Reflections on Loggerheads & Longlining

Trevor J. Kenchington
Gadus Associates
Musquodoboit Harbour, Nova Scotia, Canada

Summary

- Florida index-beach survey nest counts showed a slow and general increase until 1998, followed by a major and very serious decline of about 45%. The decline may have extended from the late 1990s to about 2004 or it may have been a short event, perhaps between the 2001 and 2002 nesting seasons. Nest counts appear to have stabilized and may have begun to increase again.
- While not certain, it is likely that the tend in nest counts reflects a trend in the numbers of adult females. If so, the adult female population was reduced by about 25,000 individuals.
- The causes of the decline remain unknown. Incidental catches by fishing gears have been suggested as a primary cause but an epizootic may better match the observed decline.
- The nest counts only indicate a decline in adult females. The trends in juveniles remain unknown, with contradictory indications given by various data sets. An increase in neritic juveniles, resulting from past conservation on the nesting beaches, remains a possibility and may result in increasing adult numbers in the coming years.

- The reef-fish longline fishery uses only bottom longlines and thus is not expected to have major impacts on turtles. Current estimates suggest about 350 turtle takes, including about 175 deaths, annually. The limited data suggest that a few dozen are adults and the rest late-stage neritic juveniles.
- Those few annual deaths constitute (to order-of-magnitude precision):
  - 0.1% of the breeding population,
  - 1% of all adult deaths,
  - 0.1% to 1% of the 25,000 "missing" adult females,
  - 0.001% of all Atlantic loggerhead deaths,
  - Less than 1% of all anthropogenic deaths of neritic-phase Atlantic loggerhead.

- It is not possible to recommend a required percentage reduction in mortality until a policy goal has been specified. It is not the SSC's task to set policy.
- Neither the ESA nor the MSFCMA anticipates specified percentage reductions.
- The criteria that appear to have been used in mortality-reduction recommendations made to the last Council meeting had no discernable underlying logic and should not be endorsed by the SSC.
- The SSC should decline to recommend any percentage reduction until the Council specifies criteria to be applied.

Introduction

The GMFMC's SSC has been charged with reviewing various aspects of Amendment 31 to the Reef Fish FMP, relating to interactions between the reef-fish longline fishery and sea turtles, particularly loggerhead. The Committee will receive detailed and specific information from turtle specialists and from staff working on the Amendment. The present document is not intended to add to that information but rather attempts to suggest a context and to offer an interpretation.

Trends in the Loggerhead Population

The only data sets that provide a reasonably-reliable and approximately-comprehensive picture of even one life stage of loggerhead turtles are the counts of nests from various surveys, most particularly the Florida index-beach surveys. As Witherington *et al.* (2009) have shown, the nest counts recorded by the latter showed a slow and general increase until 1998, followed by a major and very serious decline, which saw the counts drop about 45%.

The exact shape of the temporal trends are, however, obscured by inter-annual variability, notably a relative scarcity of nests in 1989, 1993, 1997 and, perhaps, 2001 – the periodicity perhaps reflecting a lower number of females in one "cohort" returning to the beach after four-year remigration intervals[1]. The data presented by Witherington *et al.* (2009) terminated in 2006 and suggested an on-going decline in nest numbers through to that year. The addition of data from the 2007 survey would not alter that impression. The 2008 survey, however, recorded a number of nests similar to that seen in 2002 (Amendment 31 document, Figure 1.1.1, p. 17). It now appears that nest numbers may have stabilized by 2004, inter-annual variability aside, and may even have begun to increase again. However, the current trend will only be discerned with confidence when yet more years' data have been gathered. With these complications, the approximately-45% decline in nest counts could be seen as having extended over nearly a decade, from the late 1990s to the middle of the present decade, it could be read as having occurred during a single remigration interval, the last unaffected year being 2001 and the first depressed year being 2002, or some intermediate reading might be preferred. With the limited available data, it seems impossible to distinguish between these alternatives, yet they lead to substantially different conclusions about the likely causes of the decline and hence point to quite different management responses.

These numbers of nests are clearly linked to the numbers of breeding females in the population segments surveyed. There are a considerable number of factors [well reviewed by Witherington *et al.* (2009)] that might lead to different trends in the numbers of

[1] Unlike typical fish surveys, the variability is not caused by sampling error: The surveys aim for a complete census of nests on the index beaches during the survey season. Nor can it result from rapid year-to-year changes in adult numbers, rare events aside, since turtles are long-lived. While there are other contributing factors, inter-annual variability in the counts seems likely to be primarily driven by variability in the proportion of mature females migrating to shore to spawn.

females from those seen in the nest counts recorded by the index-beach surveys. However, it seems likely that the two trends are broadly comparable. Considering that loggerhead are an ESA-listed species, it would certainly be appropriately precautionary for management to proceed on the basis that the population has recently lost nearly half of its adult females. In what follows, I will assume that that is so.

The reduction in annual nest counts by the index-beach surveys was approximately 25,000, while those surveys count about 70% of the loggerhead nests in Florida. The average number of nests laid by a female loggerhead in a year when she migrates to the beach to spawn is estimated at 3 to 5.5, while the remigration interval is thought to be 2.5 to 3.7 years (NMFS & USFWS, 2008, p. I-18). The number of females in the breeding population is thus about 70% of the number of nests laid in an average year and the decline in recorded nests in the index-beach survey therefore suggests a loss of some 25,000 adult females from population segments that breed in Florida – a major event even if it occurred over a decade and a massive one if it took only a single year.

Unfortunately, the causes of that event remain obscure. Witherington *et al*. (2009) discussed them at some length but at, multiple critical points, their logical argument explicitly relied on what they stated that they "believed" to be true. Belief is a matter of faith and has no place in scientific reasoning, hence Witherington *et al*.'s (2009) conclusions as to causality must be set aside. Their conclusions were, in any case, developed without exploring all of the implications of the empirical data.

Natural deaths have been suggested as removing perhaps 5% of adult loggerhead in a normal year. If so, even were there complete cessation of recruitment from the juvenile population for ten years, in the absence of anthropogenic deaths of adults the number of females would "only" drop 40%. In practice, nest counts dropped further in less time, while there has been no suggestion of a complete elimination of maturing juveniles. It follows that the decline in adult female numbers, which is suspected on the basis of nest counts, was (in part at least) a result of increased adult mortality. Loss of recruiting juveniles may have played a part but appears not to have been the sole cause.

Witherington *et al*. (2009) suggested that "The causal factor that best fits the nesting decline is fisheries bycatch" (their p. 50) but that seems unlikely. It presumes that, beginning in the late 1990s or early in the present decade, there was a new fishery or fisheries or else an expansion or other change in existing fisheries, which resulted in additional deaths of some 2,500 adult and late-juvenile female loggerhead per year for a decade (on top of pre-existing annual deaths) or else even higher numbers for shorter periods. Those are huge numbers of large animals and it seems improbable in these environmentally-conscious days that such a slaughter would have gone unnoticed, yet no specific fishery has been implicated as causing such deaths. Nor is it obvious why a fishery-induced decline should have ended after a few years (allowing nest counts to stabilize), without specific management actions to terminate the killing. It is, of course, possible to formulate hypotheses that would explain how bycatch losses might have caused the decline but that us apt to degenerate into special pleading.

I would suggest that the only defensible conclusion is that the causes of the decline remain unknown, though I would further suggest that the possibility of an epizootic be carefully considered. Losses caused by a disease would seem more consistent with the rapid onset, major decline and then a return to near stability than would most human agencies. Indeed, if it should emerge that the loss of adult females occurred over a very short period, such as between the nesting seasons of 2001 and 2002, then an epizootic would seem to be the only plausible explanation. While it falls far short of proof, there is independent evidence of an epizootic event, associated with a trematode infection, affecting loggerhead in southern Florida at approximately the time of interest – though in late 2000 and early 2001, whereas nest counts in the summer of 2001 were consistent with those in 1989, 1993 and 1997. Only 150 affected animals were recorded when they stranded (Jacobsen *et al.* 2006) but far larger numbers may have died and been lost offshore. (Whatever happened to the missing 25,000 females, the bulk of them must have been lost at sea as there are no reports of so many washing ashore.) There were also strandings associated with severe red-tide events in 1995, 1996, 2000, 2001, 2002, 2003 and 2005 (Turtle Expert Working Group 2009) which might indicate an on-going series of lesser epizootic events through the years of declining nest counts[2].

While they are valuable, however, inferences about turtle numbers that are drawn from nest-count data can only relate to the numbers of adult females, whereas the long-term prospects for the species depend more on the numbers of juveniles – while the late maturation of loggerhead (at ages of about 30) and their long post-maturation adult lives result in a temporal dislocation between the numbers of adults (and hence of eggs spawned) and the numbers of the resulting juveniles. The sharp drop in the numbers of nests in the years around 2000 may be reflected by a decline in numbers of older juveniles in about 2025 but there is little reason to suppose that the supposed recent decline in adult females was matched by a similar trend in neritic-phase juveniles.

Unfortunately, there are no good indicators of trends in juvenile numbers, the available scientific data being too spatially and temporally specific to be conclusive. It may be noted, however, that Epperly *et al.* (2007) observed a steady increase in loggerhead catch rates (at a rapid 13% per year) in North Carolina pound nets from 1995 to 2003 – much the same period as the decline in nest counts on index beaches in Florida. The pound nets took primarily juveniles of Florida origin. Epperly *et al.* (2007) also cited other unpublished data showing parallel increases, including numbers of turtles entrained in a power-plant cooling-water intake and those taken in South Carolina trawl surveys. The latter resumed in 2008 after a five-year break and took 50% more loggerhead than they had during 2000–03 (Arendt *et al.* 2009). Yet other scientist-observed data sets, however, have shown no trend or even a decline in numbers (NMFS & USFWS, 2008, p. I-13), leaving the overall trends in doubt. More extensive and more intensive coverage of neritic

[2] It should not be supposed that ascribing the decline to an epizootic would ease restrictions on anthropogenic deaths of loggerhead. Rather, recognizing that a single disease event can wipe out two decades of rebuilding suggests that even more effort is needed to swiftly increase the populations of ESA-listed species.

juvenile areas is provided by the observations of commercial fishermen but those come with all of the weaknesses of anecdotal data. In southern waters, all that has been claimed are quantitative changes and those cannot be trusted without rigorous control of data collection, which is clearly impossible for such observations. In contrast, in the Mid-Atlantic Bight and extending even to Georges Bank, there has been a near-qualitative change from turtles being very rare indeed to their being routinely seen[3]. While such an anecdote cannot be used as input data for a population model, it may serve as a salutary reminder.

In summary: There is little doubt that the numbers of adult female loggerhead in the population segments that breed on Florida beaches suffered a very serious decline some years ago (though whether from 1998 to 2004, exclusively in 2001–02 or over some other period is unclear). There is far more doubt about recent trends in juvenile numbers but there are reasons for optimism, hinting that all of the efforts to protect loggerhead nesting beaches, nests, hatchlings and juveniles are working. If so, there should be a very considerable increase in the numbers of newly-maturing females in the coming years, as turtles spawned from the late 1970s onwards finally reach adulthood. It would most certainly not be appropriate to relax conservation targets now, expecting a surge in maturing juveniles to rebuild the population by 2020, but neither would it be appropriate to impose crippling new restrictions on human activities in coastal Florida in an attempt to reverse a supposed "failure" of existing efforts, when there are indications that those efforts are succeeding.

Loggerhead turtles may be on the verge of becoming a major conservation success story – which would be very good news indeed.

Contribution of the Reef-Fish Longline Fishery

The Council's charge to the SSC includes a request to: "Determine percent contribution of longline mortality relative to total estimated anthropogenic mortality". It is well known that pelagic longlines pose a serious danger to turtle populations: Lewison *et al*. (2004) have estimated that they take in excess of 150,000 Atlantic loggerhead annually. Amendment 31, however, deals only with bottom longlining and only with one, small bottom-longline fishery. To date, there have only been two papers published in the primary literature on interactions between turtles and bottom longlines, both of which concern loggerhead in a small area in the Mediterranean, between Italy, Tunisia and Libya (Casale *et al*. 2007; Jribi *et al*. 2008). Otherwise, bottom longlining has been seen, globally, as at most a minor threat to turtles. Experience in the Gulf of Mexico supports that consensus.

[3] This increase has been seen by many fishermen and has been widely reported. The current writer received multiple personal communications from scallop fishermen during the period that I worked for an industry organization: 1999–2006.

Based on observer data, SEFSC (2009) estimated that the reef-fish longline fishery took an average of about 350 turtles annually from mid-2006 to the end of 2008 – most or all of them loggerhead. Only six of 21 observed turtles were recorded as "dead/unresponsive" when returned to the sea but one might suppose that, after post-release mortality, approximately half of the turtles taken died as a result. If so, the fishery killed some 175 loggerhead annually. No information is available on the sexes or maturity stages of those animals but only one of the six observed takes that were measured was adult-sized, while the other five were large juveniles. That suggests, albeit with massive uncertainty, that the reef-fish longline fishery killed two or three dozen adult loggerhead annually –with a possibility that they are all female– plus some 150 neritic juveniles.

Those few individuals are taken from a population which, as considered above, lays some tens of thousands of nests annually and which contains a similar number of breeding females. To order-of-magnitude precision, reef-fish longlines thus kill 0.1% of the breeding population annually or perhaps 1% of all adult deaths. The recent decline in nest counts suggests a loss of 25,000 adult females in less than a decade and perhaps in as little as one year. In that same time, the reef-fish longline fishery may have killed 30 to 300 adults and thus accounted for a number equal to 0.1% to 1% of the extraordinary losses – though there is no reason to suppose that the take by longliners was any higher in those years than before or since.

It may be that the 150 or so juveniles killed each year have a larger impact on the loggerhead population than the few dozen adults but juvenile deaths are harder to place in context. With some 50,000 nests annually, even following the crash in numbers, and over 100 eggs in an average nest, upwards of 5,000,000 loggerhead of the Atlantic population must die each year, albeit most when very young. The reef-fish longline fishery is responsible for only 0.003% of those deaths but it does take older juveniles which have greater conservation value than the eggs, hatchlings and oceanic juveniles. Unfortunately, determining a more-meaningful percentage would require information on the numbers of turtles reaching the ages vulnerable to the fishery and the proportion of them which would survive to lay eggs in their turn if not taken on a longline. NMFS & USFWS (2008) attempted such calculations but their model accounted for less than 2,000,000 deaths annually and hence provides no reliable basis for comparisons. They did suggest that some 40,000 "neritic" juveniles are killed by human activities annually, most of them by trawl fisheries. If that number were correct, the reef-fish longline fishery would account for less than 0.5% of the total.

Returning to the Council's charge: The percentage to report is for the SSC to decide but it seems to be well below 1%. Human impacts on the loggerhead population in the western Atlantic are undoubtedly serious and a matter for grave concern. As required by the ESA, all "reasonable and prudent measures" to reduce them should be implemented, including those that would impact on the reef-fish fisheries and other minor sources of anthropogenic mortality. However, the quantitative contribution of the reef-fish longline

fishery to the pressures on the loggerhead population do seem to be no more than negligible.

Policy Goals & Management Targets

The Council's charge also calls on the SSC to: "Recommend if possible a percent reduction in loggerhead sea turtle mortality from longlines". That request places the Committee in a very difficult position.

The recommendation cannot be provided in the abstract: No percentage reduction can be determined on any scientific basis without some reference standard being set as a policy goal, while it is the SSC's role to estimate the reductions needed to achieve goals set by the Council and not to set those goals on the Council's behalf. The Council, however, has not articulated any policy to the Committee and its charge thus pushes the SSC into the inappropriate role of a policy maker.

One might look to Congress to set the overall policy goals for management of ESA-listed species but the Act does not take an approach of setting percentage reduction goals. One might say that Congress was not so foolish as to embark on that road. Rather, in the absence of any finding that an action such as reef-fish longlining is placing recovery of the species in jeopardy, the ESA calls only for "reasonable and prudent measures". Thus, where takes can be substantially reduced without great cost to human interests, they should be, whereas an activity that has already minimized its takes as far as they reasonably can be should not be crippled in an attempt to achieve some specific (and like arbitrary) further reduction. To apply the ESA's approach, however, would require a judgement of what is and what is not "reasonable". That is not a scientific matter and is not something that should be referred to, nor responded to by, the SSC.

The approach of the MSFCMA is different in wording to that of the ESA but is similar in its import: Bycatch must be minimized "to the extent practicable" but there is no expectation of a specific reduction goal. The determination of what may be "practicable" can certainly be informed by scientific information, including social-scientific information on the costs of various alternatives, but it is ultimately a task for the Council and not the Committee.

The need for a recommended "percent reduction" comes from an approach to the management of loggerhead turtles that is quite different to anything in either Act and hence the policy goal should be spelt out before scientists seek to estimate numbers. To date, there has been no such specification.

The outline of an unstated policy can nevertheless be discerned in presentations made by SERO staff to the last Council meeting. Those appeared to be based around a rather strange reference criterion that seems to have been:

1. Assume that the anthropogenic mortality on the egg through oceanic juvenile phases will remain unchanged,
2. Assume that all sources of anthropogenic mortality on neritic-phase juveniles and adults will be reduced by a constant percentage, then
3. Determine what that percentage reduction must be if there is to be a 50% probability that the Richards model of the loggerhead population will show an increasing trend.

That criterion has, to date, only been implied and may be misinterpreted here. Perhaps it would be better if it has been since, as set down, it is absurd, even setting aside its conflicts with the ESA's approach and its obvious inefficiency[4].

Firstly, there is no justification for seeking to resolve the current challenges facing loggerhead conservation by addressing only the neritic phases, while leaving the eggs, hatchlings and oceanic juveniles with their present levels of mortality. That approach would be especially foolish when the Richards model suggests that even a complete cessation of anthropogenic mortality on neritic loggerhead may be insufficient to produce a positive trend and when the model's sensitivity analysis shows a high correlation ($R^2 = 0.68$) between population increase and pelagic mortality but much smaller ones ($R^2 = 0.02$ to 0.07) between population increase and "benthic" survival rates. Secondly, if NMFS was determined to address only anthropogenic mortality on the neritic phases, it would need to cut those sources of mortality that it can control more deeply than is suggested above in order to compensate for its inability to influence others. One may doubt, for example, whether the losses of turtles in power-plant cooling-water intakes or those struck by the screws of cruise ships working out of the Port of Miami will be affected by any NMFS regulations unless and until such operations have been shown to place recovery in jeopardy. It is not even probable that the deaths caused by recreational boating activity are subject to effective NMFS control. Thus, was the percentage reduction set as specified above and the reductions then implemented where they could be, the loggerhead population would be managed into a decline.

Unless SERO is willing to specify such an absurd goal in writing and thus to take responsibility for it, the SSC would be well advised to refuse to discuss the idea, still less to recommend percentage reductions based upon it. If the goal were to be adopted by the SSC without that specification, it would thereafter be used and justified as the Committee's "scientific" idea – and that would be very damaging indeed for both the SSC and the credibility of its advice. Further, I would suggest that the SSC would be wise to decline to formulate any alternative policy goal or to recommend any reductions until the Council can articulate a goal of its own.

[4] An efficient approach would begin by determining the costs to human interests of reducing the effects of each of the many sources of anthropogenic mortality of loggerhead and then would select those management measures which produced the greatest conservation benefits at the least cost. It would not seek to require the same percentage reductions in all sources of mortality.

Such a refusal need not delay progress. SERO should return to the ESA-mandated process, prepare a new Biological Opinion (which, considering the small number of takes by the reef-fish fishery, will return a "no jeopardy" finding), and then propose "reasonable and prudent measures". That process does not require SSC input.

References

Arendt, M., J. Byrd, A. Segars, P. Maier, J. Schwenter, D. Burgess, J. Boynton, D, Whitaker, L. Liguori, L. Parker, D. Owens & G. Blanvillain (2009) Examination of local movement and migratory behaviour of sea turtles during spring and summer along the Atlantic coast off the southeastern United States. *South Carolina Department of Natural Resources, Final Report to National Marine Fisheries Service for Grant Number* NA03NMF4720281: xi+164 p.

Casale, P., L. Cattarino, D. Freggi, M. Rocco & R. Argano (2007) Incidental catch of marine turtles by Italian trawlers and longliners in the central Mediterranean. *Aquat.Conservation: Mar.Freshw.Ecosystems* 17: 686-701.

Epperly, S.P., J. Braun-McNeill & P.M. Richards (2007) Trends in catch rates of sea turtles in North Carolina, USA. *Endang.Species Res.* 3: 283-293.

Jacobson, E.R., B.L. Homer, B.A. Stacy, E.C. Greiner, N.J. Szabo, C.L. Chrisman, F. Origgi, S. Coberley, A.M. Foley, J.H. Landsberg, L. Flewelling, R.Y. Ewing, R. Moretti, S. Schaf, C. Rose, D.R. Mader, G.R. Harman, C.A. Manire, N.S. mettee, A.P. Mizisin & G.D. Shelton (2006) Neurological disease in wild loggerhead sea turtles *Caretta caretta*. *Dis.Aquat.Org*. 70: 139-154.

Jribi, I., K. Echwikhi, M.N. Bradai & A. Bouain (2008) Incidental capture of sea turtles by longlines in the Gulf of Gabès (South Tunisia): A comparative study between bottom and surface longlines. *Scientia Marina* 72: 337-342.

Lewison, R.L., S.A. Freeman & L.B. Crowder (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.

National Marine Fisheries Service & U.S. Fish and Wildlife Service (2008) Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), Second Revision. National Marine Fisheries Service, Silver Spring, MD.

South East Fisheries Science Center (2009) Estimated takes of sea turtles in the bottom longline portion of the Gulf of Mexico reef fish fishery July 2006 through December 2008 based on observer data. *NMFS SEFSC Contribution* PRD-08/09-07.

Turtle Expert Working Group (2009) An assessment of the loggerhead turtle population in the western North Atlantic Ocean. *NOAA Technical Memorandum* NMFS-SEFSC-575: 131 p.

Witherington, B., P. Kubilis, B. Brost & A. Meylan (2009) Decreasing annual nest counts in a globally important loggerhead sea turtle population. *Ecol.Appl.* 19: 30-54.