REVIEW ON SIZE SAMPLING FRAMEWORKS FOR NORTH ATLANTIC ALBACORE (*THUNNUS ALALUNGA*) OF TAIWANESE LONGLINE FLEETS

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SUMMARY

This paper dealt with size sampling frameworks undertook by Taiwanese longliners for the purpose of understanding the size structure of total North Atlantic albacore (AlbN) catches by the Taiwanese fleets. Data sets of sampled size measurements with its corresponding Task2 catch, dating from 1981 to 2012, were used in this analysis. The 1981-2012 data sets, based on its appeared yearly characters, can be further subdivided into: 1981-1987, 1988-1991, 1992, 1993-1996, 1997-2000, 2001, 2002-2007 and 2008-2012 eight periods. As a general observation on those yearly characters of sampled size measurements indicated that the mode of yearly size distribution before 1987 appeared to be 90 cm of fork length while those after 1987 appeared two peaks: one appeared at 85 cm and the other appeared at 105 cm. The size sampling frameworks of only the initial 30 fishes, caught by each longline retrieval, were sampled for species identification and size measurement have been undertaking until present. Before mid-1980s, size measurements on albacore were sampled only from albacore-targeted vessels. Since mid-1980s, when the introduction of Taiwanese deep longliners became evident, the measured albacores were either from traditional albacore-targeted vessels or from deep bigeye-targeted vessels. Different proportion on sampling between the two types of longliners brought different uncertainty elements into the measuring frameworks for understanding the representative yearly size structure. The recent introduction of e-logbook reporting frameworks, led by bigeye-targeted longliners since 2006, further complicated the situation by reporting all catches, not the initial 30 fishes. For better understanding the nature and its limitations of those Taiwanese yearly sampled AlbN size measurements data thus obtained, the authors analyzed the sampled AlbN size as well as the Task2 catch data sets for minimizing uncertainties arouse from those years of low recovery logbooks.

RÉSUMÉ

Le présent document traite des méthodologies d'échantillonnage des tailles mises en place par les palangriers du Taipei chinois dans le but de comprendre la structure des tailles des prises totales de germon de l'Atlantique Nord réalisées par les flottilles du Taipei chinois. Les jeux de données des mesures de tailles échantillonnées, avec la prise de Tâche II correspondante, de la période 1981-2012, ont été utilisés dans la présente analyse. Les jeux de données de 1981 à 2012, sur la base des caractéristiques annuelles apparentes, peuvent être divisés en huit périodes: 1981-1987, 1988-1991, 1992, 1993-1996, 1997-2000, 2001, 2002-2007 et 2008-2012. À titre d'observation générale de ces caractéristiques annuelles des mesures des tailles échantillonnées, il ressort que la valeur modale de la distribution annuelle des tailles avant 1987 était de 90 cm de longueur à la fourche alors que celles après 1987 affichaient deux pics : un à 85 cm et l'autre à 105 cm. Jusqu'à présent, seuls les 30 premiers poissons capturés lors de chaque opération à la palangre étaient échantillonnés afin d'identifier les espèces et de les mesurer. Avant la moitié des années 80, les mesures des tailles du germon n'étaient réalisées que dans le cas des navires ciblant cette espèce. À partir de la moitié des années 80, lorsque l'introduction des palangriers de profondeur du Taipei chinois est devenue manifeste, les germons mesurés provenaient tout autant des navires ciblant le germon que des navires ciblant le thon obèse en profondeur. Une proportion différente d'échantillonnage entre les deux types de palangriers a donné lieu à différentes sources d'incertitude entourant les méthodologies de prise de mesure aux fins de la compréhension de la structure annuelle représentative des tailles. L'introduction récente de la déclaration au moyen de carnets de pêche électroniques, initiée par les palangriers ciblant le thon obèse depuis 2006, a compliqué davantage la situation car toutes les prises étaient déclarées, en ne se limitant plus aux 30 premiers poissons. Afin de mieux comprendre la nature et les limitations de ces données annuelles de tailles échantillonnées de germon du Nord de la flottille du Taipei chinois, les auteurs ont analysé les tailles échantillonnées du germon du Nord ainsi que les jeux de données de prise de Tâche II afin de minimiser les incertitudes découlant des années de faible récupération des carnets de pêche.

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RESUMEN

Este documento trata la metodología de muestreo de tallas llevado a cabo por palangreros de Taipei Chino para entender la estructura de tallas de las capturas totales de atún blanco del Atlántico norte realizadas por las flotas de Taipei Chino. En este análisis se utilizaron los conjuntos de datos de mediciones de talla muestreadas con su correspondiente captura de Tarea II, entre 1981-2012. Los conjuntos de datos de 1981-2012, basándose en sus caracteres aparentemente anuales, pueden subdividirse en: ocho periodos, 1981-1987, 1988-1991, 1992, 1993-1996, 1997-2000, 2001, 2002-2007 y 2008-2012. Como observación general, las mediciones de tallas muestreadas de estos periodos indicaban que la moda de la distribución por tallas anual antes de 1987 parecía ser 90 cm FL mientras que en los de después de 1987 había dos picos, uno en 85 cm y otro en 105 cm. Hasta el presente se muestreaban solo los 30 peces iniciales capturados por cada lance de palangre para identificar las especies y medir las tallas. Antes de mediados de los 80, las mediciones de talla del atún blanco se realizaban solo en buques que se dirigían al atún blanco. Desde mediados de los 80, cuando la introducción del palangre profundo de Taipei Chino fue evidente, los atunes blancos medidos procedían de buques tradicionales dirigidos al atún blanco o de los buques de palangre profundo dirigidos al patudo. Las diferentes proporciones en el muestreo entre los dos tipos de palangreros pusieron de relieve diferentes elementos de incertidumbre en las metodologías de medición para entender la estructura de tallas anual representativa. La reciente introducción de la comunicación mediante cuadernos de pesca electrónicos, liderada por los palangreros dirigidos al patudo desde 2006, complicó aún más la situación al comunicar todas las capturas, no los 30 peces iniciales. Para entender mejor la naturaleza y las limitaciones de los datos anuales de mediciones de talla de atún blanco del norte de Taipei Chino así obtenidos, los autores analizaron las tallas muestreadas de atún blanco del norte así como los conjuntos de datos de captura de Tarea II para minimizar las incertidumbres surgidas en los años de escasa recuperación de cuadernos de pesca.

KEYWORDS

Size sampling frameworks, North Atlantic, Albacore, Longline, Logbook

Introduction

The recommendation (Anon. 2014a, 2014b) proposed by the Albacore Working Group, i.e. requesting Chinese Taipei to clarify, as extensive as possible, the yearly North Atlantic albacore (hereafter as AlbN) size patterns compiled from the Taiwanese longliners sampled size data, for the purpose of better explanation yearly size patterns abide by principles of population dynamics. In response to the request, the authors reported the current outcomes for this regard.

The Taiwanese longliners operated in the Atlantic Ocean are mainly composed of two types of fishing gears, i.e. the regular or traditional longliners and the deep longliners. The former fishing gear is mainly targeting albacore, whereas the other gear is mainly targeting tropical tuna species (i.e. bigeye tuna and yellowfin tuna). The spatial distribution of AlbN stock is assumed to be in the oceanic regions north of 5ºN latitude, whereby bigeye tunas and yellowfin tunas of the Atlantic Ocean also distributed, although high concentrations of them were close to equatorial regions. The fact of partial overlapping among fisheries tuna resources, with an imperfect randomization of size collection scheme among the regular and deep longline fisheries, arose higher uncertainties of yearly AlbN size patterns.

As the first attempt to clarify the nature of Taiwanese yearly AlbN size data, we use the AlbN size data collected from logbook records of our fleets (including fleets of targeting tropical tunas and AlbN) to explain the size distribution patterns as requested by the Albacore Working Group.

1. Materials and methods

The sampling philosophy, adopted since the very beginning of Taiwanese involvement with ICCAT, on size measurements and reporting frameworks established for Taiwanese longliners fishing in the Atlantic Ocean is followed the same protocol as recommended by ICCAT, i.e. only the daily initial 30 fishes caught by each longline retrieval were sampled for species identification and size measurement. In practice, 30 consecutive size

measurements with its corresponding species code (mainly albacore, bigeye tuna, yellowfin tuna, swordfish, billfish and sharks) were performed and reported. The implication of species composition thus obtained is not only reflecting the habitat nature for tunas in fishing areas but also may have influenced by the preferred intention and skill of fishing masters. Nevertheless, those logbooks information are designated to collect and to maintain by the Overseas Fisheries Development Council (OFDC) since its establishment and under the supervision of the Fisheries Agency.

Since 2006, when the e-logbook system was established and strictly implemented for Taiwanese bigeye-targeted longline vessels fishing in the Atlantic Ocean, the sizes of all AlbN catches by those vessels were also reported via the e-logbook. As a result, those AlbN size measurements sampled from such a practice contained different sampling attributes as compared with those compiled from traditional size sampling frameworks of daily initial 30 fishes of catches. The effects of such differentiation in size sampling frameworks deserve future detailed investigations.

Two stocks of albacore (*Thunnus alalunga*), separated by 5°N latitude, were assumed for the Atlantic albacore resources. Although the OFDC is designated to compile, by 5° statistical block, sampled size data for submitting to the ICCAT Secretariat, only those size data of northern albacore stock from 1981 to 2012 were used in this analysis. In addition, the time period from 1981 to 2012 was further subdivided into eight periods, in accordance with the major technical difficulties occurred in the history of Taiwanese size sampling frameworks. The time periods thus identified were: 1981-1987, 1988-1991, 1992, 1993-1996, 1997-2000, 2001, 2002-2007 and 2008-2012. The characteristics for those eight periods were shown as follows.

2. Results

2.1 Period 1981-1987:

Distributions of total AlbN catch in number (Left chart) and all species caught in number (Right chart) of Taiwanese longliners fishing in the North Atlantic Ocean in Period_1 (1981-1987) were shown in **Figure 1a**. This was the time period that nearly all Taiwanese longliners (or traditional longliners) were targeting albacore. As shown in **Figure 1a**, the AlbN was widely (from 10ºN to 45ºN) distributed in subtropical and temperate waters of the North Atlantic Ocean.

The sampled size frequencies, based on initial 30 size measurements protocol, compiled from the Taiwanese longline fleet in the North Atlantic Ocean in Period_1 were shown in **Figure 1b**. As shown in **Figure 1b**, in a total of 82 5º-square-blocks having albacore catch reported in Task2, there were 78 blocks having sampled size and only 4 blocks were lacks of such information. The rate of coverage on size sampling frameworks in this period was 95.1% and the lacking rate was 4.9%. Total number on size measurements of AlbN performed in Period_1 was over 695,000 out of total number of 4,695,807 AlbN caught in this period, which was about 14.8% sampling rate of size measurements versus the total number of AlbN catches reported in Task2 (**Figure 9**).

2.2 Period 1988-1991:

This period was the time of Taiwanese super freezer longliners, or deep longliners, into these fishing areas. Since mid-1980s, the proportion of albacore in the overall catches was decreased and surpassed by bigeye and yellowfin tunas caught by deep longliners. The proportion of bigeye tuna in the overall catches increased was clearly shown in **Figure 2a** as compared to **Figure 1a** of Period_1. In addition to this development, a massive retrieval of Taiwanese traditional albacore longliners from the North Atlantic Ocean, resulted in a small number of size measurements on AlbN were performed and reported in this period. In particular, although there were AlbN catch reports in Task2 in 1988, there was no AlbN size measurements reported in that year.

As shown in **Figure 2b**, in a total of 47 5º-square-blocks having albacore catch reported in Task2, there were 24 blocks having sampled size and 23 blocks were lacks of such information. The rate of coverage on size sampling frameworks in this period was 51.1% and the lacking rate was 48.9%. Total number on size measurements of AlbN performed in this period was 15,096 out of total number of 408,436 AlbN caught in this period, which was about 3.7% sampling rate of size measurements versus the total number of AlbN catches reported in Task2 (**Figure 9**). As shown in **Figure 2a** and **Figure 2b**, there were virtually no albacore sizes reported in most 5°-square-blocks of subtropical and temperate waters, mainly because of the extremely low recover rate (18%) on logbooks. **Figure 2b** showed the size range of AlbN reported and compiled from these narrow sampling fishing areas was from 80 to 100 cm of fork length.

2.3 Period 1992:

As shown in **Figure 3b**, in a total of 21 5º-square-blocks having albacore catch reported in Task2, there were 9 blocks having sampled size and 12 blocks were lacks of such information. The rate of coverage on size sampling frameworks in this period was 42.9% and the lacking rate was 57.1%. Total number on size measurements of AlbN performed in this period was less than 500 out of total number of 263,160 AlbN caught in this period, which was only 0.2% sampling rate of size measurements versus the total number of AlbN catches reported in Task2 (**Figure 9**). As shown in **Figure 3a** and **Figure 3b**, there were virtually no albacore sizes reported in most 5°-square-blocks of subtropical and temperate waters, mainly because of the extremely low recover rate (16%) on logbooks. **Figure 3b** showed the size range of AlbN reported and compiled from these narrow sampling fishing areas was from 100 to 115 cm of fork length.

It is well known that matured albacores tend to appear in tropical waters, while smaller sized albacores tend to inhabit in temperate waters. The larger size measurements reported and compiled in this period may have stemmed from (1) only a small portion of logbooks has been recovered and (2) most of size measurements were performed from tropical waters, where most matured albacores appeared.

2.4 Period 1993-1996:

As shown in **Figure 4b**, in a total of 68 5º-square-blocks having albacore catch reported in Task2, there were 34 blocks having sampled size and 34 blocks were lacks of such information. The rate of coverage on size sampling frameworks in the period was 50% and the lacking rate was 50%. Total number on size measurements of AlbN performed in this period was 12,000 out of total number of 1,203,924 AlbN caught in this period, which was about 1% sampling rate of size measurements versus the total number of AlbN catches reported in Task2 (**Figure 9**). Except 1994, the size range of AlbN reported and compiled from the sampling areas was from 70 to 110 cm of fork length, as shown in **Figure 4b**. Size measurements reported in 1994, however, not only of 505 size measurements were reported but also most size measurements fell in 120-130 cm class resulted in an unbalanced size frequency distribution. As shown in **Figure 4a** and **Figure 4b**, main size measurements of albacore were performed in tropical waters of the North Atlantic Ocean (5°N-25°N/25°W-65°W) and fewer activities were focused in temperate waters between 35°N-45°N and 35°W-55°W and virtually no size measurements were performed and recovered in subtropical waters.

2.5 Period 1997-2000:

As shown in **Figure 5b**, in a total of 77 5º-square-blocks having albacore catch reported in Task2, there were 23 blocks having sampled size and 54 blocks were lacks of such information. The rate of coverage on size sampling frameworks in this period was 29.9% and the lacking rate was 70.1%. Total number on size measurements of AlbN performed in this period was about 27,500 out of total number of 1,070,095 AlbN caught in this period, which was about 2.6% sampling rate of size measurements versus the total number of AlbN catches reported in Task 2 (**Figure 9**).

The predominant size range of albacore during 1997-2000 was 95-110 cm. As shown in **Figure 5b**, sampled size measurements of albacore were mostly distributed in areas of 55°W-70°W/10°N-35°N and 25°W-45°W/5°N-20°N. Large sized albacores appeared mostly in tropical and subtropical waters of the western part of North Atlantic Ocean. As shown in **Figure 5a** and **Figure 5b**, although there were AlbN catch reported in most of 5°-square-blocks of Task 2, but albacore size measurements data were rather poorly reported because of low coverage of logbooks.

2.6 Period 2001:

As shown in **Figure 6b**, in a total of 60 5º-square-blocks having albacore catch reported in Task 2, there were only 10 blocks having sampled size and 50 blocks were lacks of such information. The rate of coverage on size sampling frameworks in this period was 16.7% and the lacking rate was 83.3%. Total number on size measurements of AlbN performed in this period was about 1,405 out of total number of 360,260 AlbN caught in this period, which was about 0.4% sampling rate of size measurements versus the total number of AlbN catches reported in Task 2 (**Figure 9**).

The size distribution compiled from sampled size measurements performed in 2001 indicated that the size class around 78-88 cm had a higher proportion composition, which immediately implied a higher catch of albacore in that size categories. Concerning (1) the small number in sampled size measurements and (2) the area of coverage for sampled size also highly limited, as shown in **Figure 6b**, the size distribution thus obtained revealed with irregular fragmented patterns in some areas of the North Atlantic Ocean were inevitable outcomes.

2.7 Period 2002-2007:

As shown in **Figure 7b**, in a total of 84 5º-square-blocks having albacore catch reported in Task 2, there were 81 blocks having sampled size and only 3 blocks were lacks of such information. The rate of coverage on size sampling frameworks in the period was 96.4% and the lacking rate was 3.6%. Total number on size measurements of AlbN performed in this period was over 200,000 out of total number of 947,546 AlbN caught in this period, which was about 22.7% sampling rate of size measurements versus the total number of AlbN catches reported in Task 2 (**Figure 9**).

Since 2002, the Taiwanese Fisheries Agency required, in prior, the "statistical documents" for Taiwanese longliners exporting catches of bigeye tuna, southern bluefin tuna and swordfish to foreign countries. Furthermore, new fisheries managerial measures as the VMS and the e-logbook, i.e. electronic vessel monitoring and catch reporting systems, being gradually established and put into the implementation. These new establishments led the new size sampling frameworks. The size distributions compiled from sampled size measurements, as shown in **Figure 7b**, performed in this period indicated that the size range was 62-124 cm with the mode around 90-110 cm. Notably, larger sized albacore mostly appeared in subtropical and tropical waters.

2.8 Period 2008-2012:

As shown in **Figure 8b**, in a total of 56 5º-square-blocks having albacore catch reported in Task 2, there were all 55 blocks having sampled size and only one block was lacks of such information. The rate of coverage on size sampling frameworks in this period was 98.2% and the lacking rate was 1.8%. Total number on size measurements of AlbN performed in this period were over 87,000 out of total number of 237,087 AlbN caught in this period, which was about 36.7% sampling rate of size measurements versus the total number of AlbN catches reported in Task 2 (**Figure 9**). In addition, the recovery in logbooks from those Taiwanese longliners fishing in the North Atlantic Ocean significantly increased over 85% since 2008.

Sampled size in this period, as shown in **Figure 8b**, ranged from 38 cm to 130 cm with the mode around 100-110 cm. The number of larger sized albacores sampled or reported in this period was outnumbered those of previous periods may stemmed from the fact that bigeye-targeted vessels reported sizes of all fishes caught via the e-logbook since 2006, which inevitably included many adult albacores appeared in tropical waters.

As a general conclusion through observation on those yearly sampled size measurements reported by Taiwanese longliners indicated that (1) the mode of yearly sampled size distribution appeared to be around 90 cm of fork length before 1987 and (2) there were two peaks in yearly sampled size distribution: one appeared around 85 cm of fork length and the other appeared at 105 cm of fork length after 1987.

3. Discussion

Figure 9 showed, by ICCAT albacore areas 31 & 32, yearly number of sampled AlbN size (Upper) and yearly number of AlbN catch reported in Task 2 (Lower) of Taiwanese longliners, dating from 1981 to 2012. It indicated that yearly numbers of AlbN size measurements in 1984 was the highest among 1981-2012. Those yearly numbers of AlbN size measurements, particularly from 1988 to 2002, were rather poor because of low logbook recovery. It was also believed to be the main reason of causing a reduction in mode of sampled size distribution.

Figure 10 showed, by 5° latitude, yearly percentage composition on reported AlbN size measurements and yearly percentage composition on catch in number of AlbN reported in Task2 of Taiwanese longliners, dating from 1981 to 2012. As shown in **Figure 10**, yearly percentage composition of sampled AlbN size measurements reported in the period of 1994-2000 were mostly drawn from tropical waters. Whereby yearly percentage composition of sampled AlbN size measurements reported in periods of 1981-1987 and of 2002-2012, on the other hand, appeared more coincidental patterns by 5º-latitude between the sampled number and the number of catch in Task2. Concerning future undertaken of minimizing uncertainties stemmed from deficiencies in sampling frameworks, those patterns differentiation appeared in **Figure 10** may well provide a sound basis for further justification or even rectification studies.

This was the time period (before mid-1980s) that nearly all Taiwanese longliners (or traditional longliners) were targeting AlbN stock. Luckily enough, some of those traditional longliners still operate at present which will provide an invaluable standard sampling tool for understanding the abundance of the resource. Since mid-1980s, however, when the introduction of Taiwanese super freezer longliners (or deep longliners) became evident, not only the albacore catch in number diminishing but also the information relevant to albacore stock also gradually came from those vessels mainly targeting bigeye and yellowfin tunas. In addition to this development, a massive

retrieval of Taiwanese traditional albacore longliners from North Atlantic Ocean in mid-1980s due to technical equipment capability of vessel, resulted in a small number of size measurements on AlbN in 1990s. How to justify or even rectify those sampled size may need further deliberations.

The sampling frameworks of only the initial 30 fishes caught by each longline retrieval were sampled for species identification and size measurement have been undertaking until present. The recent introduction of e-logbook reporting frameworks, led by bigeye-targeted longliners since 2006, has brought new elements into the well-established old sampling frameworks. As a result, the adequacy of traditional summing up algorithm for estimating the representative size information may need further scrutinizing and adjustment.

The species composition, summing up from all sets of independent 30 consecutive size measurements with its corresponding species code (mainly albacore, bigeye tuna, yellowfin tuna, swordfish, billfish and sharks), thus obtained may adequately describe the community nature of tunas in its fishing habitat. The summing up procedure is adequate and valid only under the condition that all those 30 consecutive size measurements sets are sampled independently and randomly. If a sampling framework may differ from preferred intention or skill of certain fishing masters, such elements may also need further identification and adjustment.

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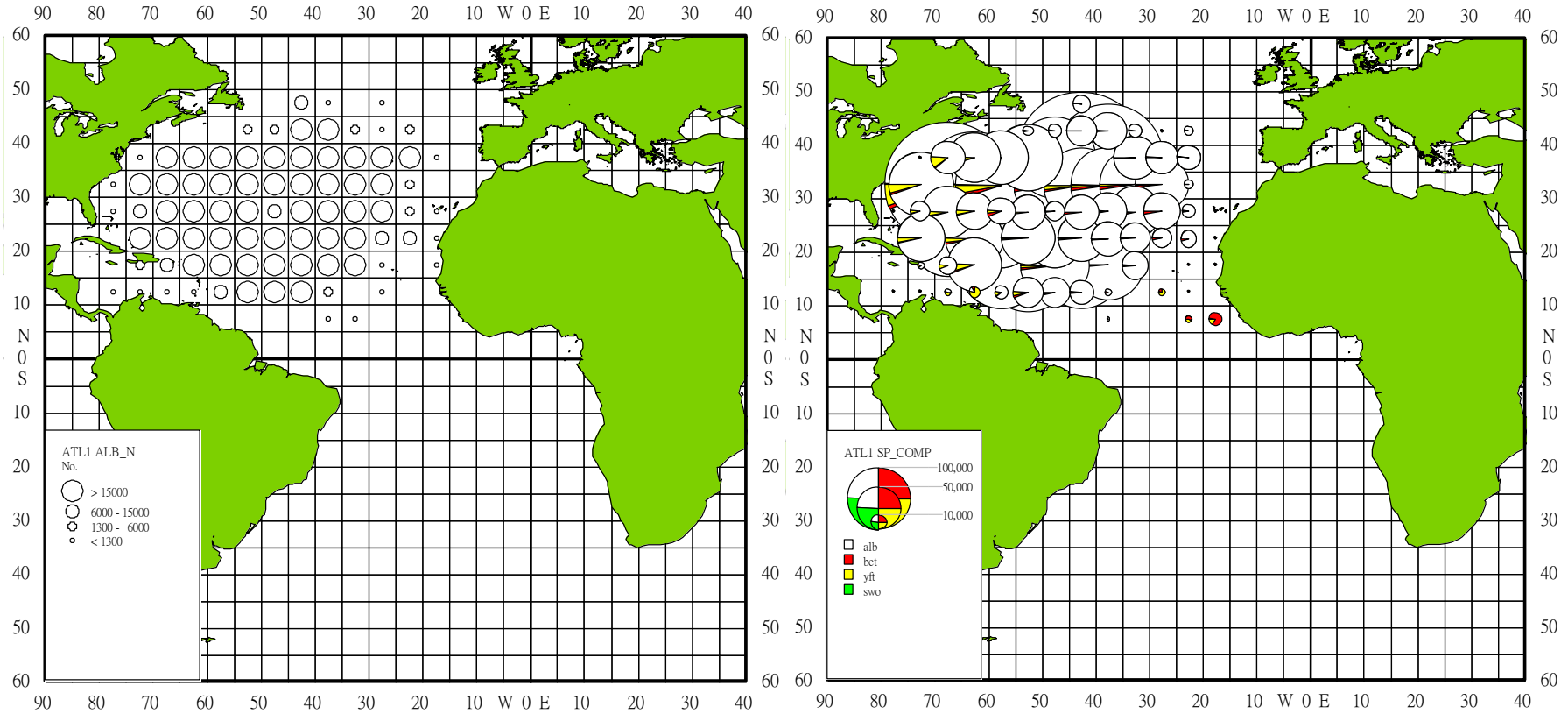
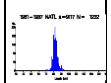
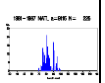
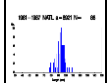
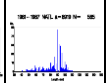
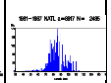
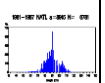
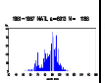
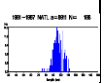
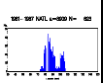
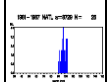
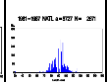
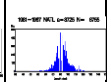
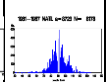
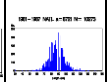
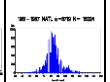
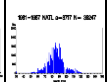
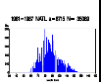
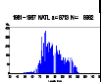
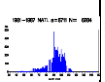
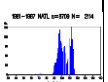
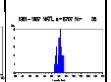
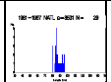
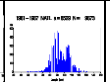
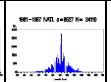
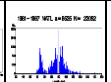
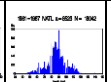
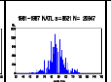
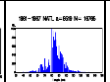
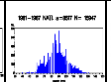
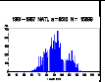
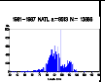
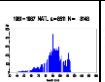
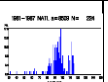
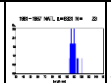
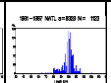
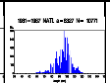
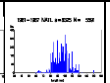
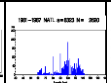
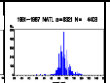
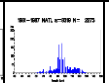


Figure 1a. Five-degree-square block distribution of total AlbN catch in number (Left) and total catch in number by main species (Right) of Period_1 (1981-1987) reported by Taiwan.

1981-1987	80-75°W	75-70°W	70-65°W	65-60°W	60-55°W	55-50°W	50-45°W	45-40°W	40-35°W	35-30°W	30-25°W	25-20°W	20-15°W	15-10°W
45-50°N	X	X	X											
40-45°N	X													
35-40°N														
30-35°N														
25-30°N														
20-25°N														X
15-20°N														X
10-15°N														X
5-10°N		X	X											

Remark: X is the land.

Figure 1b. Five-degree-square block distribution on size frequency pattern sampled by Taiwanese Longliners with blocks having Task 2 catch yet missing size measurement (in yellowish color) in Period_1 (1981-1987).

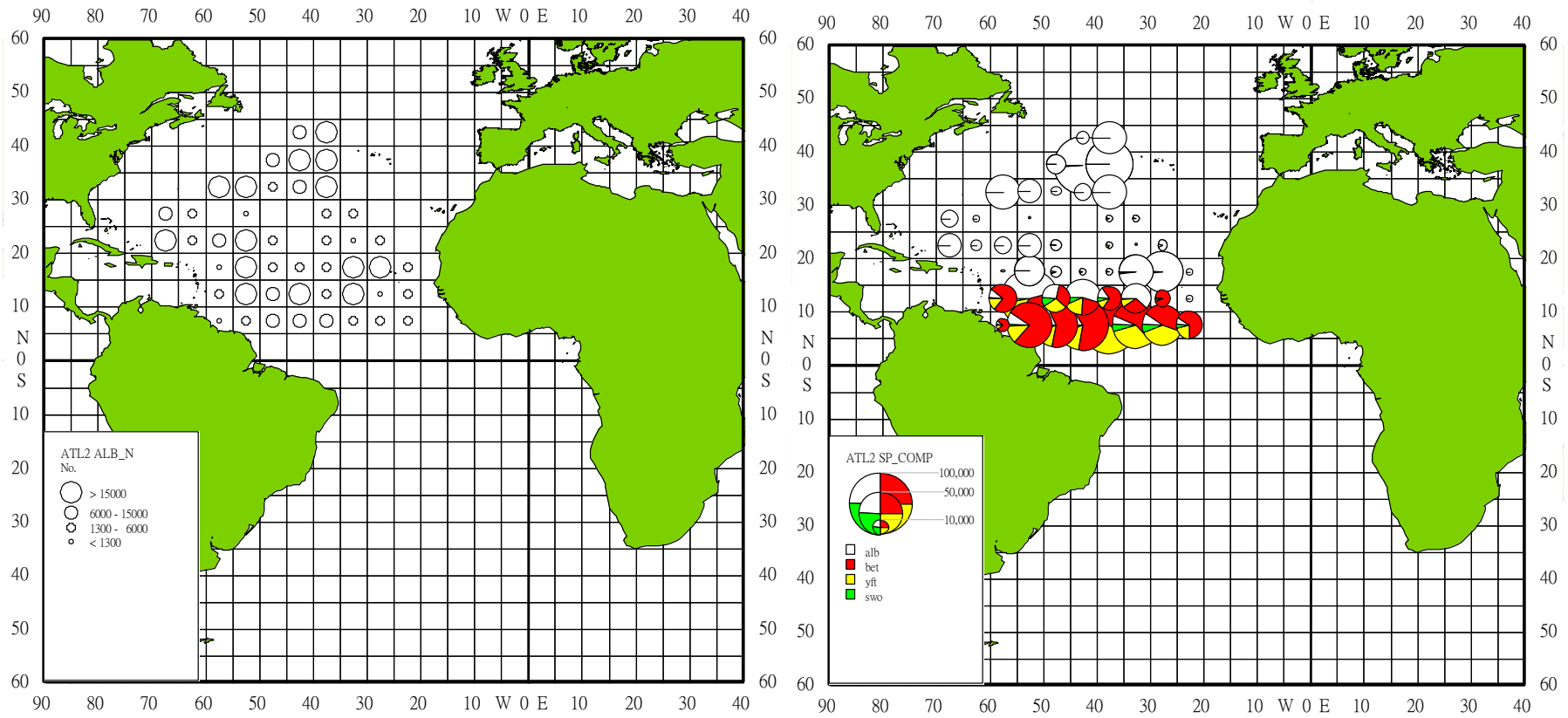
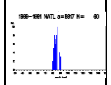
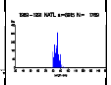
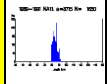
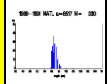
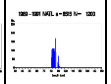
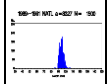
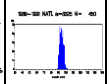
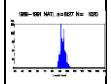
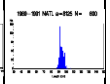
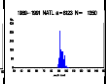
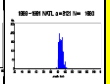
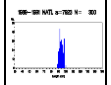
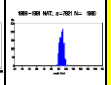
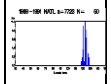
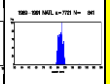
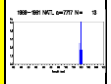
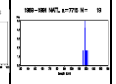
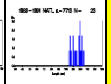
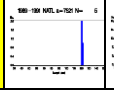
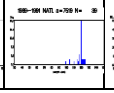
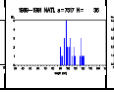
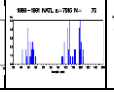
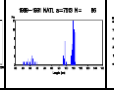
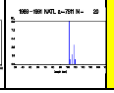


Figure 2a. Five-degree-square block distribution of total AlbN catch in number (Left) and total catch in number by main species (Right) of Period_2 (1988-1991) reported by Taiwan.

1988-1991	80-75°W	75-70°W	70-65°W	65-60°W	60-55°W	55-50°W	50-45°W	45-40°W	40-35°W	35-30°W	30-25°W	25-20°W	20-15°W	15-10°W
45-50°N	X	X	X											
40-45°N	X													
35-40°N														
30-35°N														
25-30°N														
20-25°N														X
15-20°N														X
10-15°N														X
5-10°N		X	X											

Remark: X is the land.

Figure 2b. Five-degree-square block distribution on size frequency pattern sampled by Taiwanese Longliners with blocks having Task 2 catch yet missing size measurement (in yellowish color) in Period_2 (1988-1991).

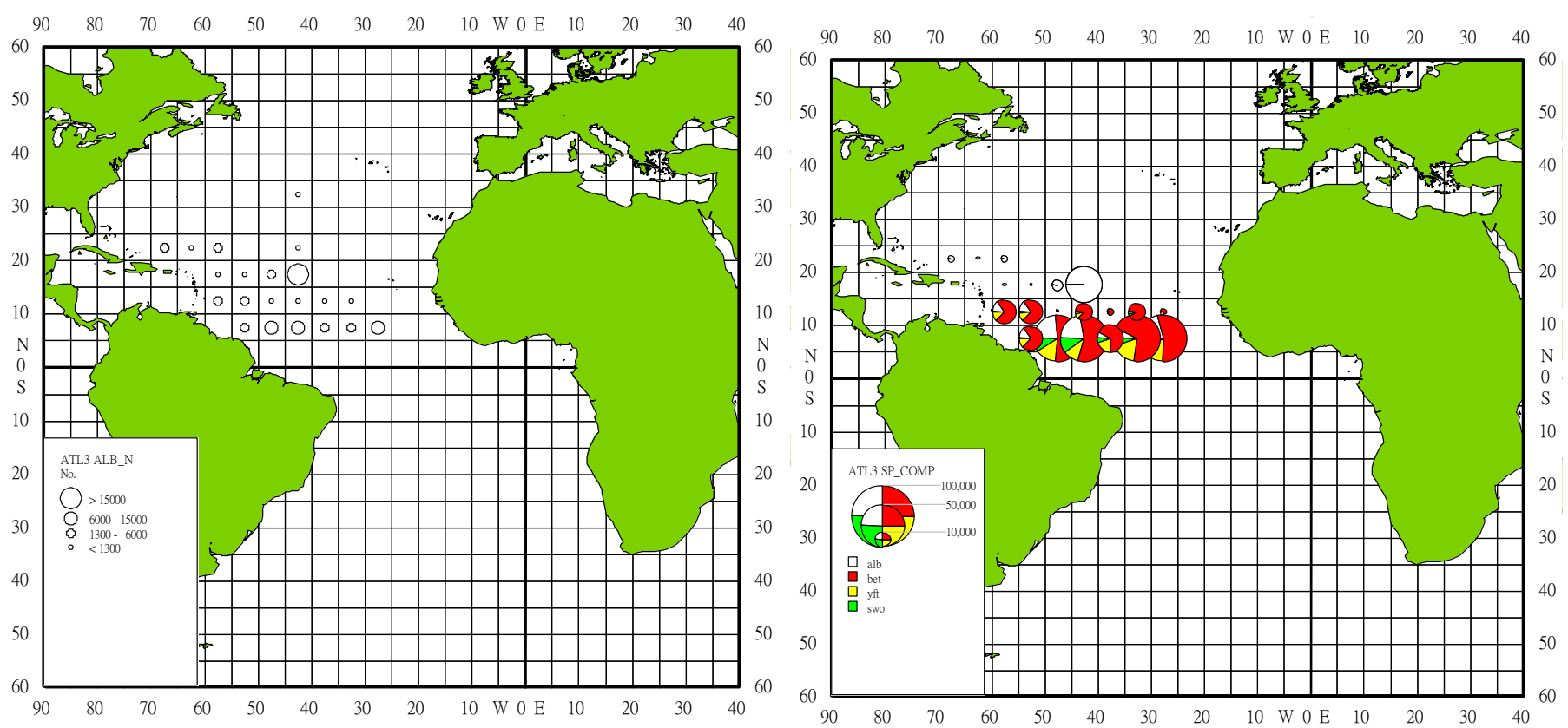
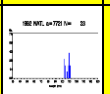
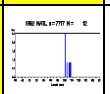
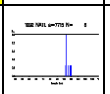
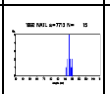
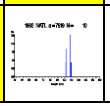
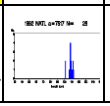
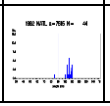
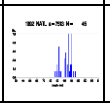


Figure 3a. Five-degree-square block distribution of total AlbN catch in number (Left) and total catch in number by main species (Right) of Period_3 (1992) reported by Taiwan.

1992	80-75°W	75-70°W	70-65°W	65-60°W	60-55°W	55-50°W	50-45°W	45-40°W	40-35°W	35-30°W	30-25°W	25-20°W	20-15°W	15-10°W
45-50°N	X	X	X											
40-45°N	X													
35-40°N														
30-35°N														
25-30°N														
20-25°N														X
15-20°N														X
10-15°N														X
5-10°N		X	X											

Remark: X is the land.

Figure 3b. Five-degree-square block distribution on size frequency pattern sampled by Taiwanese Longliners with blocks having Task 2 catch yet missing size measurement (in yellowish color) in Period_3 (1992).

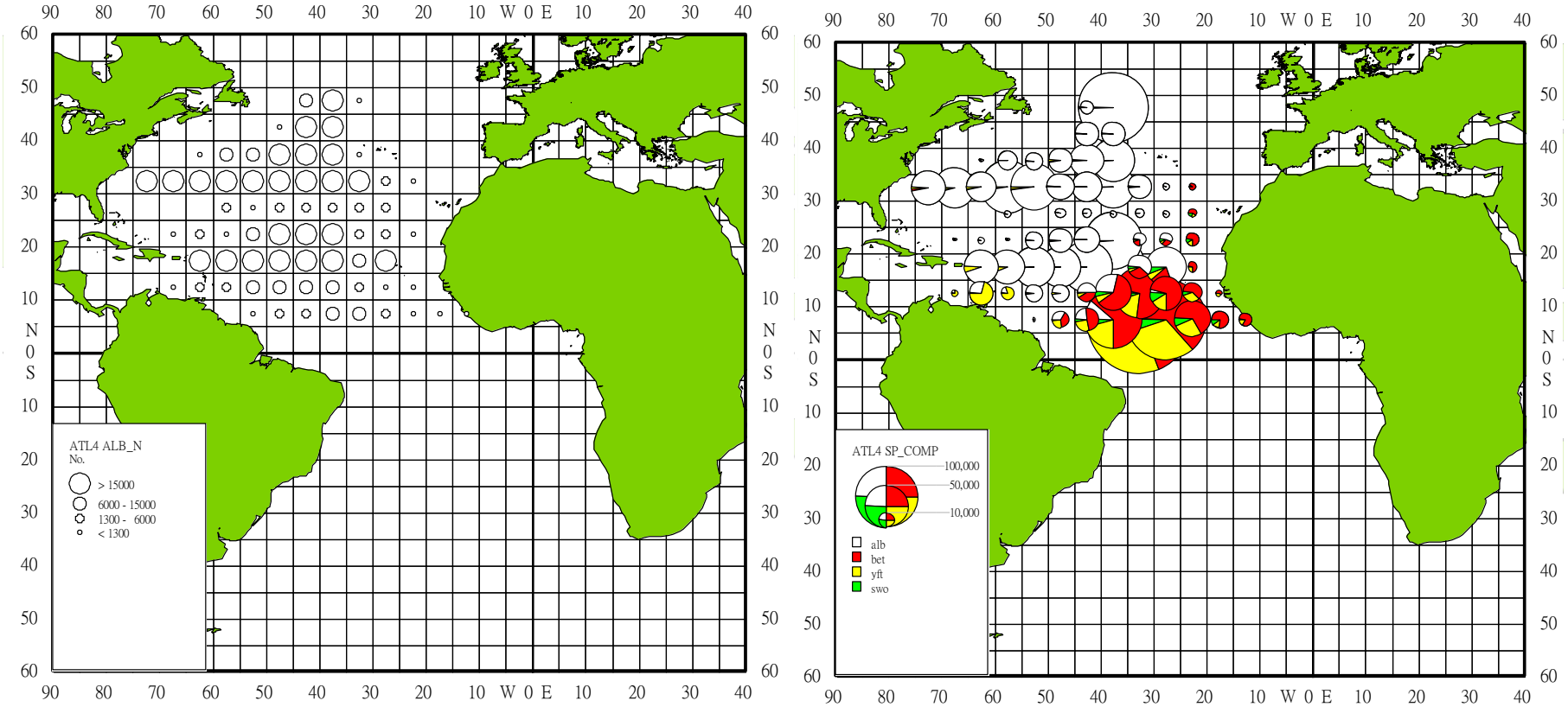
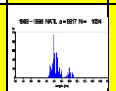
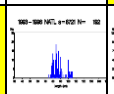
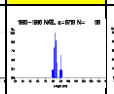
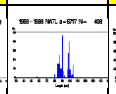
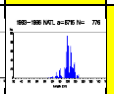
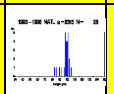
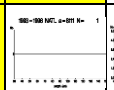
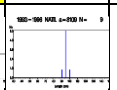
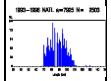
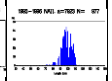
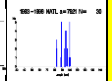
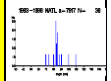
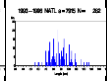
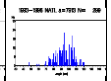
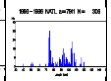
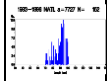
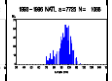
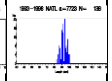
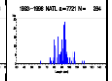
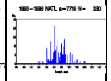
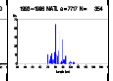
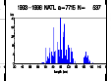
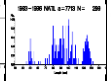
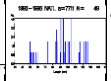
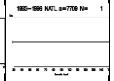
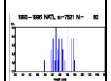
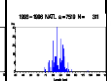
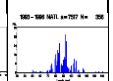
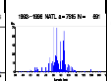
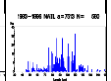
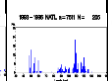
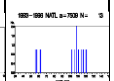
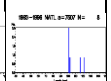
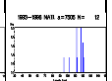


Figure 4a. Five-degree-square block distribution of total AlbN catch in number (Left) and total catch in number by main species (Right) of Period_4 (1993-1996) reported by Taiwan.

1993-1996	80-75°W	75-70°W	70-65°W	65-60°W	60-55°W	55-50°W	50-45°W	45-40°W	40-35°W	35-30°W	30-25°W	25-20°W	20-15°W	15-10°W
45-50°N	X	X	X											
40-45°N	X													
35-40°N														
30-35°N														
25-30°N														
20-25°N														X
15-20°N														X
10-15°N														X
5-10°N		X	X											

Remark: X is the land.

Figure 4b. Five-degree-square block distribution on size frequency pattern sampled by Taiwanese Longliners with blocks having Task 2 catch yet missing size measurement (in yellowish color) in Period_4 (1993-1996).

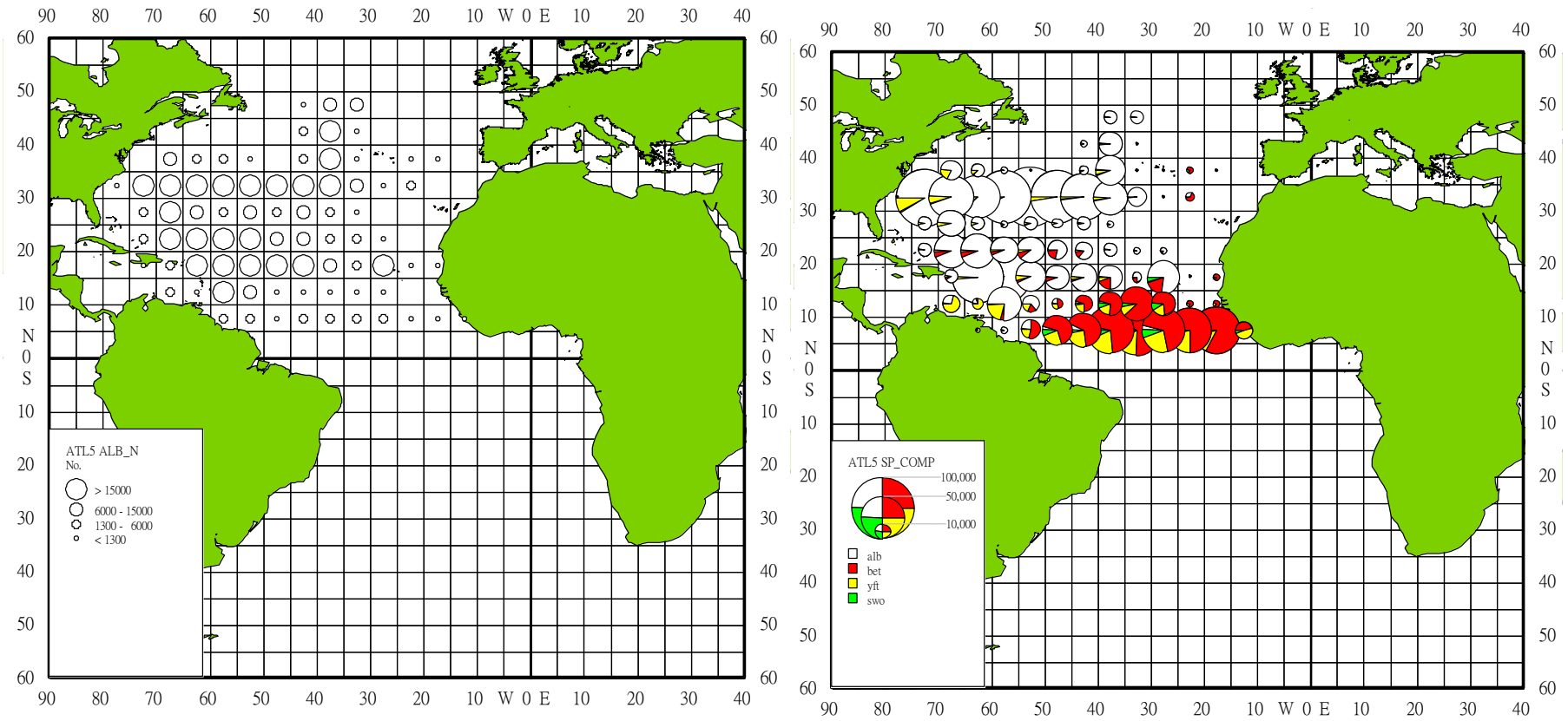
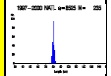
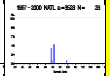
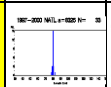
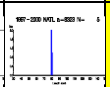
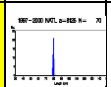
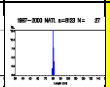
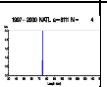
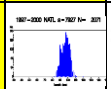
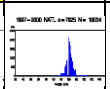
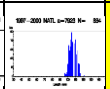
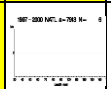
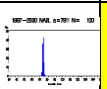
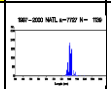
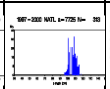
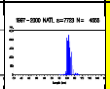
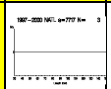
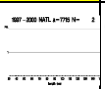
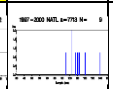
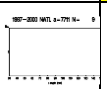
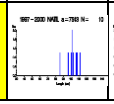
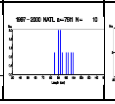
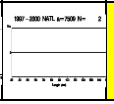


Figure 5a. Five-degree-square block distribution of total AlbN catch in number (Left) and total catch in number by main species (Right) of Period_5 (1997-2000) reported by Taiwan.

1997-2000	80-75°W	75-70°W	70-65°W	65-60°W	60-55°W	55-50°W	50-45°W	45-40°W	40-35°W	35-30°W	30-25°W	25-20°W	20-15°W	15-10°W
45-50°N	X	X	X											
40-45°N	X													
35-40°N														
30-35°N														
25-30°N														
20-25°N														X
15-20°N														X
10-15°N														X
5-10°N		X	X											

Remark: X is the land.

Figure 5b. Five-degree-square block distribution on size frequency pattern sampled by Taiwanese Longliners with blocks having Task2 catch yet missing size measurement (in yellowish color) in Period_5 (1997-2000).

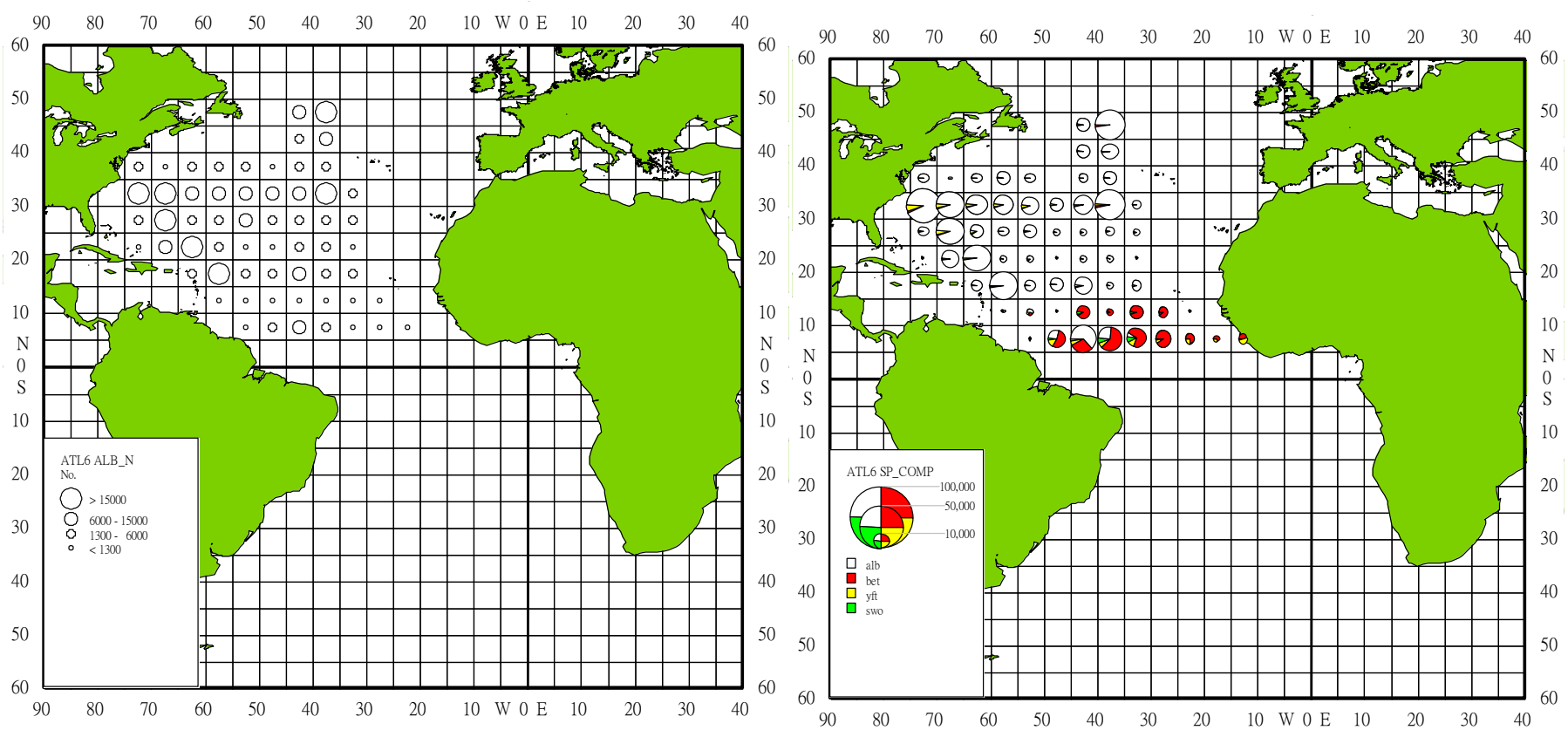
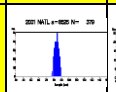
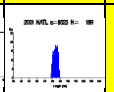
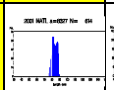
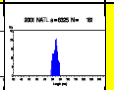
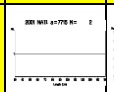
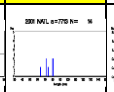
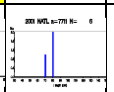
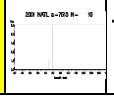
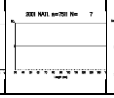
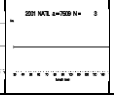


Figure 6a. Five-degree-square block distribution of total AlbN catch in number (Left) and total catch in number by main species (Right) of Period_6 (2001) reported by Taiwan.

2001	80-75°W	75-70°W	70-65°W	65-60°W	60-55°W	55-50°W	50-45°W	45-40°W	40-35°W	35-30°W	30-25°W	25-20°W	20-15°W	15-10°W
45-50°N	X	X	X											
40-45°N	X													
35-40°N														
30-35°N														
25-30°N														
20-25°N														X
15-20°N														X
10-15°N														X
5-10°N		X	X											

Remark: X is the land.

Figure 6b. Five-degree-square block distribution on size frequency pattern sampled by Taiwanese Longliners with blocks having Task2 catch yet missing size measurement (in yellowish color) in Period_6 (2001).

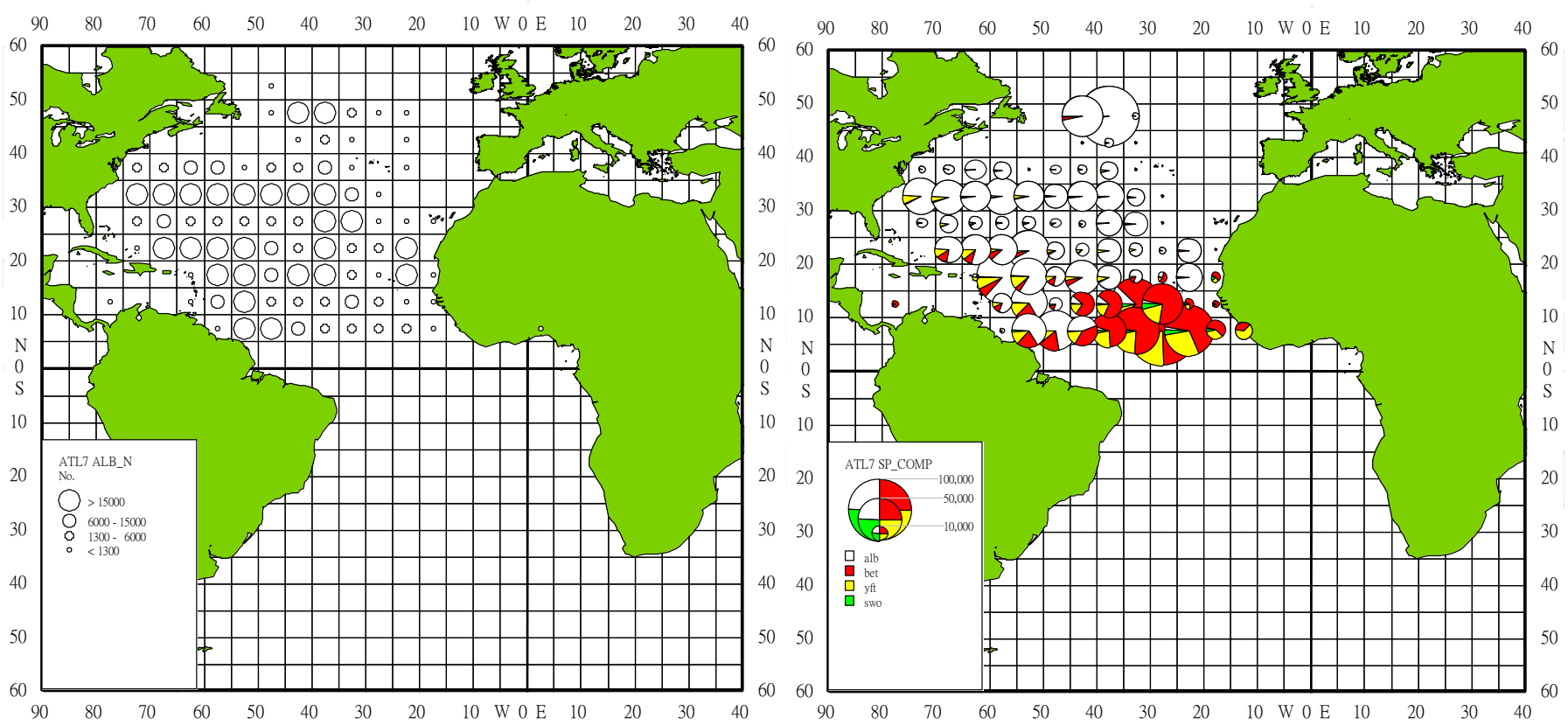
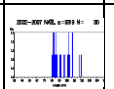
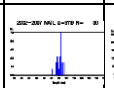
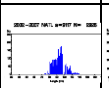
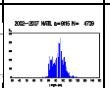
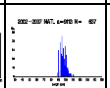
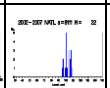
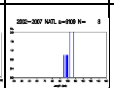
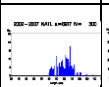
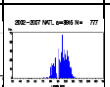
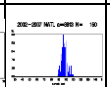
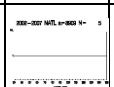
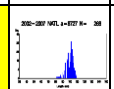
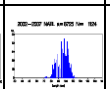
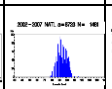
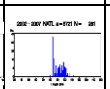
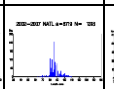
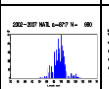
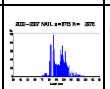
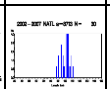
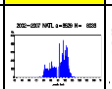
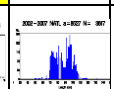
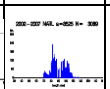
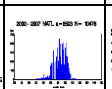
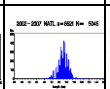
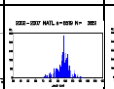
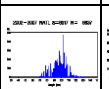
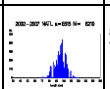
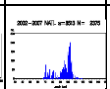
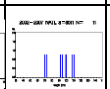
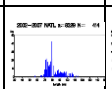
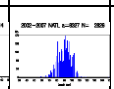
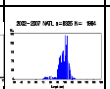
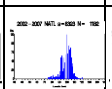
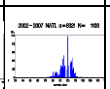
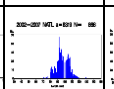
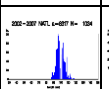
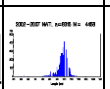
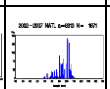
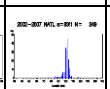


Figure 7a. Five-degree-square block distribution of total AlbN catch in number (Left) and total catch in number by main species (Right) of Period_7 (2002-2007) reported by Taiwan.

2002-2007	80-75°W	75-70°W	70-65°W	65-60°W	60-55°W	55-50°W	50-45°W	45-40°W	40-35°W	35-30°W	30-25°W	25-20°W	20-15°W	15-10°W
50-55°N	X	X	X	X										
45-50°N	X	X	X											
40-45°N	X													
35-40°N														
30-35°N														
25-30°N														
20-25°N														X
15-20°N														X
10-15°N														X
5-10°N		X	X											

Remark: X is the land.

Figure 7b. Five-degree-square block distribution on size frequency pattern sampled by Taiwanese Longliners with blocks having Task2 catch yet missing size measurement (in yellowish color) in Period_7 (2002-2007).

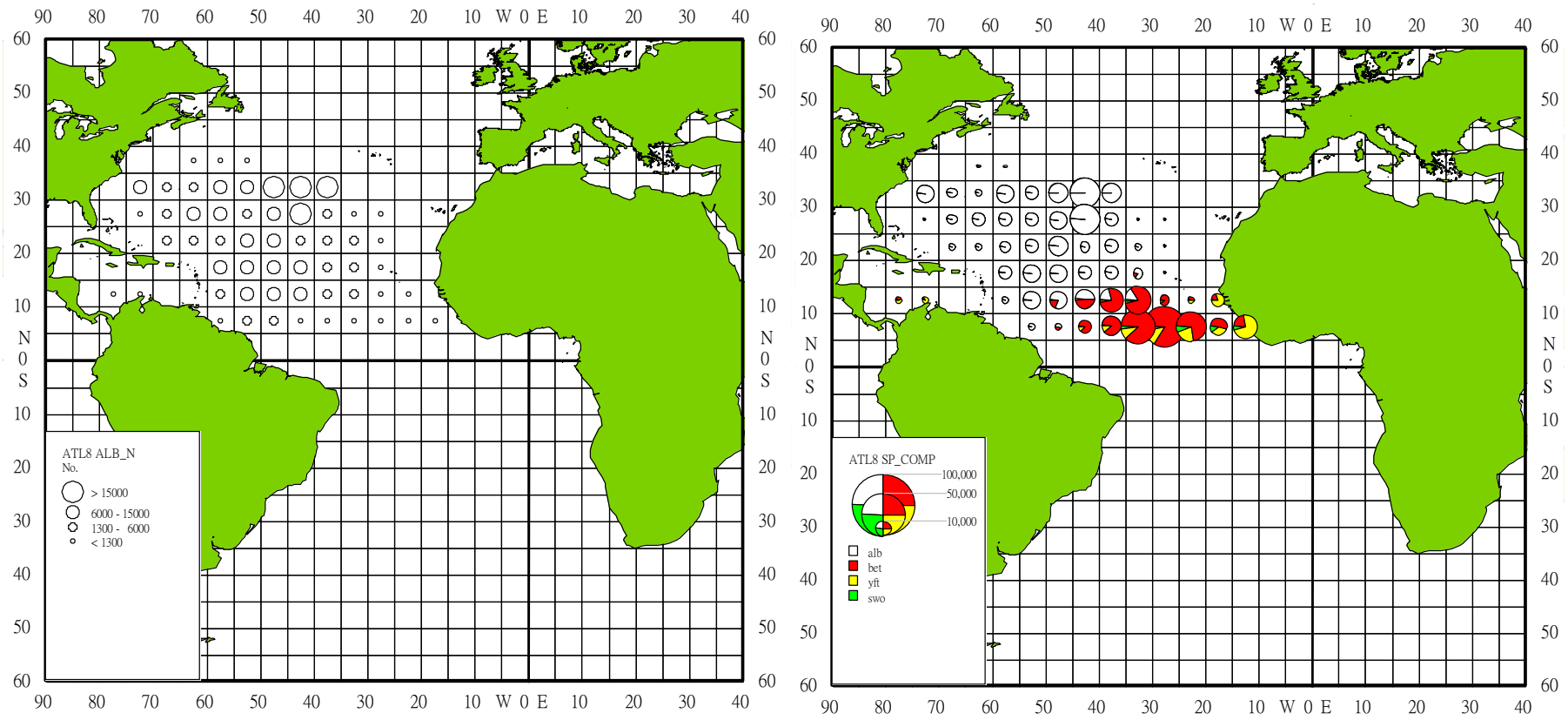
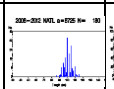
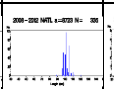
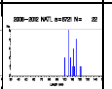
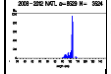
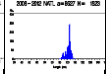
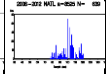
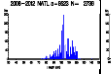
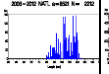
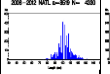
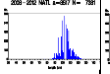
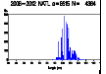
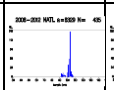
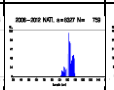
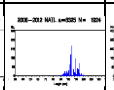
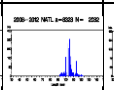
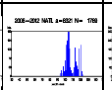
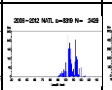
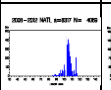
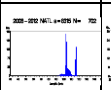
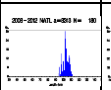
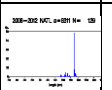
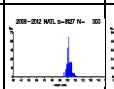
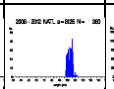
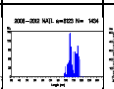
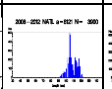
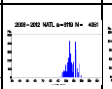
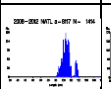
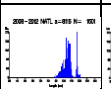
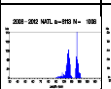
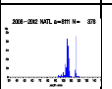
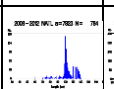
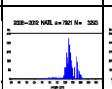
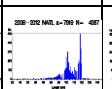
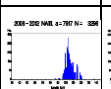
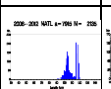
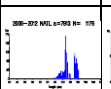
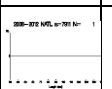
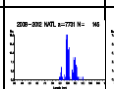
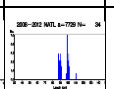
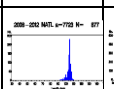


Figure 8a. Five-degree-square block distribution of total AlbN catch in number (Left) and total catch in number by main species (Right) of Period_8 (2008-2012) reported by Taiwan.

2008-2012	80-75°W	75-70°W	70-65°W	65-60°W	60-55°W	55-50°W	50-45°W	45-40°W	40-35°W	35-30°W	30-25°W	25-20°W	20-15°W	15-10°W
45-50°N	X	X	X											
40-45°N	X													
35-40°N														
30-35°N														
25-30°N														
20-25°N														X
15-20°N														X
10-15°N															X
5-10°N		X	X											

Remark: X is the land.

Figure 8b. Five-degree-square block distribution on size frequency pattern sampled by Taiwanese Longliners with blocks having Task2 catch yet missing size measurement (in yellowish color) in Period_8 (2008-2012).

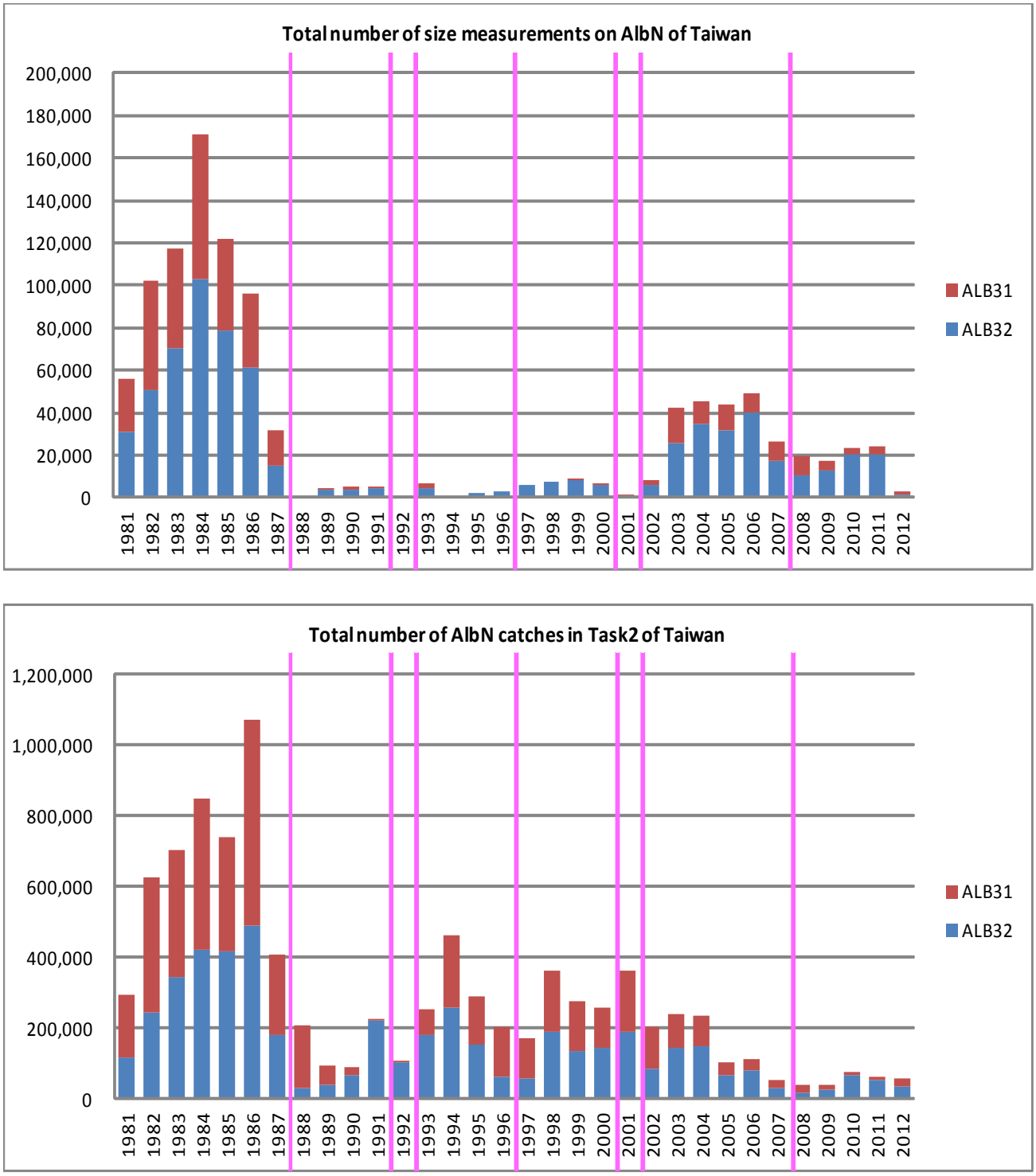


Figure 9. By ICCAT albacore areas 31 & 32, yearly number of reported AlbN size measurements (Upper) and yearly number of AlbN catches reported in Task 2 (Lower) of Taiwanese longline fisheries in the North Atlantic Ocean, dating from 1981 to 2012.

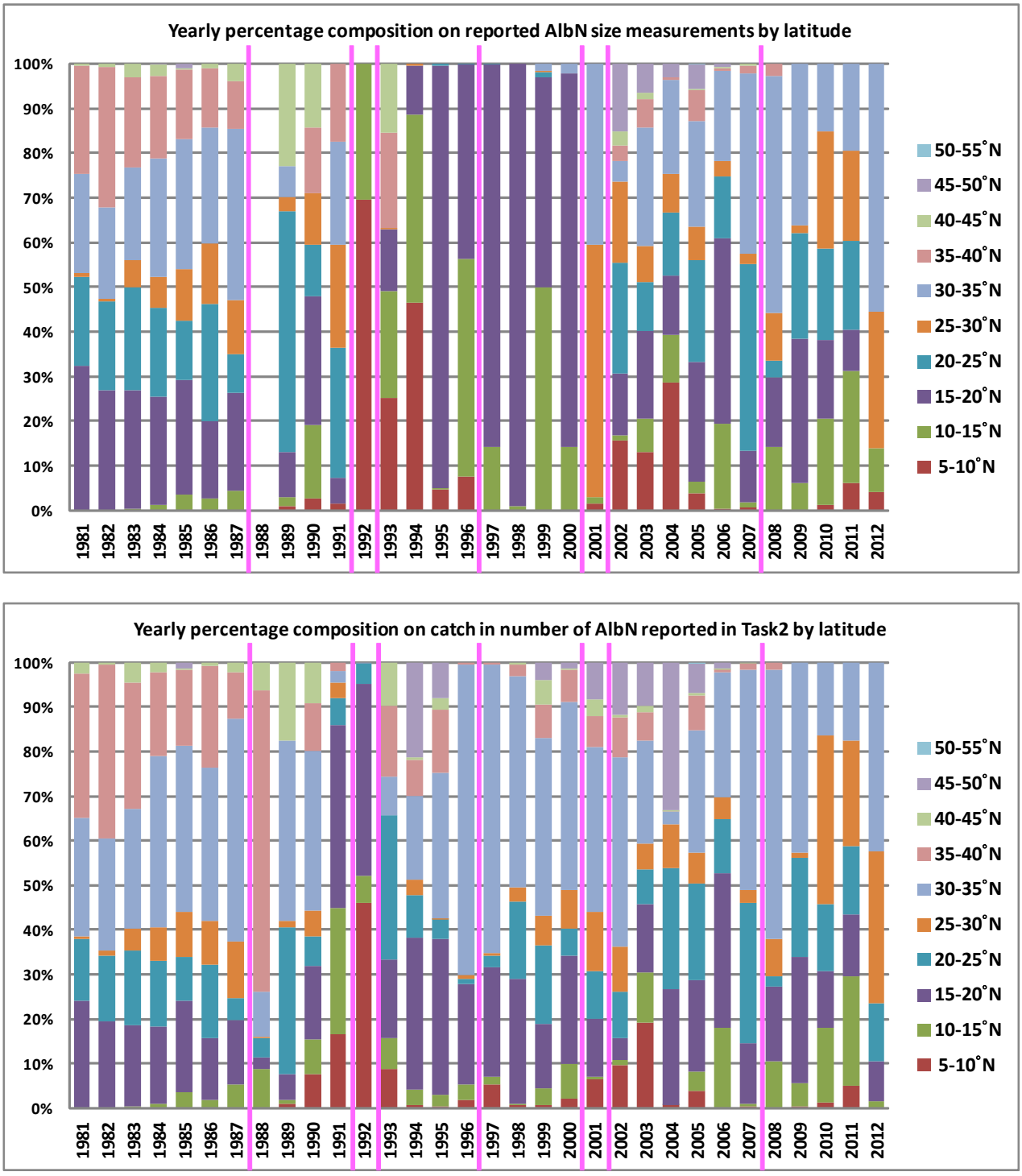


Figure 10. By five-degree latitude, yearly percentage composition on reported AlbN size measurements (Upper) and yearly percentage composition on catch in number of AlbN reported in Task 2 (Lower) of Taiwanese longline fisheries in the North Atlantic Ocean, dating from 1981 to 2012.