Levesque, J. 2010. Evolving fisheries: today's bycatch is tomorrow's target catch - escolar (Lepidocybium flavobrunneum) catch in the US pelagic longline fishery. The Open Fish Science Journal 3:30-42.

Lewison, R.I., Freeman, S.A. and Crowder, L.B. 2004. Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles. Ecology Letters 7:221-231

Maison, K.A., Kinan Kelly, I. and K.P. Frutchey. 2010. Green Turtle Nesting Sites and Sea Turtle Legislation throughout Oceania. U.S. Dep. Commerce, NOAA Technical Memorandum. NMFS-F/SPO-110, 52 pp.

Mejuto, J., Garcia-Cortes, B., Ramos-Cartelle, A. and de la Sema, J.M. 2008. Scientific estimations of bycatch landed by the Spanish surface longline fleet targeting swordfish (Xiphas gladius) in the Atlantic Ocean with special reference to the years 2005 and 2006. International Commission for the Conservation of Tunas SCRS/2008/045.

Menard, F., Fonteneau, A., Gaertner, D., Nordstrom, V. Stequert, B. and Marchal, E. 2000. Exploitation of small tunas by a purse-seine fishery with fish aggregating devices and their feeding ecology in an eastern tropical Atlantic ecosystem. ICES Journal of Marine Science 57:525-520.

Milessi, A.C. and Defeo, O. Long-term impact of incidental catches by tuna longlines: the black escolar (Lepidocybium flavobrunneum) of the southwestern Atlantic Ocean. Fisheries Research 58:203-213

Moody Marine International (MMI). 2011. North Atlantic swordfish (Xiphias gladius) Canadian pelagic longline fishery: Vol. 1 final report and determination. Contract Number:09-01 Nova Scotia swordfish.

Morgan, L.E. and Chuenpagdee, R. 2003, Shifting gears: addressing the collateral impacts of fishing methods in US waters. Pew Science Series. Washington, DC: Island Press.

Myers, R.A., Baum, J.K., Shepherd, T.D., Powers, S.P. and Peterson, C.H. 2007. Cascading effects of the loss of apex predatory sharks from a coastal. Science 315:1846-1850.

National Marine Fisheries Service (NMFS). 2009b. An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics. NMFS Southeast Fisheries Science Center Contribution PRD-08/09-14

National Marine Fisheries Service (NMFS). 2012. Status of stocks 2012, annual report to congress on the status of US fisheries. NOAA Fisheries.

National Marine Fisheries Service (NMFS). 2013. HMS Fishery Compliance Guide. Atlantic Highly Migratory Species, National Marine Fisheries Service.

National Marine Fisheries Service (NMFS). 2014. Us Foreign trade. NOAA Office of Science and Technology.

NMFS. 2015. Annual trade data by product, country/associated. National Marine Fisheries Service.

National Oceanic and Atmospheric Administration (NOAA). 2012. 2012 Stock Assessment and Fishery Evaluation Report for Atlantic highly migratory species. US Department of Commerce, National Oceanic and Atmospheric Administration. 220 pg.

Parker, C., Kleisner, K.M. and Nowlis, J.S. 2006. Preliminary assessment of the western central Atlantic dolphinfish (Coryphaena hippurus) stock: a Caribbean regional fisheries mechanism project. Sustainable Fisheries Division Contribution NO. SFD-2--6-041

Parkes, G., Mitchell, R., Trumble, R.J. 2013. MSC final report for US north Atlantic swordfish pelagic longline and handgear buoy fishery. MRAG Americas, Inc.

Paul, S.D., Hanke, A., Smith, S.C., and Neilson, J.D. 2010. An examination of loggerhead sea turtle (Caretta caretta) encounters in the Canadian swordfish and tuna longline fishery, 2002-2008. Canadian Science Advisory Secretariat Research Document 2010/088

Paxton, J.R. 2010. Alepisaurus ferox. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1.

Piraino, S., Fanelli, G., Boero, F. 2002. Variability of species roles in marine communities: change of paradigms for conservation priorities. Marine Biology 140:1067-1074.

Poncet, S.; Robertson, G.; Phillips, R. A.; Lawton, K.; Phalan, B.; Trathan, P. N.; Croxall, J. P. 2006. Status and distribution of Wandering, Black-browed and Grey-headed Albatrosses breeding at South Georgia. Polar Biology 29: 772-781.

Schindler, D.E., Essington, T.E., Kitchell, J.F., Boggs, C. and Hilborn, R. 2002. Sharks and tunas: fisheries impacts on predators with contrasting life histories. Ecological Applications 12:735-748.

Seafood Watch. 2013. Seafood Watch. 2013. Seafood Watch criteria for fisheries. Monterey Bay Aquarium Seafood Watch Version January 18, 2013. 82 p.

Southeast Data, Assessment, and Review (SEDAR) (2006) Stock assessment report of SEDAR 9 Gulf of Mexico gray triggerfish. SEDAR 9 Assessment Report 1, Charleston, SC.

Southeast Fisheries Science Center (SEFSC). 2013. Pelagic observer program catch and disposition data 2007-2009.

Seminoff, J.A. (Southwest Fisheries Science Center, U.S.) 2004. Chelonia mydas. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2.

Stevens, J.D., Bonfil, R., Dulvy, N.K. and Walker, P.A. 2000. The effects of fishing on sharks, rays, and chimaeras (chondrichthuyans), and the implications for marine ecosystems. ICES Journal of Marine Science 57:476-494.

Taylor, B.L., Baird, R., Barlow, J., Dawson, S.M., Ford, J.K.B., Mead, J.G., Notarbartolo di Sciara, G., Wade, P. & Pitman, R.L. 2012. Grampus griseus. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1.

Taylor, B.L., Baird, R., Barlow, J., Dawson, S.M., Ford, J., Mead, J.G., Notarbartolo di Sciara, G., Wade, P. & Pitman, R.L. 2011. Globicephala macrorhynchus. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1

Turtle Expert Working Group (TEWG). 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical memorandum NMFS-SEFSC-555.

Tudela, S. 2000. Ecosystem effects of fishing in the Mediterranean: an analysis of the major threats of fishing gear and practices to biodiversity and marine habitats. Report for FAO Fisheries Department (EP/INT/759/GEF). Rome, Italy.

Wallace, B.P., Kot, C.Y., MiMatteo, A.D., Lee, T., Crowder, L.B. and Lewison, R.L. 2013. Impacts of fisheries bycatch on marine turtle populations worldwide: toward conservation and research priorities. Ecosphere 4:40.http://dx.doi.org/10.1980/ES12-00388.1

Waring, G.T., Josephson, e., Maze-Foley, K. and Rosel, P.E . 2013. US Atlantic and Gulf of Mexico marine mammal stock assessments - 2-12. National Marine Fisheries Service.

Yeh, Y.M., Huan, H.W., Dietrich, K.S. and Melvin, E. 2012. Estimates of seabird incidental catch by pelagic longline fisheries in the south Atlantic Ocean. Animal Conservation 16:141-152.

Appendix A: Extra By Catch Species

BIGEYE TUNA

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

Medium

FishBase assigned a high to very high vulnerability of 72 out of 100 (Froese and Pauly 2013). But bigeye tuna's life history characteristics suggest a medium vulnerability to fishing. For example, bigeye tuna reaches sexual maturity around 100–125 cm, reaches a maximum size of 200 cm, and lives around 11 years (Davies et al. 2011) (Froese et al. 2013). It is a broadcast spawner and top predator (Froese and Pauly 2013). Based on these life history characteristics, we have awarded a medium score.

Justification:

Life history characteristic	Paramater	Score
Average size at maturity	>200 cm	1
Average maximum size	<300 cm	2
Average maximum age	10-25 years	2
Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1

Factor 2.2 - Abundance

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

High Concern

Bigeye tuna in the Atlantic was last assessed in 2015. Several models were used in this assessment. The Stock Synthesis model indicates that the biomass has decreased over time, and fell below levels necessary to produce the maximum sustainable yield (B_{MSY}) in 2010. The Age Structured Production Model indicated that the ratio of the biomass in 2014 to that needed to produce the maximum sustainable yield (B_{2014}/B_{MSY}) ranged between 0.554 and 1.225. The Virtual Population Analysis also indicated that the population is overfished (ICCAT 2015a). The status is assessed to be overfished based on the most plausible model runs (0.48–1.20). We have awarded a "high" concern score because there is evidence the population of bigeye tuna in the Atlantic is overfished.

Factor 2.3 - Fishing Mortality

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

High Concern

According to the Age Structured Production model used in the 2015 assessment, the ratio of fishing mortality in 2014 to that needed to produce the maximum sustainable yield (F_{2014}/F_{MSY}) ranged from 0.576 to 1.436. According to the stock synthesis model, the F_{2014}/F_{MSY} ratio appears to have decreased in recent years to below 1. The Virtual Population Analysis model indicated that overfishing is not occurring (ICCAT 2015a).

Based on the most plausible model runs (0.62–1.85), there is an indication that overfishing is occurring (ICCAT 2015a). We have therefore awarded a "high" concern score.

Factor 2.4 - Discard Rate

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

BLACK-BROWED ALBATROSS

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC, DRIFTING LONGLINES

High

Seabirds have a high level of vulnerability (Seafood Watch 2013). Seabirds' life history characteristics support this classification. These characteristics include a long life, late age at maturity, and small number of young.

Factor 2.2 - Abundance

SOUTH ATLANTIC, DRIFTING LONGLINES

High Concern

The International Union for Conservation for Nature (IUCN) Red List of Threatened Species classifies black-browed albatross as Near Threatened, and rapid declines in the population size are no longer occurring. The total population size worldwide is estimated to be 700,000 breeding birds or 2.1 million individual birds (BirdLife International 2014). We have awarded a "high" concern score based on the IUCN status.

Factor 2.3 - Fishing Mortality

SOUTH ATLANTIC, DRIFTING LONGLINES

High Concern

The incidental capture of black-browed albatross in longline fisheries is likely a cause of population declines (BirdLife International 2014). Within the Atlantic longline fisheries, it was estimated that between 2003 and 2006, 48,500 seabirds were incidentally caught, and of these, 57% were albatross species and 32% were black-browed albatross. The highest catch rates occurred in the South Atlantic (south of 25° S). Black-browed albatross was also reported to be one of the most commonly observed incidentally captured seabird species in the South Atlantic Taiwanese pelagic longline fishery (Yeh et al. 2012). These bycatch estimates are considered to be at a level to cause concern for vulnerable albatross populations (Klaer 2012). Bycatch mitigation measures that follow best practices (Gilman 2011) are in place in pelagic longline fisheries operating in the Atlantic, so we have awarded a "high" concern instead of critical concern score.

Justification:

In the South Atlantic (south of 25° S), information on seabird interactions must be recorded, and longline

vessels fishing must use two mitigation methods (ICCAT 2011h).

Factor 2.4 - Discard Rate

SOUTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

GREY-HEADED ALBATROSS

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC, DRIFTING LONGLINES

High

Seabirds have a high level of vulnerability (Seafood Watch 2013). Seabirds' life history characteristics support this classification. These characteristics include a long life, late age at maturity, and small number of young.

Factor 2.2 - Abundance

SOUTH ATLANTIC, DRIFTING LONGLINES

High Concern

Grey-headed albatross is listed as Vulnerable by the International Union for the Conservation of Nature (IUCN) based on quickly declining population sizes over the past 90 years or three generations. There are an estimated 96,000 breeding pairs or 250,000 mature birds (BirdLife International 2012c). We have awarded a "high" concern score based on the IUCN classification.

Factor 2.3 - Fishing Mortality

SOUTH ATLANTIC, DRIFTING LONGLINES

High Concern

Declines in the population size of this species have been attributed to incidental capture in longline fisheries (BirdLife International 2012c). Grey-headed albatross was the most commonly reported seabird bycatch species in the Japanese longline fishery between 1997 and 2009 (90) (Inoue et al. 2012). This species was not reported as observed in the Taiwanese fleet between 2004 and 2008 (Yeh et al. 2012). Bycatch mitigation measures that meet best practices (Gilman 2011) are in place in pelagic longline fisheries operating in the Atlantic, so we have awarded a "high" concern instead of critical concern score.

Justification:

In the South Atlantic (south of 25° S), information on seabird interactions must be recorded, and longline vessels fishing must use two mitigation methods (ICCAT 2011h).

Factor 2.4 - Discard Rate

SOUTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

SILKY SHARK

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

High

Fishbase assigned a very high vulnerability score of 79 out of 100 (Froese and Pauly 2013).

Factor 2.2 - Abundance

SOUTH ATLANTIC, DRIFTING LONGLINES

High Concern

A stock-wide population assessment of silky shark in the Atlantic Ocean has not been conducted. The International Union for Conservation of Nature (IUCN) has listed silky shark as Near Threatened in the Southwest Atlantic Ocean. Some analysis of catch rate series in the Northwest and Central Atlantic Ocean has been done but not in the South Atlantic (Baum et al. 2003) (Cortes et al. 2007). There are significant issues with species identification and an overall lack of reporting for this species (Bonfil et al. 2009). We have awarded a "high" concern score based on the IUCN status.

NORTH ATLANTIC, DRIFTING LONGLINES

High Concern

A stock-wide population assessment of silky shark in the Atlantic Ocean has not been conducted. The International Union for Conservation of Nature (IUCN) has listed silky shark as Vulnerable in the Northwest Atlantic and Western Central Atlantic Ocean. Some analysis of catch rate series in the Northwest and Central Atlantic Ocean has indicated large declines in population size (Baum et al. 2003) (Cortes et al. 2007). There are significant issues with species identification and an overall lack of reporting for this species (Bonfil et al. 2009). We have awarded a "high" concern score based on the IUCN status.

Factor 2.3 - Fishing Mortality

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

High Concern

Fishing mortality rates of silky shark in the Atlantic are not known but it is known to be caught in pelagic longline fisheries. An Ecological Risk Assessment found silky shark scored 8th out of 20 species for susceptibility to pelagic longline gear in the North Atlantic, indicating that it is highly susceptible (Cortes et al. 2012). A lack of reporting and species identification issues have made assessing fishing mortality rates difficult

(Bonfil et al. 2008). The majority of information in the North Atlantic is specific to the U.S. pelagic longline fishery, where silky shark represents around 30% of all elasmobranchs (Beerkircher et al. 2002). The incidental and targeted mortality from fisheries is thought to be a contributing factor to silky shark population declines (Bonfil et al. 2009). We have awarded a "high" concern score because fishing mortality rates are unknown but fishing appears to be a contributing factor to population declines. We have not awarded a critical concern score because ICCAT has recently prohibited the capture and retention of silky shark.

Factor 2.4 - Discard Rate

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

SWORDFISH

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

Medium

FishBase assigned a high to very high vulnerability of 72 out of 100 (Froese and Pauly 2013). But the life history characteristics of swordfish indicate a lower vulnerability to fishing. For example, swordfish reaches sexual maturity around 180 cm in size and around 5 years of age, reaches a maximum length of 455 cm, and lives more than 10 years. Swordfish is a broadcast spawner and top predator (Froese and Pauly 2013). This is more indicative of a moderate vulnerability to fishing based on the Seafood Watch productivity and susceptibility table score (PSA = 2).

Justification:

Life history characteristic	Paramater	Score
Age at maturity	<5 years	3
Average size at maturity	100-300 cm	2
Average maximum size	> 300 cm	1
Average maximum age	10-25 years	2
Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1

Factor 2.2 - Abundance

SOUTH ATLANTIC, DRIFTING LONGLINES

Low Concern

Swordfish populations in the South Atlantic Ocean were last assessed in 2013. There was considerable uncertainty surrounding the results, with the models providing conflicting results. But it appears that the biomass is most likely above levels needed to produce the maximum sustainable yield (B_{MSY}) and the population is likely not overfished. We have awarded a "low" concern and not very low concern score because

of the large amount of uncertainty surrounding the results (ICCAT 2013).

NORTH ATLANTIC, DRIFTING LONGLINES

Low Concern

The last assessment for swordfish in the North Atlantic was conducted in 2013. The population of swordfish in the North Atlantic is estimated to be at or above levels needed to produce the maximum sustainable yield (B_{MSY}) and the population is not overfished. The results from this assessment were very similar to those from the previous 2009 assessment (ICCAT 2013). There is some concern surrounding the size structure of the population (ICCAT 2013), so we have awarded a "low" concern and not very low concern score.

Factor 2.3 - Fishing Mortality

SOUTH ATLANTIC, DRIFTING LONGLINES

Very Low Concern

Despite a large amount of uncertainty surrounding the results of the 2013 assessment for swordfish in the South Atlantic, current fishing mortality rates are likely below those necessary to produce the maximum sustainable yield (F_{MSY}) (0.75 (0.60–1.01)) and overfishing is likely not occurring. We have awarded a "very low" concern score because fishing levels on swordfish are sustainable.

NORTH ATLANTIC, DRIFTING LONGLINES

Very Low Concern

Fishing mortality of swordfish in the North Atlantic has been below levels needed to produce the maximum sustainable yield (F_{MSY}) since 2000 and overfishing is not currently occurring. Fishing mortality peaked in 1995 and has shown a downward trend since, with a slight increase from 2002–2005 (ICCAT 2013). We have awarded a "very low" concern score because fishing levels on swordfish are sustainable.

Factor 2.4 - Discard Rate

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

YELLOWFIN TUNA

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

Medium

FishBase assigned a moderate vulnerability score of 46 out of 100 (Froese and Pauly 2013). Yellowfin tuna reaches sexual maturity around 100 cm in size and 2–5 years in age. A maximum length of 140–150 cm in

size can be attained and it can live 8–9 years. It is a broadcast spawner and high level predator in the ecosystem (Froese and Pauly 2014) (ICCAT 2014). These life history characteristics also support a moderate level of vulnerability.

Factor 2.2 - Abundance

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

High Concern

Yellowfin tuna in the Atlantic Ocean was last assessed in 2016. The population is currently estimated to be about 5% below Convention objectives (B_{2014}/B_{MSY} = 0.95 (0.71–1.36)), with a 45.5% chance that the population is not overfished or undergoing overfishing. Their status has improved since the 2011 assessment, when it was estimated at 85% of B_{MSY} with a 26% chance the population is not overfished or undergoing overfishing. However, the stock is still considered to be overfished (ICCAT 2016b). This rates as "high" concern because the population is classified as overfished.

Factor 2.3 - Fishing Mortality

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

Low Concern

The current fishing mortality rate is estimated to be 23% below F_{MSY} ($F_{current}/F_{MSY}$ = 0.77 (0.53–1.05)) and the maximum sustainable yield (MSY) is estimated at 126,304 t (ICCAT 2016b). This suggests that fishing mortality rates are sustainable and overfishing is not occurring. The assessment suggested only a 13.3% chance the stock is both overfished and undergoing overfishing and suggested that the continuation of current catch levels into the future will be sustainable through 2014. We have therefore awarded a low concern score.

Factor 2.4 - Discard Rate

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

ALBACORE

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC, DRIFTING LONGLINES
SOUTH ATLANTIC, DRIFTING LONGLINES

Medium

FishBase assigned a high vulnerability score of 58 out of 100 (Froese and Pauly 2013). But the life history characteristics of albacore suggest only a medium vulnerability to fishing. For example, albacore reaches sexual maturity between 5 and 6 years of age and reaches a maximum age of 15 years (ISCAWG 2011). It is

a broadcast spawner and top predator (Froese and Pauly 2013). Based on these life history characteristics, we have awarded a "medium" score.

Justification:

Life history characteristic	Parameter	Score
Age at maturity	<5 years	3
Average maximum age	10–25 years	2
Reproductive strategy	Broadcast spawner	3
Trophic level	>3.25	1

Factor 2.2 - Abundance

NORTH ATLANTIC, DRIFTING LONGLINES

High Concern

The population of albacore tuna in the North Atlantic has been below the level needed to produce the maximum sustainable yield (B_{MSY}) since the mid-1980s but has improved since the lowest levels in the late 1990s. There is considerable uncertainty surrounding the status of albacore tuna in the North Atlantic, as evidenced by the wide array of model results. Currently, the ratio of the current spawning stock biomass to that at the maximum sustainable yield ($SSB_{CURRENT}/SSB_{MSY}$) is estimated to be 0.94 (0.74–1.14). There is a 0.2% probability that the population is overfished and undergoing overfishing, a 27.4% probability that the population is neither overfished nor undergoing overfishing, and a 72.4% probability that the population is either overfished or overfishing is occurring but not both (ICCAT 20013). The International Commission for the Conservation of Atlantic Tunas considers this population overfished and we have awarded a “high” concern score.

SOUTH ATLANTIC, DRIFTING LONGLINES

Low Concern

The 2016 assessment of albacore tuna in the South Atlantic indicated that the population status has improved since the last assessment (2013). The majority of model runs indicated that the population was not overfished, with the ratio of the current biomass to that which would produce the maximum sustainable yield (B/B_{MSY}) ranging from 0.508 to 1.972 (ICCAT 2016). There is a high probability that the population is healthy. We have awarded a “low” concern and not very low concern score to account for uncertainty in this assessment.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC, DRIFTING LONGLINES

Low Concern

The maximum sustainable yield (MSY) of albacore tuna in the North Atlantic is estimated to be 31,680 t. Historically, fishing mortality rates were above levels needed to produce the maximum sustainable yield (F_{MSY}) from the 1960s to mid-2000s. Currently, F_{2012}/F_{MSY} = 0.72 (0.55–0.89) and the population is no longer undergoing overfishing (ICCAT 2013a). We have awarded a “low” concern and not very low concern score to account for uncertainty in this assessment.

SOUTH ATLANTIC, DRIFTING LONGLINES

Low Concern

According to the most recent assessment (2016), fishing mortality rates for South Atlantic albacore tuna have decreased since the previous (2013) assessment. The current ratios of fishing mortality rates to those that produce the maximum sustainable yield (F/F_{MSY}) are estimated to range from 0.316 to 0.851. There is a high probability that the population is no longer undergoing overfishing (ICCAT 2016). We have awarded a "low" concern and not very low concern score to account for uncertainty in this assessment.

Factor 2.4 - Discard Rate

NORTH ATLANTIC, DRIFTING LONGLINES
SOUTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

BLUEFIN TUNA

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC, DRIFTING LONGLINES

High

FishBase assigned a very high vulnerability score of 82 out of 100 (Froese and Pauly 2013). In the western Atlantic, bluefin tuna reaches sexual maturity around 9 years of age and under 200 cm in length. It is long lived, reaching ages of 40 years and lengths over 300 cm (ICCAT 2012b). Atlantic bluefin tuna is a broadcast spawner and has a high trophic level according to FishBase (Froese and Pauly 2013). These life history characteristics also suggest a high vulnerability.

Factor 2.2 - Abundance

NORTH ATLANTIC, DRIFTING LONGLINES

Very High Concern

Based on a low recruitment scenario for Atlantic bluefin tuna in the Northwest Atlantic, the current biomass (B_{2013}) is around 225% (192%–268%) above the level needed to produce the maximum sustainable yield (B_{MSY}), but under the high recruitment scenario, the biomass is only 48% (35%–72%) of B_{MSY}. Therefore, under the low recruitment scenario, Atlantic bluefin tuna is not overfished but under the high recruitment scenario it is (ICCAT 2012b). Atlantic bluefin tuna is listed as Endangered under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and is under assessment for designation on Canada's Species at Risk Act (SARA) (GOC 2013). The International Union for the Conservation of Nature (IUCN) considers Atlantic bluefin tuna to be Endangered (Collette et al. 2011). We have awarded a "very high" concern score due to the IUCN status and because the stock assessment has been hindered with data concerns and uncertainty.

Justification:

Two alternative hypotheses are currently considered by the scientific committee conducting the assessment. The first one (high potential recruitment) assumes that high recruitment levels seen in the 1970s can be

attained again if the stock is allowed to recover. The second hypothesis (low potential recruitment) assumes that these high levels of recruitment can no longer be achieved due to circumstances such as environmental changes. The results of the models and therefore the status of the population is highly dependent on which one of these hypotheses is true, and there is currently no indication which hypothesis is more plausible.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC, DRIFTING LONGLINES

Moderate Concern

For bluefin tuna in the Northwest Atlantic Ocean, the fishing mortality rate needed to produce the maximum sustainable yield (F_{MSY}) under the low recruitment scenario is 0.12 (0.17–0.24) and 0.08 (0.07–0.10) under the high recruitment scenario. The current $F_{2010–2012}/F_{MSY}$ is 0.36 (0.28–0.43) and 0.88 (0.64–1.08) under the low and high scenarios, respectively. Therefore, under both recruitment scenarios, overfishing is not occurring (ICCAT 2014). We have awarded a "moderate" and not low concern score due to the uncertainty of these results and because overfishing has been occurring under the high recruitment scenario for many years.

Justification:

Factor 2.4 - Discard Rate

NORTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

ATLANTIC SAILFISH

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC, DRIFTING LONGLINES
SOUTH ATLANTIC, DRIFTING LONGLINES

High

FishBase assigned a high vulnerability score of 65 out of 100 (Froese and Pauly 2013). Atlantic sailfish is a broadcast spawner that reaches sexual maturity between 121 and 146 cm, can reach a maximum length of 315 cm, and can live around 4 years. It has a high trophic level of 4.5 (Froese and Pauly 2013). These life history characteristics support a high vulnerability score.

Factor 2.2 - Abundance

NORTH ATLANTIC, DRIFTING LONGLINES
SOUTH ATLANTIC, DRIFTING LONGLINES

High Concern

Two populations of sailfish are assessed in the Atlantic: Eastern and Western. The last assessment was conducted in 2009 and there was a large amount of uncertainty surrounding the actual status of the two

populations. There was evidence that the populations were overfished, particularly in the Eastern region. Some model results indicated that the Western population is not overfished. Large declines in abundance of Atlantic sailfish occurred prior to 1990, but since 1990, estimates of abundance show different trends, depending on the source (ICCAT 2009c). We have awarded a "high" concern score because there is some indication the populations are overfished and because of the uncertainty surrounding its stock status.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC, DRIFTING LONGLINES
SOUTH ATLANTIC, DRIFTING LONGLINES

High Concern

The majority of fishing mortality for Atlantic sailfish comes from longline fisheries. The majority of sailfish are caught in the Eastern compared to the Western Atlantic. The last assessment conducted in 2009 was highly uncertain. The maximum sustainable yield (MSY) was almost twice as high in the Eastern Atlantic (1,250–1,950 t) as in the Western (600–1,100 t). Overfishing is likely occurring in the Eastern Atlantic and possibly occurring in the Western (ICCAT 2009c). We have awarded a "high" concern score to account for the Eastern population likely undergoing overfishing.

Factor 2.4 - Discard Rate

NORTH ATLANTIC, DRIFTING LONGLINES
SOUTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

FRIGATE TUNA

Factor 2.1 - Inherent Vulnerability

NORTH ATLANTIC, DRIFTING LONGLINES

Low

FishBase assigned a low vulnerability score of 26 out of 100 (Froese and Pauly 2013). Longevity of frigate tuna is unknown, as is the age at sexual maturity. The size at sexual maturity is estimated to occur between 29 and 35 cm. Frigate tuna reaches a maximum size of 60 cm. It is a broadcast spawner and top level predator (Froese and Pauly 2014). These life history characteristics also suggest a low vulnerability to fishing.

Factor 2.2 - Abundance

NORTH ATLANTIC, DRIFTING LONGLINES

Moderate Concern

In the Atlantic, frigate tuna is assessed along with 13 other "small tuna" species. Currently, there is not enough information to conduct a full assessment of this group (ICCAT 2012a). The International Union for the Conservation of Nature (IUCN) considers frigate tuna to be a species of Least Concern with a stable population trend. Frigate tuna is considered to be abundant but it is possible that declines in individual species of small

tunas may be not be apparent, because overall trends for small tunas mask these issues (Collette et al. 2011d). We have awarded a "moderate" concern score because its stock status is unknown and because it has a low vulnerability to fishing.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC, DRIFTING LONGLINES

Moderate Concern

Frigate tuna is one of five "small tuna" species that make up 88% of total "small tuna" catches in the Atlantic Ocean. No assessment has been conducted due to a lack of data. Landings of frigate tuna peaked in the mid- to late 1980s and late 1990s/early 2000s, but have since declined. It is likely that a number of fish identified as frigate tuna may actually be bullet tuna (ICCAT 2012a). Frigate tuna is caught by a variety of gears and there is considerable underreporting and unreporting of catches due to species identification issues and high discarding rates (Collette et al. 2011d). We have awarded a "moderate" concern score because information on fishing mortality rates is not available.

Factor 2.4 - Discard Rate

NORTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

HAWKSBILL TURTLE

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

High

Sea turtles have a high level of vulnerability to fishing pressure due to their life history characteristics (Seafood Watch 2013). These life history characteristics include late age at maturity, long life span, and producing a small number of young.

Factor 2.2 - Abundance

NORTH ATLANTIC, DRIFTING LONGLINES

Very High Concern

The International Union for Conservation of Nature (IUCN) has classified hawksbill turtle as Critically Endangered with a decreasing population trend (Mortimer and Donnelly 2008). Hawksbill turtle has been listed on the Convention on International Trade of Endangered Species (CITES) since 1977 and is currently listed on CITES Appendix I, meaning that it is threatened with extinction and that international trade is prohibited. In the Atlantic Ocean, a population decrease of 80.5% over three generations was noted in the mid-2000s (Mortimer and Donnelly 2008). The population trajectory since then is unknown. We have awarded a "very high" concern score based on the current IUCN and CITES classifications.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC, DRIFTING LONGLINES

Low Concern

The incidental capture of hawksbill turtle has been identified as adversely affecting its recovery worldwide, although declines in the population of hawksbill turtle are mainly a factor of historical targeting of this species (Mortimer and Donnelly 2008). In the Atlantic, hawksbill turtle has a low population risk and low bycatch impact from longline fisheries (Wallace et al. 2013). There are sea turtle management measures in place for pelagic longline fisheries in the Atlantic, although they do not meet best practices, such as specific hook and bait requirements (Gilman 2011). We have awarded a "low" concern score because the impact to hawksbill populations from bycatch is thought to be low in this region, and population declines have mostly been a factor of historical targeting of this species.

Factor 2.4 - Discard Rate

NORTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

OLIVE RIDLEY TURTLE

Factor 2.1 - Inherent Vulnerability

SOUTH ATLANTIC, DRIFTING LONGLINES
NORTH ATLANTIC, DRIFTING LONGLINES

High

Sea turtles have a high level of vulnerability to fishing pressure due to their life history characteristics (Seafood Watch 2013). These life history characteristics include late age at maturity, long life span, and producing a small number of young.

Factor 2.2 - Abundance

NORTH ATLANTIC, DRIFTING LONGLINES

High Concern

The International Union for Conservation of Nature (IUCN) considers olive ridley sea turtle to be Vulnerable with a decreasing population trend. Olive ridley turtle has been listed as Threatened on the U.S. Endangered Species Act (ESA) since 1978 (NMFS 2012a) and is listed on the Convention on International Trade of Endangered Species (CITES) Appendix I. Specifically, within the North Atlantic, the arribada rookeries (synchronous egg laying) have decreased by 97%–99%, while the non-arribada rookeries (non-synchronous egg laying) have increased 364% over time (Abreu-Grobois and Plotkin 2008). We have awarded a "high concern score based on the IUCN status.

Factor 2.3 - Fishing Mortality

NORTH ATLANTIC, DRIFTING LONGLINES

Moderate Concern

The incidental capture of olive ridley turtle occurs worldwide, although the other fisheries, such as trawls and gillnets, appear to have a larger negative impact compared to that of longlines (Wallace et al. 2013) (Abreu-Grobois and Plotkin 2008). Information on olive ridley bycatch rates is not readily available, but a metadata analysis suggested that bycatch impacts in the Western Atlantic were low (Wallace et al. 2013). There are sea turtle management measures in place for pelagic longline fisheries in the Atlantic, but they do not meet best practices, such as specific hook and bait requirements (Gilman 2011). We have therefore awarded a "moderate" concern score.

Factor 2.4 - Discard Rate

NORTH ATLANTIC, DRIFTING LONGLINES

< 20%

Pelagic longline fisheries have an average discard rate of 28.5%, although discard rates can range from 0%–40% (Kelleher 2005). Within the Atlantic, discard rates typically range from 10%–19% (Kelleher 2005).

Appendix B: Update Summary

This report was updated during August 2016 to incorporate a new stock assessment for south Atlantic albacore tuna that was published in May 2016. There were no changes to the overall recommendations.