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Working Paper 3.1 US Northeast Shelf LME total fish biomass, target biological reference points for fish, and worldwide cross system comparisons.

By

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Table 1. Available Biological Reference Points or proxies (MSY, Bmsy, SSBmsy, and catch/tow) for GARM species, pelagics, and elasmobranchs (NEFSC 2007).

	Garm Species	MSY	Bmsy	SSBmsy	Bmsy proxy
1	GOM cod	16,600		82,830	
2	GB cod	35,200		217,000	
3	GOM haddock	5,100			22.2 kg/tow
4	GB haddock	52,300	250,300		
5	Redfish	8,235	236,700		
7	Pollock	17,640			3.0 kg/tow
7	CC-GOM Yt	2,300		12,600	
8	GB Yt	12,900		58,800	
9	SNE-MA Yt	14,200		69,500	
10	Am plaice	4,900		28,600	
11	Witch fldr	4,375		25,248	
12	GOM Winter fldr	1,500	4,100		
13	GB Winter fldr	3,000	9,400		
14	SNE-MA Winter fldr	10,600	30,100		
15	GOM-GB Windowpane fldr	1,000			0.94 kg/tow
16	SNE-MA Windowpane fldr	900			0.92 kg/tow
17	Ocean Pout	1,500			4.91 kg/tow
18	White hake	4,234			7.70 kg/tow
19	Halibut	300	5,400		
	Pelagics				
1	Herring	194,000	629,000		
2	Mackerel	148,000		644,000	
3	Butterfish	12,175	22,978		
	Elasmobranchs				
1	Spiny Dogfish				
2	Skates				19.929 kg/tow

Table 2. Example data for converting white hake proxy reference point (kg/tow) to and estimate of proxy Bmsy (SAB=swept area biomass, Q= catchability coefficient, spr=spring, av=average).

White Hake						
Strata Set		Trawl Swept Area	Bmsy Proxy (kg/tow)	Q for biomass	spr	0.2023
21-30,33-40		0.0112	7.7		fall	0.183
Strata					av	0.19265
21	424					
22	454		Swept Area Biomass			
23	1016		SAB (kg)	17809688		
24	2569					
25	390		SAB (mt)	17809.69		
26	1014					
27	720					
28	2249		Proxy Bmsy (mt)			
29	3245		92445.82			
30	619					
33	861					
34	1766					
35	533					
36	4069					
37	2108					
38	2560					
39	730					
40	578					
sum	25905					

Table 3. Biological Reference Points (MSY, Bmsy), current biomass (from NEFSC 2007) and ratio of current biomass to Bmsy for GARM species, pelagics, and elasmobranchs.

	GARM Species	MSY (mt)	Bmsy (mt)	Current B (mt)	B/Bmsy
1	GOM cod	16,600	82,830	28,904	0.34895569
2	GB cod	35,200	217,000	22,563	0.10397696
3	GOM haddock [1]	5,100	124,076	21,976	0.17711725
4	GB haddock	52,300	250,300	400,941	1.60184179
5	Redfish	8,235	236,700	200,244	0.84598226
6	Pollock [1]	17,640	49,802	40,937	0.8219951
7	CC-GOM Yt	2,300	12,600	1,100	0.08730159
8	GB Yt	12,900	58,800	8,000	0.13605442
9	SNE-MA Yt	14,200	69,500	690	0.00992806
10	Am plaice	4,900	28,600	14,149	0.49472028
11	Witch fldr	4,375	25,248	21,175	0.83868029
12	GOM Winter fldr	1,500	4,100	3,436	0.83804878
13	GB Winter fldr	3,000	9,400	4,301	0.45755319
14	SNE-MA Winter fldr	10,600	30,100	3,938	0.13083056
15	GOM-GB Windowpane fldr [1]	1,000	9,987	7,288	0.72974867
16	SNE-MA Windowpane fldr [1]	900	15,264	2.373	0.00015546
17	Ocean Pout [1]	1,500	102,635	10,993	0.10710771
18	White hake [1]	4,234	92,446	43,077	0.46596932
19	Halibut	300	5,400	288	0.05333333
total		**196,784**	**1,424,788**	**834,002**	**0.585352**
	Pelagics				
1	Herring	194,000	629,000	1,047,000	1.6645469
2	Mackerel	148,000	644,000	2,323,000	3.60714286
3	Butterfish	12,175	22,978	7,800	0.33945513
total		***354,175***	***1,295,978***	**3,377,800**	**2.606371**
	Elasmobranchs				
1	Spiny Dogfish [23]	10,470	418,549	453,000	1.08231055
2	Skates [12]	7,323	737,182	303,418	0.41159171
total		***17,793***	***1,155,731***	**756,418**	**0.654493**

1 Bmsy based on area swept biomass and estimated Q for demersal species

2 Msy based on average landings

3 Bmsy based on average of swept area biomass during 1970-2006

Table 5. Biological Reference Points (MSY, and Bmsy, mt) for GARM species, pelagics, and elasmobranchs expressed in energy budget density units (t/km^2) (based a total area of the continental shelf of 246,662 km^2) for direct comparison to other worldwide systems.

GARM Species	***MSY (mt)***	***t/km^2***	***Bmsy (mt)***	***t/km^2***
GOM cod	16,600	0.0673	82,830	0.335803923
GB cod	35,200	0.1427	217,000	0.879747087
GOM haddock [1]	5,100	0.0207	124,076	0.503020735
GB haddock	52,300	0.2120	250,300	1.01474975
Redfish	8,235	0.0334	236,700	0.959613528
Pollock [1]	17,640	0.0715	49,802	0.201903984
CC-GOM Yt	2,300	0.0093	12,600	0.051082089
GB Yt	12,900	0.0523	58,800	0.238383082
SNE-MA Yt	14,200	0.0576	69,500	0.281762316
Am plaice	4,900	0.0199	28,600	0.115948234
Witch fldr	4,375	0.0177	25,248	0.102358776
GOM Winter fldr	1,500	0.0061	4,100	0.01662195
GB Winter fldr	3,000	0.0122	9,400	0.03810886
SNE-MA Winter fldr	10,600	0.0430	30,100	0.122029435
GOM-GB Windowpane fldr [1]	1,000	0.0041	9,987	0.040488637
SNE-MA Windowpane fldr [1]	900	0.0036	15,264	0.061882302
Ocean Pout [1]	1,500	0.0061	102,635	0.416096047
White hake [1]	4,234	0.0172	92,446	0.374788476
Halibut	300	0.0012	5,400	0.021892324
total	**196,784**	**0.7978**	**1,424,788**	**5.77628153**
Pelagics				
Herring	194,000	0.7865	629,000	2.550050312
Mackerel	148,000	0.6000	644,000	2.610862322
Butterfish	12,175	0.0494	22,978	0.093155892
total	***354,175***	**1.4359**	***1,295,978***	**5.25406853**
Elasmobranchs				
Spiny Dogfish [23]	10,470	0.0424	418,549	1.696853749
Skates [12]	7,323	0.0297	737,182	2.988634641
total	***17,793***	**0.0721**	***1,155,731***	**4.68548839**

1 Bmsy based on area swept biomass and estimated Q for demersal species

2 Msy based on average landings

3 Bmsy based on average of swept area biomass during 1970-2006

Table 6. Calculation of total additional biomass for the three categories of demersal piscivorous (sab=swept area biomass, Q=catchability coefficient, spr=spring, AV=average).

piscivore other			
	sab kg	Q	biomass mt
fall	12829623	0.151	84964.39
spr	12722393	0.1601	79465.29
AV			82214.84
picivore elasmobranch			
	sab kg	Q	biomass mt
fall	25093102	0.3588	69936.18
spr	29393560	0.3588	81921.85
AV			75929.02
piscivore gadid			
	sab kg	Q	biomass mt
fall	111846.1	0.183	611.1807
spr	89837.88	0.2023	444.0825
AV			527.6316
total			158671.5

Table 7. Total biomass (mt) and energy budget density units (t/km^2) for GARM species, elasmobranchs, other demersal

Category	Biomass (mt)	t/km^2
GARM species	1424788.00	5.78
Elasmobranchs	1155731.00	4.69
demersal omnivores	15291.40	0.06
demersal piscivores	262902.49	1.07
demersal benthivores	850566.28	3.45
medium pelagics	256677.00	1.04
Total	**3965956.17**	**16.08**

Table 9. Total biomass (mt) and energy budget density units (t/km^2) for pelagic components (c.f. Link et al 2006) of the US Northeast Shelf LME.

category	Biomass (mt)	t/km^2
pelagic commercial	1295978.00	5.25
pelegic other	438552.00	1.78
squid	312638.20	1.27
meso pelagic	228.90	0.00
anadromous	24733.20	0.10
total	**2072130.30**	**8.40**

Table 10. Energy budget density units (total t/km^2) and average (t/km^2) for nine worldwide systems for demersal and pelagic fishes with proposed US Northeast Shelf LME BRP targets and current density.

System	Demersal B (t/km^2)	Pelagic B (t/km^2)	Total t/km^2
Gulf of Alaska	26.478	14.827	41.305
Bering Sea	44.852	7.444	52.296
Barents Sea	4.313	9.323	13.636
North Sea	8.868	10.148	19.015
Baltic Sea	2.130	19.070	21.200
Faroes	10.605	27.907	38.512
Newfoundland-Labrador	10.990	21.820	32.810
Gulf of St Lawrence	21.780	24.080	45.860
Scotian Shelf	6.849	23.386	30.235
Average	**15.207**	**17.556**	**32.763**
Northeast Shelf LME Target	**16.079**	**8.401**	**24.479**
Northeast Shelf LME Current	**11.840**	**16.802**	**28.642**

Conclusions

- Results of current analysis are in agreement with historical, recent NEUS studies, and other temperate systems
- GARM, pelagic, and elasmobranch stocks have similar Bmsy targets at 5.78, 5.24, and 4.69 t/km2
- Current biomass targets are reasonable.