OVERVIEW OF YELLOWFIN FISHERIES IN THE WESTERN AND CENTRAL PACIFIC OCEAN – 2002

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1. Introduction

Yellowfin tuna (*Thunnus albacares*) are an important component of tuna fisheries throughout the western and central Pacific Ocean (WCPO) and represent over 30% of the global catch of the species. They are harvested with a diverse 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. Yellowfin usually represent ~20–25% of the overall purse seine catch and may contribute a higher percentage of the catch in individual sets. Yellowfin are often directly targetted by purse seiners, especially as unassociated schools.

This paper provides a brief overview of the WCPO yellowfin fisheries. Where possible, emphasis is made to catches taken during 2002 with comparison to catches taken in recent years.

2. Catch estimates

Since 1990, the total yellowfin catch in the WCPO has varied between 320,000–500,000 mt (Figure 1). The 1998 catch in the WCPO was the largest on record (502,960 mt). The elevated total catch in this year (and in 1997) followed the lowest catch for ten years in 1996 as a result of greatly reduced purse seine catches. The 2002 catch for all gears in the WCPO (437,984 mt) was the lowest since 1996, and almost on par with the EPO catch (427,664 mt) for 2002. The relatively low catch of yellowfin in the WCPO during 2002 is considered unusual for an El Nino event. The 2002 Pacific-wide yellowfin catch (all gears) of 865,648 mt was slightly down on the record catch of 2001 (884,514 mt).

In the WCPO, purse seine typically harvests the majority of the yellowfin catch, which for 2002 was 171,767 mt (or 39% of the total yellowfin catch). This catch level was the lowest since 1996 and the second lowest annual catch over the past decade. In contrast, the eastern Pacific (EPO) purse seine catch of yellowfin (417,472 mt) for 2002 was an all-time record and continued on from the good catches experienced during 2001.

The WCPO longline catch in recent years (53,000–80,000 mt) is well below catches in the late 1970s to early 1980s (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. The 1999 yellowfin catch of 60,414 mt was the lowest for nearly 25 years, but catches have been progressively higher in subsequent years. The 2002 catch was 77,177 mt, or 18% of the catch for all gears.

![Figure 1. WCPO yellowfin catch (mt) by gear](image-url)
The pole-and-line fisheries took 17,770 mt (4% of the total yellowfin catch) during 2002, and 'other' category accounted for 171,270 mt (which was 38% of the total catch for all gears). Catches in the 'other' category are largely composed of yellowfin taken by various assorted gears (e.g. ring net, bagnet, gillnet, handline and seine net) in the domestic fisheries of the Philippines and eastern Indonesia.

### 3. Distribution of catch

Figure 3 shows the average spatial distribution of yellowfin catch by gear type for the period 1990–2001, and the spatial distribution of the 2002 catch for the purse seine gear only (catch data by area for the other gears are not complete for 2002). As with skipjack, the great majority of the catch is taken in equatorial areas by large purse seine vessels, and a variety of gears in the Indonesian and Philippine fisheries. The distribution of yellowfin catch at the eastern equatorial boundary of the WCPO during 2002 was noticeably higher than the average distribution over the past decade, and no doubt related to the record catch experienced in the EPO for that year.

![Figure 2. Distribution of WCPO yellowfin catch for 1990–2001 (left) and the 2002 purse seine yellowfin catch (right). The five-region spatial stratification used in stock assessment is shown.](image)

The east–west distribution of catch is strongly influenced by ENSO events, with larger catches taken east of 160°E during El Niño episodes. Figure 3 highlights the inter-annual variation in the distribution of purse-seine yellowfin catch by set type in recent years. During recent El Nino years, most of the yellowfin catch to the east of 160°E was taken from unassociated schools, with logs sets accounting for most of the remainder. In contrast, during recent La Nina years, drifting FADs were widely used east of 160°E and took a significant proportion of the total purse seine catch of yellowfin. Anchored FADs are an important component of the PNG domestic purse seine fishery taking mainly juvenile skipjack and yellowfin. Note the relatively poorer catches of yellowfin between 160°E–180° during 2002 compared to the previous years, despite substantial effort in this area during 2002 (see WP GEN–1).

### 4. Catch per unit of effort

Yellowfin purse seine CPUE is characterized by strong inter-annual variability and differences amongst the fleets (Figure 4). School-set CPUE is strongly related to ENSO variation in the WCPO, with CPUE generally higher during El Niño episodes. This is believed to be related to increased catchability of yellowfin tuna due to a shallower surface mixed layer during these periods. ENSO variability is also believed to impact the size of yellowfin and other tuna stocks through impacts on recruitment. In line with

During 2001, the yellowfin CPUE increased in line with the weakening of *La Niña*. However, yellowfin CPUE for all set types declined in 2002 compared to 2001, for all but the US fleet. The US purse seine fleet effort for 2002 was concentrated more eastwards than the other purse seine fleets (see WP GEN–1) into an area where oceanographic conditions may have improved the availability of yellowfin to the gear. The 2002 effort by the other purse seine fleets does not appear to have extended as far east as in the previous El Nino event (1997–1998) and could therefore explain the poor yellowfin catch rates for these fleets during 2002.

![Figure 3. Distribution of purse-seine yellowfin catch by set type, 1998–2002 (Solid–Unassociated; Grey–Log; Striped–Drifting FAD; Dots–Anchored FADs). ENSO periods are denoted by “+”: La Niña; “-”: El Niño; “--”: strong El Niño; “0”: transitional period.](image-url)
Figure 4. Yellowfin tuna CPUE (mt per day) by major set-type categories (free-school, log and drifting FAD sets) and for all sets combined for Japanese, Korean, Taiwanese and US purse seiners fishing in the WCPO. Effort and CPUE were partitioned by set type according to the proportions of total sets attributed to each set type.

The distant-water longline fishery, which has operated since the early 1950s, provides another means of monitoring changes in yellowfin tuna abundance. As longliners target larger fish, the CPUE time series should be more indicative of adult yellowfin tuna abundance. However, as with purse-seine CPUE, the interpretation of longline CPUE is confounded by various factors, such as the changes in fishing depth that occurred as longliners progressively switched from primarily yellowfin tuna targeting in the 1960s and early 1970s to bigeye tuna targeting from the late 1970s on. Such changes in fishing practices will have changed the effectiveness of longline effort with respect to yellowfin tuna, and such changes need to be accounted for if the CPUE time series are to be interpreted as indices of relative abundance.
Time series of nominal CPUE and standardised CPUE (catch per unit of ‘effective’ effort) for the five regions used in yellowfin stock assessment (Hampton and Kleiber, 2003) are shown for all longline fleets in Figure 5. "Effective” or standardised effort is determined and used to account for factors that are understood to affect the availability of yellowfin to the longline gear. For example, habitat-based studies account for the effects of changes in targeting as well as the variation in environmental parameters that define yellowfin tuna habitat. The following standardised effort series have been used to produce the three standardised CPUE time series shown in Figure 5: (1) a general linear model (GLM - Langley 2003); (2) a deterministic habitat-based standardisation (HBS - Bigelow et al. 2003); and (3) an unconstrained statistical habitat-based standardisation (statHBS - Bigelow et al., 2003).

The following basic observations were drawn from these data (Figure 5), bearing in mind that this is only one type of information that is more appropriately considered in the comprehensive stock assessment work that follows (e.g. WP RG–3; Bigelow et al., 2003 and WP YFT–1: Hampton and Kleiber, 2003). The trends in standardised GLM CPUE follow the trends in nominal CPUE throughout, although the GLM CPUE is generally lower in the years prior to the change in targeting practice from yellowfin to bigeye (i.e. pre–1980), and generally higher than the nominal CPUE in the years since, when effective effort was directed away from yellowfin. The nominal and GLM-standardised CPUEs have been generally stable in most regions over the past twenty years, except Region 2 and to a lesser extent Region 3 (the areas accounting for most of the catch), which exhibit a steady decline in both measures over this period. In contrast to nominal and GLM standardised CPUEs, the trends in the habitat-based standardised CPUEs are generally flatter over the entire time series for all regions (for example, while there is a declining trend in the habitat-based standardised CPUEs in Region 2 over the past two decades, it is not as pronounced as in the nominal and GLM CPUEs). The habitat-based standardised CPUEs increased in the late 1970s compared to the years in the decade prior to this. This change corresponds to the period when effort was directed away from yellowfin, and in several regions, this new higher level has been sustained since.

5. Size of fish caught

Figure 6 shows annual yellowfin catch-at-size graphs for the main fishing gears taking yellowfin in the WCPO over the period 1997–2001 and Figure 7 shows quarterly yellowfin catch at size graphs for the period 2000–2001 (2002 data are not yet complete).

The domestic surface fisheries of the Philippines and Indonesia take large quantities of small yellowfin in the range 20–50 cm. Purse seine sets on floating objects (i.e. associated schools) generally take smaller fish than sets on unassociated or free-swimming schools, which are often 'pure' schools of large yellowfin. The size ranges of the yellowfin taken in associated and unassociated purse seine sets vary from year to year. For example, there were larger fish in the catch from associated sets in 1999 than in 1997, and smaller fish (< 100 cm) in the catch from unassociated sets in 1997 and 2001 than the other years presented here. The relatively high proportions of yellowfin taken from associated purse-seine sets during 1997, and again in 1999, correspond to years of strong recruitment, with the age class of fish taken in these years present as larger fish taken in unassociated purse seine sets and the longline fishery in the following years (i.e. 1998 and 2000, respectively). Yellowfin taken in unassociated purse-seine sets are of a similar size range to fish taken in the longline fishery and the handline fishery in the Philippines (both gears target adults in the range 80–160 cm). The purse-seine catch of adult yellowfin tuna is in fact higher than the longline catch in most years.

Figure 7 shows several instances of modal progression, for example, the mode at 55cm in the associated set catch in the first quarter 2001 can be followed in successive quarters, and also appears in the unassociated set catch by the 3rd and 4th quarters of 2001. There is a relative absence of medium-sized (60–100cm) yellowfin in the catches from both the longline and purse seine fisheries during most quarters of 2000 and 2001, although a "pulse" in this size range appears by the 4th quarter 2001. The absence of fish in this size range has also occurred in other years (e.g. 1998) and is perhaps explained by being a phase of the life cycle when this species is fast-growing and (for one reason or another) less available to these gears.
Figure 5. Nominal and standardised yellowfin tuna CPUEs for all longline fleets combined stratified by yellowfin stock assessment region.

The three different standardised CPUE methodologies presented here are described in Hampton and Kleiber (2003).
Figure 6. Annual Yellowfin tuna catch-at-size in the WCPO, 1997–2001.

The catch is broken down into the Indonesian/Philippines domestic fisheries component (black), the longline fishery component (hatched), unassociated-set catch from the purse-seine fishery (grey) and associated-set catch from purse-seine fishery (dotted). The y-axis scale is in weight – the figures on the right indicate the catch weight in a 2-cm size class.

Figure 7. Quarterly Yellowfin tuna catch-at-size in the WCPO, 2000–2001.

The catch is broken down into the Indonesian/Philippines domestic fisheries component (black), the longline fishery component (hatched), unassociated-set catch from the purse-seine fishery (grey) and associated-set catch from purse-seine fishery (dotted). The y-axis scale is in weight – the figures on the right indicate the catch weight in a 2-cm size class.
REFERENCES


