EXCERPT FROM SAFMC SARGASSUM FMP

Fishing Level Recommendations

Maximum Sustainable Yield (MSY) for South Atlantic pelagic Sargassum is estimated to be 100,000 metric tons (220,460,000 pounds) wet weight per year.

Overfishing Level to meet Magnuson-Stevens Act Mandate for pelagic Sargassum. Overfishing is defined as the rate of harvest, which compromises the stock's ability to produce MSY. The Maximum Fishing Mortality Threshold (MFMT) is 9.0 to 18.0 units per year. The Minimum Stock Size Threshold (MSST) is 25,000 metric tons (55,115,000 pounds).

Optimum Yield (OY) for pelagic Sargassum as 5,000 pounds wet weight per year.

SARGASSUM FMP

4.2.2 ACTION 2. Maximum Sustainable Yield (MSY) for South Atlantic pelagic *Sargassum* is estimated to be 100,000 metric tons (220,460,000 pounds) wet weight per year.

[Source: NMFS SEFSC (letter from William T. Hogarth, Regional Administrator to Pete Moffitt, SAFMC Chair dated February 24, 2000 and memo from Lawrence Settle, NMFS Beaufort Lab to William Hogarth dated November 29, 1999).]

Assumptions

1. The standing stock of *Sargassum* in the North Atlantic is nearly constant (ref. Butler and Stoner, 1984).

2. No harvest is allowed from July 1 through October 31 (based on recommendation contained in the Biological Opinion of NMFS, S.E. Region Office of Protected Resources). [Note: Action 7C. is consistent with this assumption.]

3. Harvest is restricted to an area off North Carolina between the Virginia and South Carolina lines and starting 100 miles offshore extending to the EEZ (i.e., current harvest area as recommended by SAFMC). [Note: Actions 7A. and 7B. are consistent with this assumption.]

Estimate of MSY

Biomass (B_{NA}) of *Sargassum* in the North Atlantic is on the order of 4 to 11 million metric tons wet weight (ref. Parr, 1939; Zaitzev, 1971; Peres, 1982; Butler et al., 1983; Butler and Stoner, 1984; Nierman et al., 1986; Luning, 1990).

Biomass (B_{NC}) within the proposed harvest area is on the order of 100,000 metric tons wet weight (ref. Howard and Menzies, 1969).

Growth rate (G) is on the order of $0.1Bd^{-1}$ (i.e., 1 doubling every 10-20 days)(ref. Carpenter and Cox, 1974; Howard and Menzies, 1969; LaPointe, 1995).

Fishing mortality (F) is on the order of 7 metric tons wet weight $year^{-1}$ (i.e., average annual landings in North Carolina by Aqua-10 over 15 years).

Natural mortality (M_S) due to beach stranding is on the order of 1 metric ton (km of coastline) $^{-1}$ $year^{-1}$ (ref. Bulter et al., 1983).

Natural mortality due to all other causes is (M_O)=B-(F+M_S). So for the proposed allowable harvest area off North Carolina: M_O = 100,000-(7+500) = 99,493 metric tons wet weight $year^{-1}$.

If we let total natural mortality (M_O+M_S) vary from 99% to 99.99% of B_{NC}, we have surplus production in the proposed harvest area ranging from: 1,000 metric tons wet weight at M=99% to 10 metric tons wet weight at M=99.99%.

Therefore, MSY could be set at 100,000 metric tons wet weight $year^{-1}$ corresponding to B_{NC}.

4.2.4 ACTION 4. Specify Overfishing Level to meet Magnuson-Stevens Act Mandate for Pelagic *Sargassum*. Overfishing is defined as the rate of harvest which compromises the stock's ability to produce MSY.

The Maximum Fishing Mortality Threshold (MFMT) is 9.0 to 18.0 units per year.

The Minimum Stock Size Threshold (MSST) is 25,000 metric tons (55,115,000 pounds).

Source: NMFS SEFSC (memo dated April 5, 2000 from John Merriner, Michael Prager, Lawrence Settle and Douglas Vaughan to Nancy Thompson). The assumptions and estimates discussed in estimating MSY (Action 2) are adopted in the following method to estimate MFMT and MSST:

1. The standing stock of *Sargassum* in the North Atlantic is approximately constant.
2. The harvest area is off North Carolina, as described further in the referenced memos.
3. The standing stock in the harvest area is approximately 100,000 mt.
4. The estimated doubling time of *Sargassum* is 10 to 20 days.
5. The proportion of each species harvested is equal to its proportion in the stock.

The estimated doubling time is equivalent to a range in the intrinsic rate of increase r = 18.25/yr to r = 36.5/yr. Assuming that the standing stock is presently at the carrying capacity K, and further assuming a simple Schaefer-form production function, MSY is estimated as rK/4. Thus, the range of estimates of maximum sustainable yield becomes MSY = 456,250 mt/yr to 912,500 mt/yr. Under these same assumptions, we estimate B_{MSY} = K/2 = 50,000 mt in the harvest area (i.e., the standing stock would be reduced to half its present size). Corresponding estimates of F_{MSY} are 9/yr to 18/yr. These would be limit reference points (LRPs), and overfishing and overfished status would be defined accordingly. (Using the guidelines in the NOAA Tech Memo of July 17, 1999, the MSST would be at most B_{MSY}/2).

The pelagic *Sargassum* habitat are not overfished nor is overfishing occurring.

4.2.3 ACTION 3. Specify Optimum Yield (OY) for pelagic *Sargassum* as 5,000 pounds wet weight per year.

Biological Impacts

OY is a target reference point that fishery management objectives are intended to achieve. As such, establishment of OY has no direct effect on the resource; it provides a target from which to base other regulatory management measures. Pelagic *Sargassum* supports a diverse assemblage of marine organisms including over 100 species of fishes, fungi, micro-and macro-epiphytes, at least 145 species of invertebrates, four species of threatened or endangered sea turtles, and numerous marine birds. Pelagic *Sargassum* contributes a small fraction to total primary production in the North Atlantic, however, within the oligotrophic (low nutrient) waters of the Sargasso Sea, it may constitute as much as 60% of total production in the upper meter of the water column. In addition, preliminary analysis of research conducted at "The Point" off North Carolina indicates Sargassum may be providing significant amounts of nutrients to benthic communities (Steve Ross, NC National Estuarine Research Reserve; personal communication). Allowing the harvest of 5,000 pounds of pelagic *Sargassum* will result in the take of species including endangered/threatened sea turtles.

Economic Impacts

Defining the OY does not alter current use of the resource; it merely establishes a benchmark for fishery and resource evaluation from which to base additional management actions, specifically establishing the TAC. Since defining the OY has no direct effect on resource harvest or use, there would be no direct economic effects associated with this measure. Direct effects only accrue to the additional management actions that directly alter the use of the resource.

An indirect effect of the specification of the OY is its effect on the specification of the TAC. If the TAC were set equal to OY, this proposed action implies that there will be very limited harvest of pelagic *Sargassum* from the South Atlantic Council's area of jurisdiction. Since total allowable harvest is based on the OY chosen, this measure could lead to a reduction in net revenue to the firm that currently harvests pelagic *Sargassum* from the South Atlantic Council's area of jurisdiction. A more detailed discussion of the impacts from *Sargassum* harvest restrictions is contained in Section 4.2.8 (Action 7).

Social Impact

Selecting optimum yield is less rigid than selecting an overfished level and economic and social factors are to be incorporated into the selection. This makes selecting optimum yield slightly more uncertain because economic and social information about fisheries is often lacking. There is also no time frame requirement for reaching optimum yield, although the Council is supposed to continuously make progress toward that goal. The impacts from selecting optimum yield will most likely depend

upon the time frame chosen to reach optimum yield and the associated benefits that are desired from the fishery.

However, the owner of the one firm involved in the harvesting and processing of *Sargassum* has informed the Council that setting OY at this level will force him out of business, unless he can find a suitable substitute for *Sargassum*. Even if a substitute is found, the cost of replacement may also pose a threat to the continuance of his business.

However, while the singular impacts on this individual are great, the social impacts of setting OY at 5,000 pounds wet weight per year are not determined to be as substantial. It is understood that Aqua-10 (the company in question) employs three persons on a fulltime, year-round basis (the owner, his wife, and one other employee). Other local inhabitants are employed on an irregular, as-needed basis, supposedly for less than a few days at one time. Thus the social impacts of not having such an employment opportunity exist would be very minimal, and workers can reasonably be expected to be able to substitute other employment opportunities that exist in the immediate area. Furthermore, as far as can be determined, there is no historical culture of *Sargassum* harvesting, so no other social and cultural impacts, due to the one firm going out of business, should occur.

There may be positive social impacts for groups of persons who consider themselves to be defined in some manner by their interest in environmental ethics. This benefit is less tangible and so, harder to measure than, for example, an increase in wages. However, the preservation of *Sargassum* is seen by this group as a good for society as a whole. There is a need for further research into the above-mentioned issues.

Conclusion

The Council is specifying OY as 5,000 pounds wet weight per year because this harvest level will, to the least extent practicable, impact the integrity of the *Sargassum* community as habitat. The Council's preference would be to set OY as zero (Rejected Option 2) but this was rejected by the NMFS. Therefore, to implement protection for *Sargassum*, the Council had to specify some level of allowable harvest. NMFS suggested, and the Council discussed, an OY of 10,000 to 20,000 pounds but the Council wanted to be risk adverse and set the OY at 5,000 pounds. The average landings from 1990 through 1999, after dropping the highest and lowest years, was 5,300 pounds; average landings from 1991 through 1999 was 4,800 pounds. The OY of 5,000 pounds is based on the mid-range from these two scenarios.

Pelagic *Sargassum* supports a diverse assemblage of marine organisms including over 100 species of fishes, fungi, micro-and macro-epiphytes, at least 145 species of invertebrates, four species of

threatened or endangered sea turtles, and numerous marine birds. This action is consistent, to the maximum extent practicable, with the Council's designations of *Sargassum* as essential fish habitat (EFH) and essential fish habitat-habitat area of particular concern (EFH-HAPCs) for species in the snapper grouper complex and coastal migratory pelagics. These designations are specified in the South Atlantic Council Habitat Plan (SAFMC, 1998a) and the Comprehensive Amendment addressing Essential Fish Habitat in the South Atlantic region (SAFMC, 1998b).

Because pelagic *Sargassum* has been identified as essential fish habitat, allowing higher harvest levels of pelagic *Sargassum* would be contradictory to the goals of the Habitat Plan and Comprehensive Amendment addressing Essential Fish Habitat. While the present level of pelagic *Sargassum* harvest is limited, its loss represents a direct loss of essential fish habitat and essential fish habitat-habitat areas of particular concern. Research on pelagic *Sargassum* habitat confirms that it is important to Council and other federally managed species (e.g., billfish, swordfish, tunas, and sharks), and if that harvest were to expand the impacts may not only further reduce the availability of this habitat but also may reduce recreational and commercial fishing opportunities.

The Council remains concerned about the role of *Sargassum* as habitat versus allowing some low level of yield. Were the Council to allow higher levels of optimum yield, then the risk to allowing entire rafts of habitat (*Sargassum*) to be removed could result in the loss of larval and juvenile fishes and turtles.

The Council concluded specifying optimum yield at such a low level is consistent with the proposed significant limitation on harvest and possession of *Sargassum* habitat. The Council weighed biological, social, and economic considerations and determined the optimum value of the resource is as habitat while allowing some limited level of harvest to get the fishery management plan in place. This option best achieves the stated objectives of the fishery management plan and mandates of the Magnuson-Stevens Act.

The Council also determined there is no foreign *fishing* for Sargassum and no Indian treaty fishing rights for *Sargassum* in the EEZ. U.S. fishing vessels and processors have sufficient harvesting and processing capacity, on an annual basis, to harvest and process 100% of the 5,000 pound OY. Therefore no portion of the OY will be available for foreign harvesting or processing.

Table 6. Pelagic *Sargassum* Harvested from the South Atlantic Region off North Carolina 1976 through 1997. No harvest recorded after 1997-2010. (Source: SAFMC, 2002 - *Sargassum* FMP)

Year	Number of Trips	Harvest region	Landings (wet weight in lb.) (approximately = 10x dry weight)
1976	4	WCS-MCS-GS	30,000
1977	0	-	0
1978	0	-	0
1979	1	ECS-GS	22,000
1980	0		0
1981	3	ECS-GS	20,000
1982	2	GS	11,000
1983	1	ECS	1,000
1984	3	GS	30,000
1985	1	ECS	10,000
1986	1	GS	9,000
1987	7	SS	50,000
1988	3	SS	22,000
1989	0		0
1990	14	SS	200,000
1991	0		0
1992	0		0
1993	0		0
1994	0		0
1995	4	ECS-GS-SS	11,000
1996	6	SS	20,000
1997	2	SS	12,000
1998	0	-	0
1999	0	-	0
2000	0	-	0
2001	0	-	0
2002	0		0
2003	0	-	0
2004	0	-	0
2005	0	-	0
2006	0	-	0
2007	0	-	0
2008	0	-	0
2009	0	-	0
2010	0	-	0

Notes: WCS - West of Continental Shelf
MCS - Mid Continental Shelf
ECS - East of Continental Shelf
GS - Gulf Stream
SS - Sargasso Sea