Jacksonville Estuarine System Stock area from 2016 to 2020, including the number of strandings for which evidence of human interaction (HI) was detected and number of strandings for which it could not be determined (CBD) if there was evidence of HI. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 15 June 2021). Please note HI does not necessarily mean the interaction caused the animal's death.

Stock	Category	2016	2017	2018	2019	2020	Total
Jacksonville Estuarine System Stock	Total Stranded	11	10	11	15	8	55
	HI--Yes	7a	6b	1c	3d	2e	19
	HI--No	0	0	0	0	0	0
	HI--CBD	4	4	10	12	6	36

a. Includes 6 fisheries interactions (FIs), including 2 entanglement interactions with commercial blue crab trap/pot gear (1 mortality; 1 released alive, CBD if seriously injured), and 3 entanglement interactions with hook and line gear (2 mortalities; 1 released alive, seriously injured). In addition to the FIs, it also includes 1 entanglement in unidentified rope/line.

b. Includes 5 FIs, including 2 entanglement interactions with hook and line gear (1 mortality; 1 released alive, seriously injured), and 3 live entanglements in blue crab trap/pot gear (confirmed to be commercial gear in 2 cases - 1 seriously injured, 1 not seriously injured; and 1 CBD if seriously injured).

c. Includes 1 FI which was an entanglement interaction with commercial blue crab trap/pot gear (mortality, 3 sets of gear involved); this animal also had evidence of a vessel strike.

d. Includes 1 animal with evidence of a vessel strike (healed series of propeller scars).

e. Includes 2 FIs, both of which were live entanglements in commercial blue crab trap/pot gear (both released alive, 1 seriously injured and 1 CBD if seriously injured).

HABITAT ISSUES

This stock inhabits areas with significant drainage from industrial and urban sources, and as such is exposed to contaminants and nutrients in runoff from them. No contaminant analyses of dolphin tissues have yet been conducted in this area. In other estuarine areas where such analyses have been conducted, it has been suggested that exposure to anthropogenic contaminants could potentially result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Harmful algal blooms occur regularly in the St. Johns River (Brown *et al.* 2018). The most prevalent and persistent cyanotoxins from water samples collected in the St. Johns River, microcystins and nodularins, have been detected throughout the year. Dolphins utilizing this habitat may be exposed to these cyanotoxins. Brown *et al.* (2018) suggested that the high levels of human activity coupled with environmental stressors characterizing the St. Johns River could lead to the dolphins utilizing this area being more susceptible to the harmful effects of cyanotoxin exposure.

STATUS OF STOCK

Common bottlenose dolphins in the western North Atlantic are not listed as threatened or endangered under the Endangered Species Act. However, this stock is considered strategic under the MMPA because the documented mortalities and serious injuries are incomplete and biased low, and likely exceed PBR when corrected for unrecovered carcasses. While the abundance of the JES Stock is currently unknown, based on the previous minimum abundance estimate (e.g., Caldwell (2001), it is likely small and therefore relatively few mortalities and serious injuries would exceed PBR. The documented minimum mean annual human-caused mortality for the JES stock for 2016–2020 was 2.0, with all mortalities having evidence of fishery interactions (crab trap/pot and hook and line gear). However, it is likely the estimate of annual fishery-caused mortality and serious injury is biased low as indicated above (see Annual Human-Caused Mortality and Serious Injury section). Wells *et al.* (2015) estimated that the proportion of common bottlenose dolphin carcasses recovered in Sarasota Bay, a relatively open and more urbanized estuarine environment, was 0.33, indicating significantly more mortalities occur than are recovered. For a less developed area consisting of a more complex salt marsh habitat, the Barataria Bay Estuarine System, the estimated proportion of common bottlenose dolphin carcasses recovered was 0.16 (DWH MMIQT 2015). The Sarasota Bay recovery rate may be most appropriate for this stock given that much of the habitat is urban. When annual human-caused mortality and serious injury is corrected for unrecovered carcasses using the 0.33 recovery rate (n=6.0), it exceeds PBR for this stock based on an older minimum abundance of 122 residents (Caldwell 2001). Total fishery-related mortality and serious injury for this stock is unknown, but at a minimum is greater than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The status of this stock relative to optimum sustainable population is unknown. There are insufficient data to determine population trends for this stock.

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