NSW Gamefish Tournament Monitoring – Angling Research Monitoring Program. Final report to the NSW Recreational Fishing Trust.

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4.8. Spatial catch, effort and CPUE distribution

Each tournament chart is subdivided into a system of grids identified with an alphanumeric code. When the tournament charts were compiled the grids were non-systematic, and where charts overlapped the grids were of differing sizes and centroid locations. Some tournament charts had grids that varied in size over the chart. To ensure consistency in comparing areas covered by tournaments, sched data were aggregated to $\frac{1}{4} \times \frac{1}{4}$ degree grids of latitude and longitude.

The effort, catch and CPUE per $\frac{1}{4} \times \frac{1}{4}$ degree grids are illustrated for the 2000/01 – 2004/05 seasons combined in the following figures. This gives five years of relatively consistent monitoring coverage for comparison. Vessels were aggregated to those targeting billfish and those targeting sharks for effort and CPUE calculations.

Effort was calculated as hours fishing. Scheds were not uniform in duration among tournaments. Thus effort was determined by multiplying the number of scheds reported by the duration of each completed sched for that grid. To calculate the duration to the first sched of the day, the time from the tournament start of fishing was used. Only those scheds that a vessel reported for were used. Potential errors include that vessels may cover more than one grid location in a sched period; there is also some potential bias in the last sched as most vessels would be reporting as they travel to port, rather than where they have been fishing. Those that reported they were travelling were excluded.

CPUEs were calculated by number of fish caught or tagged per vessel-hour per $\frac{1}{4} \times \frac{1}{4}$ degree. To standardise for large CPUEs representing unusual capture events in areas of low effort, those grids in which there was very low effort were filtered out. For billfish targeting this was done for grids with less than 20 hours effort, for shark fishers this was for grids with less than 10 hours fishing.

4.8.1. Targeted effort

Most effort by billfish fishers was in the waters southeast of Port Stephens (6,988 hours at grid centred 32.875S, 152.625E) (Figure 29A). This is attributed to the scale of the Port Stephens Interclub tournament where there are approximately 230 vessels fishing four days in the peak period of a fishing season. There were also high levels of fishing effort off the south coast from Ulladulla to Bermagui (3,203 hours at grid 36.375S, 150.375E). Billfish effort tended to be concentrated along or inside the continental shelf edge (Figure 29A).

Shark effort was also highest in the Port Stephens area due to the Interclub tournament (Figure 29B). A grid southeast of Port Stephens, centred on 32.875S, 152.625E had 1,084 reported hours fishing; the same grid as the highest recorded billfish effort. Shark fishing effort was relatively high in the Central Zone, particularly in the Botany Bay to Wollongong area (Figure 29B). Shark fishing effort was highest along the continental shelf edge, although effort targeted at sharks had a larger proportion beyond the continental shelf, along the upper continental slope and further offshore than did fishers who targeted billfish.

4.8.2. Billfish

Striped marlin were mostly caught in waters off Port Stephens and Ulladulla. A total of 160 were caught south of Port Stephens in grid centred at 33.125S, 152.375E, while the continental shelf edge east of Ulladulla had 113 striped marlin reported caught (grid 35.375S, 150.875E) (Figure 30A). Most striped marlin were caught along the shelf edge and continental slope. Catch rates appeared to be similar for the central to south NSW coast, with the oceanic waters east of Broken
Bay having had the highest catch rate of 0.053 striped marlin per hour (Figure 30B). Catch rates tended to be highest in oceanic waters beyond the continental shelf.

Black marlin catches were concentrated in the shelf waters southeast of Port Stephens (Figure 31A). The largest number recorded per grid for the five seasons was 214 at grid centred 33.125S, 152.375E. Relatively few black marlin were caught elsewhere. Small black marlin were targeted by anglers at the Interclub because of their numbers in certain years and the high points awarded for tagged marlin. Catch rates appeared relatively uniform around Port Stephens though black marlin are notable among the marlin in having high catch rates mostly within the continental shelf waters (Figure 31B).

Blue marlin catches were relatively low and diffuse (Figure 32A). The highest number of blue marlin caught per grid (34) was southeast of Port Stephens in the same grid as the highest catches of the other marlins, grid 32.875S 152.625E. The CPUE for blue marlin was relatively low and very dispersed along the coast. Blue marlin catch rates were highest beyond the shelf and the highest CPUE was in grids farthest from the coast (Figure 32B).

4.8.3. Sharks

Tiger shark catches were highest off Sydney from Broken Bay to Port Hacking (Figure 33A). Though the overall numbers were relatively low with the largest catch (23) on the shelf edge east of Broken Bay (grid centroid 33.375S 152.125E). Catches of tiger sharks were greatest along the upper continental slope. Catch rates were also highest along the continental slope and in particular the continental slope off Broken Bay (Figure 33B).

Mako sharks were predominantly caught in the waters from Sydney to Ulladulla and in particular the waters east of Wollongong (27 were reported caught in the grid centred on 34.375S, 151.375S). Most mako sharks were caught from continental shelf and slope waters (Figure 34A). The catch rates of mako sharks were also highest in the area from Sydney to the south coast, particularly in the Wollongong region (Figure 34B). Mako shark catch rates were high on the continental shelf as well as continental slope waters.

Blue shark catch numbers were relatively low along the coast; the main catches were between Port Hacking to Wollongong (Figure 35A). The largest number (10) was caught east of Wollongong in 34.375S, 151.375E. Catch rates for blue sharks were also highest in the Wollongong area in oceanic waters beyond the shelf (Figure 35B).

The catches of hammerhead sharks in the five seasons were relatively low and scattered along the whole coast, the largest catch (3) was southeast of Port Stephens (grid centred at 32.625S 152.625E) (Figure 36A). The low catch numbers and their broad distribution make the catch rates of hammerheads diffuse (Figure 36B).

4.8.4. Sportfish

Catches of yellowfin tuna were distributed along the coast and greatest in the far north east of Coffs Harbour (244 in grid centred at 30.375S 153.375E) and in the far south, southeast of Bermagui (193 in grid at 36.625S, 150.375E) (Figure 37A). Catch rates were relatively similar in most areas of the coast that were monitored, but highest in the far south and far north and low around Port Stephens and Port Macquarie waters. Catch rates were highest in offshore waters beyond the continental shelf (Figure 37B).

Mahi mahi catches were highest in continental waters due east of Port Stephens (425 reported to be caught in 32.625S 152.375E) (Figure 38A). Catch rates of mahi mahi were highest in the Central
Zone and mostly in continental shelf waters (Figure 38B). This can most probably be attributed to their association around NSW DPI Fish Attracting Devices (FADs) and other fish attracting items such as trap floats.

Albacore catches and catch rates were concentrated in the far south coast between Bermagui and Eden, closely associated with the continental slope (Figure 39A). The seasons illustrated were a period of relatively low albacore catches (Figure 39B).

Kingfish were caught all along the coast though the largest catches were in near-shore waters along the south coast in areas with prominent coastal features such as around Shellharbour (75 at 36.375°S 150.125°E), Greenwell Point and Bermagui (Figure 40A). Port Stephens and Coffs Harbour were the locations of catches on the north coast. Catch rates appeared highest in the Central Zone (Figure 40B).
Figure 29. Spatial distribution of directed effort in hours: A) Billfish directed effort; and, B) Shark fishing directed effort.
Figure 30. Striped marlin $\frac{1}{4} \times \frac{1}{4}$ degree distribution of: A) tournament catch as number of fish reported; and, B) CPUE as number of fish reported per vessel-hour for the five fishing seasons 2000/01 – 2004/05. CPUE calculations have grids with less than 20 hours excluded.
Figure 31. Black marlin distribution of: A) tournament catch as number of fish; and, B) CPUE as number of fish per vessel-hour for 2000/01 – 2004/05 fishing seasons. CPUE calculations have grids with less than 20 hours excluded.
Figure 32. Blue marlin distribution of: A) tournament catch as number of fish reported; and, B) CPUE as number of fish reported per vessel-hour. Data are for the five fishing seasons 2000/01 – 2004/05 aggregated to ¼ x ¼ degree latitude and longitude. CPUE calculations have grids with less than 20 hours excluded.
Figure 33. Tiger shark distribution of: A) tournament catch as number of fish; and, B) CPUE as number of fish per vessel-hour for 2000/01 – 2004/05 fishing seasons. CPUE calculations have grids with < 10 hours excluded.
Figure 34. Mako distribution of A) tournament catch as number of fish reported and B) CPUE as number of fish reported per vessel-hour. Data are for the five fishing seasons 2000/01 – 2004/05 aggregated to $\frac{1}{4} \times \frac{1}{4}$ degree latitude and longitude. CPUE calculations have grids with < 10 hours excluded.
**Figure 35.** Blue shark distribution of: A) tournament catch as number of fish; and, B) CPUE as number of fish per vessel-hour for 2000/01 – 2004/05 fishing seasons. CPUE calculations have grids with less than 10 hours excluded.
Figure 36. Hammerhead shark distribution of: A) tournament catch as number of fish reported; and, B) CPUE as number of fish reported per vessel-hour. Data are for the five fishing seasons 2000/01 – 2004/05 aggregated to ¼ x ¼ degree. CPUE calculations have grids with less than 10 hours excluded.
Figure 37. Yellowfin tuna distribution of: A) tournament catch as number of fish; and, B) CPUE as number of fish per vessel-hour for 2000/01 – 2004/05 fishing seasons.
Figure 38. Mahi mahi distribution of: A) tournament catch as number of fish reported; and, B) CPUE as number of fish reported per vessel-hour. Data are for the five fishing seasons 2000/01 – 2004/05 aggregated to $\frac{1}{4} \times \frac{1}{4}$ degree latitude and longitude.
Figure 39. Albacore distribution of: A) tournament catch as number of fish; and, B) CPUE as number of fish per vessel-hour for 2000/01 – 2004/05 fishing seasons.
Figure 40. Kingfish distribution of: A) tournament catch as number of fish reported; and, B) CPUE as number of fish reported per vessel-hour. Data are for the five fishing seasons 2000/01 – 2004/05 aggregated to ⅛ ° x ⅛ ° degree latitude and longitude.