



Autumn distribution of hake lineage

Autumn, for the purposes of NABIS, is defined as being the months of April, May and June. This definition is based on research regarding the spatial and temporal variability of sea surface temperature in the New Zealand region (Uddstrom and Oien 1999).

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 hake from depths greater than 1500 m are probable misidentifications and were ignored. Records of hake from depths as shallow as 50 m around coastlines are likely to be real as hake have been caught close inshore, for example, in Tasman Bay. Records as deep as 1500 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 1500 m during research trawl surveys.
 - 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.
 - 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. Records of hake from depths greater than 1500 m are probable mis-identifications and were ignored.
 - 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.

- e. Museum of New Zealand Te Papa records of this species based on voucher specimens held in their collection were searched for distributional information that added to the distributional ranges determined from other databases.
 - f. Databases of commercial tuna longline catches (**TLCER**), observer records from tuna longlines (**l_line**), recreational fishing (**rec_data**), and 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 has not been validated.
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 hake were TCEPR, CELR, and fish_comm databases.
 - c. Hake occur in New Zealand and South America. They are also called Austral hake and Antarctic Queen hake (Alheit and Pitcher 1995). Hake occur throughout mainland waters around New Zealand, typically south of 40° S. They are also found around South America, south of about 40° S.
 - d. In New Zealand, hake are mostly caught around the South Island in waters associated with the Subtropical Front and Sub-Antarctic water (Alheit and Pitcher 1995). They may also be associated with hills or seamounts that are 900 m or deeper. Hake are mostly

caught by bottom trawlers in the West Coast South Island, Sub-Antarctic, and Chatham Rise areas. Good catch rates are also made when the fish are densely aggregated during spawning (spring and summer), particularly off Westland, west of the Chatham Islands, on the Stewart-Snares shelf, and Puysegur Bank. Hotspots relate largely to spawning aggregations on the West Coast of the South Island, Chatham Rise, and in the Sub-Antarctic. Spawning ground hotspots are largely seasonal, relating to spawning months only.

- e. Although hake have been caught around much of the North Island, catch rates are very low. Hake have been caught in low densities outside the EEZ but not north of 30° S. It is likely that hake occur in small numbers in oceanic waters south of 30° S.
- f. The autumn distribution of hake shows hotspots on the West Coast South Island that relates to the spawning ground around and to the north of the Hokitika Canyon, northern slope of the Chatham Rise, and the corridor between the Snares and Auckland Islands.
- g. The known depth range of hake is 10–1500 m.

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.

Alheit, J.; Pitcher, T.J. (eds.) (1995). Hake: biology, fisheries and markets. *Fish and Fisheries Series 15*. Chapman and Hall, London. 478 p.

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.

Colman, J.A. (1995). Biology and fisheries of New Zealand hake (*Merluccius australis*). In: pp 365–388, Hake: biology, fisheries and markets. *Fish and Fisheries Series 15*. Alheit, J.; Pitcher, T.J. (eds.). Chapman and Hall, London.

Colman, J.A. (1998). Spawning areas and size and age at maturity of hake (*Merluccius australis*) in the New Zealand Exclusive Economic Zone. *New Zealand Fisheries Assessment Research Document 98/2*. 17 p. (Unpublished report held in NIWA library, Wellington.)

Dunn, A. (2003). Stock assessment of hake (*Merluccius australis*) for the 2002–03 fishing year. *New Zealand Fisheries Assessment Report 2003/38*. 57 p.

Horn, P.L. (1997). An ageing methodology, growth parameters, and estimates of mortality for hake (*Merluccius australis*) from around the South Island, New Zealand. *Marine and Freshwater Research 48*: 201–209.

Horn, P.L. (1998). The stock affinity of hake (*Merluccius australis*) from Puysegur Bank, and catch-at-age data and revised productivity parameters for hake

stocks HAK 1, 4, and 7. *New Zealand Fisheries Assessment Research Document 98/34*. 18 p. (Unpublished report held in NIWA library, Wellington.)

Hurst, R.J.; Bagley, N.W.; Anderson, O.F.; Francis, M.P.; Griggs, L.H.; Clark, M.R.; Paul, L.J.; Taylor, P.R. (2000a). 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.

Hurst, R.J.; Stevenson, M.L.; Bagley, N.W.; Griggs, L.H.; Morrison, M.A.; Francis, M.P. (2000b). Areas of importance for spawning, pupping or egg-laying, and juveniles of New Zealand coastal fish. *Final Research Report for Ministry of Fisheries Research Project ENV1999/03, Objective 1*. 302 p.

Uddstrom, M.J.; Oien, N.A. (1999). On the use of high-resolution satellite data to describe the spatial and temporal variability of sea surface temperatures in the New Zealand region. *Journal of Geophysical Research. Oceans* 104 C9: 20729-20751.