SCTB13 Working Paper

GEN–1

OVERVIEW OF THE WESTERN AND CENTRAL PACIFIC OCEAN TUNA FISHERIES, 1999

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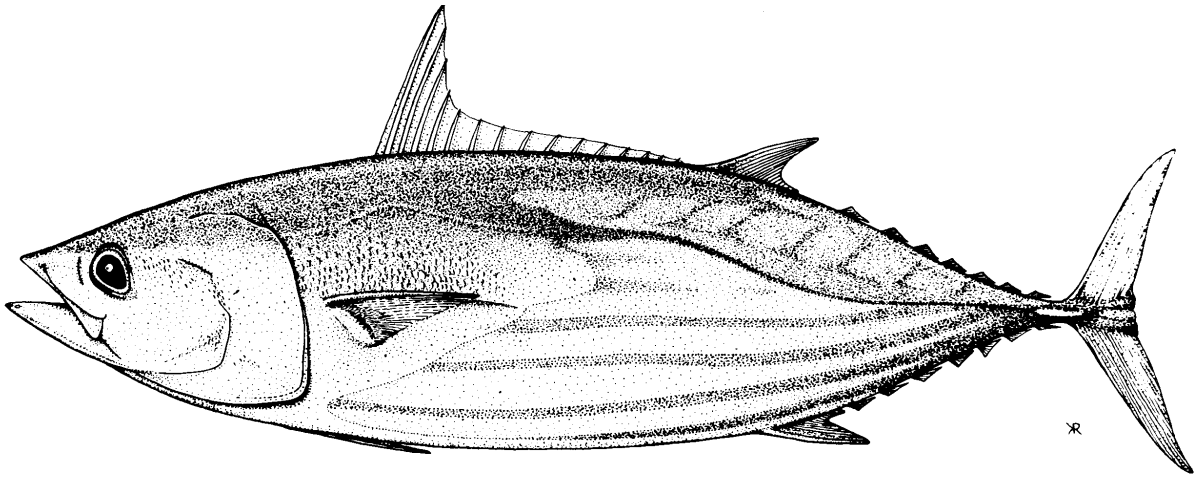

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CONTENTS

INTRODUCTION

The tuna fishery in the western and central Pacific Ocean is diverse, ranging from small-scale artisanal operations in the coastal waters of Pacific states, to large-scale, industrial purse-seine, pole-and-line and longline operations in both the exclusive economic zones of Pacific states and on the high seas. The main species targetted by these fisheries are skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*) and albacore tuna (*T. alalunga*).

All catch statistics presented in this review have been compiled for an area termed the *western and central Pacific Ocean* (WCPO), being the area of the Pacific Ocean west of 150°W longitude. Catch estimates presented herein are available in Working Paper SWG–2 *(Estimates of annual catch of target species in the western and central Pacific Ocean*).

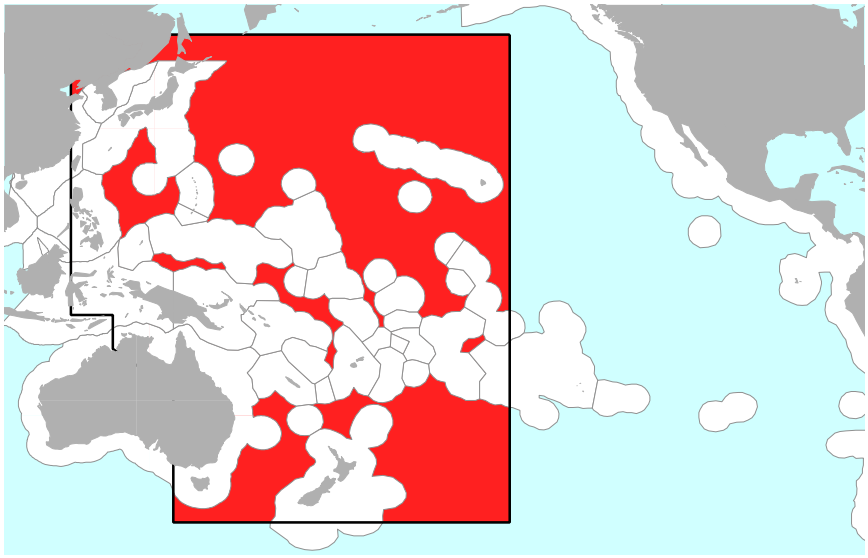

Figure 1. Pacific Ocean showing the WCPO

TOTAL CATCH IN THE WESTERN AND CENTRAL PACIFIC OCEAN

Annual catches of the four main tuna species (skipjack, yellowfin, bigeye and albacore) in the WCPO have been relatively stable since 1991, after steady increases in the catch during the 1980s (Figures 2 and 3). The total WCPO catch of tunas during 1999 was estimated at **1,716,806 mt**, the second highest annual catch recorded after 1998 (1,893,648 mt). During 1999, the purse seine fishery accounted for an estimated 1,035,219 mt (60% of the total catch), with pole-and-line taking an estimated 285,144 mt (17%), the longline fishery an estimated 184,112 mt (11%), with the remainder (12%) taken by troll gear and a variety of artisanal gears, mostly in eastern Indonesia and the Philippines.

The WCPO tuna catch represented 72% of the total estimated Pacific Ocean catch of 2,378,301 mt in 1999, and 48% of the provisional estimate of world tuna catch (3,569,144 mt) of the four species. The EPO catch in 1999 (661,405mt) was the highest on record, and the global catch, after two very productive years in the Pacific Ocean, may have been the highest ever.

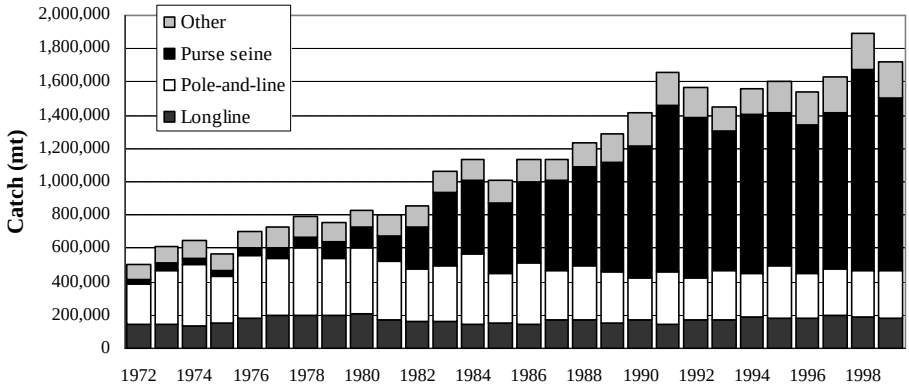

Figure 2. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO, by longline, pole-and-line, purse seine and other gear types

The 1999 catch of skipjack (1,104,121 mt) was slightly down on the record level of the previous year (1,242,415 mt), but as usual dominated the total species catch (64%). Yellowfin (393,998 mt; 23%) and albacore[1] (116,392 mt; 7%) catches were also slightly down on the 1998 levels, but the bigeye catch (102,295 mt; 6%) increased and was just under the record high taken in 1997 (104,558 mt).

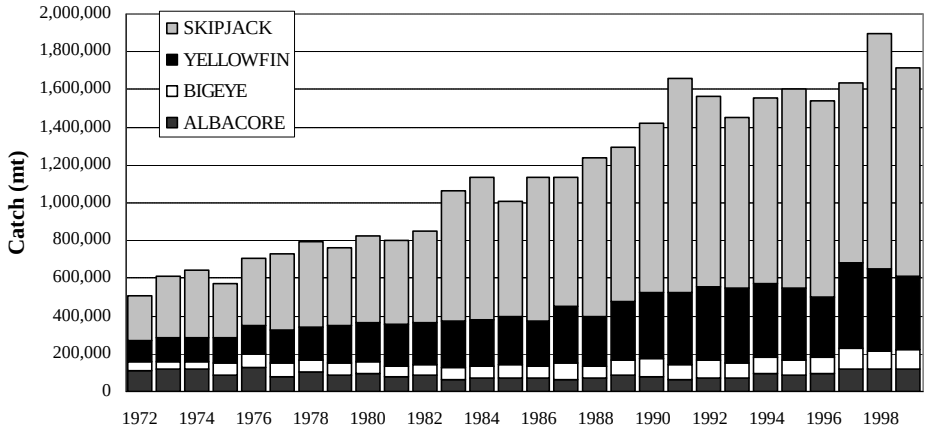

Figure 3. Catch (mt) of albacore, bigeye, skipjack and yellowfin in the WCPO.

This paper provides an overview of the WCPO tuna fisheries, in turn by gear and species, and makes some observations on recent developments in each fishery, with emphasis on 1999 catches relative to those of recent years, where information is currently available.

[1] includes catches of North and South Pacific albacore west of 150^0 W, which comprised 89% of the total Pacific Ocean albacore catch of 131,163t in 1999; the subsequent section, "Tuna Fishery Catch by Species - Albacore" is concerned only with catches of South Pacific albacore, which make up less than 40% of the WCPO catch.

TUNA FISHERY BY GEAR

1. PURSE SEINE

1.1 Overview

The purse seine fishery has accounted for around 60% of the WCPO total catch by volume since the early 1990s, with annual catches in the range 790,000 – 1,200,000 mt. The majority of the WCPO purse seine catch is taken by the four main DWFN fleets – Japan, Korea, Taiwan and USA, but with an increasing contribution from the growing number of Pacific Islands domestically-based vessels (Figure 4) in recent years. Skipjack regularly account for 70–75% of the purse seine catch - the WCPO purse seine fishery is essentially a skipjack fishery, unlike those of other ocean areas. The purse seine catches in recent years have been the highest ever - the WCPO record was established in 1998 (1,207,992 mt), with the second highest taken in 1999 (1,035,219 mt), this despite the prevailing unfavourable economic conditions in the fishery, with historically low prices for part of the year, and some voluntary effort reduction.

Features of the purse seine fishery during the past decade have been

- skipjack catches fluctuating between 600,000 and 700,000 mt p.a. until the sharp increases with the 1998 and 1999 catches;
- increases in the proportion of yellowfin in the catch during El Niño years (Figure 5), and sharp reductions during La Niña years (1995/96 and to a lesser extent 1998/1999);
- increased bigeye purse seine catches in the late 1990s associated with the use of drifting FADs; bigeye catch in 1997 (31,365 mt) was, at the time, a WCPO high, and has now been exceeded in 1999 (33,309 mt).

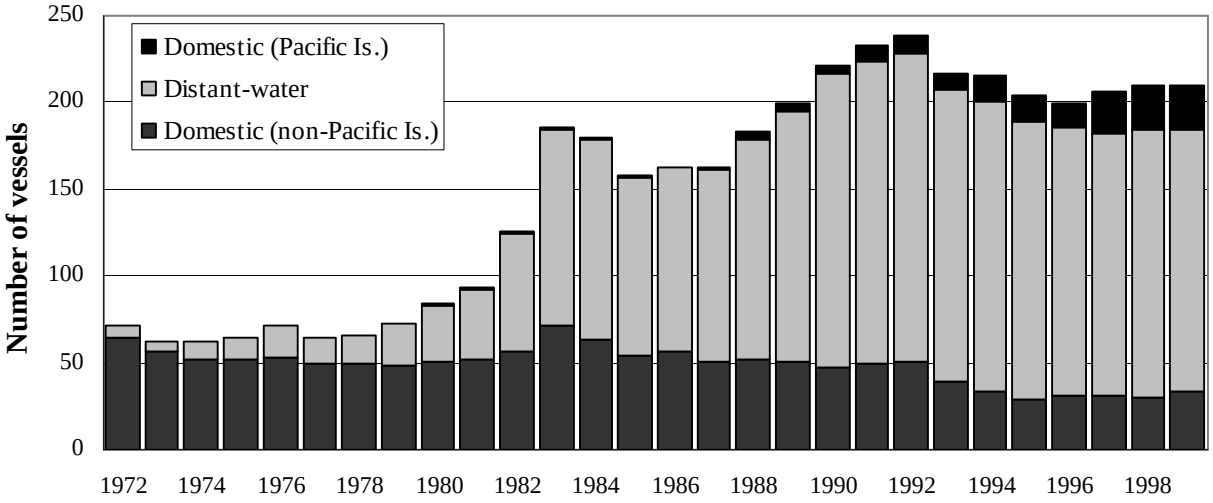

Figure 4. Number of purse seine vessels operating in the WCPO

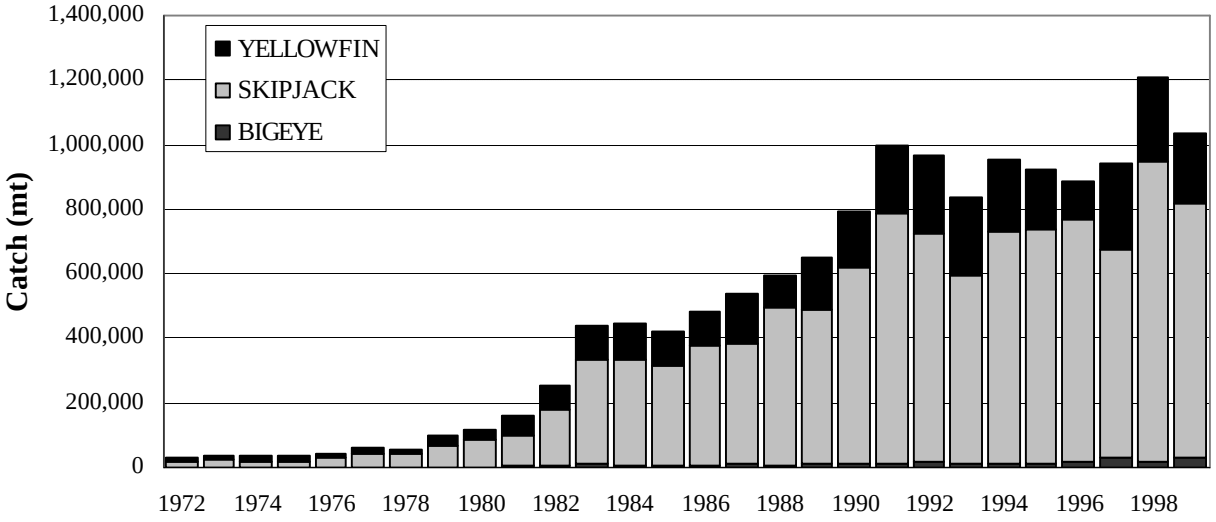

Figure 5. Purse seine catch (mt) of bigeye, skipjack and yellowfin in the WCPO

1.2 Recent developments

The 1999 purse seine catch of 1,035,219 mt was only the second annual catch exceeding 1,000,000 mt. The purse seine skipjack catch for 1999 (785,246 mt – 76%) was nearly 150,000 mt less than the 1998 (record) catch (931,266 mt), and appears to have returned to pre-1998 levels, although it is unclear how much of this reduction is attributable to reductions in effort. The purse seine yellowfin catch for 1999 (216,664 mt – 21%) continued the 1998 trend in further declining from the record 1997 catch; the decrease in the yellowfin catch is understood to be typical of a *La Nina* situation. In contrast to skipjack and yellowfin, the purse seine bigeye catch for 1999 (33,309 mt – 3%) was the highest on record.

Table 1 compares annual purse seine catches (skipjack and yellowfin) for the four main purse seine fleets operating in the WCPO. As mentioned, the catch trends in the past year were generally downwards; at the two extremes were the Japanese fleet, who experienced a significant reduction in skipjack catch in 1999 over 1998, and the US fleet, who were able to maintain 1998 catch levels during 1999, despite a reduction in effort.

Table 1. Comparison of annual catches for the four main purse seine fleets operating in the WCPO, 1997–1999.

	SKIPJACK					YELLOWFIN				
	1997	1998	1999			1997	1998	1999		
FLEET	MT	MT	MT	% diff to 1998	% diff to 1997	MT	MT	MT	% diff to 1998	% diff to 1997
Japan	145,478	230,294	**143,053**	*-61%*	*-2%*	57,050	37,785	**40,329**	*6%*	*-41%*
Korea	115,927	143,390	**109,773**	*-31%*	*-6%*	40,525	55,923	**30,523**	*-83%*	*-33%*
Taiwan	115,934	193,728	**160,453**	*-21%*	*28%*	48,171	63,581	**41,905**	*-52%*	*-15%*
USA	79,386	131,564	**131,000**	*0%*	*39%*	54,638	37,501	**34,384**	*-9%*	*-59%*
	456,725	698,976	**544,279**	*-28%*	*16%*	200,384	194,790	**147,141**	*-32%*	*-36%*

1999 catch estimates for the Pacific Islands (PI) domestic purse seine fleets are not yet finalised, but it appears they continue to take a significant proportion of the WCPO purse seine catch, which in 1998 was nearly 10% of the total purse seine catch (Lawson, 2000). The major PI domestic fleets are from FSM, PNG, Solomon Islands, and Vanuatu. The 1999 Solmon islands catch (39,055mt) appears to have been the highest ever, and nearly double that of 1998.

Figures 6–8 provide further insights into the activities of the four major purse seine fleets operating in the WCPO during 1999. Observations of activities for these fleets during 1999 include:

- The 1999 purse seine skipjack catch appears to have returned to pre-1998 levels (Figure 5), though CPUE levels remain high for some fleets (Figure 6) and effort may have declined;
- The percentage of sets on drifting FAD increased for all fleets during 1999 (Figure 7). Drifting FAD sets accounted for close to 90% of the all sets made by the US purse seine fleet during 1999 and is a significant change in fishing strategy for this fleet. Catch data for the Japanese fleet during 1999 are not complete, but also indicate an increase (albeit not as significant as the US fleet) in the proportion of drifting FAD sets. The proportion of drifting FAD sets significantly increased for the Taiwanese fleet also. However, unassociated sets remained the prominent fishing strategy for the Korean fleet during 1999;
- The significant increase in the proportion of drifting FAD sets by the US fleet during 1999 was the main reason for a sharp increase in overall skipjack CPUE, measured in metric tonnes per day (Figure 6). The change in strategy by the US fleet (i.e. an increase in setting on drifting FADs) is understood to be a means of increasing efficiency whilst decreasing costs;
- The US fleet took a record 16,673 mt of bigeye during 1999 (Coan et al., 2000), largely due to the significant increase in setting on drifting FADs. This catch easily exceeds the previous maximum annual catch of slightly under 10,000 mt, taken by this fleet during 1996.

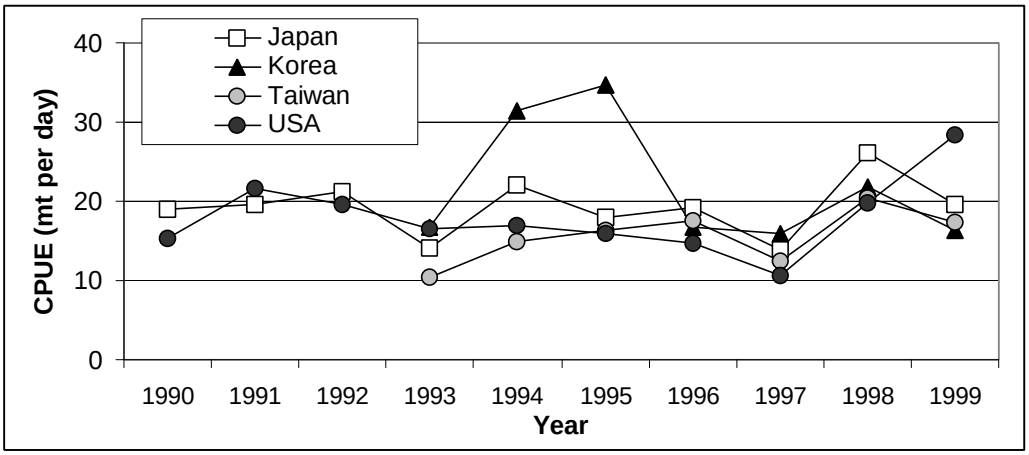

Figure 6. Nominal skipjack CPUE (mt per day) for selected purse seine fleets

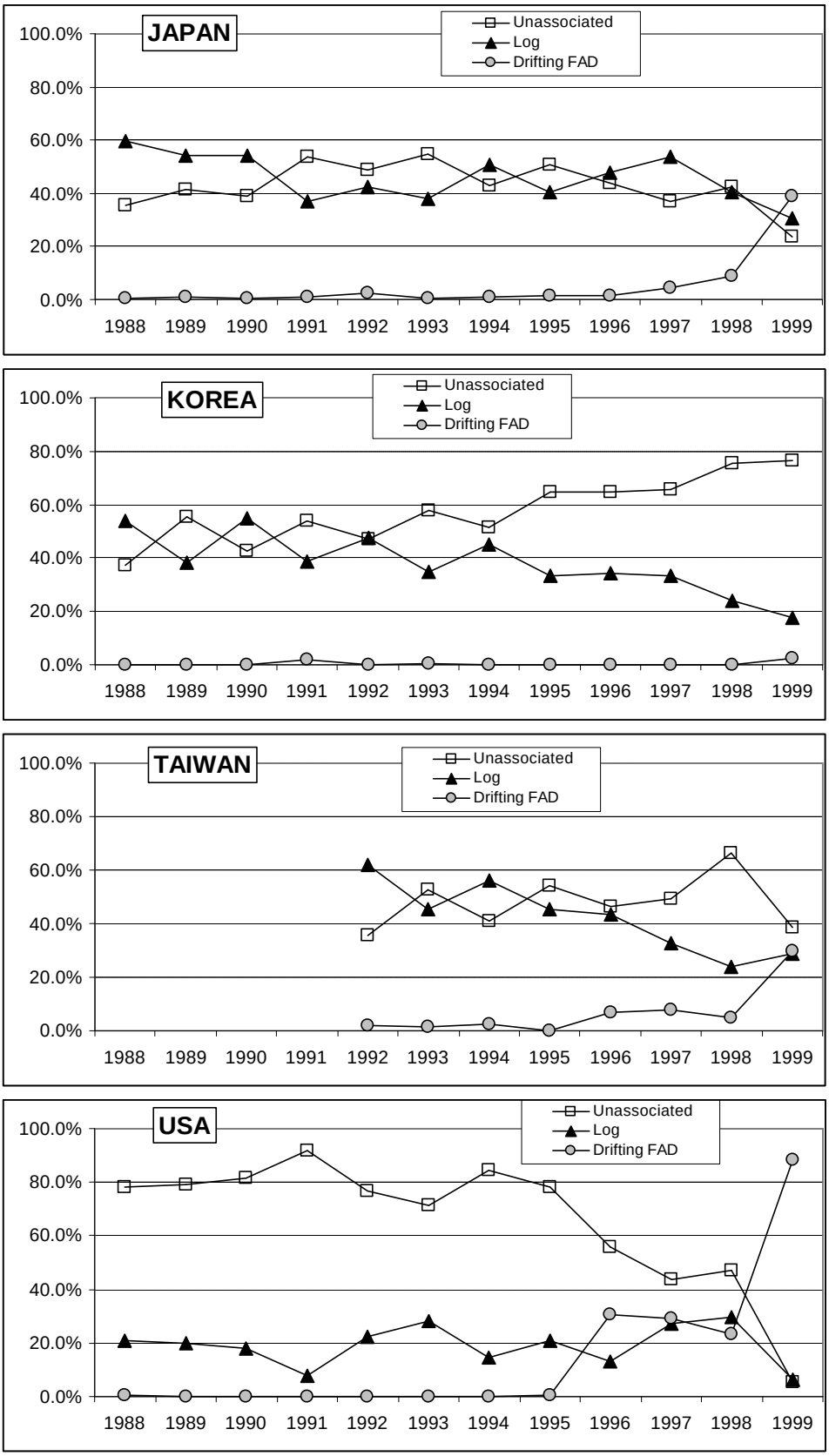

Figure 7. Time series showing the percentage of total sets by school type for the major purse-seine fleets operating in the WCPO.
(1999 data are provisional)

Figures 8–11 shows the shift in areas fished during 1998 and 1999 for each of the major purse seine fleets, also highlighting the differences in areas fished by each fleet.

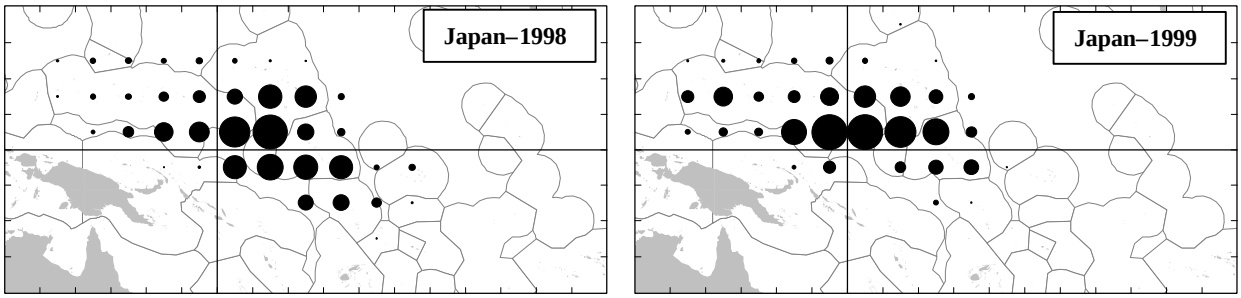

Figure 8. Distribution of effort by the Japanese purse seine fleet during 1998 and 1999 (provisional) lines for the equator (0° latitude) and 160°E longitude included.

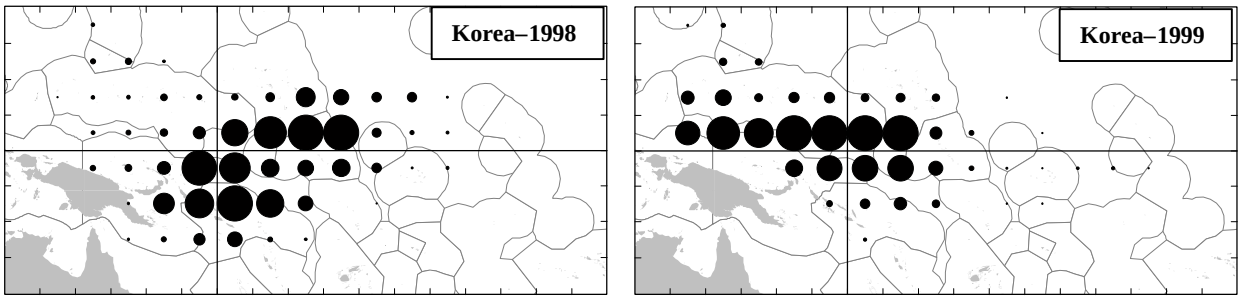

Figure 9. Distribution of effort by the Korean purse seine fleet during 1998 and 1999 (provisional) lines for the equator (0° latitude) and 160°E longitude included.

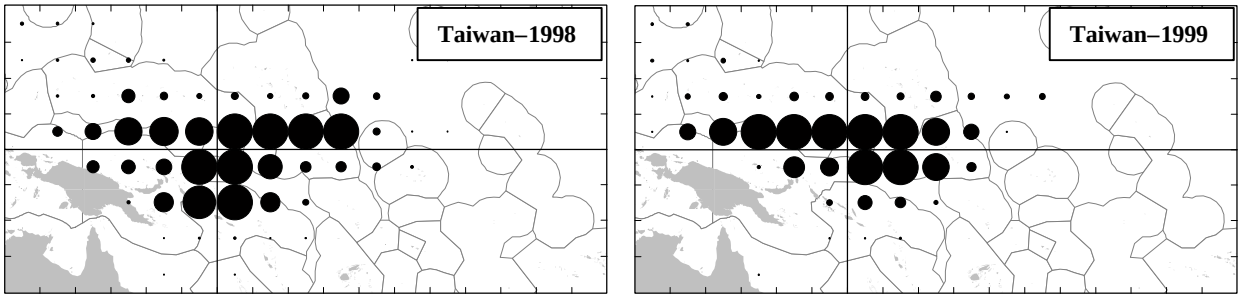

Figure 10. Distribution of effort by the Taiwanese purse seine fleet during 1998 and 1999 (provisional) lines for the equator (0° latitude) and 160°E longitude included.

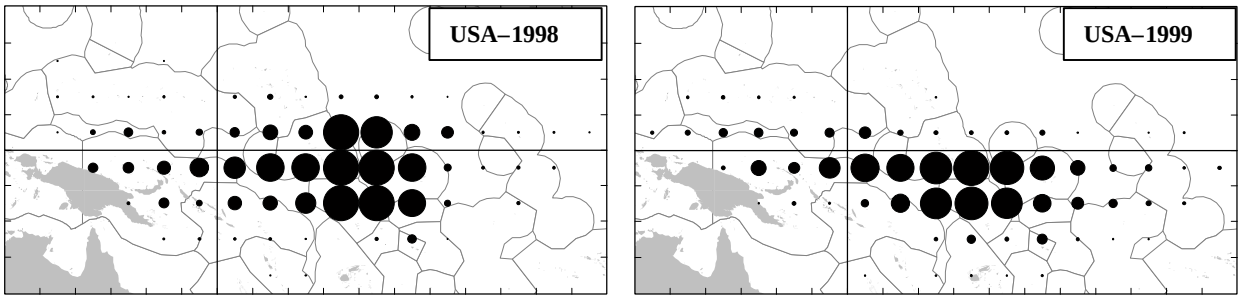

Figure 11. Distribution of effort by the US purse seine fleet during 1998 and 1999 (provisional) lines for the equator (0° latitude) and 160°E longitude included.

Figure 12 shows the shift in areas fished by quarter during 1998 and 1999, relative to the warm pool (water warmer than 28^0C) and illustrates the relationship with the South Oscilllation Index (SOI - *El Niño/La Niña* phenomena). The SOI remained in the positive range (normally related to a *La Niña* episode) throughout 1999. This was reflected in the fishing effort for most fleets contracting further westwards during this period. The US purse seine fleet however tended to remain in the eastern areas (Figure 11) and fished almost exclusively on drifting FADs during 1999 (Figure 7).

Figure 13 shows the annual effort distribution for the years 1995-1999 inclusive, and demonstrates on a wider scale the effect of ENSO events on the spatial distribution of catch.

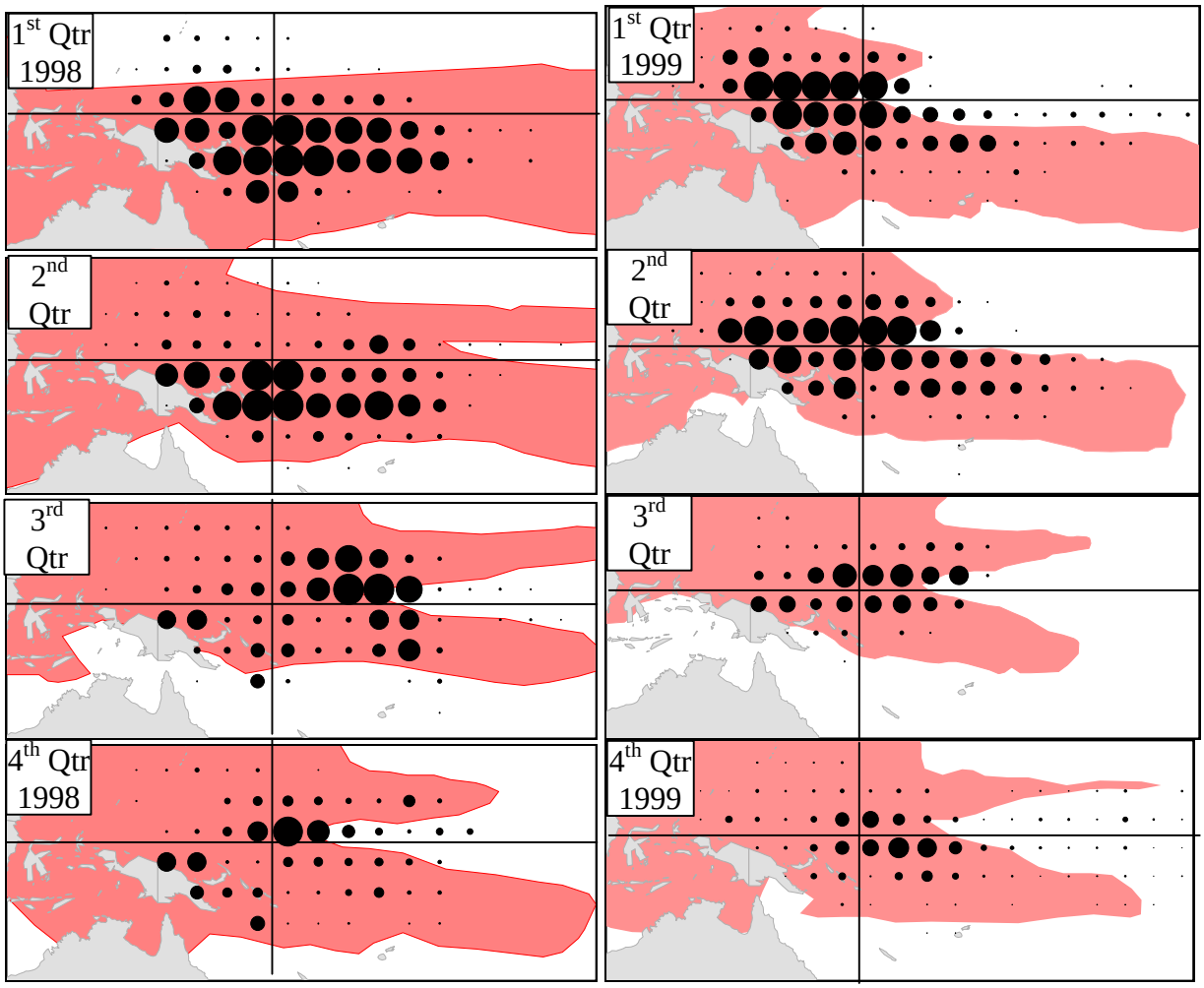

Figure 12. Distribution of 1998 and 1999 regional purse-seine effort by quarter. The shaded area is the warm pool (>28 ℃), with lines for the equator (0° latitude) and 160°E longitude included.

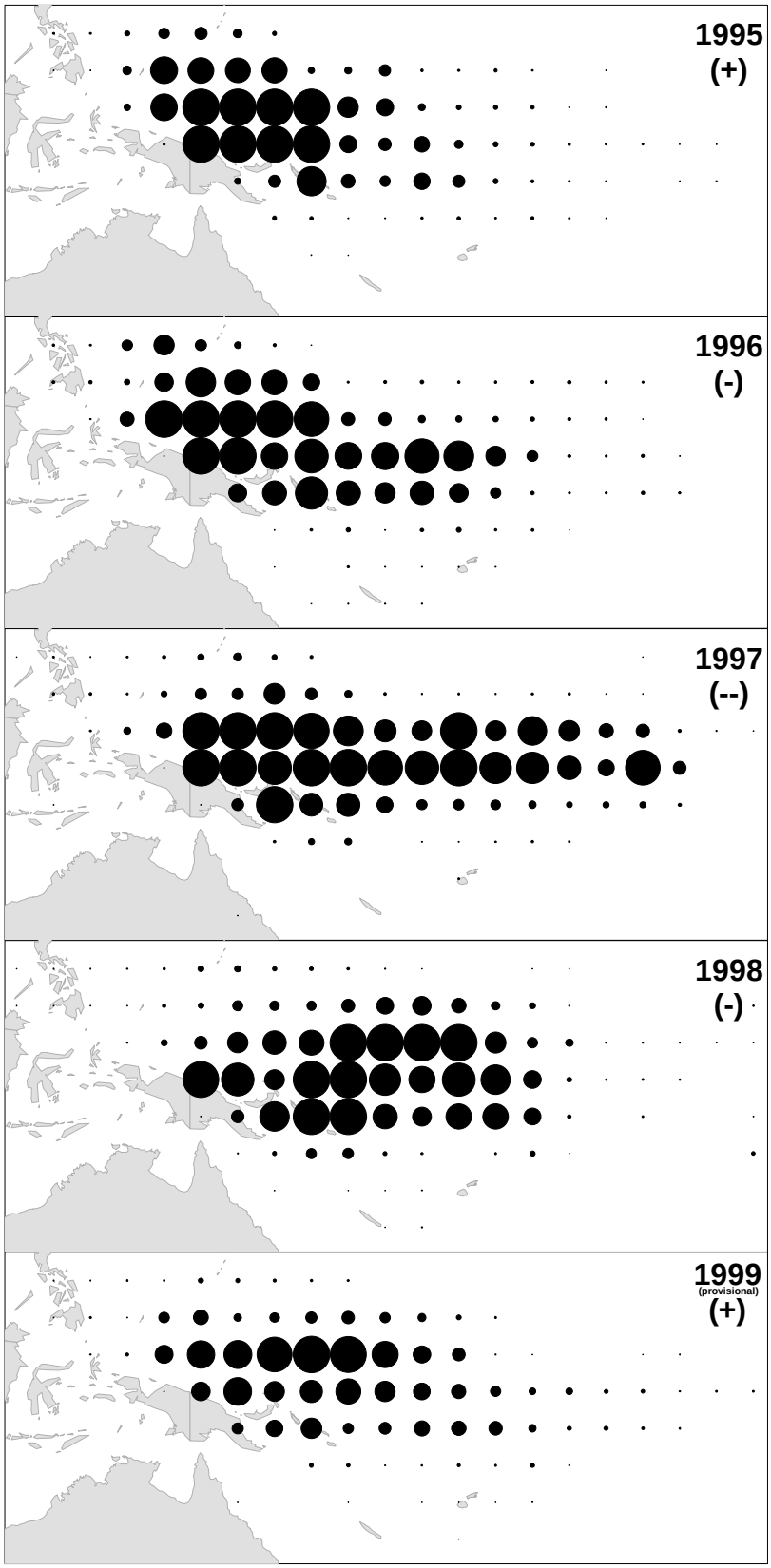

Figure 13. Distribution of purse-seine effort, 1995–1999. ENSO periods are denoted by "+": La Niña; "-": El Niño; "--": strong El Niño.

2. POLE-AND-LINE

2.1 Overview

The WCPO pole-and-line fishery has several components:

- the year-round tropical skipjack fishery, mainly involving the domestic fleets of Indonesia, Solomon Islands and French Polynesia, and the distant water fleet of Japan
- seasonal sub-tropical skipjack fisheries in the home waters of Japan and Australia
- a seasonal albacore/skipjack fishery east of Japan (largely a subset of the Japan homewater fishery).

Economic factors and technological advances in the purse seine fishery (primarily targeting the same species, skipjack) have seen a gradual decline in the number of vessels in the pole-and-line fishery (Figure 14) and stabilisation in the annual pole-and-line catch during the past decade (Figure 15; note that distinction between troll and pole-and-line gears in the the Japanese coastal fleet was not possible for years prior to 1995). The gradual reduction in numbers of vessels has occured in all pole-and-line fleets over the past decade; Pacific Island domestic fleets have declined in recent years – fisheries formerly operating in Palau, Papua New Guinea and Kiribati are no longer active, and only one or two vessels are now operating in Fiji. Several vessels continue to fish in Hawai'i, and the French Polynesian bonitier fleet remains active.

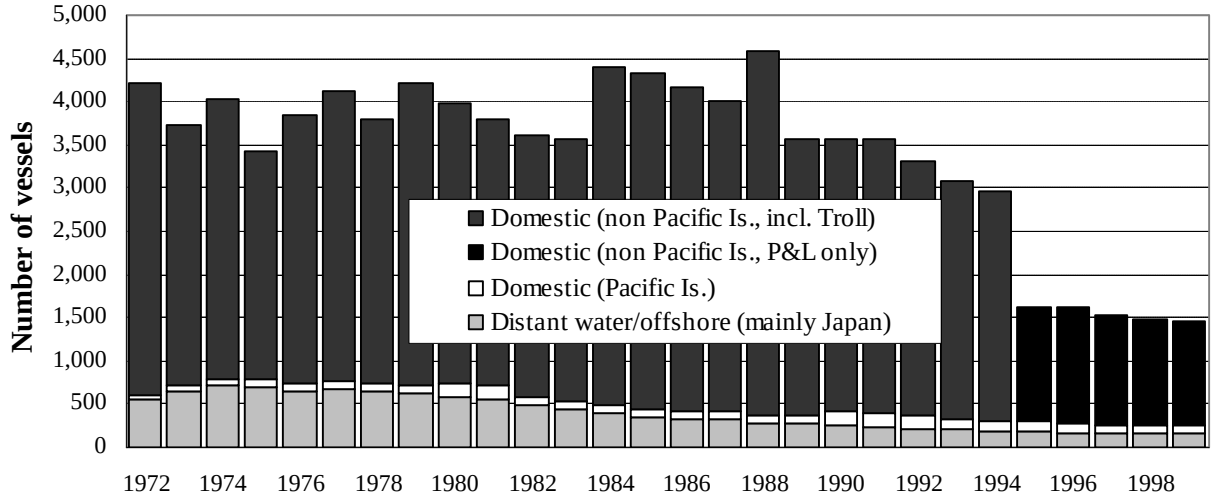

Figure 14. Pole-and-line vessels operating in the WCPO

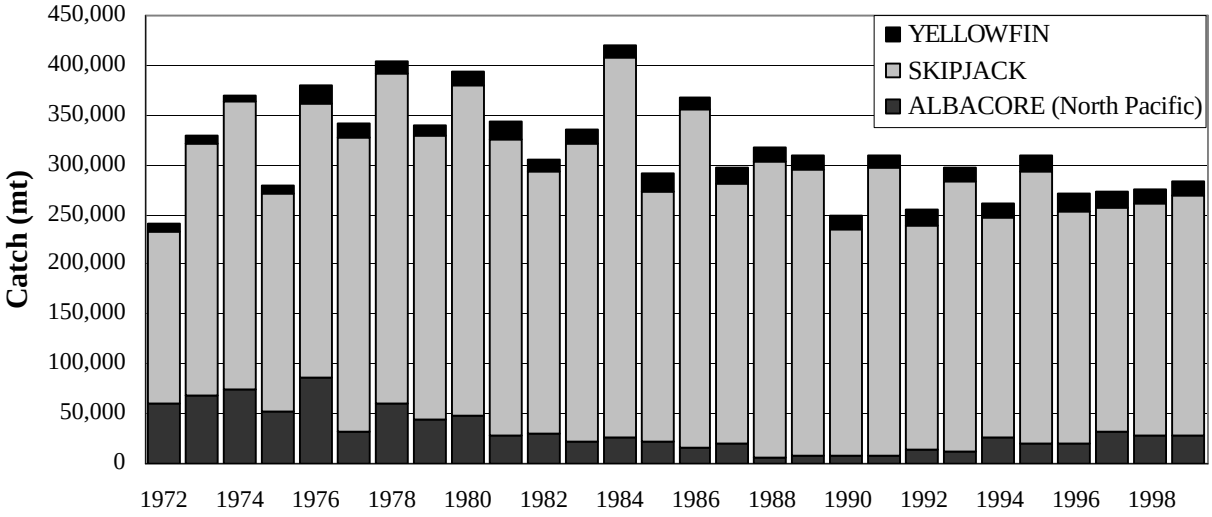

Figure 15. Pole-and-line catch in the WCPO

2.2 Recent developments

The preliminary pole-and-line catch estimate for 1999 (285,144 mt) is a slight increase on the 1998 level (277,223 mt); this catch represents about 17% of the total WCPO catch. As in previous years, skipjack accounts for the vast majority of the catch (84%); albacore taken by the Japanese coastal and offshore fleets in the temperate waters of the north Pacific (10%), yellowfin (5%) and a small component of bigeye (1%) make up the remainder of the catch. Catch estimates by fleet for 1999 are not yet finalised, but the Japanese distant-water and offshore (118,822 mt in 1998) and the Indonesian fleets (86,466 mt in 1998) are expected to once again account for most of the catch; the Solomon Island fleet accounted for 30,520 mt during 1999, the highest catch for this fleet in five years (Figure 15; Lawson, 2000).

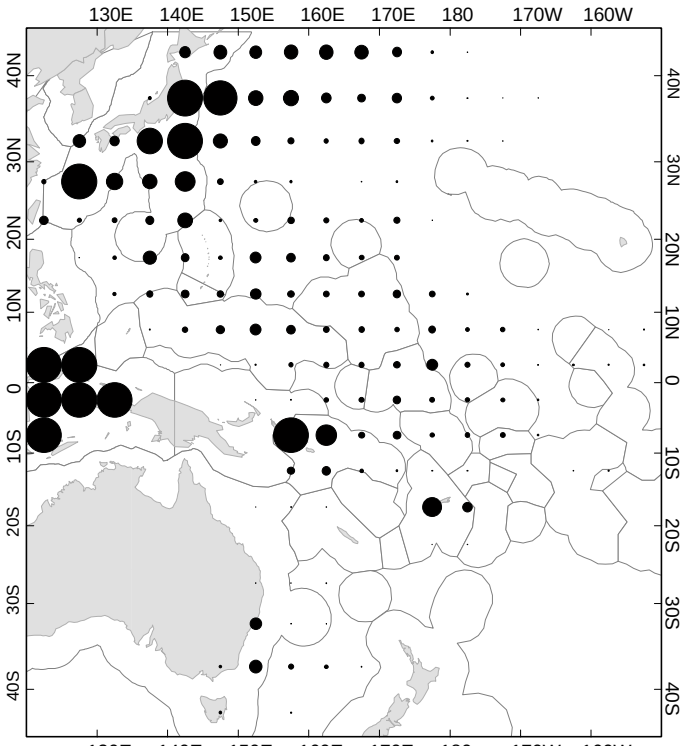

Figure 16. Average distribution of WCPO pole-and-line effort (1995–1997)

3. LONGLINE

3.1 Overview

The longline fishery provides the longest time series of catch estimates for the WCPO, with estimates available since the early 1950s (Lawson, 2000). The annual total longline catch has been relatively stable during the past 25 years (Figures 17), with total catches generally between 130,000 and 200,000 mt. The fishery involves two main types of operation –

- large (typically >250 GRT) freezer vessels) which undertake long voyages (months) and operate over large areas of the region; they may target either tropical (yellowfin, bigeye) or subtropical (albacore) species;
- smaller (typically <100 GRT) vessels which are usually domestically-based, with ice or chill capacity, and serving fresh or air-freight sashimi markets; they operate mostly in tropical areas.

Additionally, small vessels in Indonesia and Philippines take quantities of longline species by handlining and small vertical longlines.

There have been significant changes in fleet operations during the past two decades. For example, a feature of the 1980s was a change in targetting practices in order to capitalise on a higher price for bigeye over yellowfin. The gradual increase in the number of Pacific Islands domestic vessels, and entrance and subsequent decline of the smaller "offshore" sashimi longliners of Taiwan and mainland China into the fishery during the past decade (Figure 18) is also noteworthy. There has also been a trend towards flexibility in species targetting in some fleets, notably those with ultra-low temperature freezing capacity, and the capability of some fleets to shift operations beteween oceans.

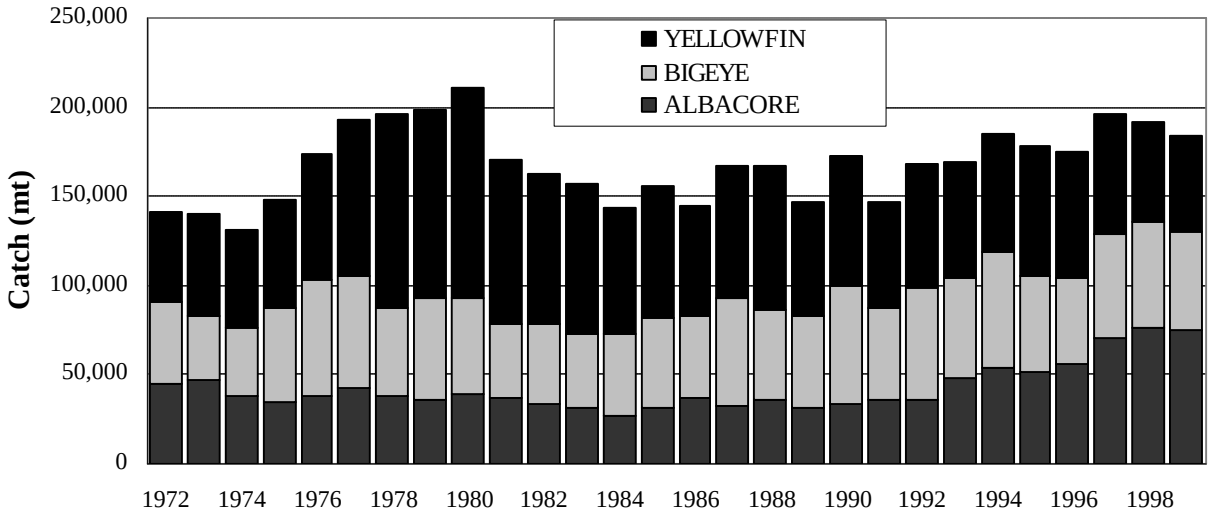

Figure 17. Longline catch (mt) in the WCPO

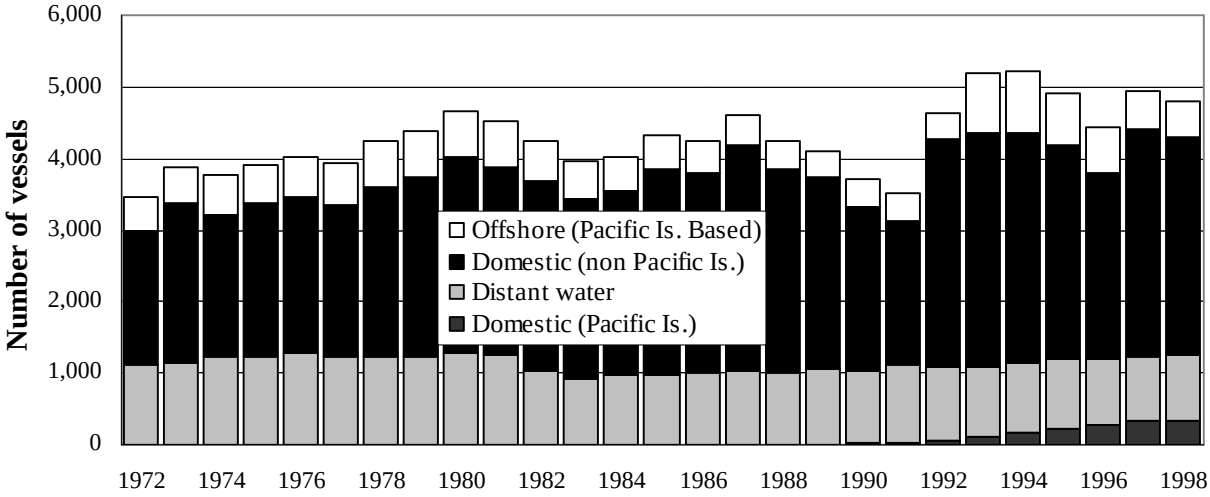

Figure 18. Longline vessels operating in the WCPO

3.2 Recent developments

The longline catch in the WCPO in 1999 of 184,112 mt accounted for 11% of the total WCPO catch (Lawson, 2000), but rivals the much larger purse seine catch in value. This catch represents a slight decrease on the 1998 catch of 191,993 mt. The overall species composition of the 1999 WCPO longline catch was 29% yellowfin, 41% albacore and 30% bigeye. The yellowfin catch of 53,381 mt was the lowest for nearly 30 years and appears to be attributable in part to a reduction of 22% in the number of distant-water Japanese vessels (from 679 vessels in 1998 to 528 in 1999). Figure 19 shows the distribution of effort by category of fleet, and Figure 20 shows species composition by area for 1998 activities. As in previous years, most of the 1999 WCPO catch was taken by the large vessel distant-water fleets of Japan, Korea and Taiwan. Effort by these fleets is widespread as sectors of these fleets target bigeye and yellowfin for the frozen sashimi market, and albacore in the more temperate waters for canning.

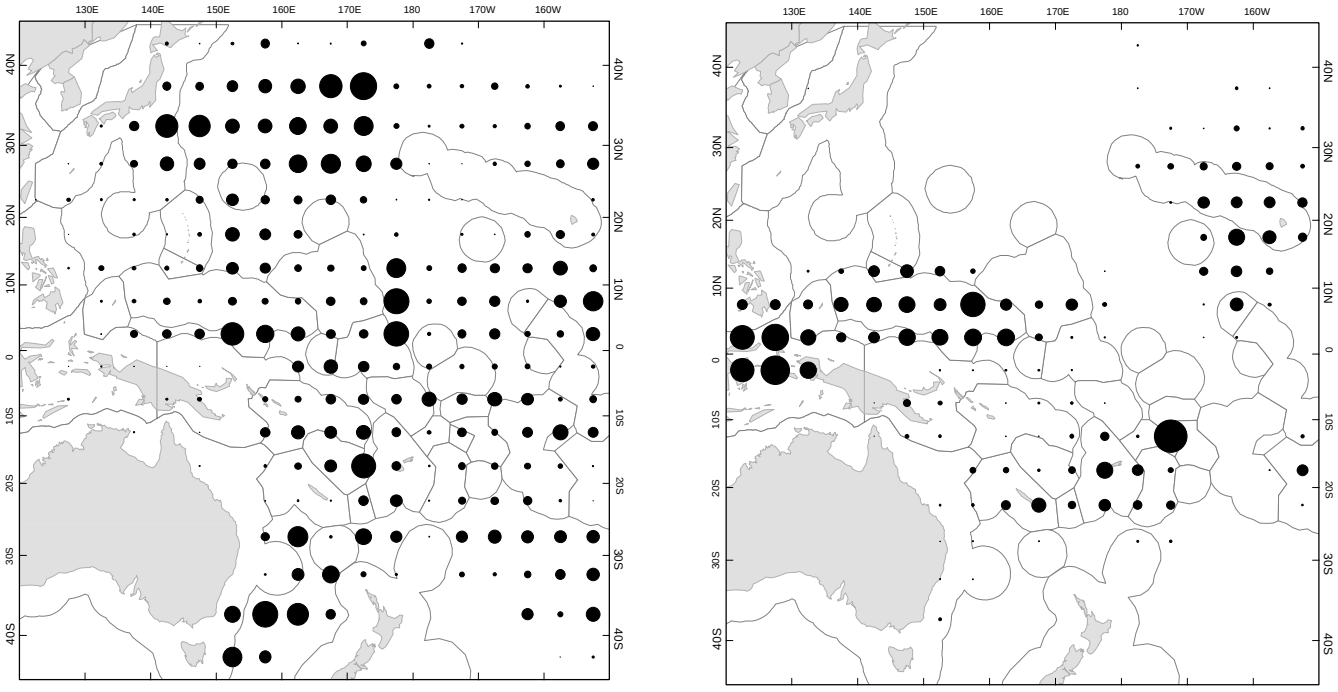

Figure 19. Distribution of distant-water longline effort (left), and offshore and domestic fleet effort (right) during 1998

In contrast, the offshore fleets from Japan, mainland China and Taiwan are restricted to the tropical waters and target bigeye and yellowfin for the fresh sashimi market. Indeed, there is some complementarity in effort distibution of the two fleet categories In recent years, there has been an increase in domestic fleet activity in some areas of the WCPO; the most significant example is the establishment of the domestic Samoan fleet targetting albacore in their EEZ and just beyond.

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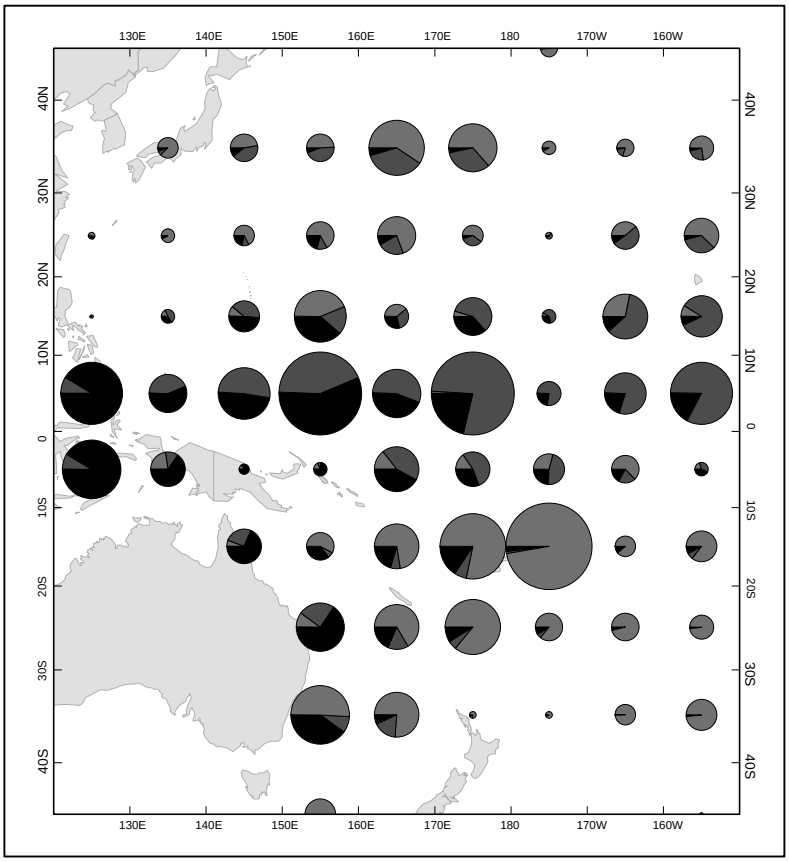

Figure 20. Distribution of longline catch by species during 1998
(Black–yellowfin; hatched–bigeye; grey–albacore)

4. TROLL

4.1 Overview

The South Pacific troll fishery is based in the coastal waters of New Zealand, and along the Sub-Tropical Convergence Zone (STCZ); the fleets of New Zealand and United States have historically accounted for the great majority of the catch, which in turn consists almost exclusively of albacore tuna.

The fishery (Figure 22) expanded following the development of the SCTZ fishery after 1986, with the largest annual catch (around 9,000 mt) taken in 1991 (Lawson, 2000). Since then, annual catches have varied from year to year, but generally have declined to half the peak level. The level of effort expended by the troll fleets each year tends to reflect the price commanded for the product (albacore for canning) to some extent, and by expectations concerning likely fishing success.

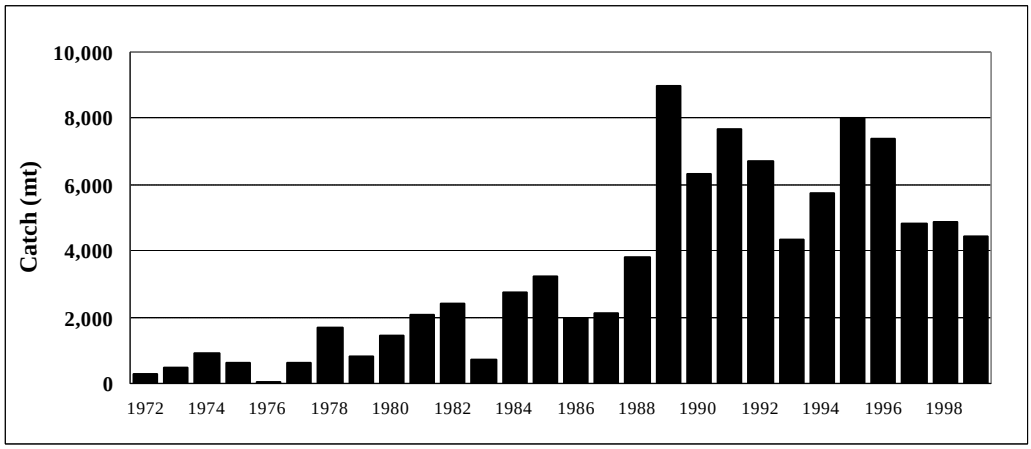

Figure 21. Troll catch (mt) of albacore in the south Pacific Ocean

4.2 Recent developments

The preliminary 1999 troll albacore catch was similar to (but slightly less than) the catches of recent years (1997 and 1998). Figure 22 shows the distribution of effort for troll fleets for 1997, which is expected to be a likely distribution of fishing effort for 1998 and 1999 (i.e. off the coasts of Australia and New Zealand and in the STCZ).

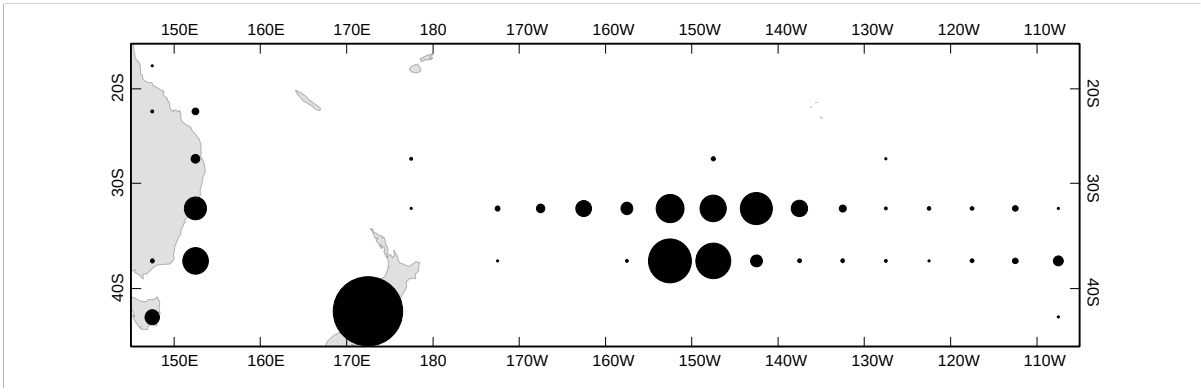

Figure 22. Distribution of South Pacific troll effort during 1997

TUNA FISHERY BY SPECIES

5. SKIPJACK

5.1 Catch

Skipjack, the dominant species in the western and central Pacific Ocean (WCPO) tuna catch, are taken primarily by purse seine and pole-and-line gear, with smaller catches by artisanal gears in eastern Indonesia and Philippines. Catches in the WCPO have increased steadily since 1970, more than doubling during the 1980s, and relatively stable since then (range 800,000–1,200,000 mt), with catches of more than one million mt in 1991, 1992, 1995, 1998 and 1999 (Figure 23). Pole-and-line fleets, primarily Japanese, initially dominated the fishery, with the catch peaking at 380,000 mt in 1984, but the relative importance of this fishery has declined steadily largely due to economic factors. The skipjack catch increased during the 1980s due to growth in the international purse seine fleet, combined with increased catches by domestic fleets from Philippines and Indonesia (which now make up 20-25% of the total skipjack catch in WCPO in recent years).

The 1999 estimated catch of 1,104,121 mt by gear was as follows:

- purse seine - 785,246 mt (71%), of which most was taken by the four main DWFN fleets (544,279 mt) and Philippines purse seine and ringnet fisheries;
- pole-and-line - 240,519 mt (22%), of which 120,000 mt was taken by Japanese fleets, an estimated 80,000 mt in Indonesia and close to 30,000 mt in Solomon Islands.
- other gears – 77,564 mt (7%), mostly unclassified gears in Indonesia, Philippines and Japan.

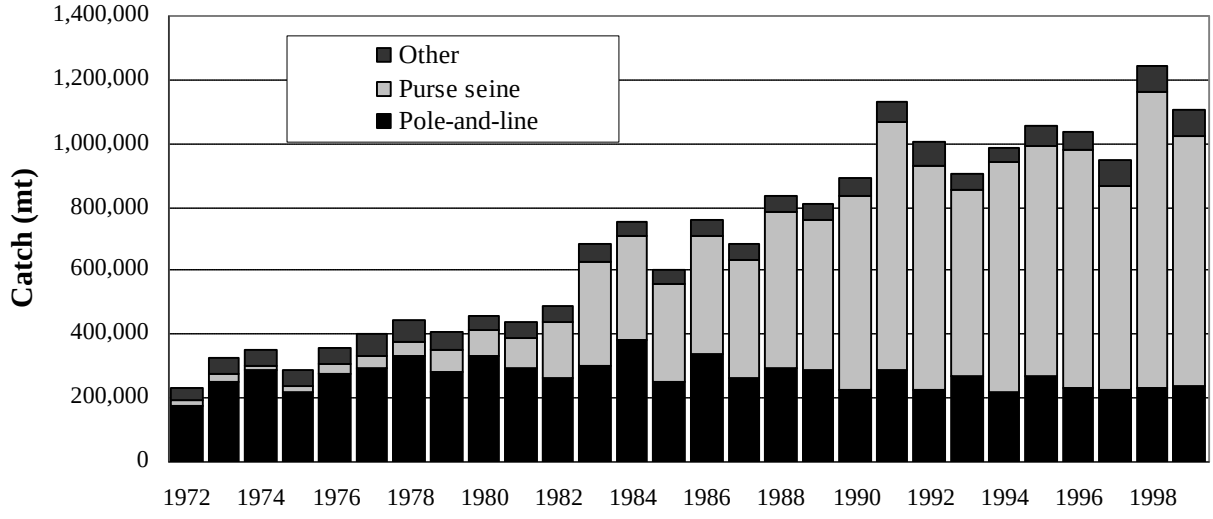

Figure 23. WCPO skipjack catch (mt) by gear

Figure 24 shows the average spatial distribution of skipjack catch in the WCPO for the period 1988–1998, with the great majority of the catch taken in equatorial areas, and a lesser amount in the seasonal home-water fishery of Japan (note that the Japanese purse-seine home fishery is not

represented here). The distribution of skipjack in equatorial areas east of PNG is strongly influenced by ENSO events, as noted earlier. During *El Niño* years such as 1997, a greater portion of the skipjack catch occurs east of 160^0 E, while in *La Nina* years, such as 1999, most of the skipjack catch is taken to the west of 160°E.

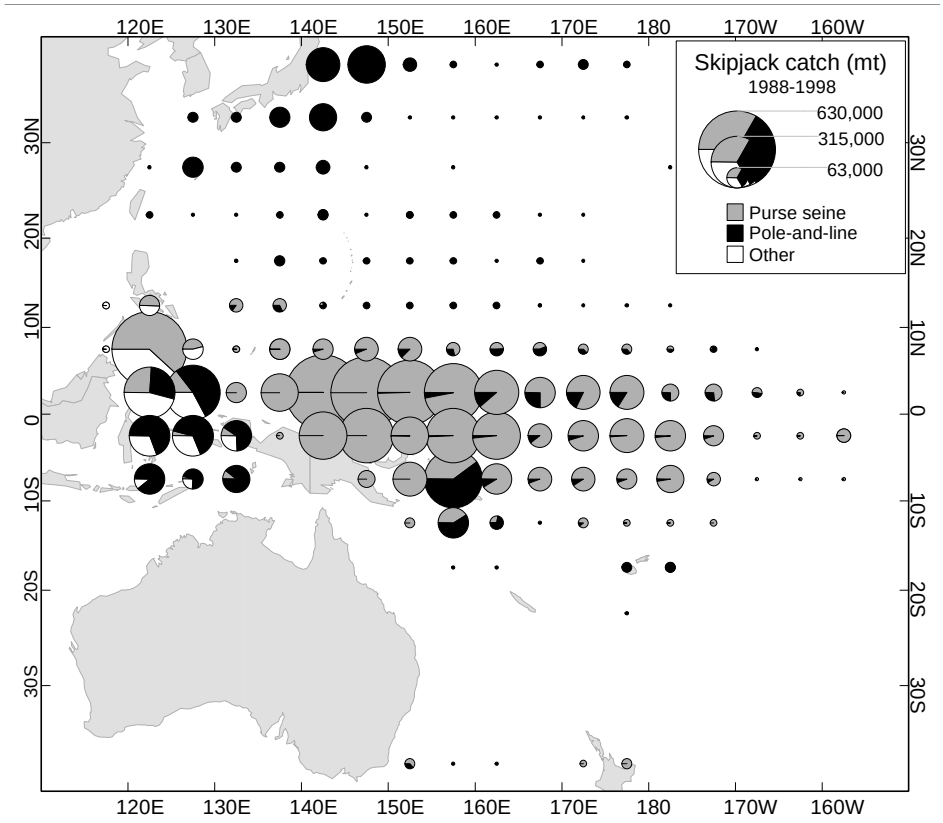

Figure 24. Distribution of WCPO skipjack catch, 1988–1998

5.2 Catch per unit of effort

Purse seine sets are made on two main school types – associated (floating object) and unassociated (free-swimming). Associated sets initially accounted for most of the catch as the fishery developed in the WCPO, but as experience was acquired and gear technology improved, unassociated (free) schools become more important. In recent years, several fleets have moved back to making more associated sets, especially as drifting man-made FADs have been increasingly used (Figure 7). This has had some implications for the species (and size) composition of the catch.

In order to standardise effort by school type, effective purse seine effort has been calculated as the total number of days fishing and searching (stratified by month and 1°x1° square) apportioned according to the number and types of set undertaken in that stratum. The time series of skipjack catch per effective effort (Figures 25–27), show the difference in catch rates for unassociated, which generally fall into the range of 10–20 mt per set, versus associated sets, which are often more than 20 mt per set. These figures also show some degree of convergence amongst the major fleets in recent years, which appears to be related to a greater overlap of areas fished and similar strategies employed by these fleets.

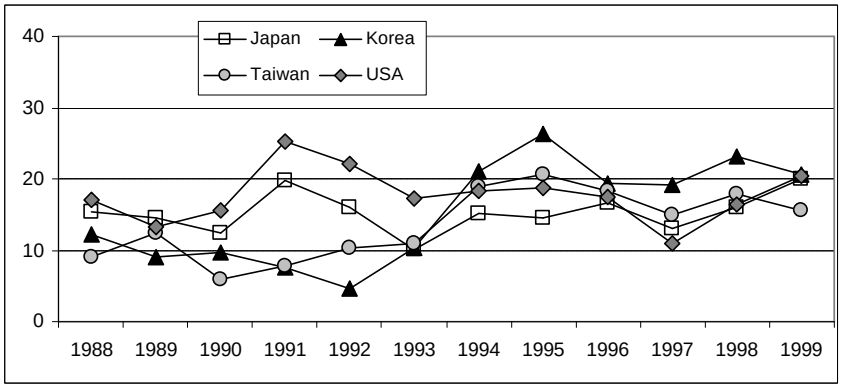

Figure 25. Skipjack catch per effective effort on UNASSOCIATED sets

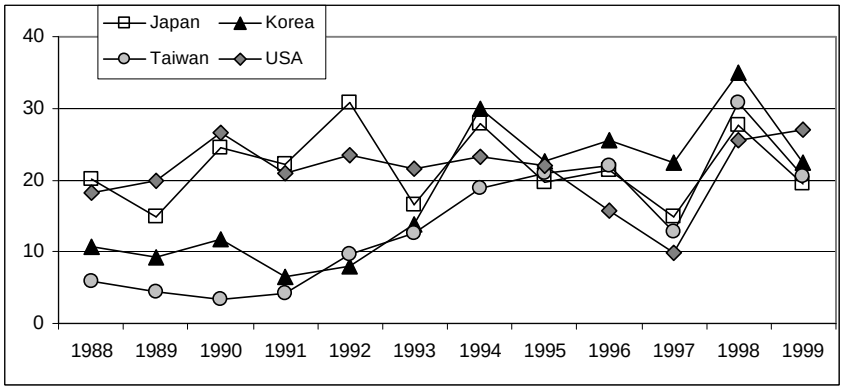

Figure 26. Skipjack catch per effective effort on LOG sets

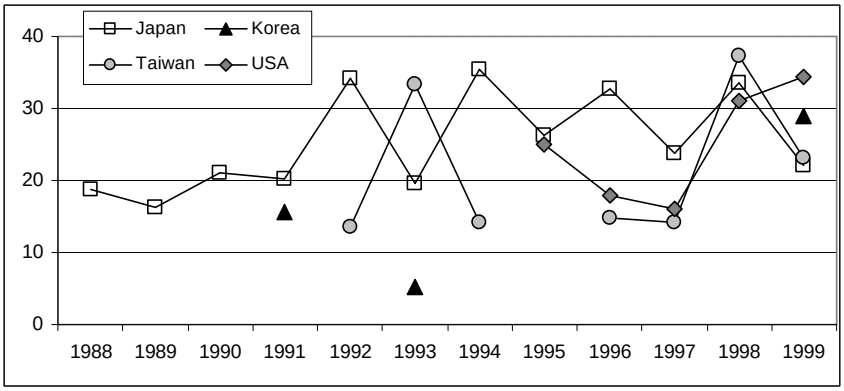

Figure 27. Skipjack catch per effective effort on DRIFTING FAD sets

Skipjack CPUE by the Japanese pole-and-line fleet has also shown an increasing trend over the past decade (Figure 28). These increases in CPUE have coincided with substantial effort reduction and the departure of less competitive boats from the fishery, as well as the acquisition of improved technology, e.g. bird radar. CPUE has generally been higher, but more variable, in the equatorial fishing area than in the northern area. CPUE trends are however generally consistent across all fisheries, suggesting that stock-wide effects are involved. Catch rates in the Solomon Islands domestic pole-and-line fishery tend to be higher every three or four years, but on average are lower than those of Japanese fleets in the WCPO. The Solomon Islands CPUE index may be a better indicator of fishery performance than the Japanese fleet because of the relative stability of the domestic fleet.

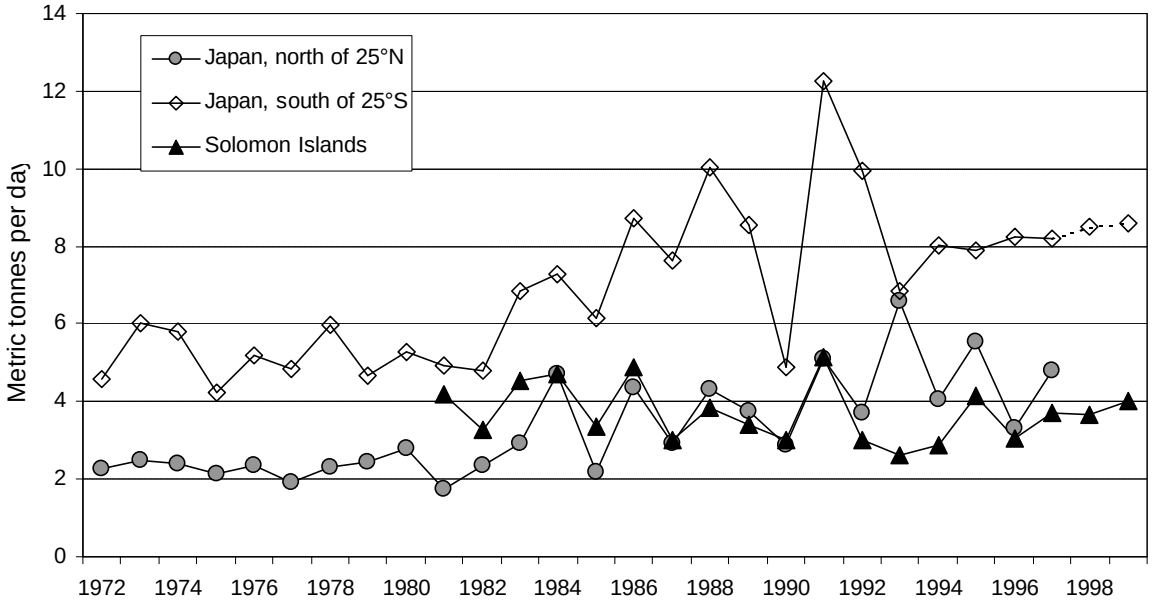

Figure 28. Nominal skipjack CPUE (mt/day) for selected pole-and-line fleets

5.3 Size of fish caught

In the WCPO, skipjack size composition data are available from fishery observers and port sampling activity, mostly involving the international fleet fishing east of 140^0E. Monthly skipjack size in the purse seine fishery is illustrated for both associated and unassociated sets from January 1997 to December 1999 (Figure 29). Skipjack were usually between 30 and 70 cm FL and there were only small differences in the length composition between associated and unassociated sets. In general, unassociated sets capture skipjack of a greater size range than associated sets, and this is apparent especially during 1998. In viewing the progression of length frequency modes, skipjack appear to recruit to the fishery in November-December of each year. In the purse seine fishery from 1997 to 1999, size composition has been relatively stable.

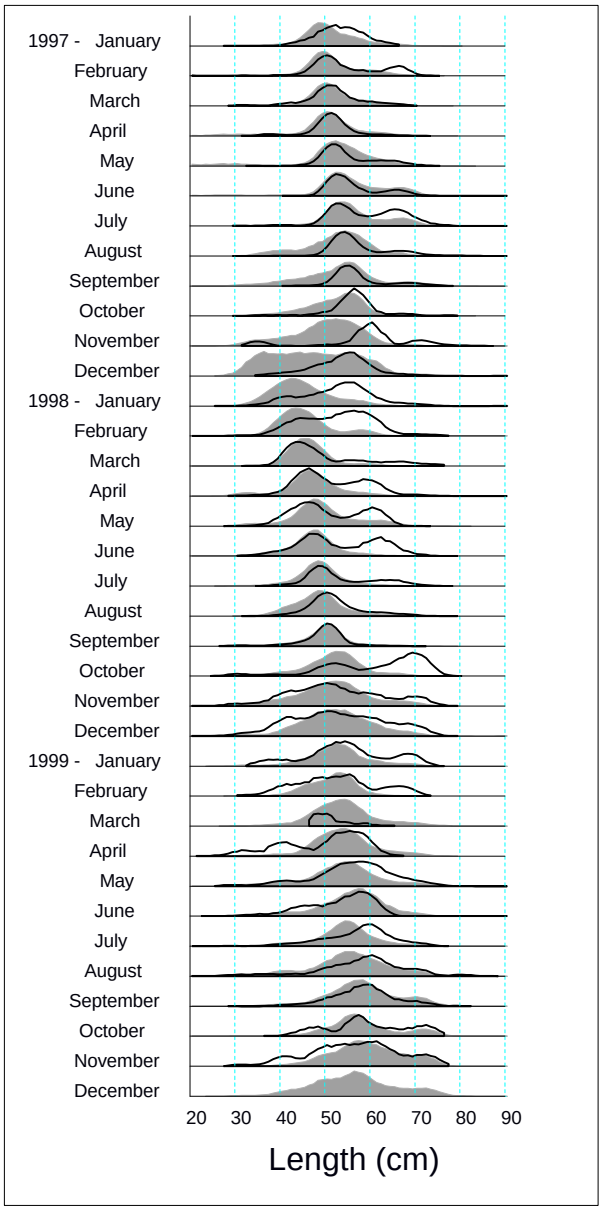

Figure 29. Size comparison of skipjack sampled from the WCPO purse seine catch, 1997–1999
(**Grey shading**: Associated schools catch; **Solid line**: Unassociated schools catch)

6. YELLOWFIN

6.1 Catch

Yellowfin tuna, an important component of tuna fisheries throughout the western and central Pacific Ocean (WCPO) are harvested with a range of gear types, from small-scale artisanal fisheries in Pacific Island and southeast Asian waters to large 'distant-water' longliners and purse seiners that operate widely in equatorial/tropical waters. Purse seiners take a wide size range of yellowfin, whereas the longline fishery takes mostly adult fish.

Since 1990, yellowfin catch in the WCPO has varied between 320,000–457,000 mt (Figure 30). The 1997 catch in the WCPO and Pacific-wide was the largest on record (457,004 mt), with the estimated 1998 catch only slightly lower (437,090 mt). The elevated total catch in these most recent years followed the lowest catch for ten years in 1996, as a result of greatly reduced purse seine catches. Purse seine harvests the majority of the yellowfin catch (55% by weight in 1999), while longline and pole-and-line fisheries caught 14% and 3%, respectively.

Yellowfin usually represent ~20–25% of the overall purse seine catch and may contribute a higher percentage of the catch in individual sets. Yellowfin may also be directly targetted by purse seiners, especially as unassociated schools.

The longline catch in recent years (53,000–74,000 mt) is well below catches in the late 1970s/early1980s (90,000–120,000 mt), presumably related to changes in targetting practices by some of the large fleets and the gradual reduction in the number of distant-water vessels. Significantly, the 1999 yellowfin catch of 53,381 was the lowest for nearly 30 years.

Catches in the 'Other' category in Figure 30 are largely composed of yellowfin from the Philippines and eastern Indonesia. These catches come from a variety of gear types (e.g. ring net, bagnet, gillnet, handline and seine net) and have increased steadily over the past decade.

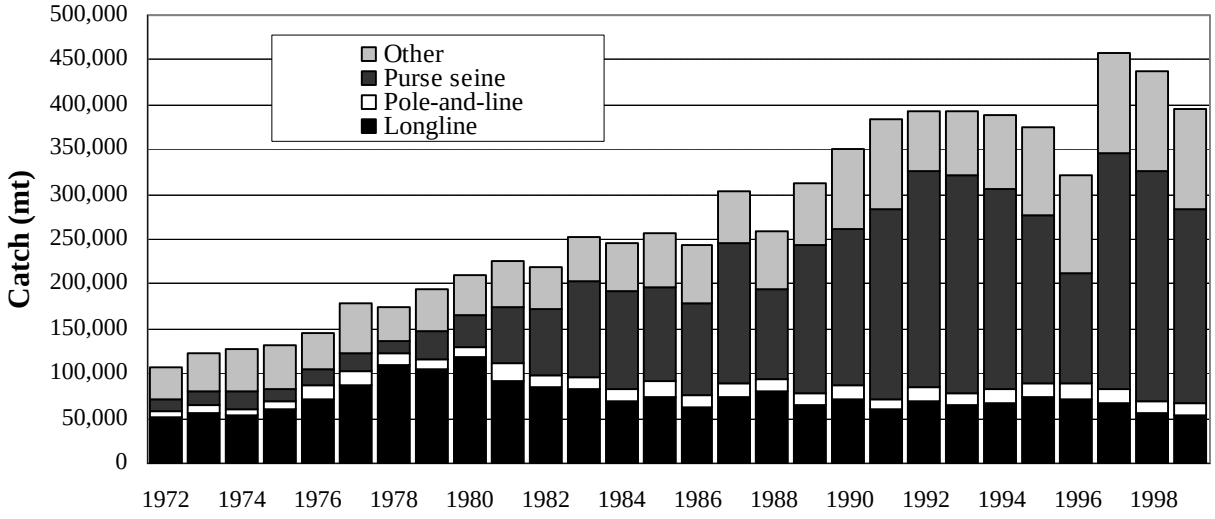

Figure 30. WCPO yellowfin catch (mt) by gear

Figure 31 shows the average distribution of yellowfin in the WCPO for the period 1988–1998 (since longline catch by area is not yet available for 1999). As with skipjack, the great majority of the catch is taken in equatorial areas by purse seine vessels and vessels in the Indonesian and Philippine fisheries.

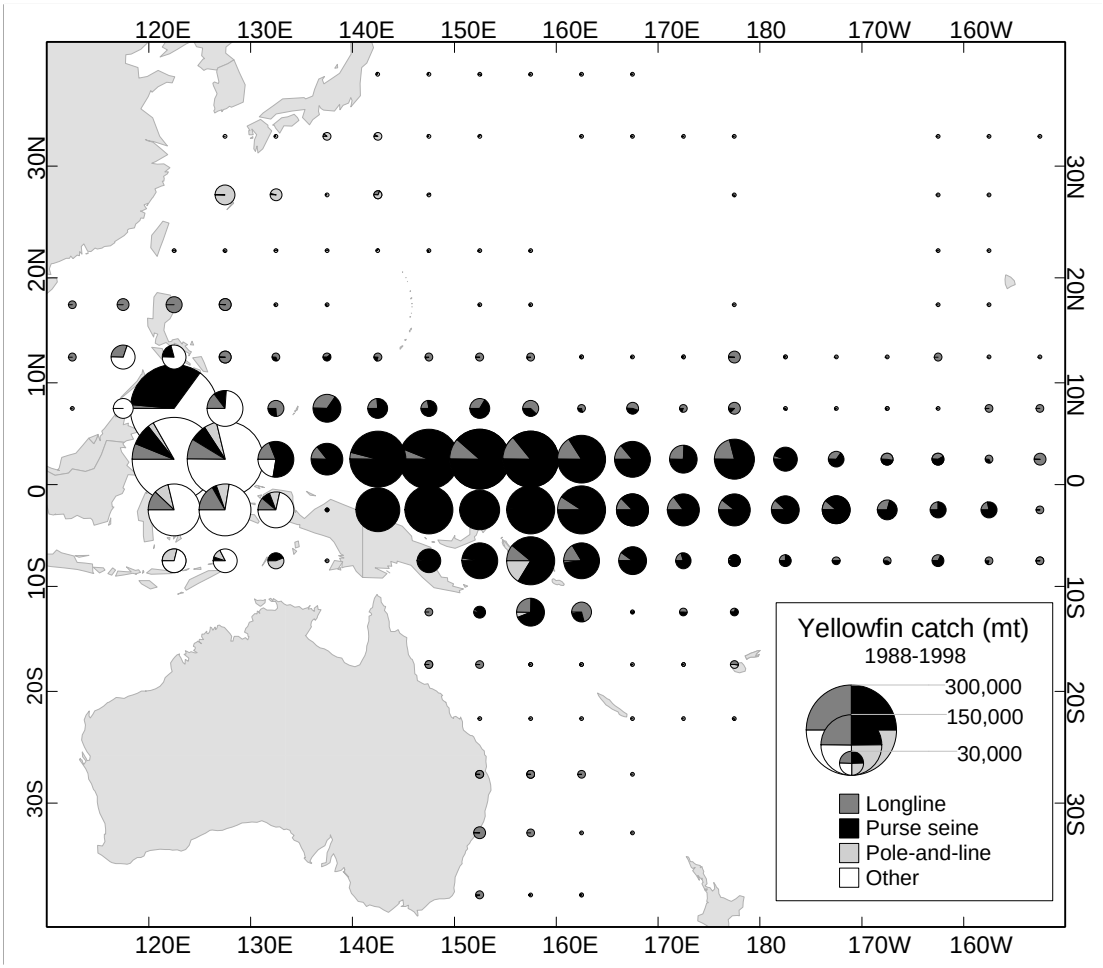

Figure 31. Distribution of WCPO yellowfin catch, 1988–1998

6.2 Catch per unit of effort

Yellowfin purse seine CPUE is characterized by strong interannual variability and differences amongst the fleets. It is suspected that much of this yellowfin variability in the purse seine fishery is due to variation in environmental conditions associated with the El Niño Southern Oscillation (ENSO) cycle. Whilst the nature of these environmental impacts is not fully understood, it is suspected that they could affect both the vulnerability of the stock to purse seining (for example by changing the thermal structure of the ocean or by promoting fish aggregation in certain areas) and the size of the stock itself through impacts on recruitment. In line with this hypothesis, and as seen in previous *La Niña* years (1995–96), the 1999 yellowfin CPUE declined from the recent highs experienced in the *El Niño* years of 1997–1998 (Figure 32).

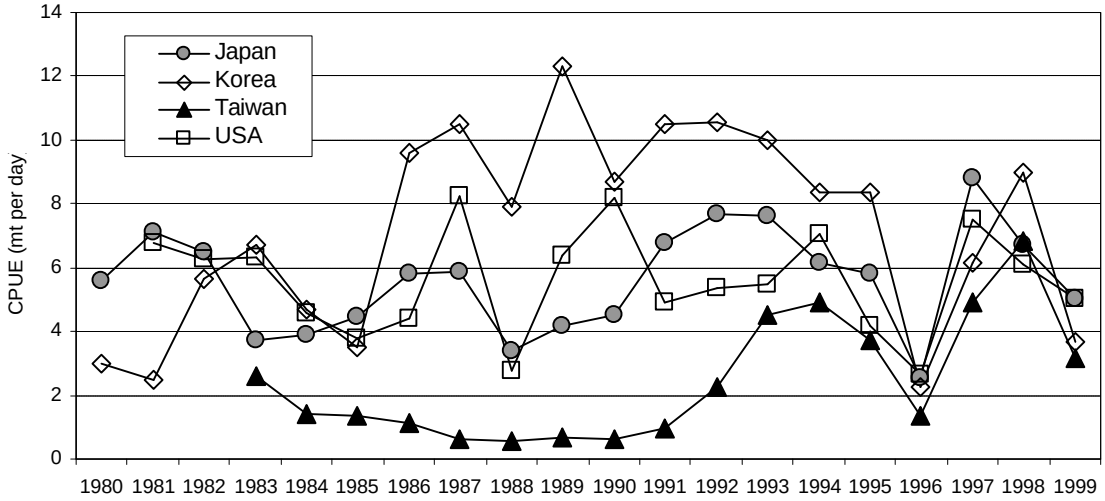

Figure 32. Nominal yellowfin CPUE for the four main purse seine fleets in the WCPO (1999 is preliminary)

Longline catch rates for yellowfin (Figure 33) declined steadily for most fleets during the 1980s, this coinciding both with increased targetting on bigeye and the growth of the purse seine fleets. In recent years, the nominal catch rate has continued to decline for the distant-water fleets of Japan and Korea, and increased slightly for the Japanese fleet based in Micronesia.

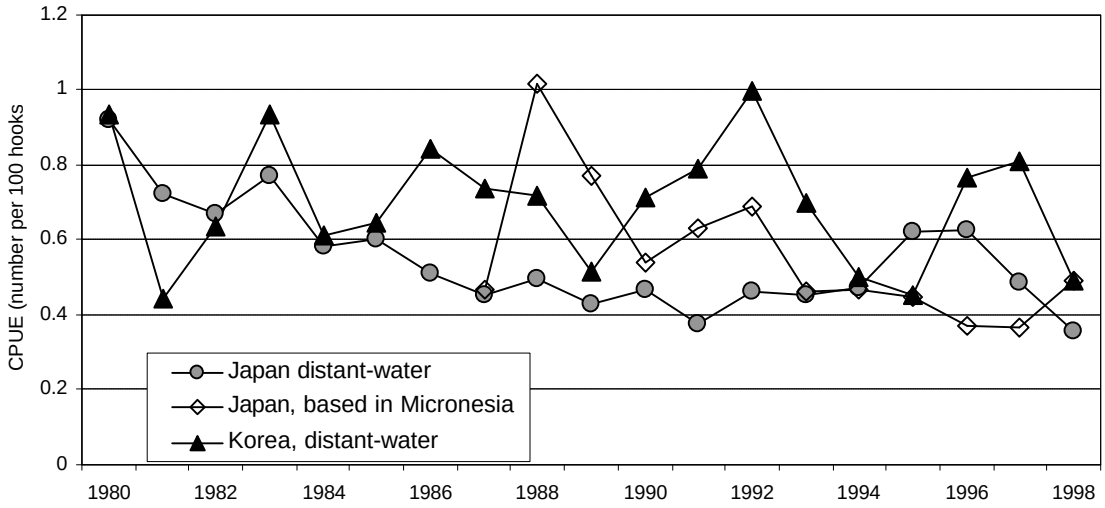

Figure 33. Nominal yellowfin CPUE for selected longline fleets operating in the WCPO

6.3 Size of fish caught

Monthly yellowfin size (fork length, FL) is illustrated for both the longline and purse seine fleet from January 1997 to December 1999 (Figure 34). For the purse seine fleet, lengths are stratified by unassociated and associated sets. Most of the yellowfin measured from the purse seine fishery was sampled from the US fleet under the conditions of the multilateral treaty (USMLT). Note that there are no size composition data available from the Philippine and Indonesian fisheries, where small fish in considerable quantities are normally taken. Associated sets usually contain smaller yellowfin than unassociated sets. In 1997, yellowfin larger than 70 cm FL were more frequent in associated sets. The larger size classes in 1997 resulted when the US fleet was distributed farther to the east

due to *El Niño* conditions. Conversely, when the US fleet was fishing in the western Pacific in 1998 (with the onset of a *La Nina* event), yellowfin from associated sets were represented by a single size mode with few large (>70 cm FL) fish. Yellowfin sizes in unassociated sets are usually larger and more variable than in associated sets. Unassociated sets comprise yellowfin mixed with skipjack of similar size or just large yellowfin. Since mid-1997 to the end of 1998, unassociated sets appear to contain a higher proportion of large yellowfin.

Yellowfin sampled in the longline fishery by observers and port samplers at various locations in the WCPO are predominantly adult fish (range 80–160 cm FL). Mean size is ~120 cm FL and the progression of length modes showing recruitment into the longline fishery is clearly visible (Figure 34). Yellowfin size in associated sets rarely overlaps with yellowfin size in the longline fishery, and from mid-1997 until the end of 1998, similar sizes were clearly harvested from longline and unassociated purse seine sets. Note the absence of medium-sized (60-100cm) yellowfin in the catches from both the longline and purse seine fisheries during 1998, which may have contributed to the low catches in 1999.

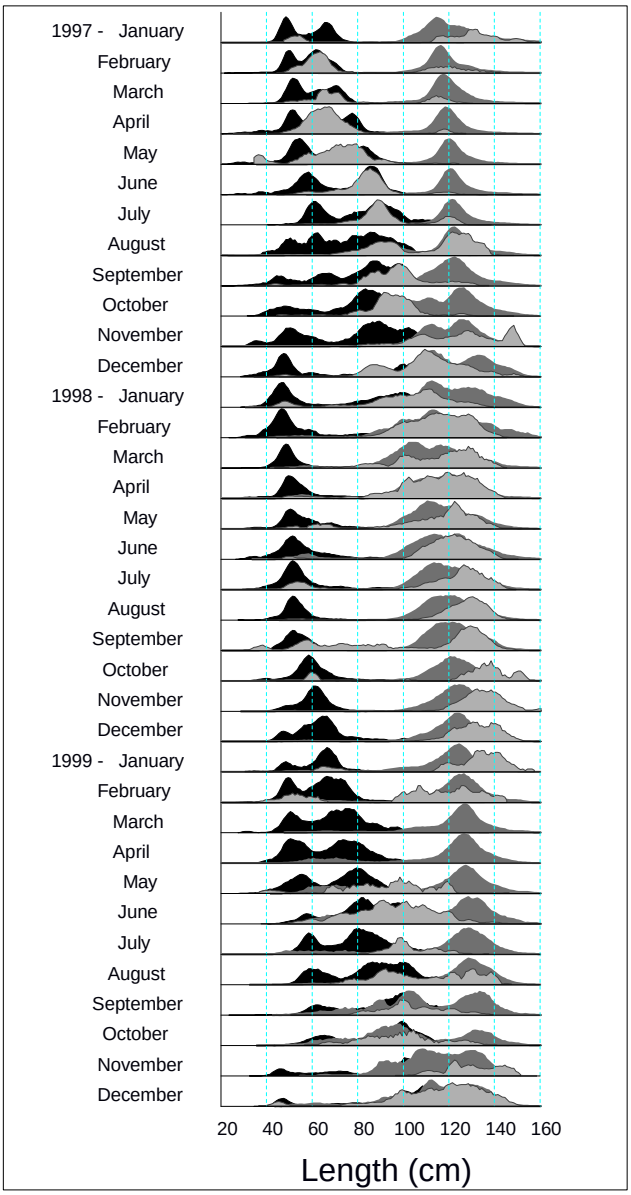

Figure 34. Size comparison of yellowfin sampled from the WCPO longline and purse seine catch, 1997–1999

(**Dark grey shading**: Longline; **Light grey shading**: Unassociated schools catch; **Black**: Associated schools catch)

7. BIGEYE

7.1 Catch

Bigeye tuna are an important component of tuna fisheries throughout the Pacific Ocean, and given the reasonable assumption that Pacific bigeye may comprise a single basin-wide stock, fishery data from the EPO and kindly provided by the I-ATTC are included in this species overview. Bigeye are taken by both surface gears, mostly as juveniles, and longline gear, as valuable adult fish. They are a principal target species of both the large 'distant-water' longliners from Japan and Korea and of the smaller 'fresh sashimi' longliners based in several Pacific Island countries. Prices paid for both frozen and fresh product on the Japanese sashimi market are the highest of all the tropical tunas. Bigeye tuna are the cornerstone of the tropical longline fishery in the western and central Pacific Ocean, the catch of which in the SPC area had a landed value in 1998 possibly approaching US$900 million.

Since 1980, the Pacific-wide *longline* catch of bigeye has varied between 100,000 and 200,000 mt (Figure 35), with Japanese longline vessels generally contributing over 80% of the catch. Longline catch in the eastern Pacific Ocean (EPO), the area east of 150°W and historically the primary bigeye longline fishing area, has varied in the range 50,000–110,000 mt since 1980, surpassing 100,000 mt during two years (1986/87), but has fallen to below 40,000 mt in recent years. In contrast, the longline catch has been typically 40,000–66,000 mt in the western and central Pacific Ocean (WCPO), the area west of 150°W (Figure 36).

Since about 1994, there has been a rapid increase in *purse-seine* catches of juvenile bigeye, first in the EPO and since 1996, and to a lesser extent, in the WCPO. Purse-seine catches in the EPO increased from typical levels of less than 10,000 mt per year to approximately 30,000 mt in 1994, 37,000 mt in 1995 and 52,000 mt in 1996, declined to around 35,000 mt in 1998, but increased again to 42,000 mt in 1999 (Lawson, 2000). The increases in the EPO catch resulted from fishing in largely new or previously lightly fished areas, with different fishing methods ie the use of drifting fish aggregating devices (FADs) to aggregate tuna and deeper purse-seine nets to catch the tuna, mostly bigeye, located deeper in the water column. In the WCPO, purse-seine catches of bigeye are estimated to have been less than 20,000 tonnes per year up to 1996 (Lawson, 2000). By 1997, this catch had increased to approximately 30,000 mt through the adoption of similar fishing techniques to those used in the EPO, before falling to 18,564 mt during 1998. The estimated 1999 WCPO purse seine catch reached a record level of 33,309 mt, mainly as a result of increased fishing on drifting FADs. The US fleet took an estimated 16,673 mt of bigeye in the WCPO during 1999 (Coan et al., 2000), this catch easily exceeding the previous maximum annual catch of slightly under 10,000 mt, taken by this fleet during 1996.

The total 1999 WCPO bigeye catch was an estimated 102,295 mt, just below the record catch of 1997 (104,000 mt), and the total Pacific catch an estimated 181,476 mt, some 13,000 mt below the record 1997 catch, largely due to the drop in the longline catches catch of bigeye in recent years.

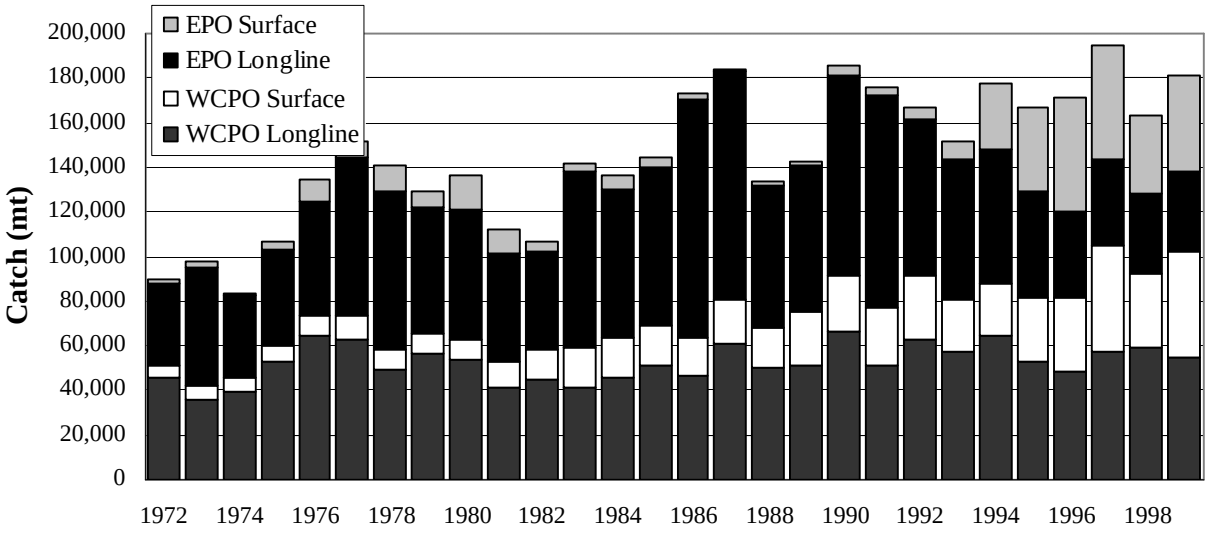

Figure 35. Pacific bigeye catch (mt) by gear

Figure 36 shows the spatial distribution of bigeye catch in the Pacific for the period 1994–1998 (1999 longline data are not yet available). The majority of the WCPO catch is taken in equatorial areas, both by purse seine and longline, but with significant longline catch in some sub-tropical areas (east of Japan, east coast of Australia). In equatorial areas, much of the longline catch is taken in the central Pacific, continuous with an important longline area in the eastern Pacific.

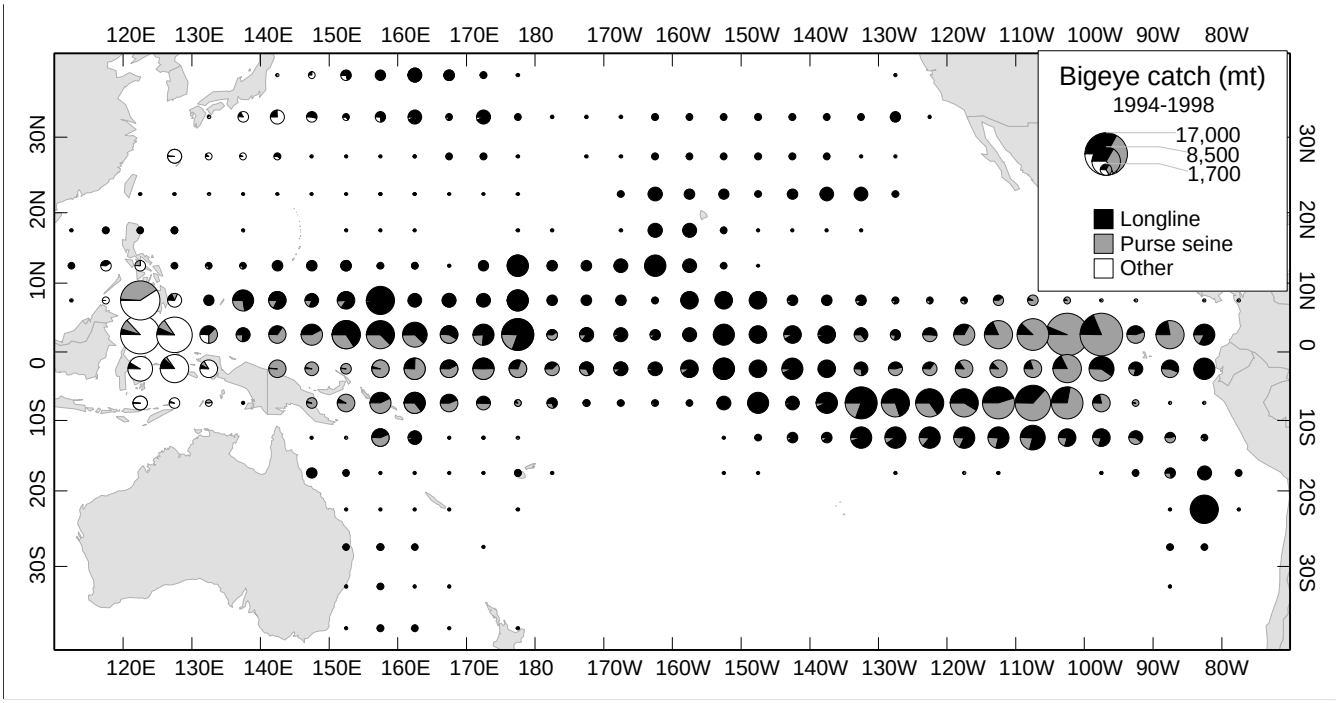

Figure 36. Distribution of bigeye catch, 1994–1998

7.2 Catch per unit of effort

The annual purse seine CPUE for bigeye in the WPCO has been relatively stable, generally varying between 0.1 and 1 mt per day (Figure 37). The dramatic increase in use of drifting FADs and technological changes in recent years (and in particular 1999 – Figure 7) has seen a corresponding increase in bigeye CPUE by fleet (Figure 37).

Trends in nominal bigeye longline CPUE for most fleets have been relatively stable in the WCPO (Figire 38), despite increased targetting of that species. In the EPO, nominal CPUE for the main fleet (Japan) declined throughout the early-mid 1990s, but has since increased in recent years, and still remains higher than those for the WCPO.

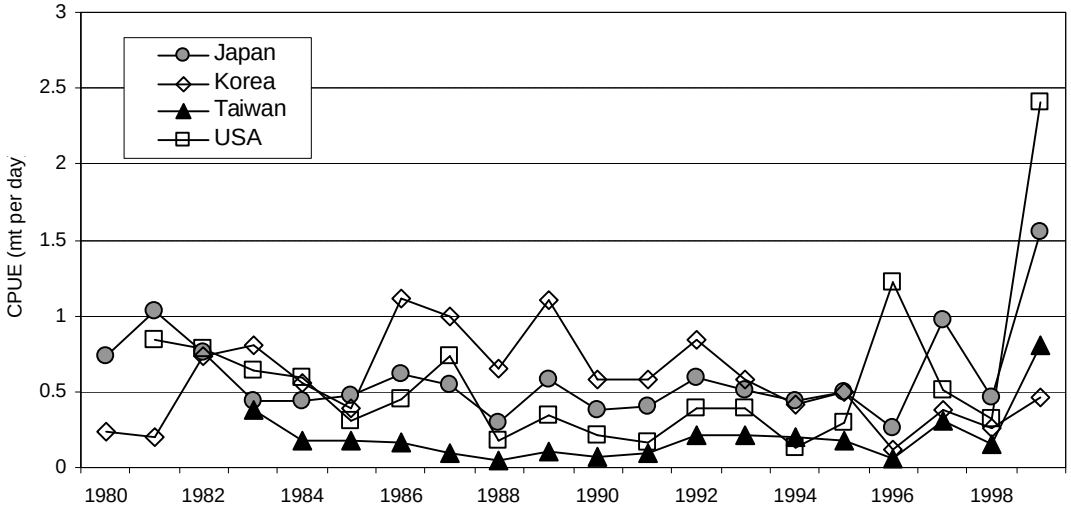

Figure 37. Estimated bigeye CPUE for the four main purse seine fleets in the WCPO

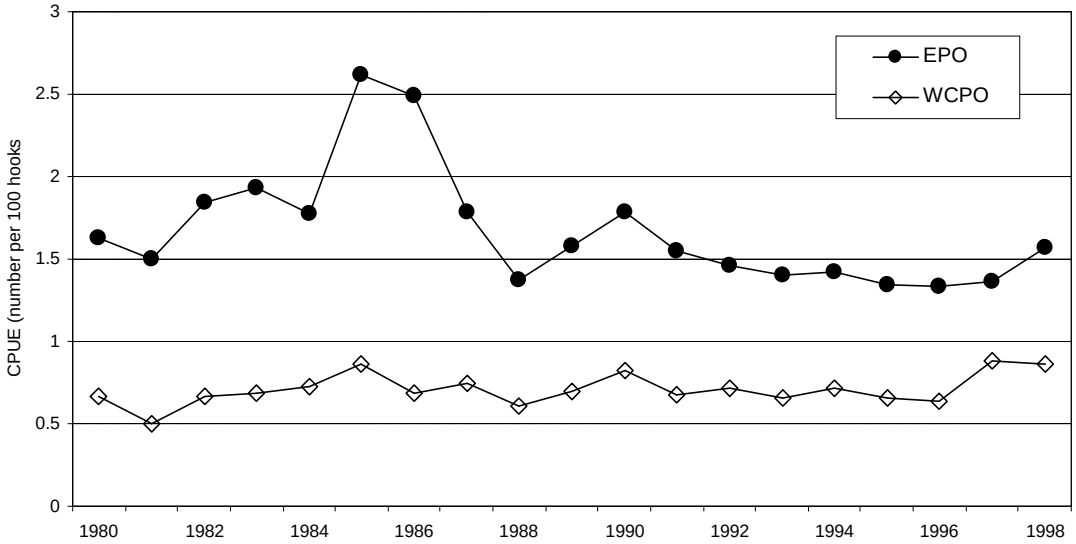

Figure 38. Nominal bigeye CPUE for the Japanese distant-water longliners in the EPO and WCPO

7.3 Size of fish caught

Monthly bigeye size (fork length, FL) is illustrated for both the longline and purse seine fleets from January 1997 to June 1999 (Figure 39). For the purse seine fleet, lengths are only illustrated for associated sets as fewer bigeye occur in, and are measured from unassociated sets. Most of the bigeye measured from the purse seine fishery were sampled from the US fleet under the conditions of the USMLT. Bigeye from associated sets comprised one size mode in 1998, two size modes in 1997 and possibly three size modes by late 1999. Bigeye sampled in the longline fishery are predominantly adult fish with a mean size of ~130 cm FL (range 100–160 cm FL). As with yellowfin (Figure 34), there was an general absence of medium-sized (60–100 cm) bigeye in the longline and purse seine catches during 1998, but this did not have an apparent affect in the longline bigeye catch one year later (i.e. 1999; Figure 35). The progression of length modes of purse seine caught fish is clearly visible throughout the three-year time-series, as is the recruitment of medium-sized fish into the longline fishery in late 1997 and again in late 1999.

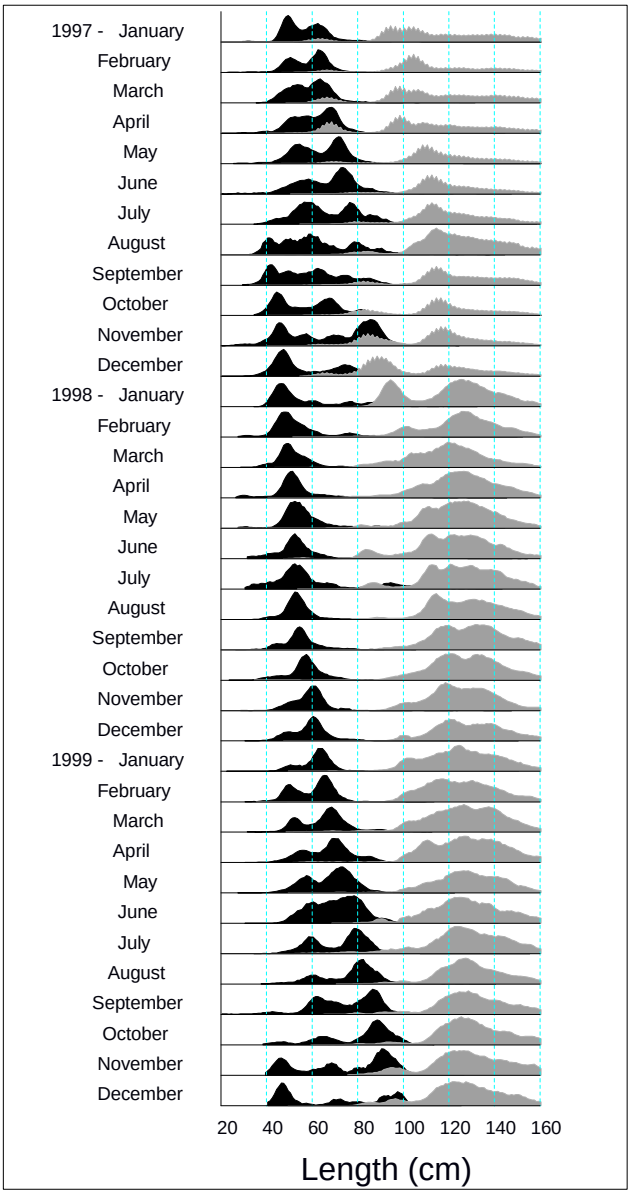

Figure 39. Size comparison of bigeye sampled from the WCPO longline and purse seine catch, 1997–1999

(**Black**: Associated schools catch; **Dark grey**: Longline)

8. SOUTH PACIFIC ALBACORE

8.1 Catches

Albacore catches, taken south of the equator and west of 110^0 W (the former SPAR area) represent less than 40% of the total WCPO catch of albacore (estimated 116,392 mt in 1999).

South Pacific albacore are exploited by a variety of longline fleets, by an international troll fleet operating seasonally in the region of the subtropical convergence zone (STCZ) and by a domestic troll fleet in New Zealand coastal waters. In the 1990s, the longline catch in the South Pacific has been 23,000–38,000 mt, while the troll catch for a season spanning November – April has been in the range 4,000–8,000 mt (Figure 40), with total catches of 31,000–41,000 mt, well below the peak estimated catch of 53,800 mt in 1989, when driftnet fishing was occurring . In 1998, the total catch jumped to 40,805 mt, the highest since 1989 and the third highest on record, mainly as a result of longline catch increases (+ 3,500 mt). The estimated 1999 albacore catch was a slightly less than this at 38,425 mt.

Albacore catch in several Pacific Island countries has increased dramatically in recent years. Both Samoa and French Polynesia had domestic catches of around 2,500 mt of albacore in 1995, with the Samoan catch increasing to 4,042 mt in 1998 and the French Polynesian catch to 3,189 mt. This represents a large increase in albacore production compared to the early 1990s when albacore catch was less than 200 mt per year in French Polynesia and virtually non-existent in Samoa. The 1999 albacore catches by these fleets were slightly less than the 1998 catches (French Polynesia–2,580 mt; Samoa–3,422 mt).

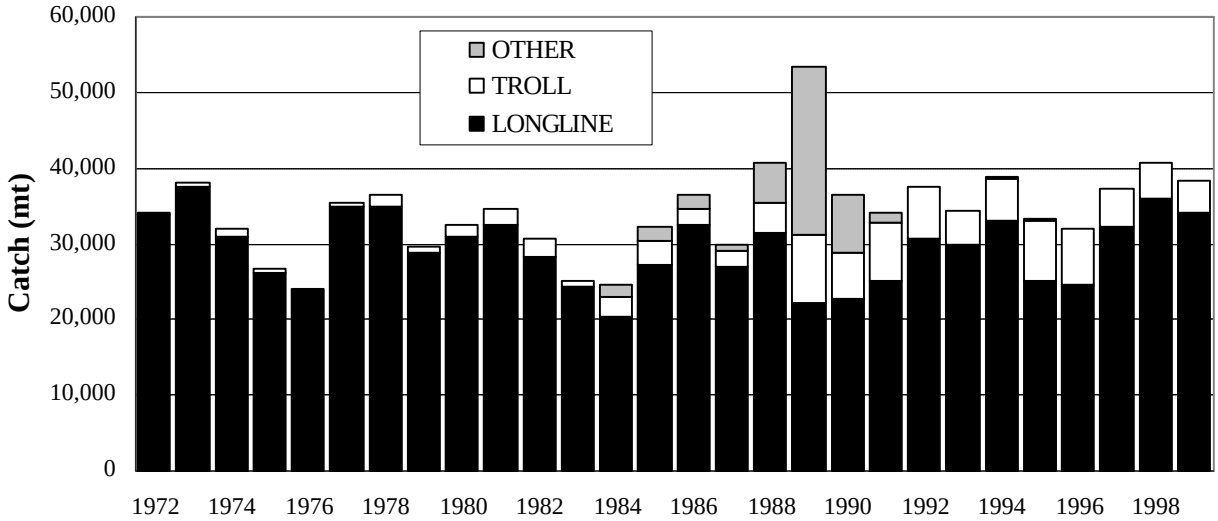

Figure 40. South Pacific albacore catch (mt) by gear ("Other" is primarily catch by the driftnet fishery.)

The longline catch by DWFN fleets, primarily Taiwan, is widely distributed in the South Pacific (Figure 41), but with catches concentrated in the western part of the region (west of 130^0W). Catches by domestic longline fleets in Samoa, French Polynesia, Fiji, Solomon Islands, Tonga, and New Caledonia, and the Japanese fleet east of Australia, also contribute significantly to this wide geographical catch distribution. Troll catches are distributed in New Zealand coastal waters, mainly in the South Island, and along the SCTZ**.**

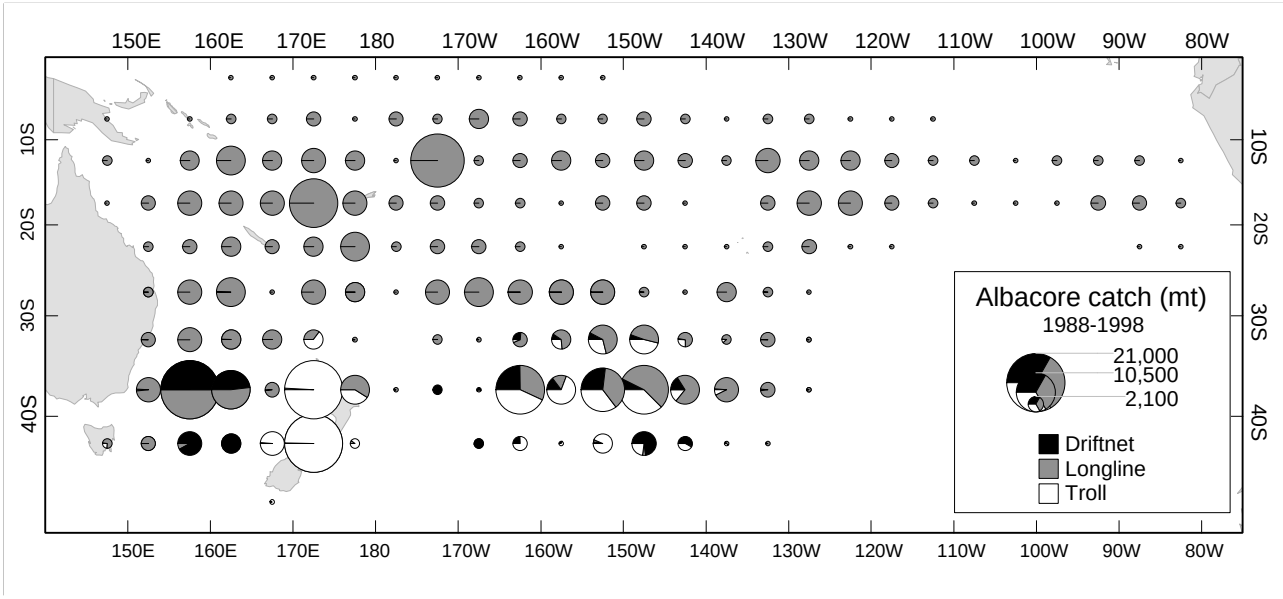

Figure 41. Distribution of south Pacific Albacore catch 1988–1998.

8.3 Catch per unit of effort

The key fishery indicators for south Pacific albacore are longline catch per unit effort (CPUE) and troll CPUE. For the longline fishery, data from the Taiwanese distant-water fleet (Figure 42) are generally used as this fleet has consistently targeted albacore over a long period of time; Japanese longline CPUE is also included for comparison. Longline CPUE (numbers of fish) is typically highest in the higher latitudes (STCZ and 30–50°S), moderate in the tropics and subtropics (10–30°S) and low near the equator (0–10°S). For each of the two main latitudinal areas, longline CPUE has increased in the 1990s after a low point in 1989–1990. Preliminary data for 1999 suggests that nominal CPUE appears to have decreased slightly in the 30°–50°S latitude band, with a corresponding increase in the 10°–30°S latitude band.

Several other longline fleets catch significant quantities of albacore while targeting yellowfin and bigeye tuna, but there is considerable variation in CPUE among these fleets. The New Caledonian and Tongan fleets have the highest albacore CPUE due to fishing at subtropical latitudes south of 20°S.

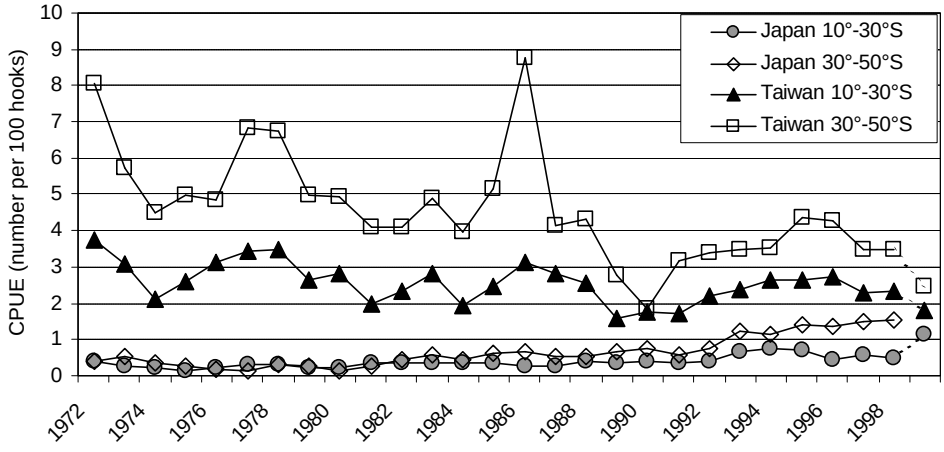

Figure 42. Nominal South Pacific albacore CPUE (number/100 hooks) by longline fleet (1999 is provisional)

The troll fishery CPUE for the New Zealand (NZ) domestic fleet tended to increase during the 1980s, but has been relatively stable during the 1990s (Figure 43). CPUE for the USA fleet operating in the STCZ is generally higher, but more variable, indicating possibly a greater impact of environmental variation on the ability of this fleet to locate and catch albacore.

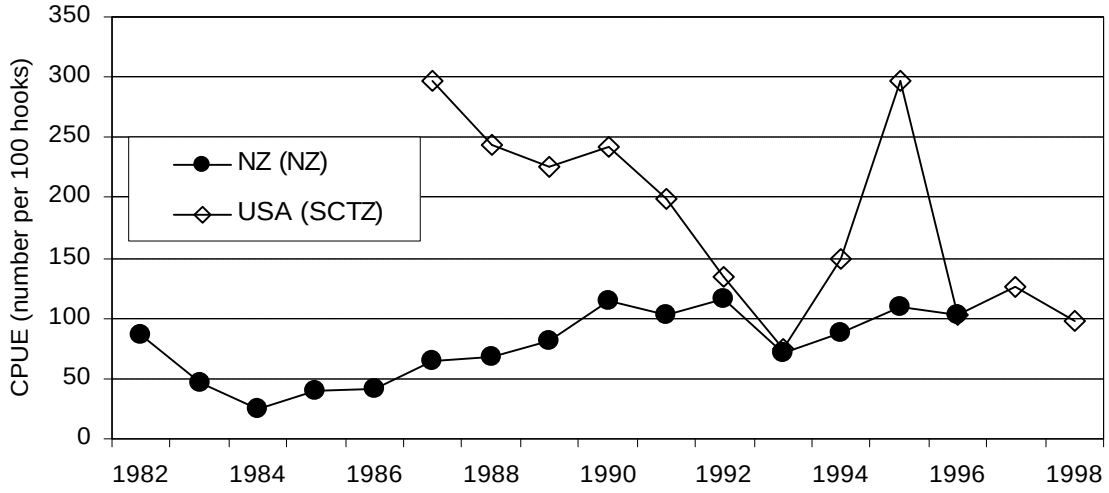

Figure 43. South Pacific albacore CPUE (number/day) for the NZ troll fleet (operating in NZ coastal waters and the USA troll fleet (operating east of 180° along the STCZ)

8.3 Size of fish caught

Size composition data of South Pacific albacore are derived primarily from port sampling. Monthly albacore length frequencies from the troll and longline fishery are illustrated from January 1997 to December 1999 (Figure 38). Albacore from the troll fishery are measured in New Zealand ports (1997–1999 domestic fishing data). The troll fishery usually operates during the summer (January – March) and typically lands albacore between 45 and 80 cm FL (Figure 44), with modal structure differing considerably between years.

Longline caught albacore are measured in various port in the SPC region (e.g. American Samoa, Fiji, French Polynesia, New Caledonia, Samoa and Tonga). Usually a single multiple-age class length mode is evident throughout the year. Albacore are often smaller (~75 cm FL) during winter (April – September) than during other months of the year (~95–100 cm FL), this differing size composition within the year reflecting spatial changes in fleet distribution (smaller fish caught in temperate waters).

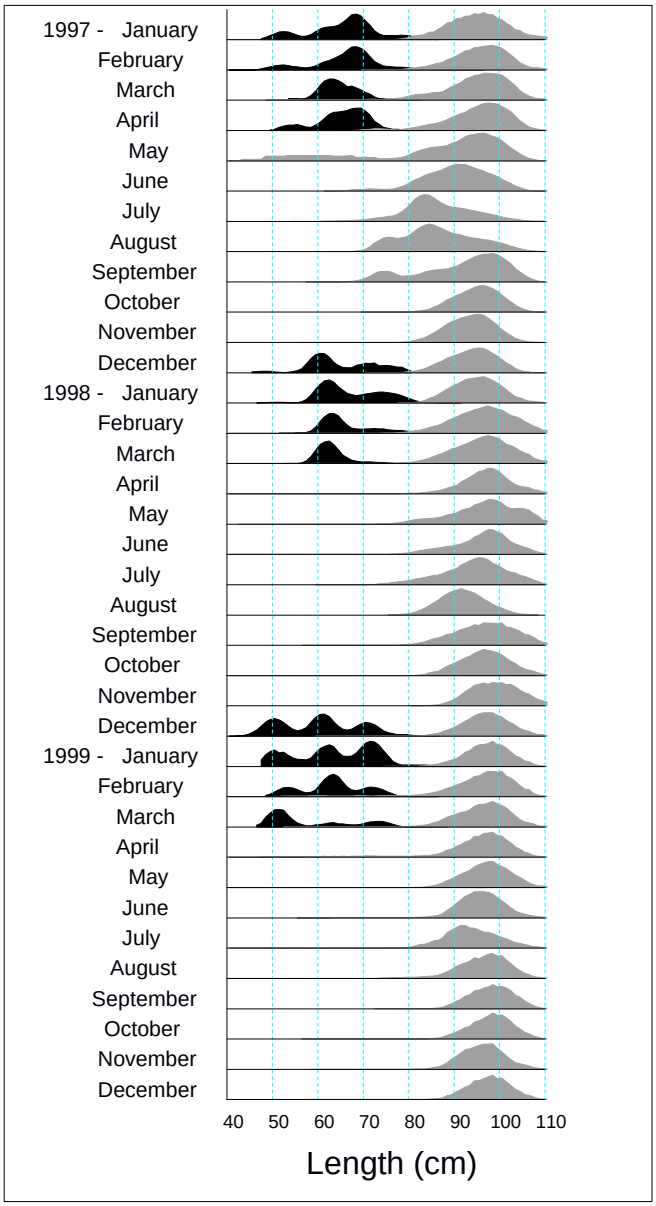

Figure 44. Size comparison of albacore sampled from the south Pacific longline and troll catch, 1997–1999

(**Black:** Troll; **Grey**: Longline)

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