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## **Abstract**

Korean fisheries for tunas and tuna-likely species in the North Pacific consist of distant water tuna longlines (DWLL) and distant water tuna purse seines (DWPS). As Korea is a member of both WCPFC and IATTC. DWLL and DWPS have been fishing in the RFMOs convention areas. In the recent years, the fishing areas of DWLL and DWPS have been focused on exclusively south of 20°N. DWLL and DWPS are managed under the ‘Distant Water Fisheries Development Act’. Offshore large purse seiners, set nets, trolls and trawls are also involved in the catch of Pacific bluefin tuna (PBF) in the area of Korean EEZ. Fisheries affecting fishing mortality of PBF in the Korean EEZ are managed under the Ministerial Directive put in place in 26 May 2011.

Total catch of tuna and tuna like species caught by Korean distant water fisheries in the North Pacific was 65,506 t in 2014. Longline catch was 13,208 t in 2014, which is 66.6 % of the total catch in 2004. Purse seine catch was 52,298 t in 2014. This was also 51.9% of the total catch in 2003. In longline catch, bigeye, yellowfin, swordfish, blue marlin, albacore, striped marlin and black marlin were 58.6%, 15.9%, 6.3%, 6.1%, 0.9%, 0.6% and 0.2%, respectively. For purse seine, skipjack, yellowfin and bigeye tuna were 77.8%, 21.7 % and 0.5%, respectively. Fishing effort of longline was 11,646 thousand hooks used in 2014. That of purse seine decreased from 2,876 sets in 2003 to 1,732 sets in 2014. Most of fishing effort of purse seine fishery was focused on the western areas in 2013, moved to the eastern areas in 2014, while that of longline was deployed relatively higher in the eastern areas. PBF catch caught by offshore large purse seiners in the Korean EEZ was 1,311 t in 2014. It was distributed in the South Sea centering around Jeju Island throughout the year with the highest in March to July but less than 10 t in August to November, which is the same pattern during the last 5 years.

## **Introduction**

The 55 year-old Korean distant water tuna longline fishery that stepped up the first fishing in the Indian Ocean in 1957, has explored the Pacific Ocean since 1958 and the Atlantic Ocean since 1967. The high-seas and within the coastal states in the South Pacific have been the main fishing grounds for Korean longline fishery and tuna purse seine fishery as well. In early years, longliners based at foreign ports near the fishing grounds but became to use home ports as they have been equipped with deep freezing facilities since 1972. All longline vessels have based on home ports

since 1999. This change gave advantages in exporting the products to Japanese markets and some others. In domestic markets, tuna SASHIMI demands have been increasing year by year.

Korean tuna purse seine fishery was initiated by accessing into the Eastern Pacific fishing ground with 3 vessels in 1971. Helicopter-aided mass operations were introduced in 1979 for the first time and the number of active vessels increased to 28 in 2014. Most of catches are supplied to the packers for our domestic consumption, and the remainders are being exported to foreign canneries.

Korean distant water fisheries are managed under the ‘Distant Water fisheries Development Act’ put into effect on the 4 February, 2008. Currently, over 90% of tuna and tuna-like species caught by Korean distant water fisheries have been harvested in the Pacific ocean, of which about 10% of purse seine catches and 44% of longline catches were attributed to the north Pacific south, of 20°N, during the past 5 years.

Pacific bluefin tuna has been caught throughout the year by domestic fleet, mostly by the offshore large purse seiners targeting pelagic species such as mackerels within the Korean EEZ. The data and information had been rarely available until 2009 when the WCPFC adopted the CMM 2009-07 that was replaced by the CMM 2010-04 and again by the CMM 2012-06, CMM 2013-09 and CMM 2014-04. Accordingly, fisheries affecting fishing mortality of PBF in the Korean EEZ are managed under the Ministerial Directive put in place in 26 May 2011. To strengthen management of Pacific bluefin tuna in Korea, the Ministerial Directive are revising. Through this revised Ministerial Directive, catch limitation of juvenile Pacific bluefin tuna will be set, and catch reporting by fisherman will be improved.

Since 2010, National Fisheries Research and Development Institute (NFRDI) has been undertaking a ‘Five-year Scientific Research Plan on PBF’, which is scheduled to be completed up to 2014. Under this plan, NFRDI is collecting and analyzing the biological data (e.g. length, weight, other biological aspects); and updating and correcting historical and current data.

This report provides the information on the Korean distant-water tuna fisheries in the North Pacific Ocean and Pacific bluefin tuna catch in Korean EEZ by domestic fleet.

## **Data collection and handling**

Distant water tuna purse seine and longline are Korean fisheries to fish for tuna and tuna-like species in the Pacific Ocean. Fishing vessel submits monthly their logbook that contains information on catch, effort and length measurement to the NFRDI. Fishing companies report the catches of their vessels to the Korea Overseas Fisheries Association (KOSFA). NFRDI conducts cross-checking both total catch from logbook data and that complied by KOSFA.

Statistic of Korean Distant water tuna purse seine and longline fisheries in the North Pacific Ocean are derived from the data of whole Pacific Ocean that based on the logbook

The catch data of Pacific bluefin tuna for 1982-1999 were Japanese import records, those for

2000-2004 were the Korean export data to Japanese markets obtained from Korean offshore large purse seine fisheries cooperatives, and for 2005 - 2014, monthly sale slips of Busan Cooperative Fish Market were compiled by the NFRDI. In addition, the data for 2005-2014 were revised on the basis of Yoo et al. (2011) and the data for 2000-2004 were done based on Yoo et al. (2012).

## **Information on distant water fisheries**

### **1. Fleet structure**

The North Pacific Ocean is an integral part of the Pacific Ocean fishing ground of Korean distant water tuna purse seine and longline fisheries in both the WCPFC and the IATTC convention areas of south of 20°N. All the vessels registered to both RFMOs are engaging in fishing for tuna and tuna-like species in the North Pacific Ocean. The number of vessels by gear operating in the Pacific Ocean is presented in Fig. 1 and Table 1. The number of purse seine vessels, once peaked at 39 in 1990, has been reduced to the present level of 28 in 2014, the lowest in the last 10 years. 10 vessels were of 500-1000 class, 13 vessels of 1000-1500 class and 5 vessels of over 1500 class. The number of longline vessels, once culminated at 220 in 1991, had also been reduced to 108 in 2008 but slightly increasing to 125 in 2012 and 128 in 2014. Most longline vessels were in the class of 201-500 GRT with deep freezing facilities.

### **2. Annual catch and effort**

Annual catch and effort by gear and primary species in the North Pacific are tabulated in Table 2, 3 and Fig. 2 and 3. The catch portion of the North Pacific to the entire Pacific was 55.6% in longline fishery and 19.4% in purse seine fishery in 2014. The catches occurred in the areas south of 20°N. Longline catch was 13,208 t in 2014, which decreased 66.6 % from the peak in 2004. Purse seine catch was 52,298 t in 2014. This declined 51.9% from the peak in 2003. As for the catch proportion by species caught by longline in 2014, bigeye, yellowfin, swordfish, blue marlin, albacore, striped marlin and black marlin were 58.6%, 15.9%, 6.3%, 6.1%, 0.9%, 0.6% and 0.2%, respectively. Bigeye increased from 6,041 t in 2013 to 7,735 t in 2014, yellowfin and striped marlin slightly increased, albacore, blue marlin, swordfish and black marline slightly decreased. For the purse seine, skipjack, yellowfin and bigeye tuna were 77.8%, 21.7 % and 0.5%, respectively. Skipjack catch in 2014 was 45.9% of the peak in 2003 and yellowfin catch in 2014 was 39.7% of the peak in 1993. Fishing effort of longline fishing efforts was 11,646 thousand hooks in 2014. That of purse seine decreased from 2,876 sets in 2003 to 1,732 sets in 2014.

### **3. Fishing pattern**

Catch and effort by gear are mapped in Fig. 4 and 5. Fishing effort of Korean tuna longline was higher in the eastern area than those of other years (Fig. 4). While that of purse seine was concentrated on the eastern areas in 2014 than those of other years (Fig. 5). Purse seine fishery has generally been operating in the tropical area of the western and central Pacific Ocean between 140°E-180°E and, when oceanographic conditions were favorable, it extended farther to the east. It was remarkable that it most inclined to the western part in 2013, but moved to the eastern part in 2014. While longline efforts were deployed relatively higher in the eastern areas.

## **Information on Pacific bluefin tuna catch by coastal fisheries in Korean EEZ**

### **1. Coastal large purse seine fishery**

The annual and monthly catches of Pacific bluefin tuna are presented in Table 4 and Fig. 6 and 7. The number of offshore large purse seiners was 24 in 2014, continuously decreasing from 48 in 1994 by virtue of the fishing capacity control by the government. The catch increased from 604 t in 2013 to 1,305 t in 2014, which was 50.2% of the highest catch (2,601 t) in 2003. The catch occurred throughout year with the highest from March to July but less than 10 t from August to November during the last 5 years. Monthly peak of catch is slightly different annually.

Quarterly distributions of fork length of PBF were presented in Fig. 8. They were almost juvenile (<150 cm). In the first quarter, it showed above 180cm of large PBF with three modes of 50cm 80cm and 185cm. The 3<sup>rd</sup> and 4<sup>th</sup> quarters have distributed juvenile with the range of 30-50cm.

The catch distribution is shown in Fig. 9. The catches were distributed in the South Sea centering around Jeju Island throughout the year. Catches were mostly distributed until June in 2014.

### **2. Set net fishery**

Pacific Bluefin tuna caught by set net fishery were 1 ton and 6 ton in 2013 and 2014, respectively (Table 4). The set net where PBF was caught has located in the East Sea (Fig. 1). Most PBF caught by set net fishery were juvenile. The range of PBF caught by set net fishery was 48cm-90cm.

### **3. Coastal troll fishery**

In accordance with the Ministerial Directive put into effect in 26 May 2011, anyone who wish to catch bluefin tuna for fattening farming were obliged to get the approval by the regional government. 61 coastal trollers (1.6-9.2 G/T) targeting Spanish mackerels and yellowtails were approved for fishing Pacific bluefin tuna around Jeju Island in 2012. Among them, 12 coastal

trollers (3.6-7.3 G/T) caught Pacific bluefin tuna in 2013. The catches were presented in Table 4 and 5, indicating that a total of 42 kg (53 individuals with 0.8 kg) were in 2013, which were all transferred to the fattening farms. No catch of PBF was in 2014.

#### **4. Offshore trawl fishery**

There were PBF caught by the offshore trawl fishery had been collected from 2000. The data in 2000-2004 were the Korean export data to Japanese markets obtained from Korean offshore large purse seine fisheries cooperatives, and for 2005 to 2014, the monthly sale slips of Busan Cooperative Fish Market compiled by the NFRDI. Annual PBF catch amount have changed largely, because PBF was not a target species, i.e. incidental catch, for the offshore trawl fishery. Most PBF caught by this fishery were juvenile. For example, over 70% of PBF catch in 2010 have been caught by only 1.3% of number of set in 2010. The variance of monthly catch of PBF was high (Fig.11). The difference of catch by month and yearly was also not significant (one-way ANOVA,  $p\text{-value}_{mm}=0.8795$  and  $p\text{-value}_{yy}=0.4437$ ). Most PBF caught by this fishery were juvenile. Fig. 12 indicates monthly distributions of Pacific bluefin tuna caught by offshore trawl fishery in Korean waters from 2005 to 2014.

#### **References**

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- Yoo J.T., Z.G. Kim, S. I. Lee, I. J. Yeon, S. C. Yoon and D.W. Lee. 2012. Recent update of Pacific bluefin tuna catch in Korea waters. ISC/12-1/PBFWG/19.

Table 1. The number of Korean active vessels by gear and size, operating in the Pacific Ocean, 2008-2014

Year	GRT class by gear									
	Longline					Purse seine				
	Total	0-50	51-200	201-500	500+	Total	0-500	501-1000	1001-1500	1500+
2008	108	-	-	108	-	28	-	15	12	1
2009	111	-	-	111	-	27	-	13	11	3
2010	122	-	-	122	-	28	-	13	13	3
2011	124	-	-	124	-	28	-	12	11	5
2012	126	-	-	126	-	28	-	12	11	5
2013	125	-	1	124	-	27	-	12	10	5
2014	113	-	1	112	-	28	-	10	13	5

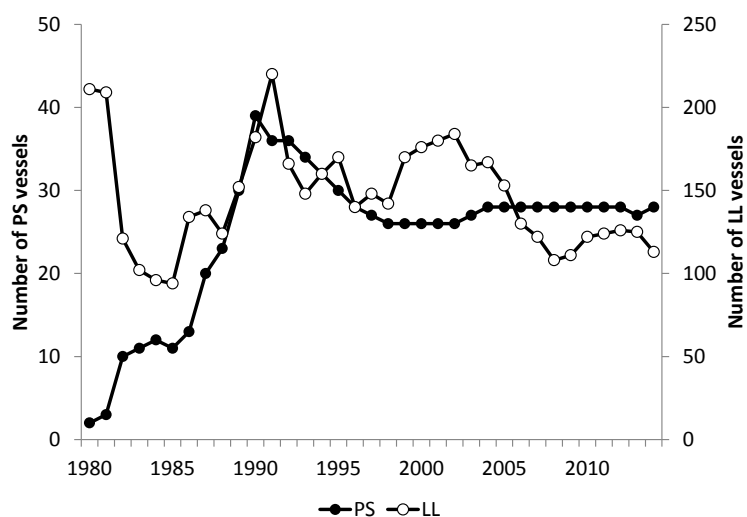


Fig. 1. The annual number of fishing vessels of the Korean tuna distant water fishery in the Pacific Ocean, 1980-2014.

Table 2. Number of hooks (1,000 hooks) and catch (t) of tuna and tuna-like species by the Korean distant-water longline fishery in the North Pacific, 2008-2014. Data for 2014 is provisional

Year	No. of hooks (1,000)	ALB	YFT	BET	SKJ	BUM	MLS	SWO	BLM	SFA	SHK	OTH	Total
2002	16,478	112	3,137	10,786	0	152	188	439	479	123	185	1,400	17,001
2003	21,431	146	4,741	9,739	6	159	206	381	819	129	95	931	17,352
2004	18,746	78	5,144	12,453	101	227	75	410	919	1	8	404	19,819
2005	14,955	420	2,958	9,257	35	304	136	404	997	0	10	820	15,340
2006	18,259	135	5,096	11,494	0	217	56	465	1,063	0	0	941	19,468
2007	15,441	137	2,175	9,606	0	121	47	453	887	0	1	291	13,718
2008	16,466	400	2,730	11,075	0	220	30	795	748	0	4	741	16,742
2009	13,286	95	2,992	10,979	0	224	23	994	654	0	13	878	16,852

2010	14,729	107	2,011	9,303	0	257	18	663	570	0	69	532	13,531
2011	16,654	78	3,146	9,047	0	684	48	962	159	1	546	941	15,614
2012	15,553	157	2,398	11,385	8	587	34	856	57	1	499	876	16,859
2013	13,780	173	1,988	6,041	22	963	65	1,071	41	2	735	204	11,306
2014	11,646	116	2,102	7,735	50	801	82	829	31	3	610	256	13,208

ALB : Albacore tuna, YFT : Yellowfin tuna, BET : Bigeye tuna, SKJ : Skipjack tuna, BUM : Blue marlin, MLS : Striped marlin, SWO : Swordfish, BLM : Black marlin, SHK : Sharks, OTH : Others

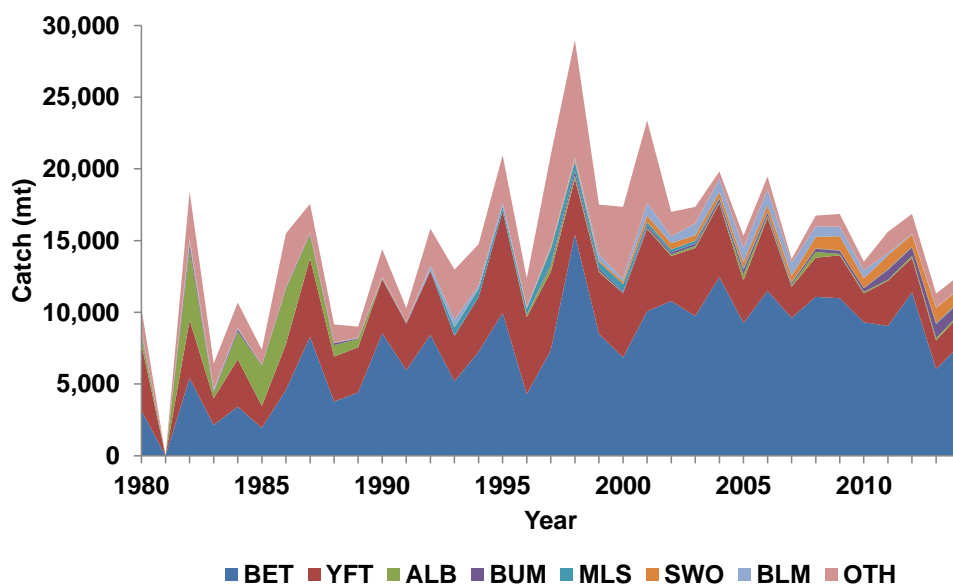


Fig. 2. Annual catch of Korean distant-water longline fishery by primary species in the North Pacific, 1980-2014.

Table 3. Fishing effort (sets) and catch (t) of tunas by the Korean distant-water purse seine fishery in the North Pacific, 2002-2014. Data for 2014 is provisional

Year	No. of sets	Catch (ton)				Total
		SKJ	BET	YFT	OTH	
2002	2,537	64,897	0	16,389	0	81,286
2003	2,876	88,654	319	11,714	0	100,687
2004	1,633	43,797	48	7,426	0	51,271
2005	1,035	49,724	0	11,027	0	60,751
2006	510	67,564	13	15,394	0	82,970
2007	543	18,270	0	3,585	0	21,855
2008	490	9,233	4	7,842	0	17,079
2009	1,237	38,436	15	7,232	0	45,683
2010	727	20,751	374	4,020	0	25,145
2011	770	18,331	216	5,256	0	23,803
2012	2,402	67,448	404	19,467	1	87,320
2013	1,644	40,809	232	4,344	0	45,386



2014	1,732	40,690	265	11,343	0	52,298
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SKJ : Skipjack tuna, BET : Bigeye tuna, YFT : Yellowfin tuna, OTH : Others

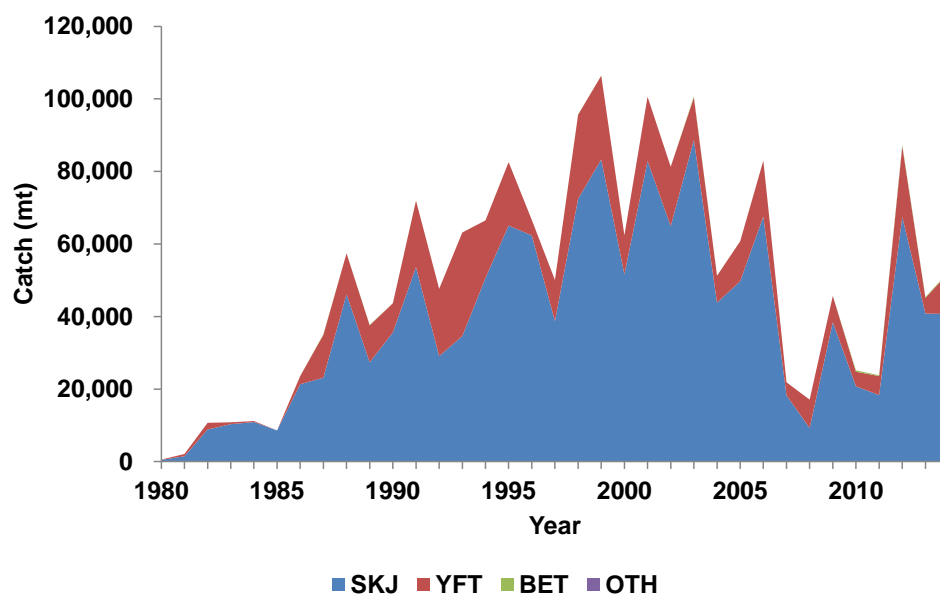


Fig. 3. Annual catch of Korean distant-water purse seine fishery by primary species in the North Pacific, 1980-2014.

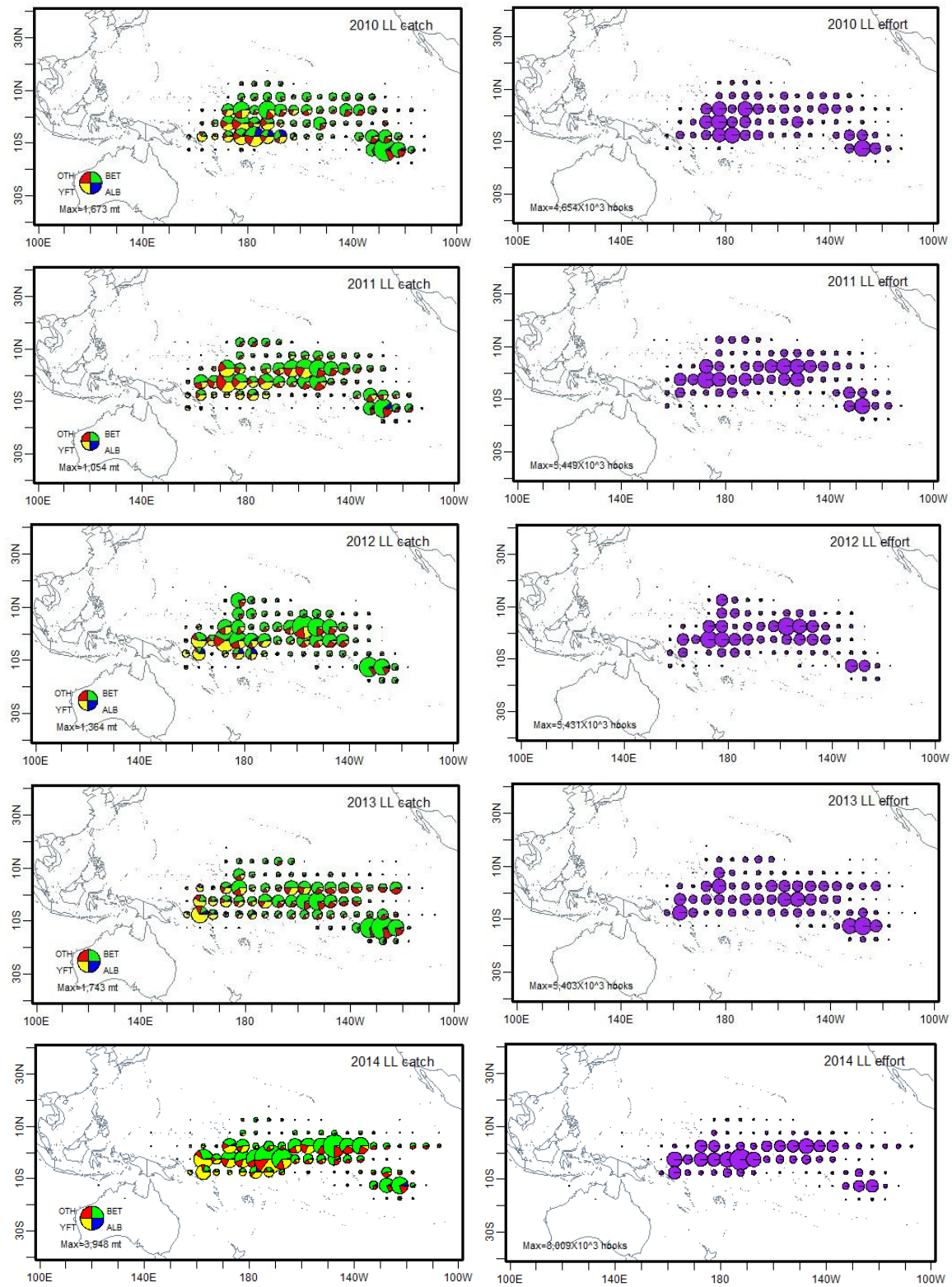


Fig. 4. Annual catch and effort distributions of target species by Korean distant-water longline

fishery operating in the Pacific Ocean, 2010-2014.

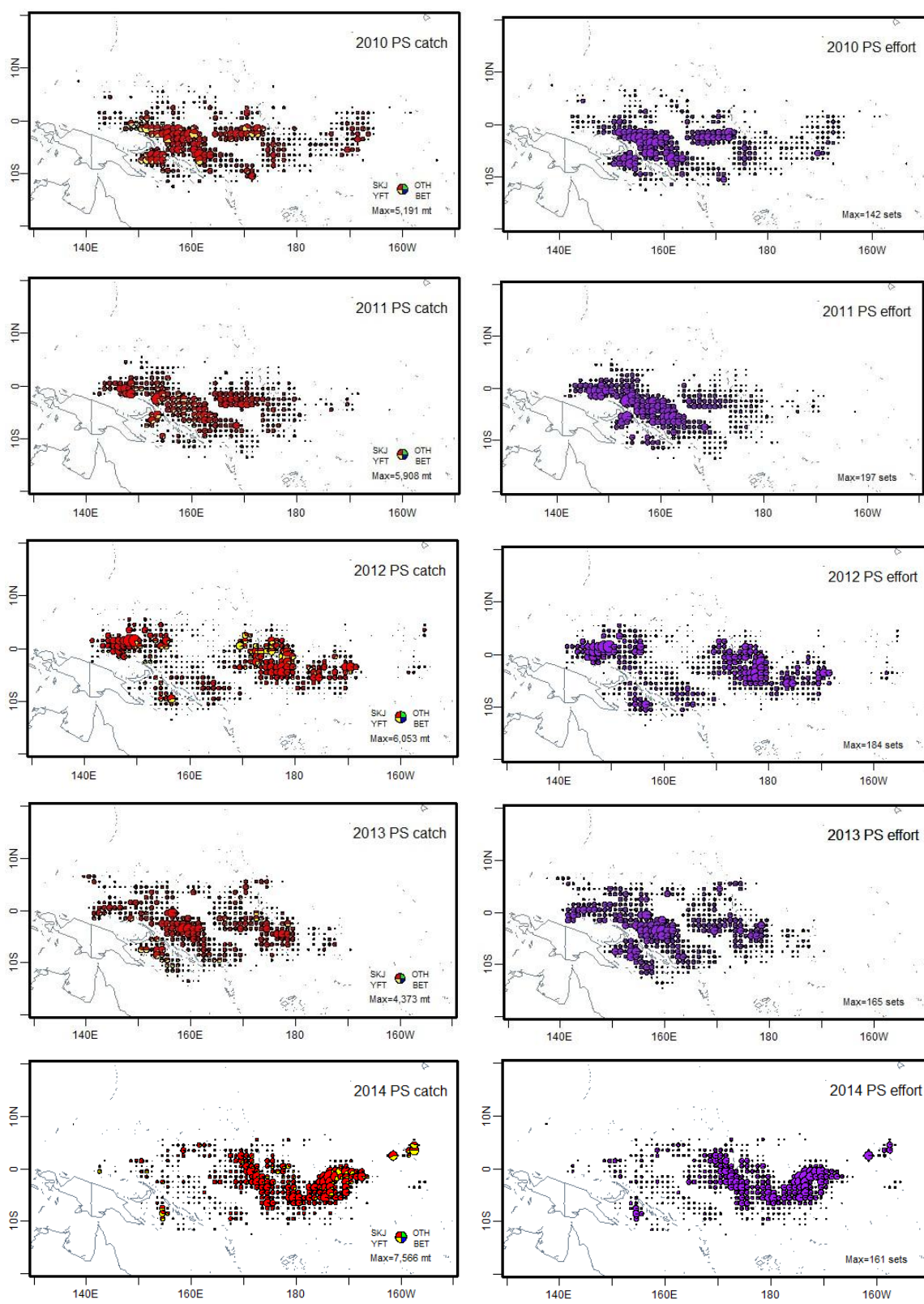


Fig. 5. Annual catch and effort distributions of target species by Korean distant-water purse seine

fleets operating in the Pacific Ocean, 2010-2014.

Table 4. Annual catch of Pacific bluefin tuna by fishing gears in Korean waters, 1982 - 2014

unit: ton

Year	Number of OLPS* vessel	Purse Seine	Set Net	Troll	Trawl	SUM
1982	48	31				31
1983	48	13				13
1984	48	4				4
1985	48	1				1
1986	48	344				344
1987	48	89				89
1988	48	32				32
1989	48	71				71
1990	48	132				132
1991	48	265				265
1992	48	288				288
1993	48	40				40
1994	48	50				50
1995	36	821				821
1996	36	102				102
1997	36	1,054				1,054
1998	36	188				188
1999	36	256				256
2000	32	2,401			0	2,401
2001	32	1,176			10	1,186
2002	32	932			1	933
2003	29	2,601			0	2,601
2004	29	773			0	773
2005	29	1,318			9	1,327
2006	29	1,012			3	1,015
2007	29	1,281			4	1,285
2008	29	1,866			10	1,876
2009	27	936			4	940
2010	25	1,196			16	1,212
2011	25	670		0	14	685
2012	24	1,421		1	2	1,424
2013	24	604	1	0	0	605
2014**	24	1,305	6		0	1,311

\* : OLPS is Offshore Large Purse Seiner

\*\* : Data for 2014 is provisional

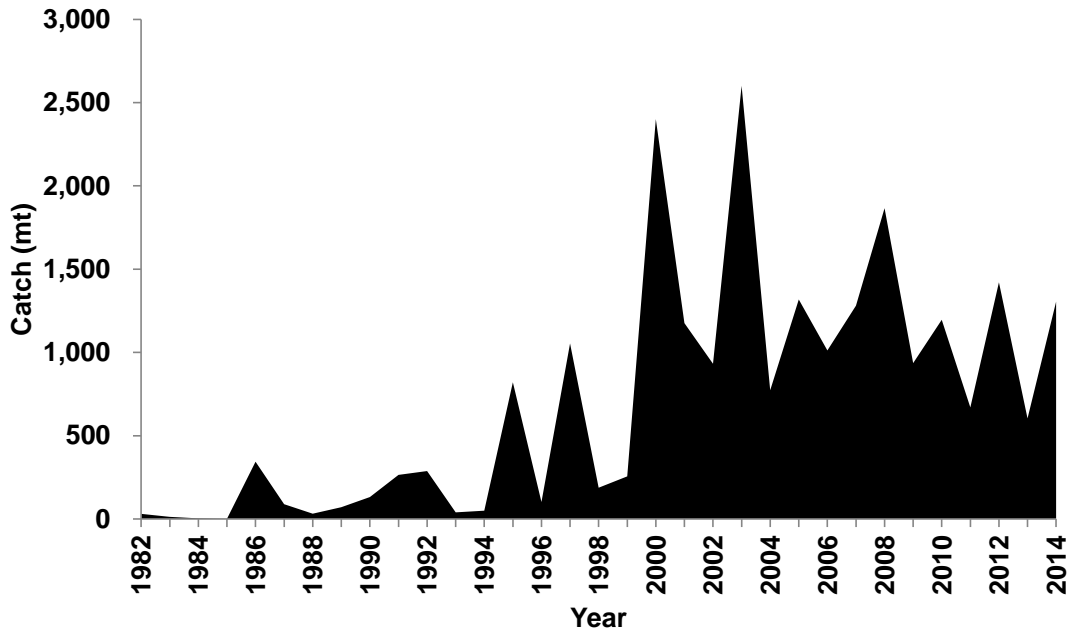


Fig. 6. Annual catch of Pacific bluefin tuna caught by offshore large purse seiners, 1982-2014.

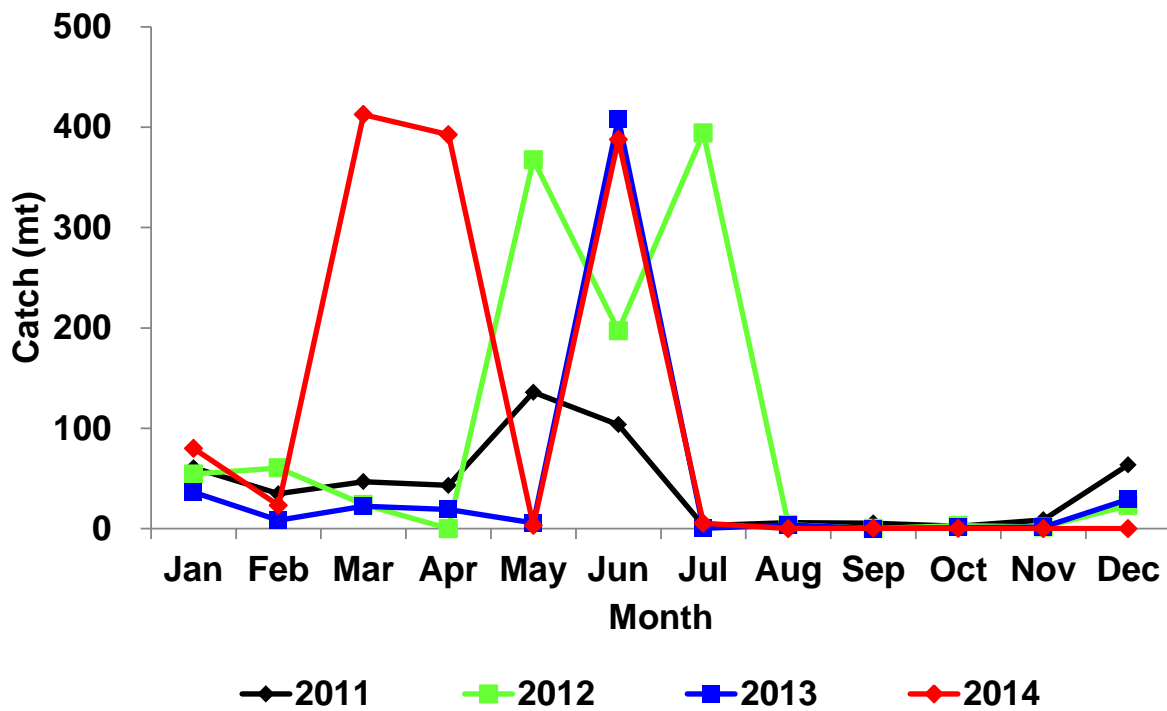


Fig. 7. Monthly catches of Pacific bluefin tuna caught by offshore large purse seiners, 2011-2014.

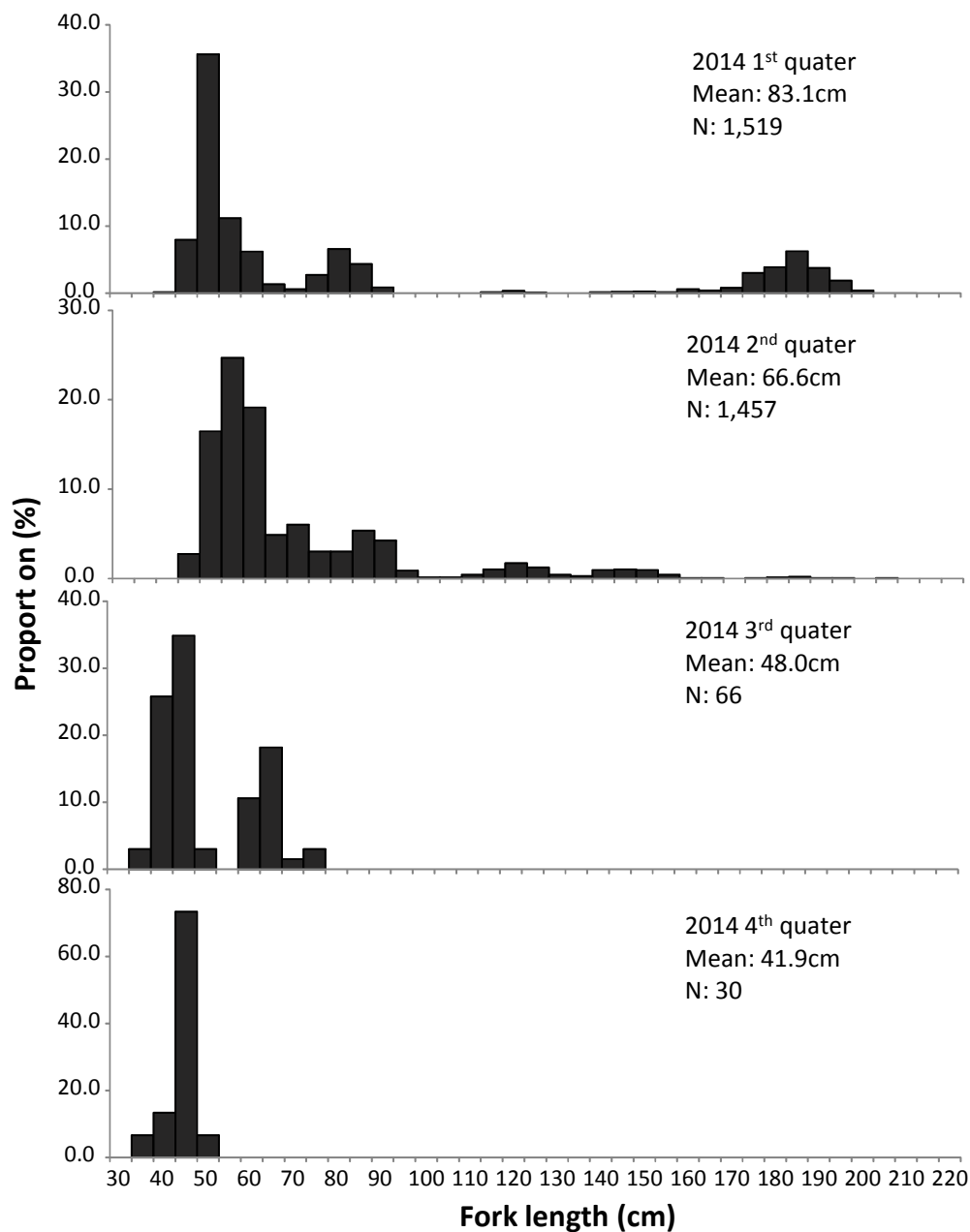


Fig. 8. Quarterly length proportion of Pacific bluefin tuna caught by offshore larger purse seiners, 2014.

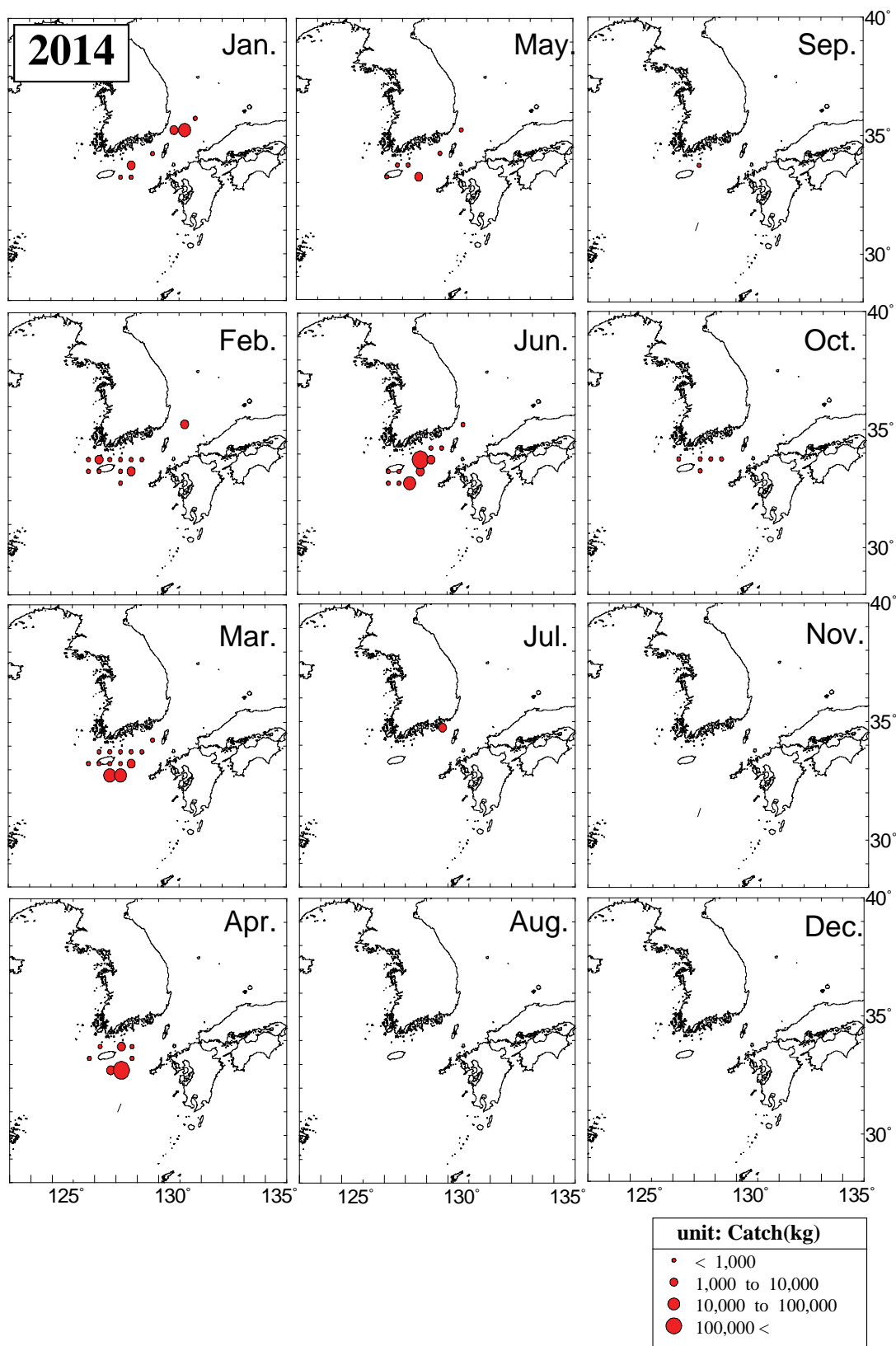


Fig. 9. Monthly distributions of Pacific bluefin tuna caught by offshore large purse seiners in



Korean waters, 2014.

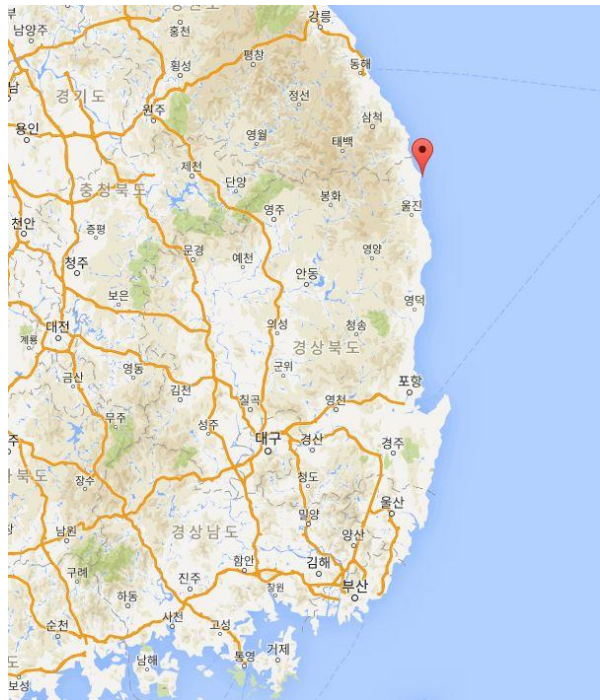


Fig. 10. The location of set net fishery in Korean waters.

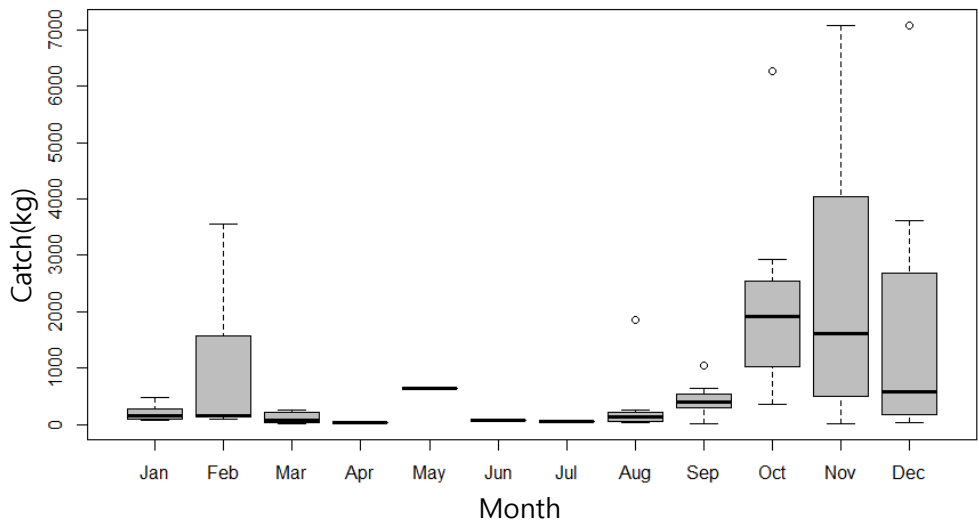


Fig. 11. Monthly catch of PBF caught by offshore trawl fishery, 2005-2014.

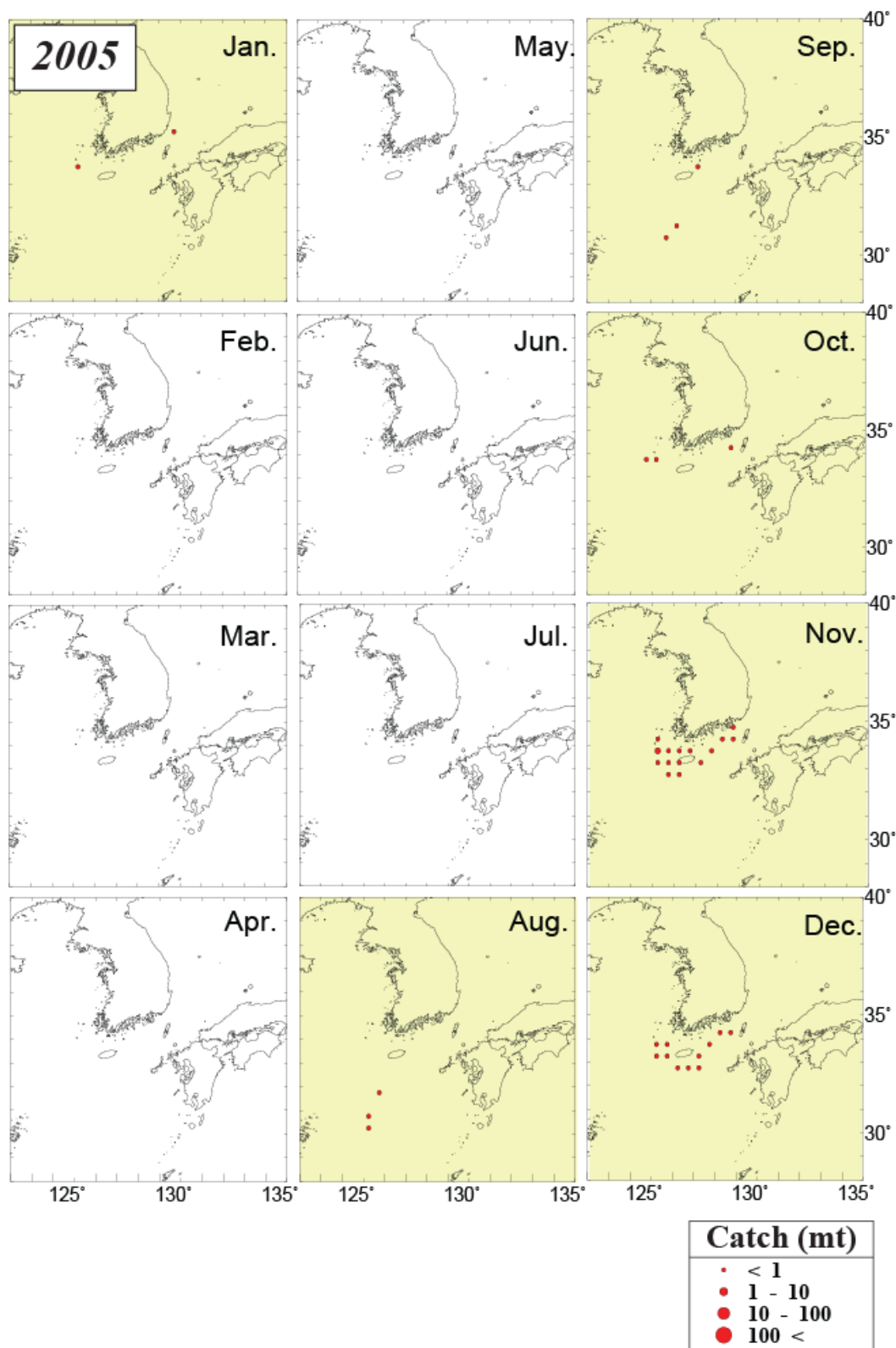


Fig. 12. Monthly distributions of Pacific bluefin tuna caught by offshore trawl fishery in Korean waters, 2005-2014.



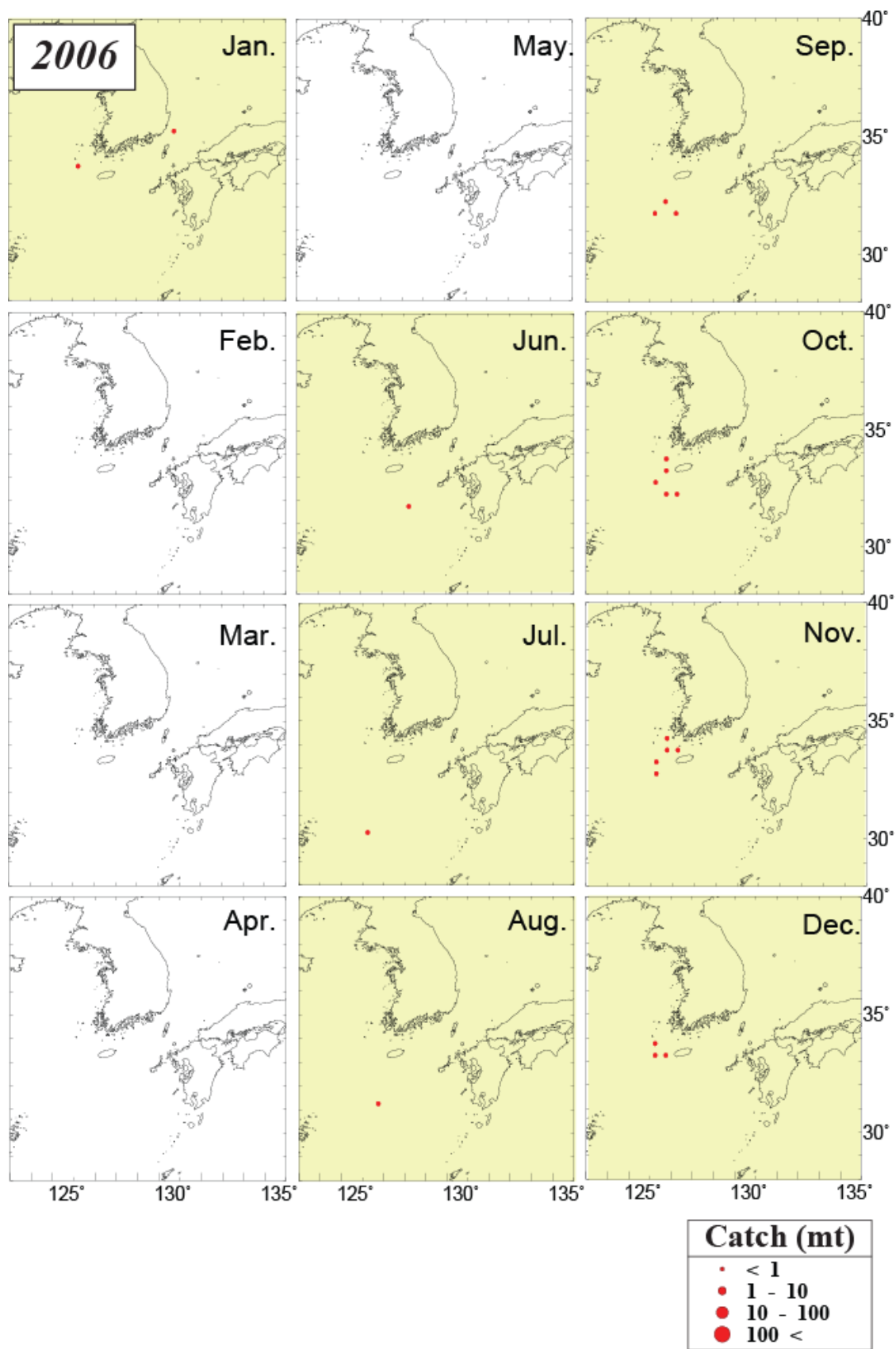


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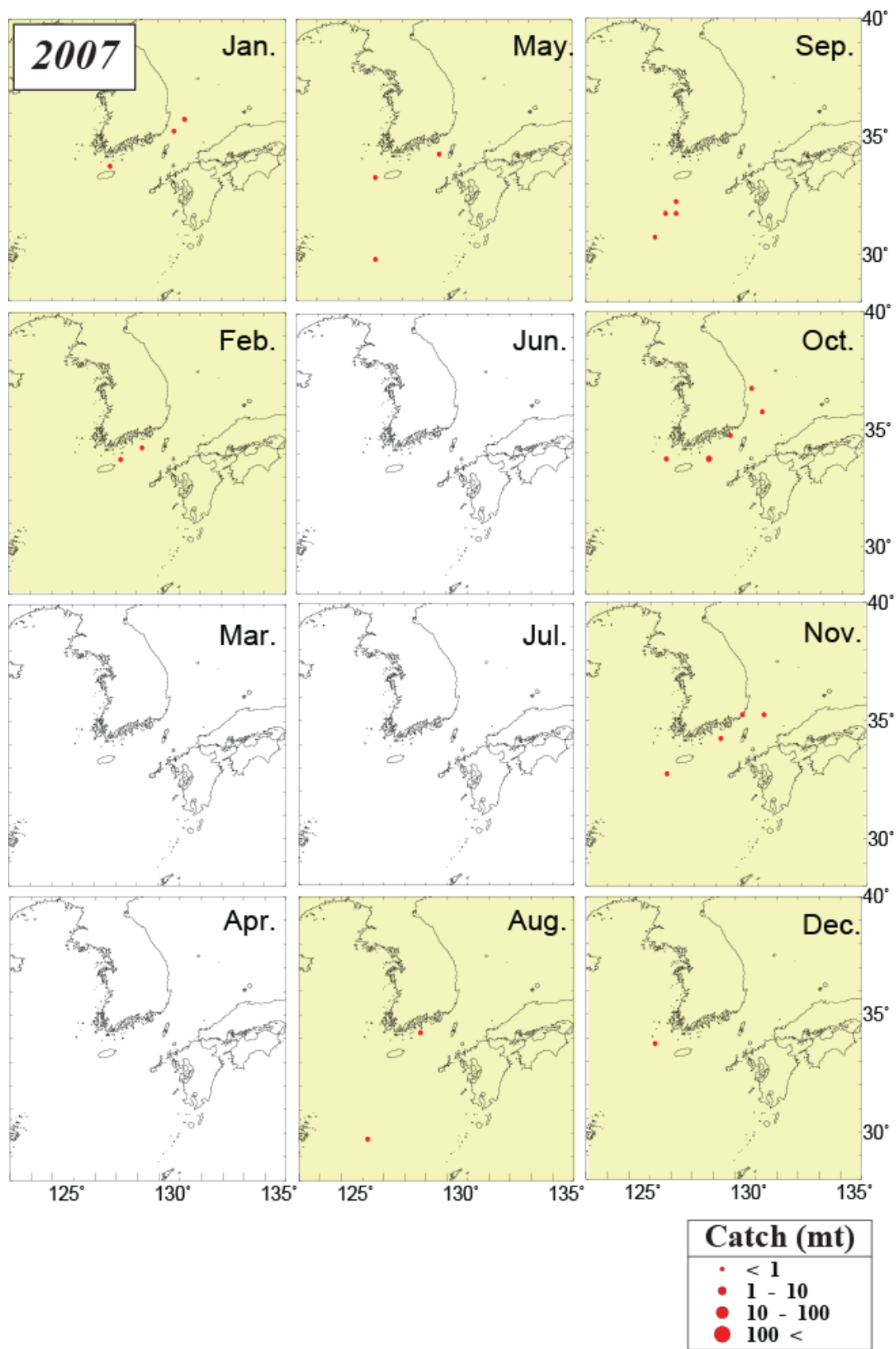


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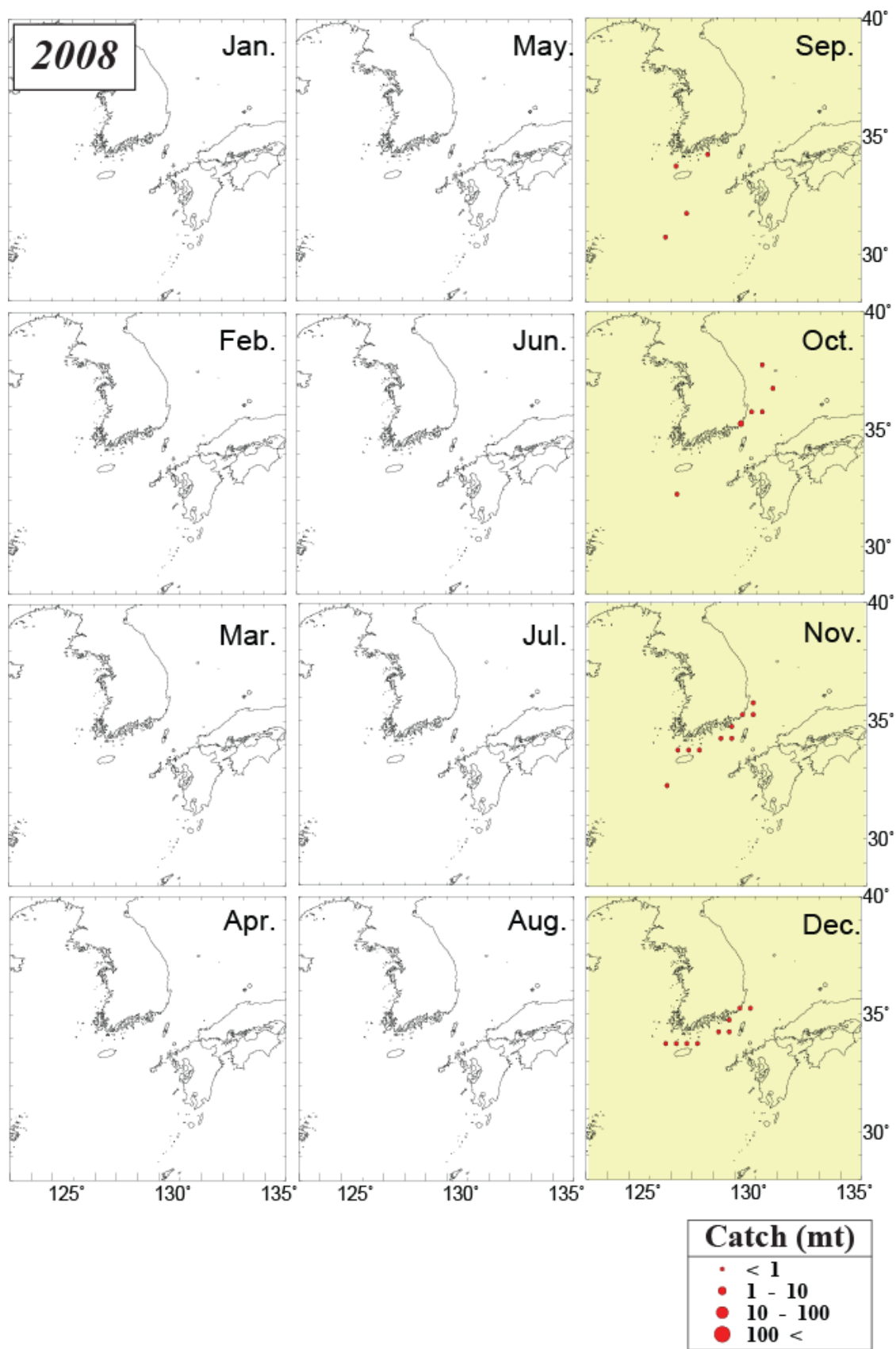




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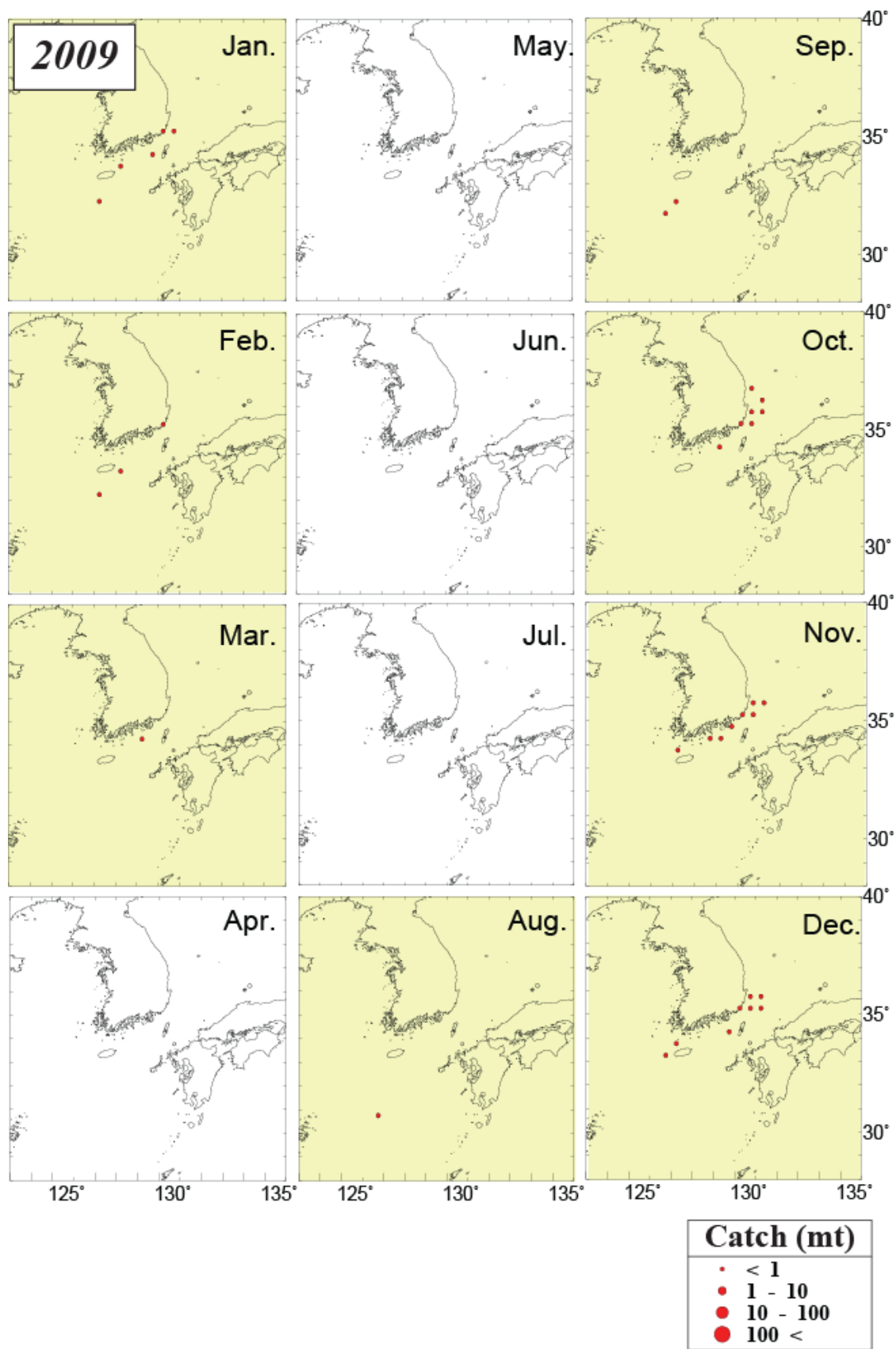


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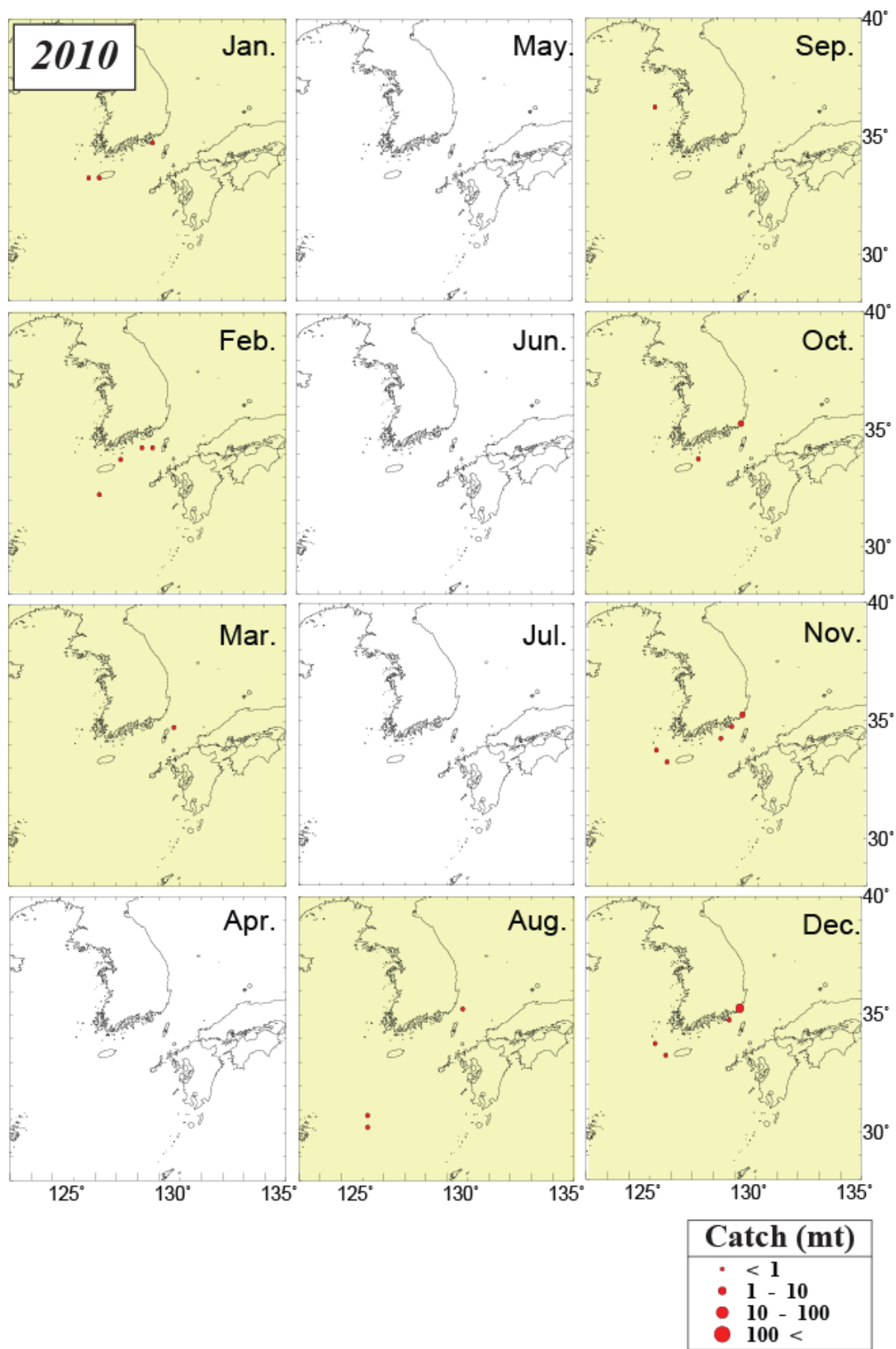


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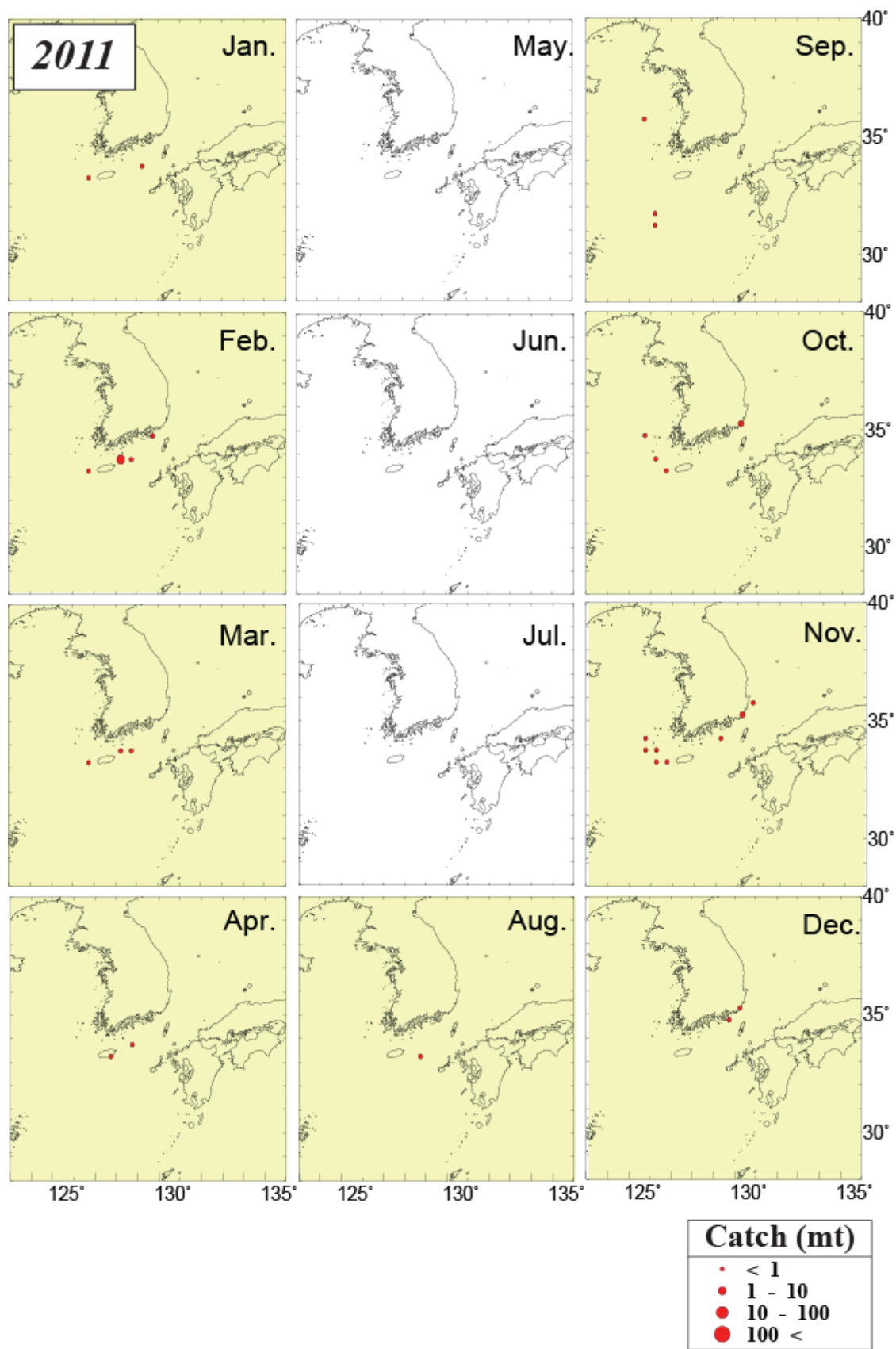


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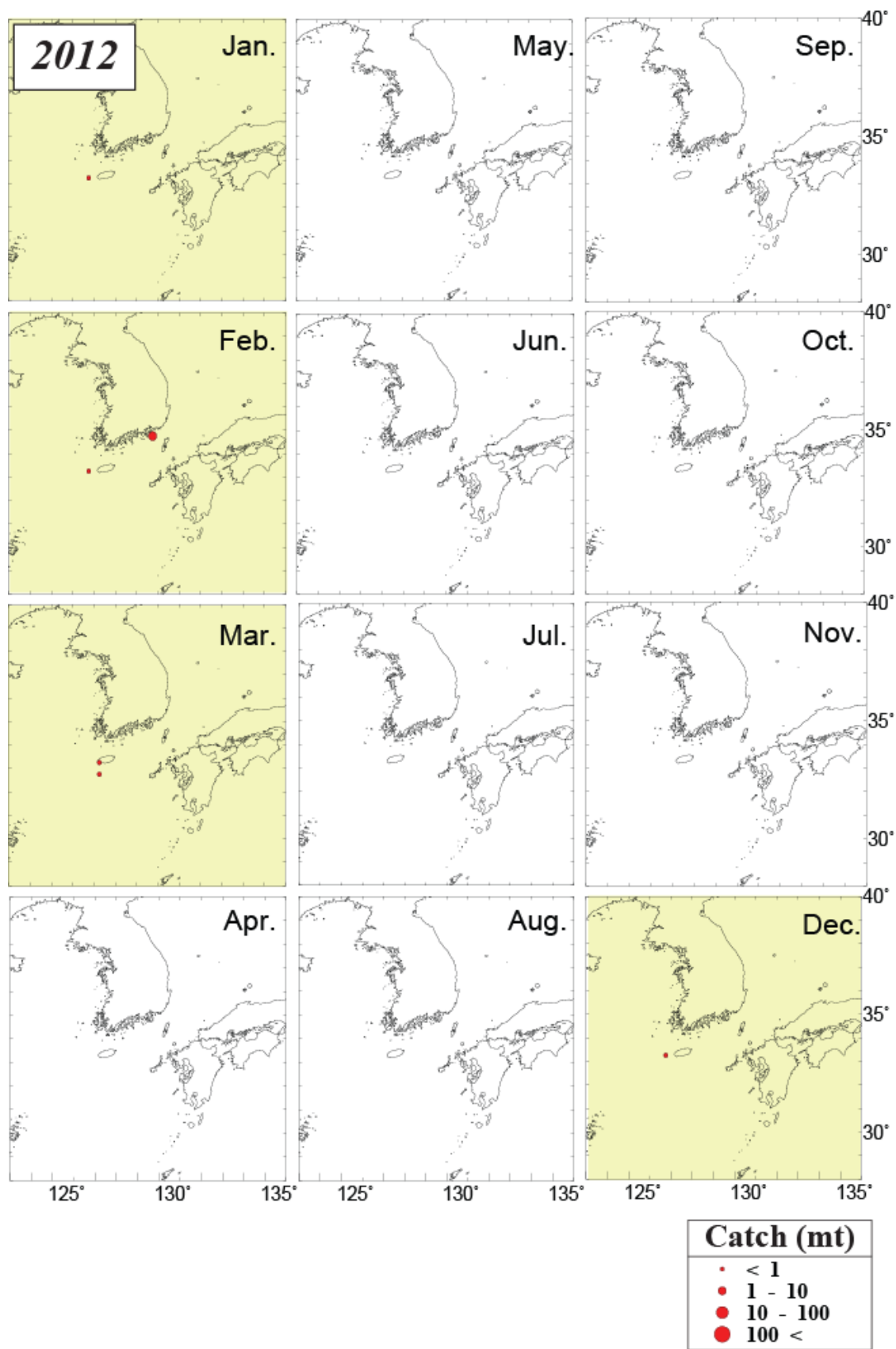




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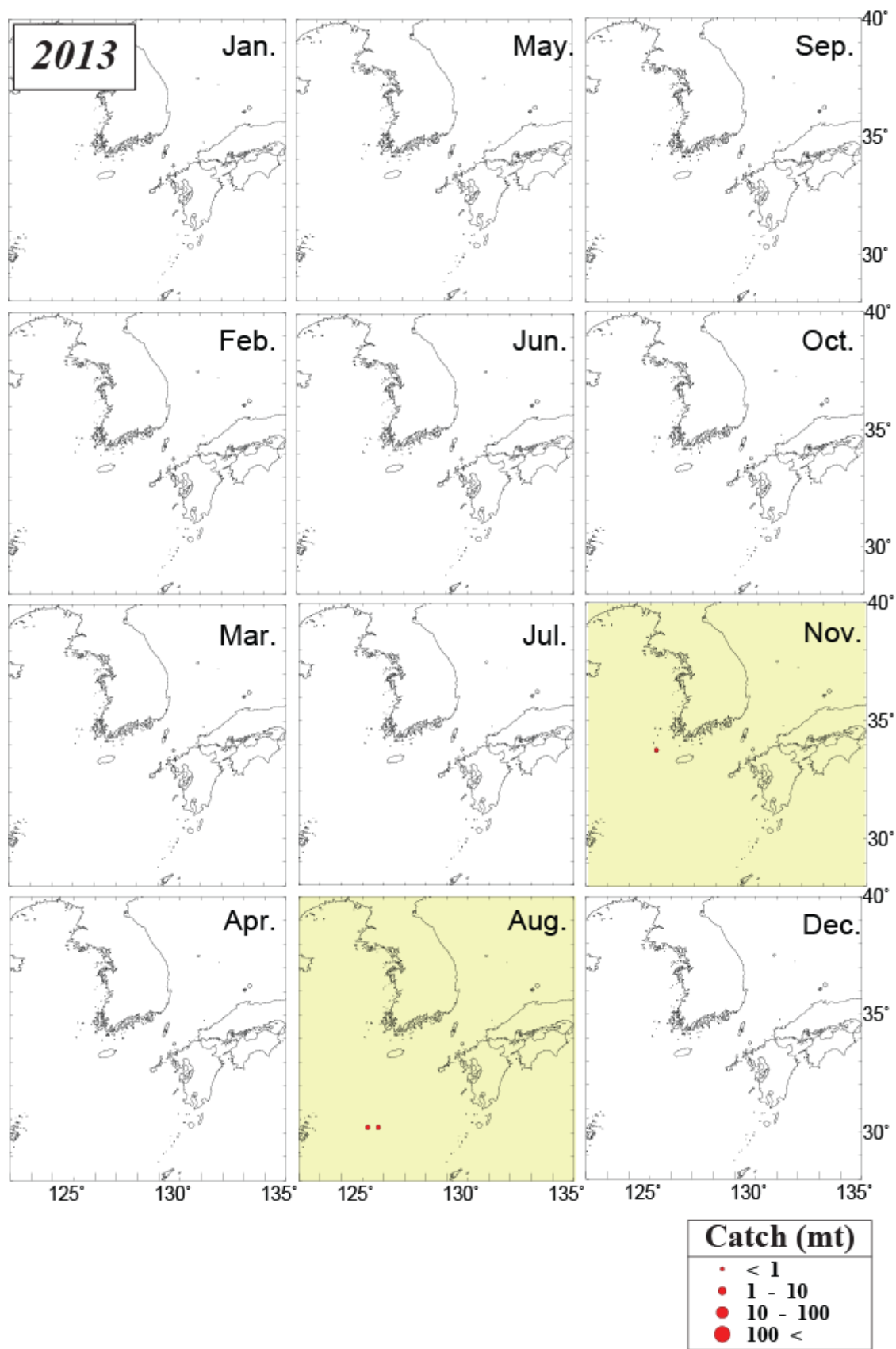


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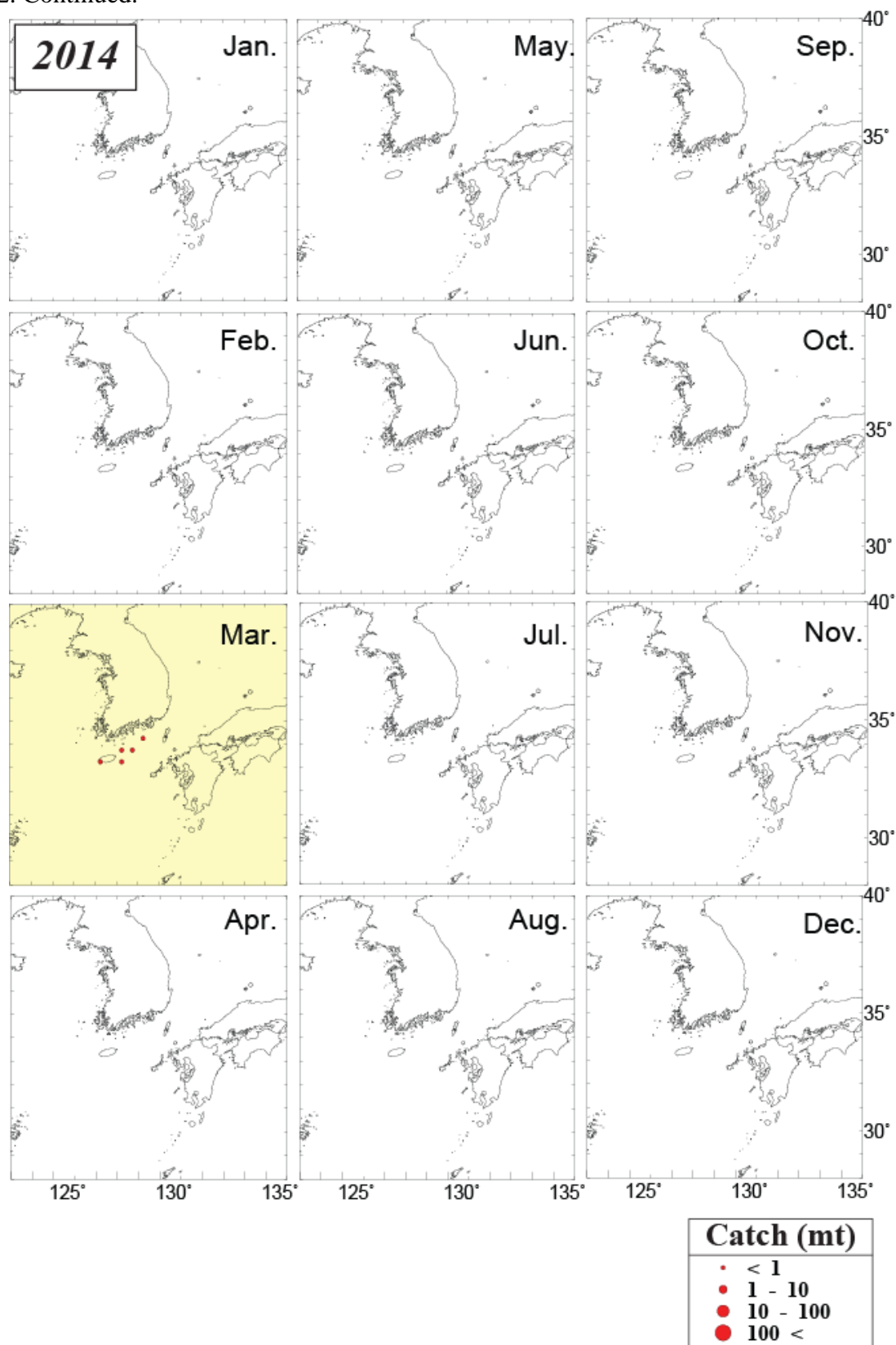


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