



Autumn distribution of hoki lineage

1. Electronic databases were used to generate initial maps of species distribution.
 - a. Commercial fishing returns (larger vessels): **TCEPR** database. All records from 1 October 1989 to 30 September 2005 were extracted on 17 October 2005. Data were used to estimate mean annual catch and catch rate (kilograms per kilometre towed) in 0.25 degree rectangles. Only the top five species caught are reported on these forms so information on the absence of a species is not available. Records of hoki (species code HOK) from depths as shallow as 10 m around coastlines are likely to be real as hoki are caught close inshore, particularly where the continental shelf is narrow and the continental slope is steep. Records as deep as 2000 m off the Chatham Rise, Campbell Plateau, and Macquarie Ridge are also likely to be real as this species has been caught at depths of 1800 m during research trawl surveys. The TCEPR database has been examined in some detail for patterns of hoki migration (Bull and Livingston 2000).
 - b. Commercial fishing returns (smaller vessels): **CELR** database. All records from 1 October 1989 to 30 June 2003 were extracted on 15–17 July 2003. Data were used to estimate mean annual catch in statistical areas. Information from statistical areas 1–10 was down-weighted because of likely mis-recording of Fishstock instead of statistical area. Only the top five species caught are reported on these forms so information on the absence of a species is not available. This database contains information about the smaller vessels which fish for hoki inside the 25-mile limited fishing zones, and includes data on hoki distribution not recorded by larger vessels that do not have access to these fishing zones.
 - c. Scientific observer records from larger vessels: **obs** database. All records from 1 March 1990 to 30 September 2005 and stored in the new data format were extracted on 20 October 2005. Data were used to estimate mean annual catch and catch rate (kilograms per kilometre towed), and proportion of tows that caught the species, in 0.25 degree rectangles. This database provides an important check against how well observed vessel data matches the larger TCEPR data.
 - d. Research bottom trawl records: **fish_comm** database. This database is a groomed version of the research trawl database **trawl**. All records from 2 September 1978 to 30 September 2005 were extracted on 19 May 2006. Data were used to estimate total catch, proportion of tows that caught the species, and catch rate (kilograms per kilometre towed) in 0.25 degree rectangles. This database adds information about the distribution of hoki outside areas of commercial concentration, and also of juvenile hoki on the

Chatham Rise. The database is however limited to seasons in which surveys have been carried out, and is not therefore as extensive as the TCEPR coverage.

- e. Tuna longline fishing returns: **TLCER**. All records were extracted on 17 May 2006. Data were used to estimate mean annual catch and catch rate (kilograms per hook) in 0.25 degree rectangles. However, the latitudes and longitudes used were for the set start position, and because longline length is often greater than 140 km, the resolution of the data is about 1 degree square. This database is useful for determining hoki distribution outside trawled areas, and shows that although tuna longliners catch very low densities of hoki, they are nevertheless found in midwater over very deep areas (greater than 2000 m bottom depth).
 - f. Scientific observer records from tuna longline vessels: **I_line** database. All records between 1 October 1992 and 30 September 2005 were extracted on 9 December 2005. Data were used to estimate catch rate (number per 1000 hooks) in 0.25 degree rectangles. However, the latitudes and longitudes used were for the set start position, and because longline length is often greater than 140 km, the resolution of the data is about 1 degree square.
 - g. NORFANZ voyage: **biods** database. Records from a research trawling and dredging survey of the Norfolk Ridge and Lord Howe Rise carried out in May–June 2003 were extracted on 9 January 2006.
 - h. Databases of aerial sightings (**aer_sight**) were not used as they contained no records of this species, or the number of records was too small to provide useful additional distributional information. Records from Russian trawl surveys (**trawl**) were not used because they were historic (pre 1987), and species identification is regarded as unreliable. Museum of New Zealand specimen records were not used as they added little to the overwhelming quantity of data from commercial and research databases
2. Literature sources were searched for distributional information that added to the distributional ranges determined from databases.
 - a. Unpublished electronic bibliography of New Zealand fishes compiled by L. J. Paul and held on a NIWA computer.
 - b. Aquatic Sciences and Fisheries Abstracts.
 - c. *New Zealand Professional Fisherman* and *Seafood New Zealand* for 1986–2002.
 - d. *New Zealand Fishing News* for 1998–2002.
 - e. Scientific papers, unpublished reports and university theses available to the expert who prepared the distributional layers.
 3. Other sources.
 - a. Nil.
 4. Summary
 - a. Maps generated from the electronic databases were provided to an expert scientist who integrated this information with other

information from the literature, and expert opinion, and produced hand-drawn distributional zones on a template map containing depth contours at 250 m, 500 m, and 1000 m. These maps were then digitised and imported into a GIS software package as layers. The areas of the zones were calculated, and the layers were linked to attribute and metadata files.

- b. The primary sources of distributional data for hoki were TCEPR, CELR, TLCER, and fish_comm databases.
- c. Hoki occur in New Zealand, South Australia and South America. New Zealand hoki and Tasmanian hoki (blue grenadier) are the same species, *Macruronus novaezelandiae*, though genetically distinct (Smith et al. 1996). The South American hoki is currently described as a separate species, *Macruronus magellanicus*, but recent genetic studies have indicated that it is probably the same species as in New Zealand (P. Smith, NIWA, unpublished data).
- d. In New Zealand, hoki are mostly caught around the South Island in waters associated with the Subtropical Front and Subantarctic water (Livingston et al. 2002, Bull and Livingston 2000, Dunn and Livingston 2003). Tuna vessels have caught hoki in midwater over very deep water associated with the Bounty Trough and offshore from Fiordland. They are also associated with hills or seamounts that may be 900 m or deeper. Hoki are mostly caught by bottom trawlers in the Subantarctic and Chatham Rise areas during their dispersed phase (October–May) but good catches are also made when the fish are densely aggregated during spawning (July–September), particularly off Westland, Cook Strait, and Puysegur Bank. Other known spawning grounds include the western Challenger Plateau, Pegasus Canyon, Conway Trough, and White Island. Hotspots in the dispersed phase (spring–autumn) relate largely to juvenile hoki on the Chatham Rise and mature-size fish in the Subantarctic. Spawning ground hotspots are largely seasonal, relating to spawning months only (winter).
- e. Records of hoki on seamounts and hills are largely anecdotal. However, outlier records in TCEPR records reveal a few locations that have produced reasonable catches. A trawl survey of the Chatham Rise in January 2003 confirmed the presence of large hoki aggregated in midwater (about 650 m) above the Andes Hill complex east of the Chatham Rise (Livingston et al. unpublished data)
- f. Although hoki are caught around much of the North Island, the commercial catch is relatively small (O’Driscoll et al. 2002), and catch rates tend to be low. There appears to be a small hotspot to the east of North Cape. Hoki have been caught in low densities outside the EEZ but no further north than 30 °S. It is likely that hoki occur in small numbers in oceanic waters south of 30 °S.
- g. The autumn distribution of hoki shows hotspots on the southern and northern slopes of the western Chatham Rise, Central Cook Strait, the eastern edge of the Stewart and Snares Shelf, and in the gap between the Stewart and Snares Shelf and the Campbell Plateau. There is a hotspot on the West coast spawning grounds,

presumably early arrivals for the spawning season. Catches around the south west edge of the Challenger Plateau are slightly higher at this time of year.

5. References

The following sources provided useful information on the distribution of this species. This is not an exhaustive list of all references to the species.

- Anderson, O.F.; Bagley, N.W.; Hurst, R.J.; Francis, M.P.; Clark, M.R.; McMillan, P.J. (1998). Atlas of New Zealand fish and squid distributions from research bottom trawls. *NIWA Technical Report 42*. 303 p.
- Bull, B.; Livingston, M.E. (2000). Hoki migration patterns: an analysis of commercial catches in New Zealand waters 1985–99. NIWA Client Report 2000/63. 49 p. (Unpublished report held in NIWA library, Wellington.)
- Bull, B.; Livingston, M.E.; Hurst, R.J.; Bagley, N. (2001). The Chatham Rise demersal fish community (200-800 m), 1992 to 1999. *New Zealand Journal of Marine and Freshwater Research 35*: 795–815.
- Clark M.; King, K. (1989). Deepwater fish resources off the North Island, New Zealand: results of a trawl survey May 1985 to June 1986. *New Zealand Fisheries Technical Report 11*. 56 p.
- Dunn, A.; Livingston, M.E. (2003). Updated catch-per-unit-effort indices for hoki (*Macrurus novaezelandiae*) on the west coast South Island, Cook Strait, Chatham Rise, and sub-Antarctic for the years 1990 to 2002. Draft *New Zealand Fisheries Assessment Report*.
- Francis, M.P.; Hurst, R.J.; McArdle, B.H.; Bagley, N.W.; Anderson, O.F. (2002). New Zealand demersal fish assemblages. *Environmental Biology of Fishes 65*: 215-234.
- Hurst, R.J.; Bagley, N.W.; Anderson, O.F.; Francis, M.P.; Griggs, L.H.; Clark, M.R.; Paul, L.J.; Taylor, P.R. (2000). Atlas of juvenile and adult fish and squid distributions from bottom and midwater trawls and tuna longlines in New Zealand waters. *NIWA Technical Report 84*. 162 p.
- Kerstan, M.; Sahrhage, D. (1980). Biological investigations on fish stocks in the waters off New Zealand. *Mitteilungen aus dem Institut für Seefischerei der Bundesforschungsanstalt für Fischerei, Hambur 29*. 187 p. (In English, held in NIWA library, Wellington.)
- Kuruwa, K. (1985). Hoki resources in New Zealand waters. *JAMARC 29(7)*: 15–35. (Translation from Japanese held in NIWA library, Wellington.)
- Livingston, M.E. (1990a). Spawning hoki (*Macrurus novaezelandiae* Hector) concentrations in Cook Strait and off the east coast of the South Island, New Zealand, August-September 1987. *New Zealand Journal of Marine and Freshwater Research 41*: 503-517.

- Livingston, M.E. (1990b). Stock structure of New Zealand hoki, *Macruronus novaezelandiae*. New Zealand Fisheries Assessment Research Document 90/8. 15 p. (Draft report held in NIWA library, Wellington.)
- Livingston, M.E.; Stevens, D. (2002). Review of trawl survey data inputs to hoki stock assessment 2002. *New Zealand Fisheries Assessment Report 2002/48*. 69 p.
- Livingston, M.E.; Bull, B.; Stevens, D.W. (2002). Migration patterns during the life-cycle of hoki (*Macruronus novaezelandiae*): an analysis of trawl survey data from New Zealand waters 1991–2002. Final Research Report for Ministry of Fisheries Research Project HOK2000/01 Objective 6.
- O'Driscoll, R.L.; Phillips, N.L.; Livingston, M.E.; Hicks, A.C.; Ballara, S.L. (2002). Catches, size, and age structure of the 2000–01 hoki fishery, and a summary of biological research for the 2002 stock assessment. *New Zealand Fisheries Assessment Report 2002/39*. 70 p.
- Smith, P.J.; McVeagh, S.M.; Ede, A. (1996). Genetically isolated stocks of orange roughy (*Hoplostethus atlanticus*), but not of hoki (*Macruronus novaezelandiae*), in the Tasman Sea and southwest Pacific Ocean around New Zealand. *Marine Biology* 125: 783–793.