Appendix F

Assessment of associated species

1. List of fish species

According to the 1993 trawl survey, where the most detailed taxonomic resolution is available among the Japanese surveys, the four dominant fishes were splendid alfonsin (*Beryx splendens*), mirror dory (*Zenopsis nebulosa*), North Pacific armorhead (*Pseudopentaceros wheeleri*) and *Epigonus denticulatus* (Appendix A).

2. Available time series of density of major fish species

During the past four Scientific Working Group (SWG) meetings, historical catch data of both target and associated fishes were identified and their summary (by ship, year, seamount, and depth zone) were exchanged by member countries (Table 1).

Table 1. Number of fishing operations observed and exchanged among member countries

Year/Ship name	Akademik Berg	Astronom	Lira	Meisho Maru No. 128	Mys Tikhiy	Novodrutsk	Oryong503	Poseidon	Professor	Raduga	Tamgu1	Tomi Maru No. 58
Country	Russia	Russia	Russia	Japan	Russia	Russia	Korea	Russia	Russia	Russia	Korea	Japan
1969	54											
1970	43											
1972			7									
1973										23		
1974								15				
1975		31										
1979					32							
1981						194						
1982						10			10			
1983									2			
1993				56								
2004							94				33	61
2005												73
2006												70

Time series of density (kg per swept area in km^2, assuming catchability coefficient of one, i.e., all fishes encountered with the trawl net are assumed caught) and biological information of these four species (including other *Epigonus* species) and broad alfonsin (*Beryx decadactylus*) in the SE-NHR have been accumulated and summarized in the documents submitted to fourth SWG (SWG4/WP5/J1, SWG4/WP5/J2, SWG4/WP16, SWG4/WP17, SWG4/WP18).

This report compared time series in densities of these five species for the 200-400m depth zones of C-H, Colahan, Koko, Milwaukee seamounts, and the 400-700m depth zone of Milwaukee, where data was available over the entire period (Figures 1 and 2). Time series of the densities of two commercially targeted species (armorhead and splendid alfonsin) were also included in order to check if the trend is similar to the commercial catch and stock assessment results (SWG4/WP5/J1). Since the two Japanese ships observed in 1993 (Meisyo Maru #128) and 204-2006 (Tomi maru #58) are commercial trawlers, their fishing efficiencies could be higher than those of research vessels. Also, the data of Meisyo Maru #128 would be accompanying some bias, since her get was equipped with a 4mm meshed cod-end for the observed cruise.

No substantial differences were noticed between Figures 1 and 2, except for 1) extremely high densities in 1993 for some species, and 2) relatively higher densities of splendid alfonsin in the Yuryaku seamount during 2004-06. Therefore, exclusion of these commercial ships would give more reliable results.

3. Evaluation of the observed trends in densities

Figure 2 indicates that 1) pelagic armorhead and broad alfonsin showed exponential declines of densities over the period, and 2) splendid alsonsin, mirror dory and Epogonus showed decreasing trend except for the Mulwaukee seamount group. Since these tendencies generally coincided with commercial catch history of armorhead and biomass trajectory of splendid alfonsin, the observed densities for the three associated species are considered reliable.

A decline of the density is not necessarily indicates an adverse effects of fishing, if we consider a classic MSY curve, where maximum production can be obtained at the midpoint between zero and the carrying capacity. Therefore, less than the half value at the onset of fishing (average of 1969-70), were assumed as a criterion. In order to obtain more stable trend, years were combined in Table 2. According to this criterion, adverse impacts of the bottom fishing were detected for broad alfonsin for all four strata, mirror dory in the CH and Colahan seamounts (200-400m), and *Epigonus* in the Koko seamount (200-400m). On the contrary, densities of mirror dory increased in the two depth zones of Mulwaukee. This contradictory trend was also detected in splendid alfonsin.

4. Conclusion

There is a larger concern of adverse impacts of the bottom fishing for broad alfonsin and *Epigonus*, and some concern for mirror dory.

Table 2. Mean density and density ratio of five fishes and number of observed fishing operations by depth zone and seamount. Density ratios were standardized for 1969-70 and those less than 0.5 were indicated in red color.

		Mean density (kg / km^2)				Density ratio			
Depth zone (m)	Seamount a	1969-70	1972-75	1979-83	2003-6	1969-70	1972-75	1979-83	2003-6
	Beryx decadactylus								
200-400	C-H								
	Colahan	62		10	3	1.0	0.0	0.2	0.0
	Koko	31	1	1	13	1.0	0.0	0.0	0.4
	Milwaukee	103	12	2	18	1.0	0.1	0.0	0.2
400-700	Milwaukee	18	2	4	20	1.0	0.1	0.2	1.1
	Beryx splendens								
200-400	C-H			910					
	Colahan	3,009	77	716	333	1.0	0.0	0.2	0.1
	Koko	1,099	1,256	3,618	1,032	1.0	1.1	3.3	0.9
	Milwaukee	1,525	4,283	230	8,047	1.0	2.8	0.2	5.3
400-700	Milwaukee	58	129		1,506	1.0	2.2	0.0	25.8
	Epigonus atherinoides/ E. denticulatus								
200-400	C-H								
	Colahan								
	Koko	1,657	221	478	588	1.0	0.1	0.3	0.4
	Milwaukee		4	10	1,275				
400-700	Milwaukee			126	61				
	Pseudopentaceros wheeleri								
200-400	C-H	54,087	7,941	1,794	2	1.0	0.1	0.0	0.0
	Colahan	67,486	65,022	724	2,748	1.0	1.0	0.0	0.0
	Koko	129,451	10,747	65	253	1.0	0.1	0.0	0.0
	Milwaukee	50,314	49,490	36	2,459	1.0	1.0	0.0	0.0
400-700	Milwaukee	24,313	42,654	13	2,814	1.0	1.8	0.0	0.1
	Zenopsis nebulosa								
200-400	C-H	195			8	1.0	0.0	0.0	0.0
	Colahan	176	280	15	29	1.0	1.6	0.1	0.2
	Koko	80	203	8	67	1.0	2.6	0.1	0.8
	Milwaukee	86	185	47	279	1.0	2.2	0.5	3.3
400-700	Milwaukee	4	268	24	87	1.0	70.1	6.3	22.9

		Number of trawl operation			
200-400	C-H	4	1	3	1
	Colahan	29	6	11	93
	Koko	23	39	168	67
	Milwaukee	35	21	49	119
400-700	Milwaukee	5	8	2	20

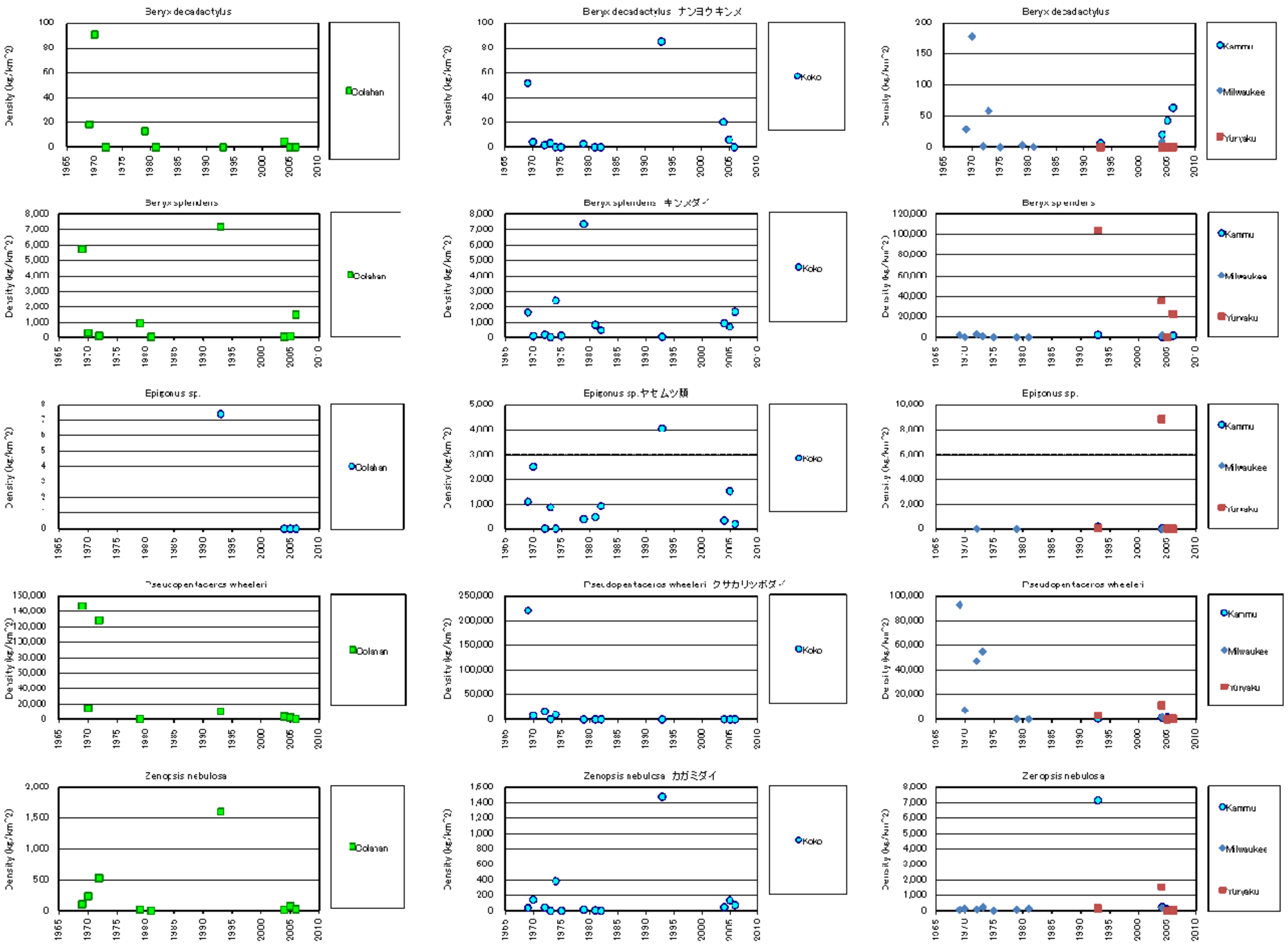

Figure 1. Changes in density from 1969 to 2006 (research vessel and commercial data (1993, 2004-06))

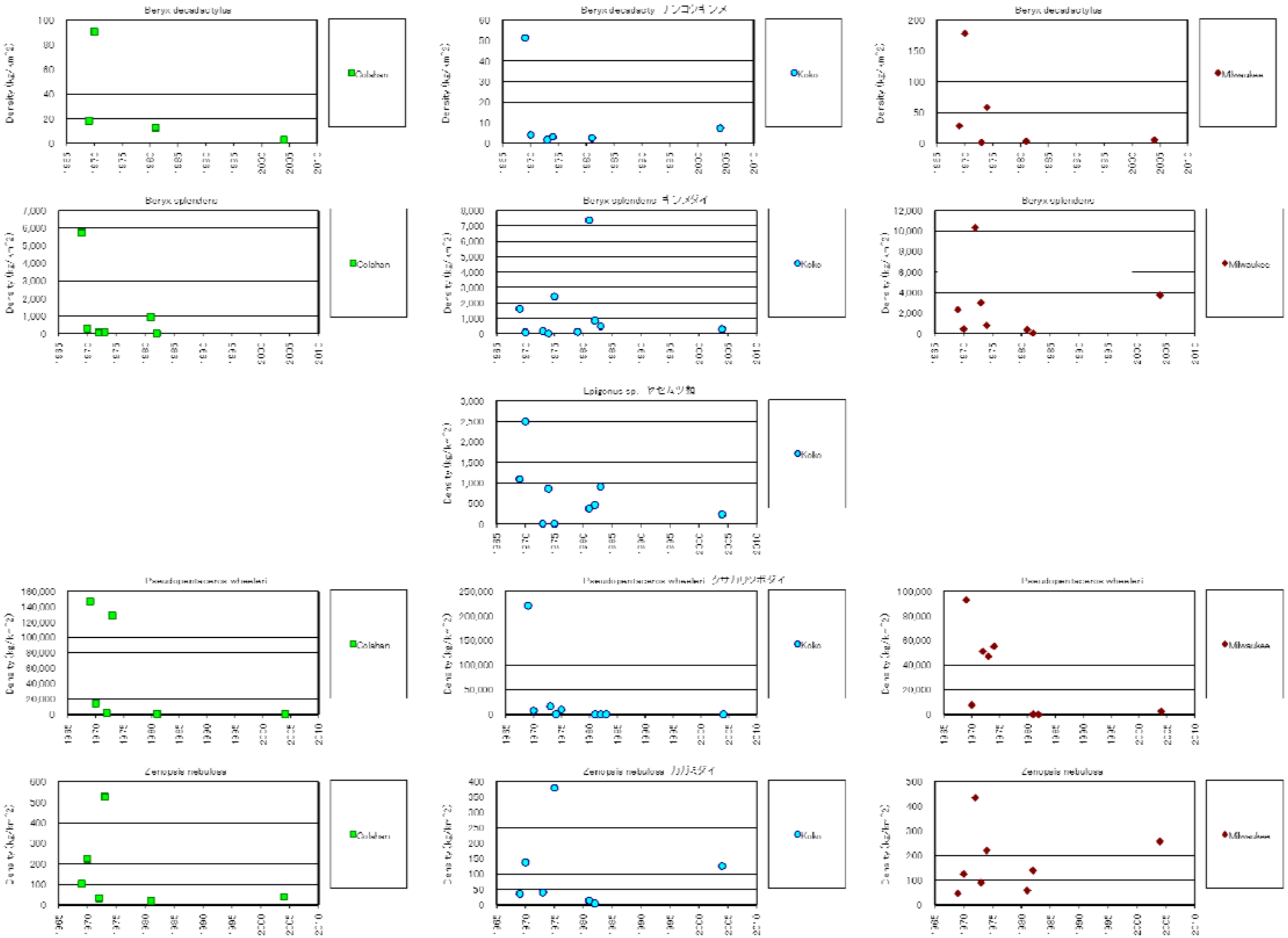

Figure 2. Changes in density from 1969 to 2006 (commercial vessel data excluded)