CCSBT-ESC/1009/BGD01
(Originally CCSBT-OMMP/1006/09)

2006 年の IQ 制導入に伴う日本のミナミマグロ延縄操業パターンの 2009 年の変化

Change in operation pattern of Japanese SBT longliners in 2009 resulting from the introduction of the individual quota system in 2006.

伊藤智幸

Tomoyuki ITOH

遠洋水産研究所　National Research Institute of Far Seas Fisheries

要約

日本延縄船によるミナミマグロの漁獲データは、CCSBT におけるミナミマグロの資源評価において最も重要なものである。2006 年に日本はえ縄の国内漁業管理制度が変更されたことに対して、その操業パターンの変化を調べた。2009 年には、2001-2005 年平均値に対して隻数 41%、使用鈎数 31%、ミナミマグロ漁獲尾数 43%に減少した。漁期の撤廃によって新たに操業データが得られた月・海区もあるが、一つの 5x5 度月区画の操業回数は 32.2%と大きく減少した。ミナミマグロの体長組成は以前と大きく異なった。2009 年に見られた違いは、漁業管理制度の変更に伴うだけでなくミナミマグロ資源の年齢構成や他の社会学的要因によっても複雑に影響を受けたと考えられ、また顕在化していない違いが生じているかもしれない。複雑な要素を全て解明しようとするよりは、むしろ、延縄操業の操業パターンの不確実性を認識し、3000 トン未満の小規模な延縄操業に見合った資源評価への役立て方を考えるべきだろう。

Summary

The Japanese longline data is the most important scientific data for the stock assessment of southern bluefin tuna (SBT) in the CCSBT. Changes in operation pattern of Japanese SBT longliners in 2009 resulting from the enforcement of the individual quota system in 2006 were investigated. In 2009, the numbers decreased to 41% in vessel number, 31% in hooks used and 43% in SBT caught comparing to the average of 2001-2005. Due to the lift of the seasonal area closure, there were some areas and months newly operated in these years, but the number of operations per 5x5 degree square in a month decreased largely to 32.2%. Size of SBT caught in 2009 was changed largely from those in 2001-2005. Changes observed in 2008 are considered to be the results not only by the change of fishery regulation system but also by the changes of age composition of SBT stock and complex socio-economical factors. There might be other changes which could not be detected. It is more practical way to use the Japanese longline data for the stock assessment by taking into account its small scale operations (less than 3000 MT) and its uncertainty on changes in operation patterns, which will be unsolvable in the near future, rather than try to understand quite complex factors completely.

Introduction

日本延縄船によるミナミマグロの漁獲データは、CCSBT におけるミナミマグロの資源評価において最も重要なものである。日本水産庁は 2006 年にミナミマグロ延縄漁業への管理方法を変更した。すなわち、個別漁獲枠を導入し、また時期による漁場制限を撤廃した。このような漁業の管理措置の変更が操業パターンにどのような影響を及ぼすのかは、注意深くモニターしなくてはならない。我々はモニタリングを継続しており、これまで分析結果を何度か CCSBT の会議に提出してきた（CCSBT-ESC/0609/44, CCSBT-CPUE/0705/05, CCSBT-ESC/0709/39, CCSBT-ESC/0809/37, CCSBT-ESC/0909/28)。本文書は、それらに引き続いて、2009 年末までの日本延縄船の操業パターンを分析するものである。

The Japanese longline data is the most important scientific data for the stock assessment of southern bluefin tuna (SBT) in the CCSBT. Fisheries Agency of Japan changed the regulation rule for Japanese longliners for SBT in 2006; the individual quota (IQ) system had been enforced and seasonal area closure was stopped. Any changes on their operational pattern caused by changing of the regulation rules for the fishery are needed to be monitored carefully. We have kept the monitoring and results of the analyses have already been reported in several CCSBT meetings (CCSBT-ESC/0609/44, CCSBT-CPUE/0705/05, CCSBT-ESC/0709/39, CCSBT/0809/37, CCSBT-ESC/0909/28). This paper succeeds those papers and up dated using the data up to the end of 2009.

Material and method

2001 年から 2009 年までの RTMP データを用いた。Logbook が公式統計ではあるが、Logbook データにはミナミマグロを対象としない操業も含まれ、また使用可能となるまでに 2 年程度の遅れがあることから、最近年のデータと同じ条件で比較することができない。なお、RTMP はミナミマグロを対象として出漁する日本延縄船の全てが報告しており、日本が 4-9 海区において漁獲するミナミマグロ漁獲尾数全体の 90%以上（2001-2005 年の平均値は 93%）が含まれていることから、日本のミナミマグロ操業を十分に反映している(CCSBT/0909/FisheriesJapan)。

漁業管理が変更される前の 5 年間（2001-2005 年）を比較対照とし、管理変更後の 2006 年からのデータを解析した。ある月の緯度 5 度、経度 5 度区画をセルと称し、解析の単位とした。

The RTMP (RealTime Monitoring Program) data between 2001 and 2009 were used. Although logbook data is Japanese official catch-and-effort data, logbook data, including longline operations targeting for other tuna species and being necessary about two years to be available, do not allow to comparison with recent year to previous years in same condition. RTMP data, including all of longline operations targeting for SBT and including more than 90% of total SBT catch of Japan in Area 4-9 (mean of 2001-2005 is 93%), represent Japanese SBT longline operation (CCSBT/0909/FisheriesJapan).

RTMP data after 2006 were compared with RTMP between 2001 and 2005, five years data

before the regulation rule changed. Five degree longitude, five degree latitude in a month is defined as one “cell”.

Result

1. 2009 年の漁獲、努力量、サイズの概要 Summary of the catch, effort and size in 2009

図 1 に、CCSBT 統計海区 4-9 海区における、2001 年からの毎年の隻数、使用鈎数、ミナミマグロ漁獲尾数を、2001-2005 年の平均値に対する相対値で示す。値は 2006 年に急減し、2007 年から 2009 年までさらなる減少が継続している。尾数は 2008 年までの減少後、2009 年は横ばいであった。2009 年には 41%（隻数）、31%（釣鈎数）、43%（ミナミマグロ尾数）であった。

図 2 に、統計海区別の隻数、使用鈎数、ミナミマグロ漁獲尾数の内訳を示す。2001 年から 2006 年までには、9 海区の割合が増加し、4 海区、7 海区の割合が低下してきた。2007 年から 2009 年は、8 海区の割合がやや増加した以外は海区別割合は類似していた。

図 3 にミナミマグロの体長組成を示す。2006-2009 年の体長組成は 2005 年以前のものとは異なっている。

Figure 1 shows relative values of the numbers of vessels, hooks used and SBT caught to the mean values in 2001-2005 in the CCSBT statistical area (Area) between 4 and 9. These values decreased largely in 2006 and have been decreasing until 2009, though the number of SBT caught in 2009 was same as in 2008. In 2009, these are 41% in vessel number, 31% in hooks used and 43% in SBT caught.

Figure 2 shows the numbers of vessels, hooks used and SBT caught by Area. From 2001 to 2006, proportions in Area 9 had been increased and those in Area 4 and Area 7 had been decreased. In 2007 and 2008, proportions in Area 8 was increased, that in Area 7 was slightly increased and that in Area 9 was decreased compare to 2006.

Figure 3 shows fork length frequency of SBT. Those between 2006 and 2009 were different from those in previous years.

2. 操業時空間の変化 Changes of the time and space operated

図 4 に、4-9 海区内の操業のあったセル（5x5 度・月単位）の数の変化を示す。2009 年の合計セル数は、2008 年より大きく減少して 2001 年以降の最低となった。2009 年のセル数減少は全海区で見られたが、9 海区で著しかった。

表 1 に、年、月、海区別のセル数を示す。表 2 には、その操業回数を示す。2001-2005 年に比較して 2009 年に新たに操業が行われた、または増加した（操業回数>10 かつセル数>1）セルがいくつかある（表 1 のシャドー）。これらの多くは 2006-2008 年にも操業が行われていた。これらの新たなセル数は 2009 年に 2008 年よりも減少した。5,6 海区はニュージーランドとのジョイ

ントベンチャーで操業が行われていることを考えると新たなものではないかもしれない。

図 5 に、1 セル当たりの操業回数を示す。総漁獲枠が半減し、セル数は増加したことから、1 セル当たりの操業回数は減少しており、2009 年には 2001-2005 年平均値の 32.2%にまで減少した。2007 年からは安定している。

Figure 4 shows the change of the number of cell in Area 4-9. The total number of cell in 2009 was largely decreased from 2008 and become minimum since 2001. Decreases of cells were observed in all Areas but remarkably in Area 9.

Table 1 shows the number of cell by year, month and Area. Table 2 shows the number of operations. In 2009, comparing to 2001-2005, there were several Area/month that newly operated or cell increased (number of operation > 10 and the number of cell > 1). Most of these new cells were operated in 2006 - 2008. The number of the new cells in 2009 is smaller than in 2008. Operations in Area 5 and Area 6 since 2006 may not be new one because there have been joint venture vessels' operations in New Zealand.

Figure 5 shows the number of operations per cell. Because the allocation of TAC to Japan was reduced by half and the number of cell operated was increased, the number of operations per cell has been decreasing and reached 32.2% of the mean of 2001-2005 in 2009. It has been stable since 2007.

3. 船の一貫性 Vessel consistency

表 3 に、2009 年の RTMP 参加船（かつミナミマグロを漁獲した船）が 2001-2005 年とどれほど共通しているかを示す。2009 年の 100 隻中、87 隻は 2001-2005 年に RTMP においてミナミマグロ操業を実施したことがあり、4 年または 5 年間実施した船が 64 隻（64%）と大きな割合を占めた。

Table 3 shows the consistency of the vessels that participated the RTMP in 2009 (and caught any SBT) with those in 2001-2005. Among 100 vessels in 2009, 87 vessels have caught SBT in 2001-2005 RTMP and most of them (64 vessels, 64%) have caught SBT in four or five years in 2001-2005 RTMP.

Discussion

IQ 制導入以前の 2001-2005 年と比較して、2006 年には操業時空間（セル数）が増加し、隻数、合計操業回数、ミナミマグロ漁獲尾数、1 セル当たりの操業回数が大きく減少した。操業海区の内訳や魚のサイズも大きく変化していた。船は共通したものがほとんどで、操業のあった時空間も多くの場合では 2001-2005 年と共通していた。2006 年以降も、隻数、使用鈎数、ミナミマグロ漁獲尾数の減少は継続している。操業海域、1 セル当たりの操業回数は安定している。

これらの変化に対して原因を考えてみると、まず、新たな操業セルが生じた主な原因は漁期が

撤廃されたからであろう。隻数、操業回数、ミナミマグロ漁獲尾数の減少は、総漁獲枠の半減によるところが大きい。加えて、2009 年のセル数、使用鈎数の減少は、高い CPUE によってもたらされた結果と考えられる。海区内訳の変化、特に 4 海区、7 海区の割合の減少に続く増加は、ミナミマグロ資源の年齢構成の変化（低レベルの加入魚とその後の回復）を反映したものだろう。

反対に、様々な要素の観点から、生じた可能性のある現象を考えてみる。ミナミマグロ資源の年齢構成の変化（小型魚の増加）が、小型魚が主体の海区、時期（4 海区、7 海区、8 海区の 8 月）への操業の増加をもたらしたと考えられ、また新たな操業セルが生じたこととも関連していよう。漁獲枠の減少は、隻数、操業回数、ミナミマグロ漁獲尾数の減少をもたらした。これらの変化は漁獲データの解析でも容易に検出できる。

しかし他の要素から想定される変化は特段認められなかった。例えば、操業隻数の減少、特に漁期の撤廃によって操業可能な時期範囲が広がったことに伴う同一時期に操業する隻数の減少は、船間の情報交換による好漁場の探索能力を低下させたと考えられる。また、近年の燃油高騰は、漁場の探索能力をさらに弱めたと思われる。しかし変化が認められなかったのは、そのような変化がないのか、それとも漁業データからは検出ができないだけなのか、判断できない。

IQ 制の導入による影響についても、その評価は困難である。ある船は限定された IQ の範囲で、漁獲するミナミマグロの価値を最大限にするために大型魚のみを狙って操業したかもしれない。別の船は、小型魚であっても可能な限り短期間にミナミマグロの IQ を消化し、東部太平洋やインド洋熱帯海域のメバチやキハダ操業にすばやく切り替える戦略を選択したかもしれない。

延縄漁船の行動を全て詳細に理解するためには、ミナミマグロのみならず、全世界のメバチやキハダの資源状況、海洋環境も正確に理解する必要があるが、それ以外の要素、例えば各魚種の現在の価格、将来の予測価格、燃料費やエサ代、人件費、流通システムの特性といった社会学的、人為的な要素も理解する必要がある。しかしそのような複雑な過程を全て解明するのは著しく困難なことである。むしろ、延縄操業から得られる情報の不確実性を認識し、小規模な延縄操業に見合った資源評価への役立て方をすべきであり、必要であれば他の調査を実施するほうが現実的であろう。

Comparing to 2001-2005 before the IQ system was enforced, the number of time and space operated (cell) was increased, and the number of vessels, operations in total, SBT caught and operation per cell decreased largely in 2006. Composition of the number of operations by Area and size of SBT caught were changed largely in 2006. Most of the vessels engaged, as well as most of the time and space operated, were same in 2006 to 2001-2005. After 2006, it has been decreasing in the numbers of vessels, hooks used and SBT caught, though the Area operated and the number of operations per cell become stable.

Causes of these changes would be as follows. Occurrence of the new time-and-space operated after 2006 is due to the lift of the seasonal area closure. Decreases of the numbers of vessels, total operation and total SBT caught would be due to reduction of TAC allocation for Japan by half in the large part. In addition, decrease of the numbers of cells and hooks used in 2009 was the result of high CPUE in the limited IQ. Changes in the composition of the number of operations by Area, especially decrease followed by

increase in 2007 in Area 4 and Area 7, would be due to the change of age composition of SBT stock (low recruitment year classes and recovery thereafter).

Look at from the opposite point of view, phenomena which may be caused by any factors are considered. The change of the age composition of SBT (increase of small size fish) had made the number of operations increased in Area and month in which small size SBT were caught mainly (Area 4, Area 7, Area 8 in August), and had made the occurrence of new cells in these several years. Reduction of TAC allocation by half had made the decrease of the numbers of vessels, operations and SBT caught. These are changes which are able to detect easily by analysis of fishery data.

However, other changes which may be occurred by other factors were not observed. For example, the decrease of the number of vessels operated in an area simultaneously may reduce the ability to find a good fishing area by exchange their information among vessels. Expansion of the range of the fishing season by the lift of the seasonal area closure would have made the number of vessels operated in an area simultaneously decreased and enhance this. Drastic increase of fuel price in recent years would have weakened the power of search for good fishing area. We cannot interpret the reason of no changes observed whether there was no change or we cannot detect such a change from the fishing data.

Evaluation of influences by enforcing the IQ system is difficult. Some vessels might operate targeting for large size SBT in order to maximize their economic gain in their limited IQ. But, there might be another type of vessels in different strategy that operated targeting for any size SBT including small size and consume their IQ as soon as possible in order to move for other areas and operate for bigeye and yellowfin tunas.

If we need to understand the behaviors of longline vessels completely, we need to understand the stock status of not only SBT but also bigeye and yellowfin tunas and oceanic environment accurately and precisely all over the world. In addition, we also need to understand other socio-economical factors, such as market prices of various species at present and future, costs for fuel, bait and labors, and characteristics of market and distribution systems. But, complete understanding of such a complex process is quite difficult and impracticable. Rather, it is reasonable that seeking a way using for the stock assessment by taking into account of its small scale operations of Japanese longliners and of its uncertainty which will be unsolvable in the near future. It is also a practical way to seek for other fishery data or researches which will be useful for stock assessment.

References

Itoh, T. 2006. Matters arise from changing of Japanese fishery regulation. CCSBT-ESC/0609/44

Itoh, T. 2007. Change in operation pattern of Japanese SBT longliners in 2006 resulting the enforce of the individual quota system. CCSBT-CPUE/0705/05

Itoh, T. 2007. Change in operation pattern of Japanese SBT longliners in 2007 resulting the enforce of the individual quota system. CCSBT-ESC/0709/39

Itoh, T. 2008. Change in operation pattern of Japanese SBT longliners in 2007 resulting from the introduction of the individual quota system in 2006. CCSBT-ESC/0809/37

Itoh, T. 2009. Change in operation pattern of Japanese SBT longliners in 2008 resulting from the introduction of the individual quota system in 2006. CCSBT-ESC/0909/28

Takahashi, N. 2005. Preliminary analysis on effect of changes in fishing pattern on CPUE. CCSBT-ESC/0509/45

Sakai, O., T Itoh and T. Sakamoto. 2009. Review of Japanese SBT Fisheries in 2008. CCSBT-ESC/0909/Fisheries-Japan.

Table 1. Number of 5x5 degree square where longline operations conducted by year, month and area

Area	Month	Year 2001	2002	2003	2004	2005	2006	2007	2008	2009
4	3								3	
	4			1	2	2		2	4	2
	5	2	2	3	2	2	2	3	2	5
	6	4	3	4	5	5	3	5	5	5
	7	4	6	4	6	6	4	6	5	2
	8				3	1	1	1	1	3
	9								1	1
	10			4				1	2	
	11			4						
	12			4						
5	7				1	1	2	2	2	2
	8						3	3	2	2
	9							2	2	
	10								1	
6	4							2		
	5	1						2		
	6	2					1	1		
	7	1								
7	4	9	5	6	2	2		2	2	2
	5	6	6	2	2	2	3	2	2	2
	6	4	3	2	2	2	2	2	2	
	7	4	6	1			1			
	9	2		2			2			
	10	2	3	1	1			1		
	11	2	3		1			1		
8	1									2
	2								2	
	3								2	
	4								2	
	5			1	3	5	1		3	
	6				4	5				
	7						5	8	6	4
	8						8	8	6	6
	9	11	12	11	13	5	7	6	5	4
	10	10	13	13	9	7	8	8	8	8
	11	10	13	9	9	8	8	7	7	6
	12			7	8	4	7	6	4	6
9	3								3	
	4							5	7	8
	5	14	17	14	19	25	21	16	14	8
	6	20	14	17	23	20	18	18	15	10
	7	17	11	15	19	19	21	16	16	12
	8	9			12	13	15	8	11	9
	9						11	5	5	3
	10						7	4	6	1
	11						4	2	2	
	12								1	1

Shadow denotes the value since 2006 of which much larger than that before 2005.
(The number of operation > 10 and the number of cell > 1)

Table 2. Number of operations by year, month and area

Area	Month	Year 2001	2002	2003	2004	2005	2006	2007	2008	2009
4	3								30	
	4			2	23	13		39	45	47
	5	87	56	347	447	731	530	55	140	203
	6	559	1017	1015	1179	1122	457	324	147	46
	7	509	807	911	1110	732	115	75	49	35
	8				10	1	3	2	1	3
	9								12	4
	10			96				2	6	
	11			120						
	12			47						
5	7				2	6	11	22	17	8
	8						27	34	23	11
	9							17	7	
	10								2	
6	4							13		
	5	11						31		
	6	13					1	22		
	7	1								
7	4	905	842	648	530	603		27	2	189
	5	1741	1731	1032	646	397	180	352	181	64
	6	1058	588	254	2	3	66	92	183	
	7	145	44	1			46			
	9	71		47			6			
	10	85	369	1	6			1		
	11	7	183		13			2		
8	1									4
	2								2	
	3								30	
	4								5	
	5			1	411	651	12		26	
	6				104	13				
	7						76	103	177	33
	8						407	773	921	988
	9	1305	1335	961	489	551	270	630	482	251
	10	1332	755	842	589	687	343	379	131	163
	11	1260	321	825	904	821	518	750	362	357
	12			316	618	488	259	115	177	280
9	3								23	
	4							66	111	46
	5	2384	2314	2564	2383	1897	905	160	220	184
	6	2508	2362	2672	2826	2537	1163	575	792	394
	7	1944	325	586	2832	2802	1513	683	1032	436
	8	49			522	1261	1738	755	623	266
	9						1033	623	224	34
	10						262	183	105	50
	11						24	5	30	
	12								5	1
総計		15974	13049	13288	15646	15316	9965	6911	6323	

Shadow denotes the value since 2006 of which much larger than that before 2005.
(The number of operation > 10 and the number of cell > 1)

Table 3. Number of vessels that caught SBT in RTMP between 2006 and 2009 by the number of years participated in RTMP in past years (2001–2005)

	Number of years participate in the RTMP during 2001–2005					
	0year	1year	2year	3year	4year	5year
2006	5	7	15	9	20	67
2007	5	10	16	10	22	74
2008	11	8	16	8	22	61
2009	13	4	13	6	15	49

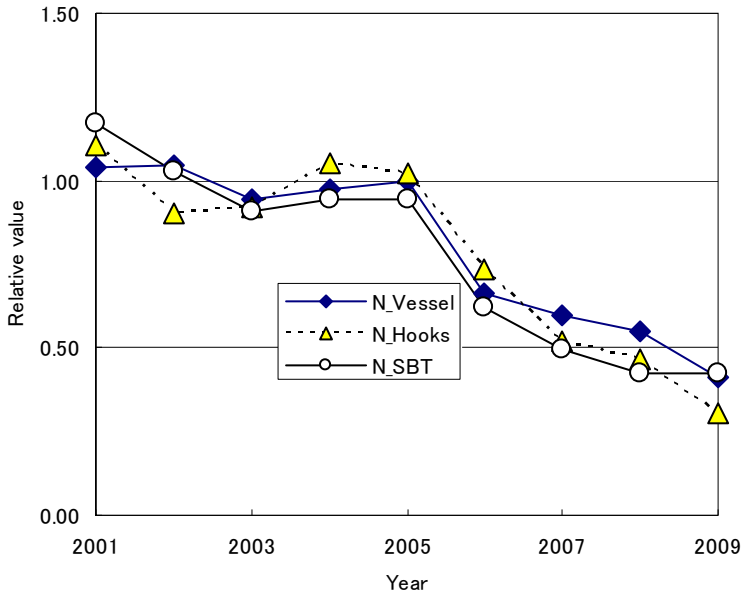

Fig.1. Changes of the number of operation, the number of vessels and the number of SBT caught between 2001 and 2009. Y axis is the relative value to the average of 2001-2005.

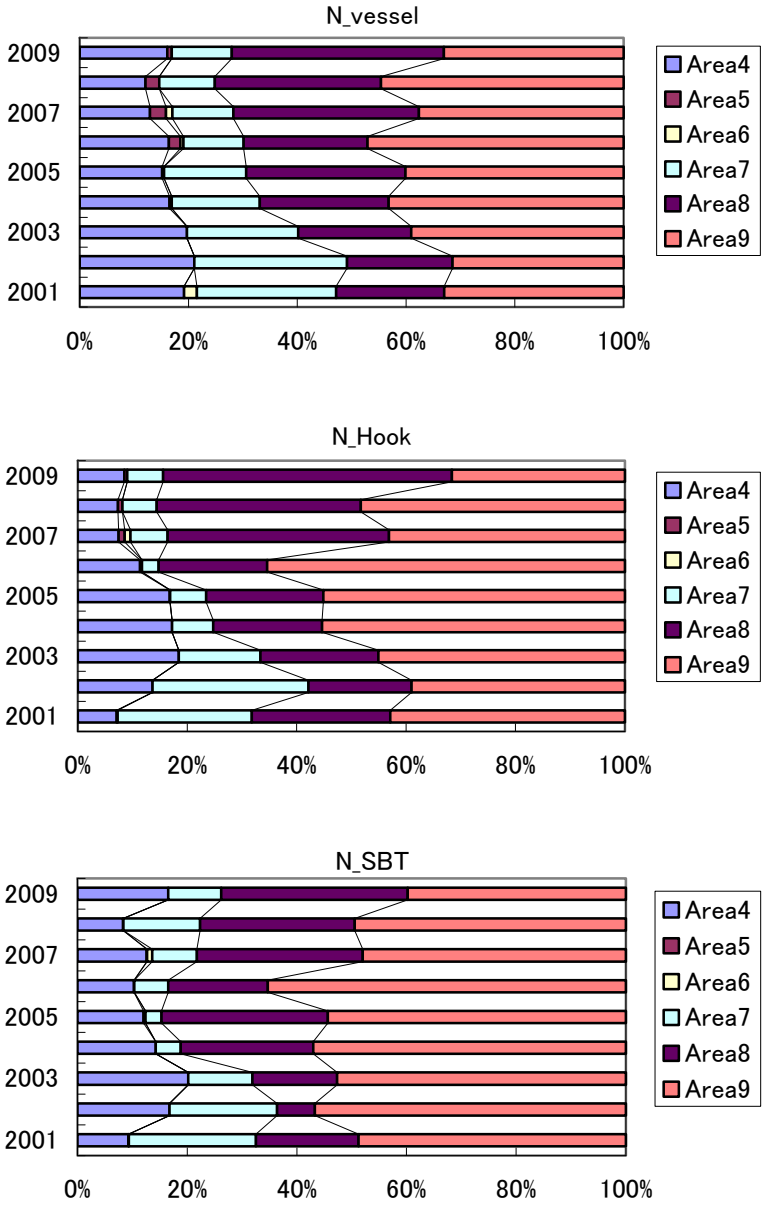

Fig.2. Proportions by Area for the number of vessels, the number of hooks used and the number of SBT caught between 2001 and 2009.

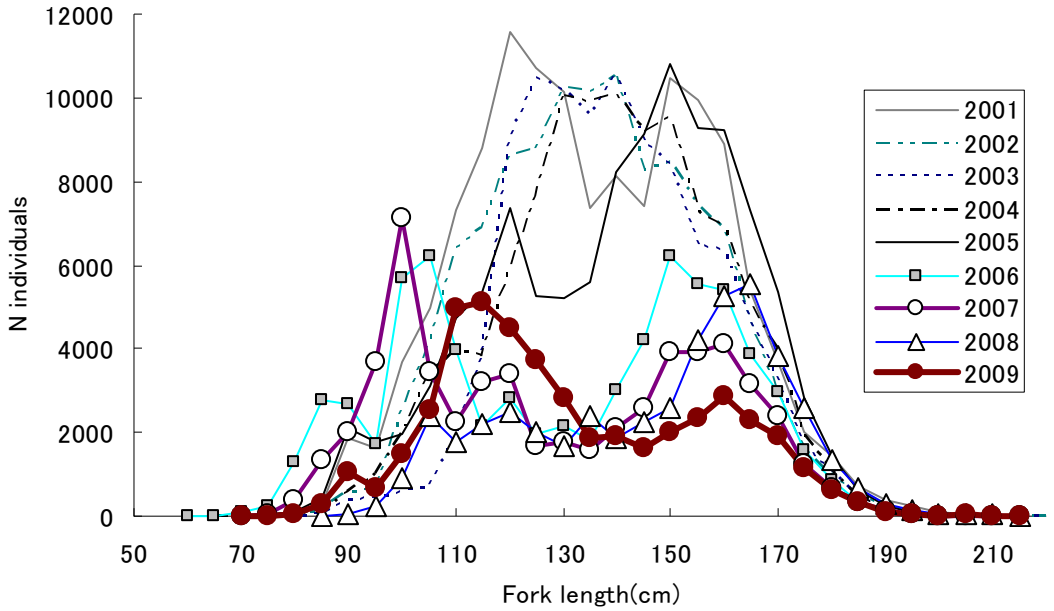

Fig.3. Length frequency distributions of SBT by year between 2001 and 2009 (all Areas).

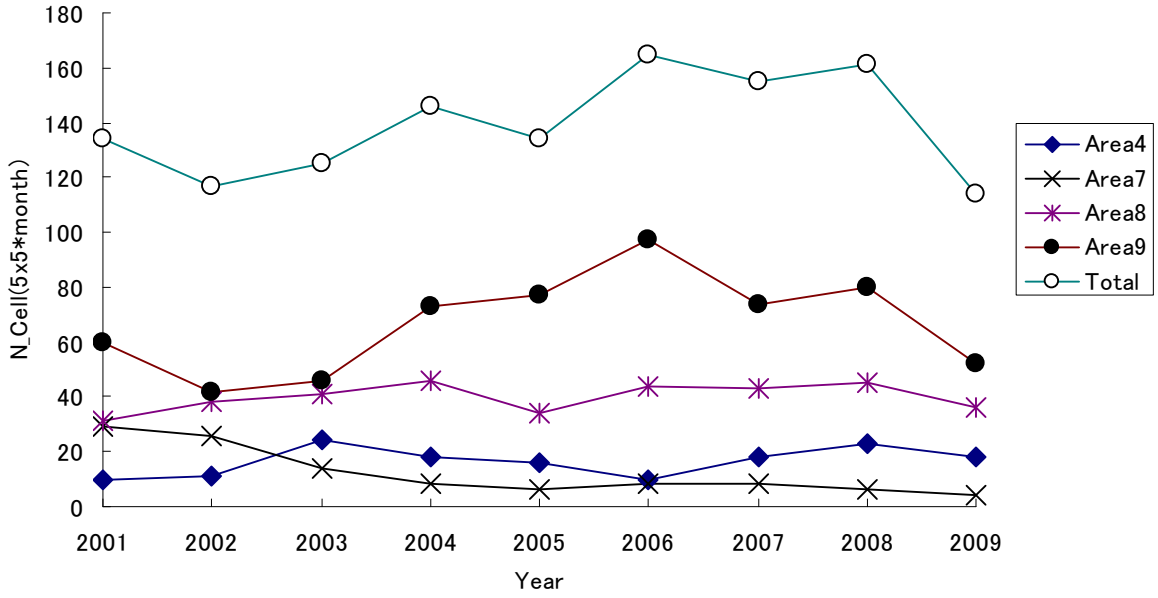

Fig.4. Changes of the number of cells (5 degrees latitude and longitude and month) operated between 2001 and 2009 in Area 4-9.

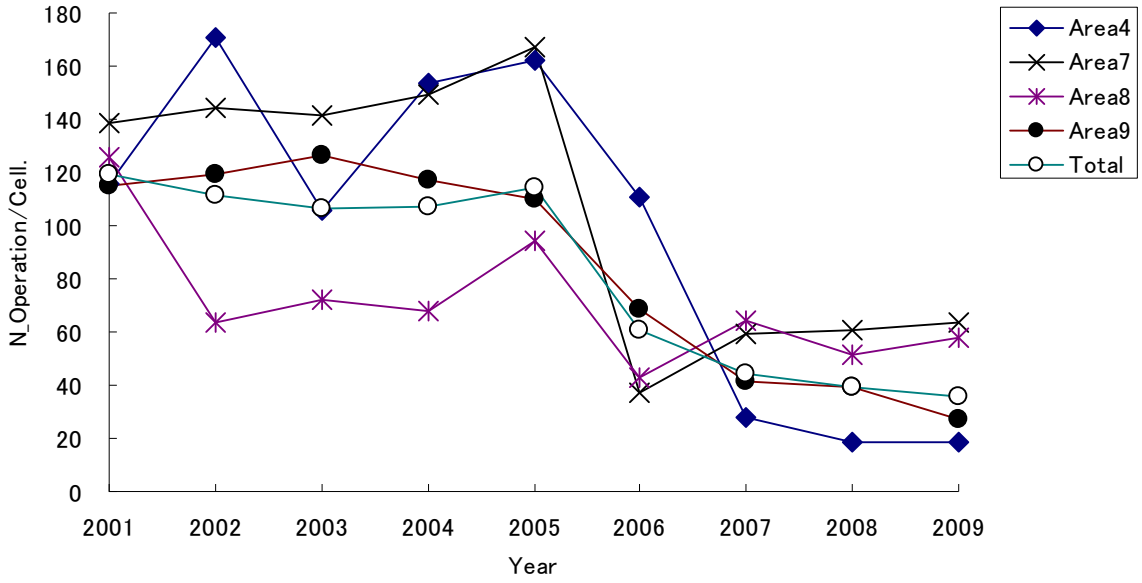

Fig.5. Changes of the number of longline operations per cell (5 degrees latitude and longitude and month) between 2001 and 2009 in Area 4-9.

Appendix 1

Update of the number of 5x5 and 1x1 degree square operated up to 2009

5x5 度及び 1x1 度の操業セル数の集計の 2009 年までのアップデート

21 June, 2010
Tomoyuki Itoh
NRIFSF

Data used　データ

The data used were chosen from the dataset comprised of longline from Japanese, Australian and New Zealand's between 1986 and 2009. The data were limited in Area 4-9 and month 4-9. Two datasets were used, one was all vessels and the other was for 118 core vessels (x=52, y=3). Note that most data in 2009 are based on RTMP.

日本、オーストラリア、ニュージーランドから提供された 1986-2009 年の延縄データセットから、4-9 海区、4-9 月のデータを抽出した。全船によるデータと、コア船 118 隻（x=52、y=3）のデータについて解析した。2009 年はほとんどを RTMP データに依存している点に留意。

Method and Result　方法と結果

Calculations were made for the two datasets in two different ways, one for all operations and the other for operations of SBT 4+ catch was positive, so that four calculations were made (Table 1). Each figure consists of three panels.

Panel 1: Top left. Bar represents the number of 5x5 degrees square (cell) where fishing operated by CCSBT statistical area and refer to left side y-axis. Line with circle plot represents the mean annual number of operations per 5x5 cell and refer to right side y-axis.

Panel 2: Top right. Bar represents the number of 1x1 degrees square where fishing operated by CCSBT statistical area and refer to left side y-axis. Line with circle plot represents the mean annual number of operations per 1x1 cell and refer to right side y-axis.

Panel 3: Bottom left. Composition of frequency for the number of 1x1 cells operated in a 5x5 cell. Refer to left side y-axis. The grey band at the bottom is one of 25 cells and that at top is 25 of 25 cells, and every five is colored. Line with triangle represents the mean number of 1x1 cells operated in a 5x5 cell and refer to right side y-axis.

In the data of all vessels, the number of 5x5 cells operated decreased from about 80 in the 1980s to about 60 in the 2000s. The number of operations per 5x5 cell also decreased from 1980s to the 2000s. It further decreased to 2009 and reached 42. Because the number of 5x5 cell is different among Areas (e.g. Area 9 is large), changes were examined by each Area.

In Area 4, the number of cells is stable. That in Area 7 became low since 2004. In Area 8 and Area 9, the numbers of cells decreased along with the total number of cells decreased between 2006 and 2009.

The features are similar in 1x1 cells.

In the composition of 1x1 cells per 5x5 cell, little difference was observed along with years, though slightly decreased in 2009. The number of 1x1 cells per 5x5 cell have been stable about 10 and reached 7.0 in 2009.

These features in all vessels were similar in core vessels, though some differences were observed. In core vessel, the numbers of 5x5 cells in the 1980s were smaller than those in the early 1990s, and the number of operations per 5x5 cell increased along with years.

Because data limited in SBT positive catch is more identical to RTMP data, it allows better comparison between 2009 and other years. In the operations limited to positive catch of SBT age4+, little difference was observed with those for all operations. The numbers of 1x1 degree cells operated in 5x5 degree square in 2009 are same as those in 2008.

2 種類のデータに対して、全操業と SBT4+が漁獲された操業の 2 種類について、集計をした（Table 1）。各図は以下の 3 枚のパネルから構成される。

パネル 1：左上。棒グラフは操業のあった年海区別 5 度区画数で左 Y 軸参照。折線プロットは 5 度区画あたりの平均操業回数で、右 Y 軸参照。

パネル 2：右上。棒グラフは操業のあった海区別 1 度区画数で左 Y 軸参照。折線プロットは 1 度区画あたりの年平均操業回数で、右 Y 軸参照。

パネル 3：左下。棒グラフは、5 度区画内での操業のあった 1 度区画数の頻度組成。左 Y 軸参照。下が 1 区画、最上部が 25 区画で、5 区画ごとに色をつけた。折線プロットは 5 度区画内での操業のあった 1 度区画数の年平均で、右 Y 軸参照。

全船の操業 5 度区画数は、1980 年代の約 80 から 2000 年代の約 60 へと減少した。5 度区画当りの操業回数も 1980 年代から 2000 年代にかけて次第に減少した。さらに減少して 2009 年には 42 に達した。CCSBT 統計海区の 5 度区画数が異なっているので、海区別にも検討した。4 海区のセル数は一定している。7 海区のセル数は、2004 年から少なくなっている。8 海区と 9 海区では 2006 年から 2009 年に掛けて全体の減少に伴ってセル数が減少した。

1 度区画数でも傾向は 5 度区画と同様である。

5 度区画内の操業のあった 1 度区画数に、年代によって違いは見られなかったが、2009 年には減少した。平均 1 度区画数は 10 前後でほぼ一定しており、2009 年には 7.0 に減少した。

コア船では、多くの点で全船と類似している。ただし、1980 年代の 5 度区画数が 1990 年代初めよりも低くなる点、5 度区画当りの操業回数が次第に増加する点において、全船のものと違っている。

ミナミマグロの漁獲があった操業に限定したデータはより RTMP データと類似するので、2009 年と他の年とのより良い比較が可能となる。ミナミマグロ 4 歳以上魚が漁獲された操業に限定したものは、全操業を含んだものとほとんど違いはなかった。5

度区画内で操業のあった一度区画数は 2009 年のものは 2008 年と同様であった。

Conclusion　　結論

In the number of cells operated which can be an indicator of concentration of fishing effort, little difference was observed between 1986 and 2009 that suggest no substantial change of the fishing operation pattern for SBT.

操業海域の集中度の指標となる操業セル数には 1986 年から 2009 年までに顕著な違いはなかった。

Table 1.　Categories of data analyzed.

Dataset	All operations	Operations of SBT 4+ positive
All vessels	Fig.1	Fig.3
Core vessels	Fig.2	Fig.4

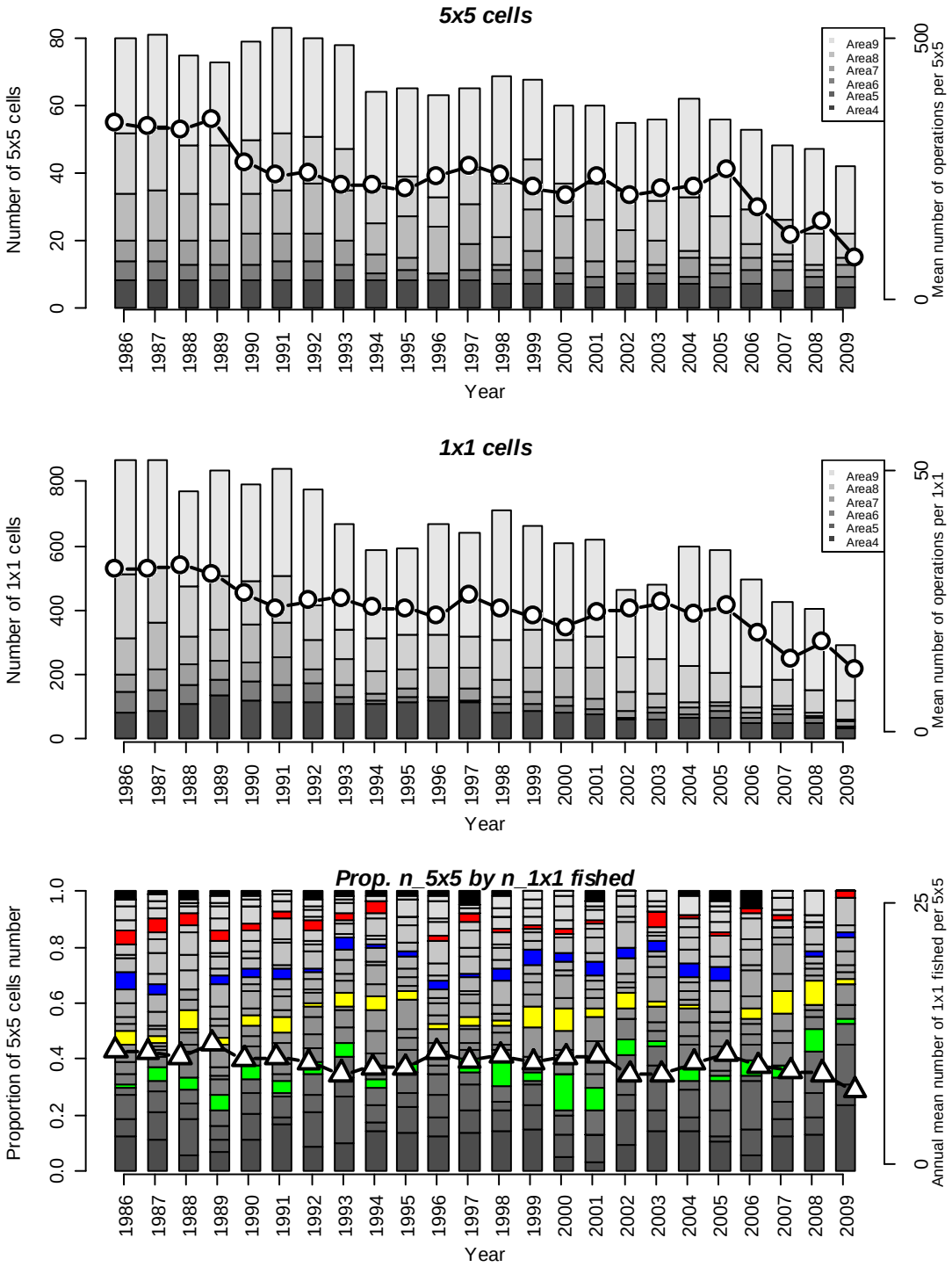

Figure 1. Number of cells in the data of all vessels for all operations. See text for explanation.

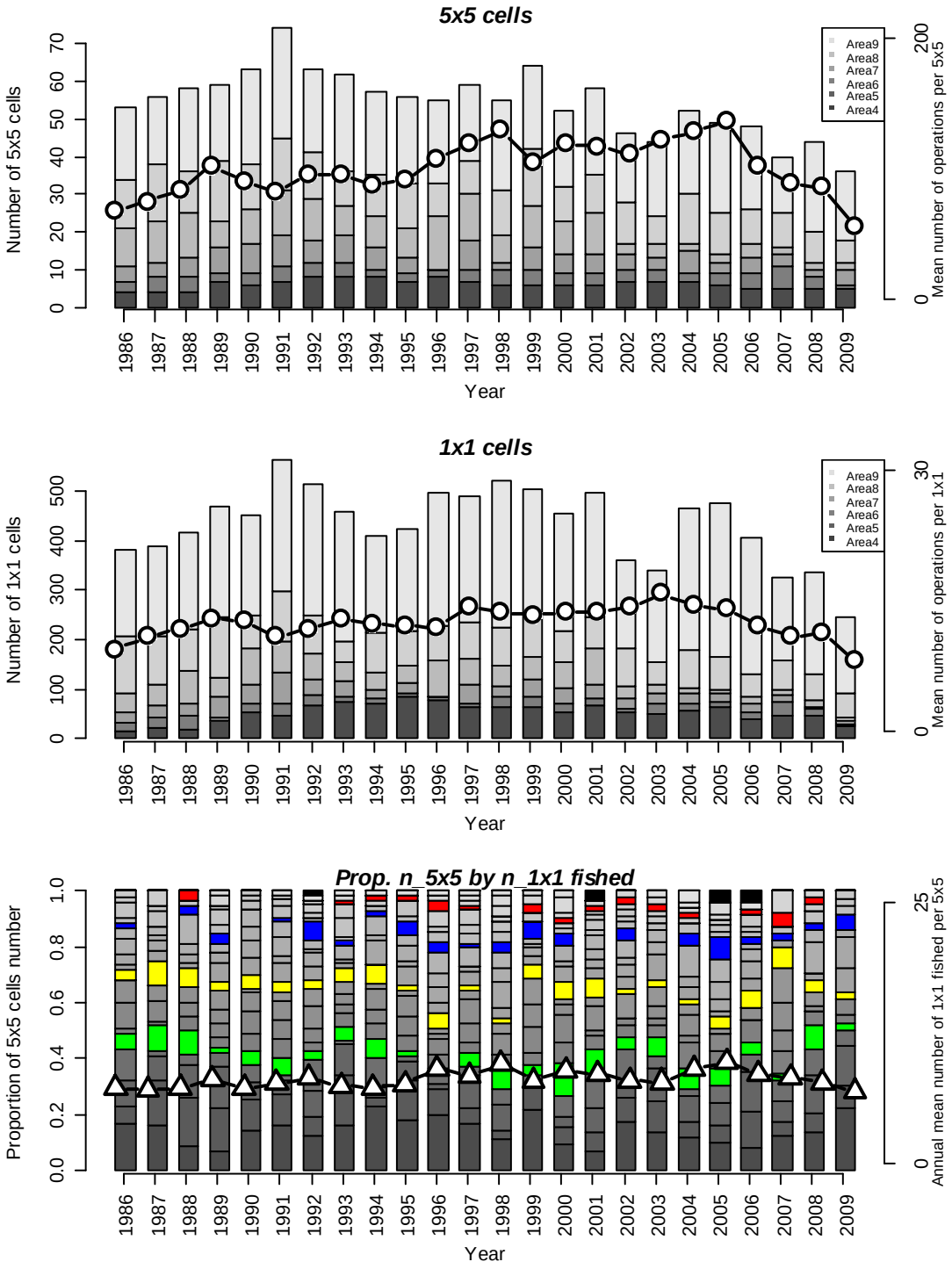

Figure 2. Number of cells in the data of core vessels for all operations. See text for explanation.

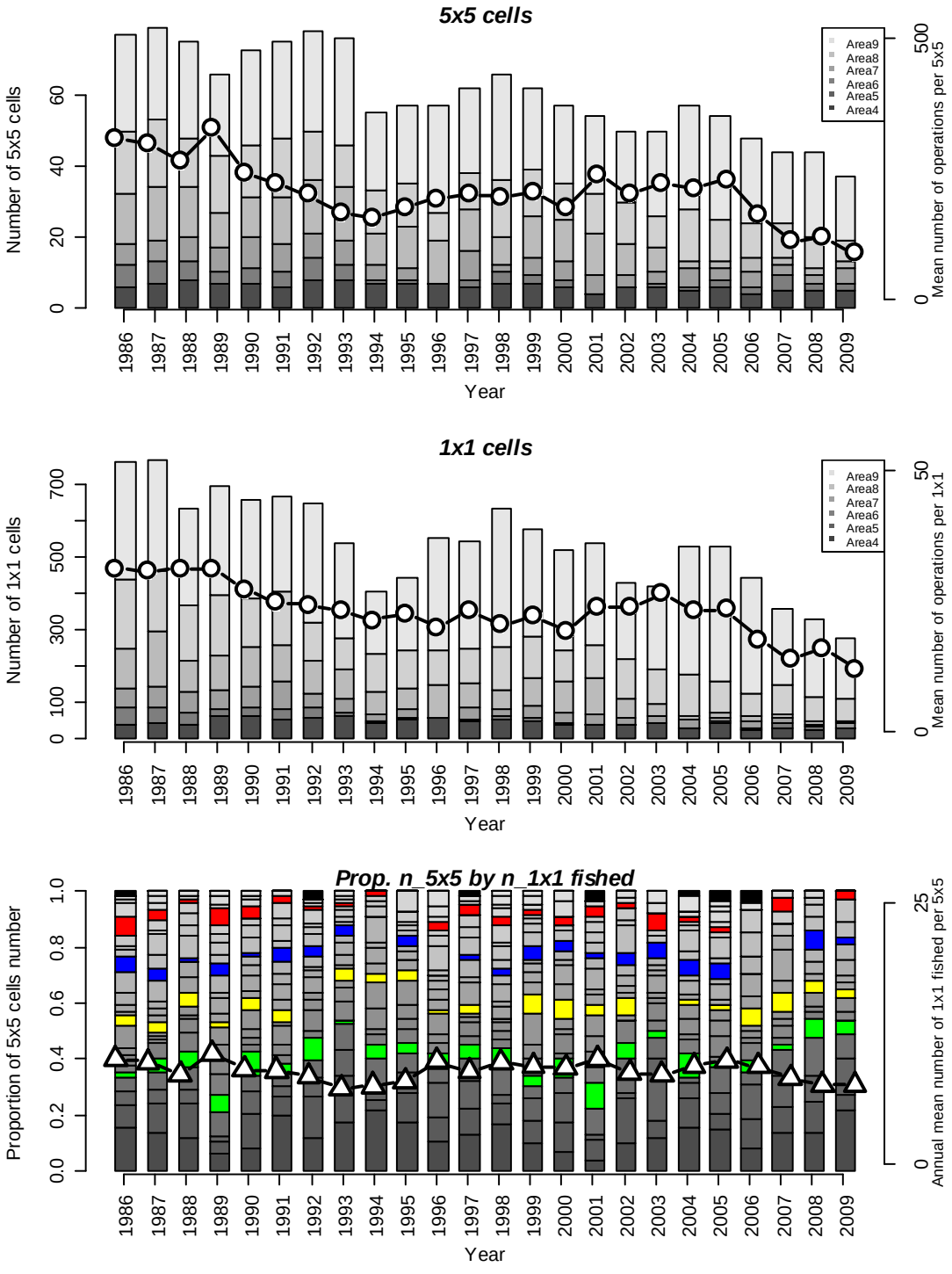

Figure 3. Number of cells in the data of all vessels for operations of SBT 4+ catch positive. See text for explanation.

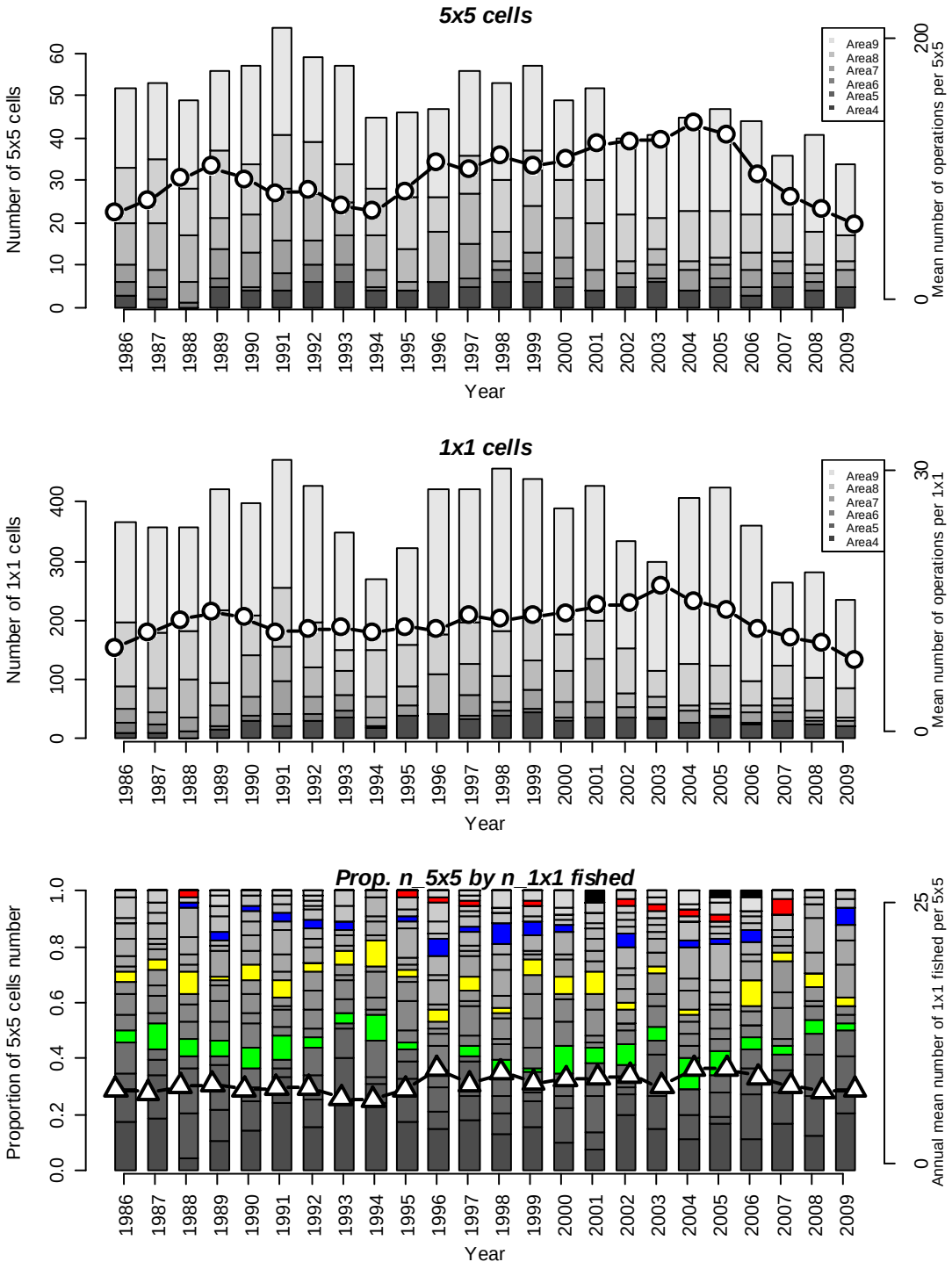

Figure 4. Number of cells in the data of core vessels for operations of SBT 4+ catch positive. See text for explanation.