Lineage

Winter Distribution of Orange Roughy

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 June 2003 were extracted on 16 July 2003. 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.
    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 June 2003 and stored in the new data format were extracted on 28 July 2003. 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.
    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 3 September 1997 were extracted on 15–16 July 2003. Further surveys have been added to **trawl** and **fish_comm** since 1997, but were not used because they have not been properly groomed for species identification and positional errors. 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. Russian research bottom trawl records: **trawl** database. These data are a subset of the research trawl database **trawl**. All records were extracted on 9 August 2003. Data were used to determine the presence of this species north of 37 ^{o}S. Because the data are old (the most recent record was 1987), and there are problems with species identifications, these data were given low weighting.
    f. 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.
    g. 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.

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 orange roughy were TCEPR, CELR, and fish_comm databases.
    c. Orange roughy is widely distributed throughout temperate waters of the Southern Hemisphere and the North Atlantic Ocean. It does not occur north of about 30 ^{o}S in the Pacific Ocean. Orange roughy occurs throughout most of the New Zealand region; the main area of uncertainty is on the Kermadec and Colville ridges where little fishing or research in deeper waters has been carried out. Its distribution extends along ridges into the Tasman Sea, and into the Pacific Ocean east of New Zealand, where it is commonly found on seamounts. It covers a wide depth range (600–1500 m), but is most common between 800 m and 1200 m.
    d. In winter, orange roughy form dense spawning aggregations in a number of consistent areas. The main areas are north of the Chatham Islands (the ‘Spawning Box’), seamount features on the northeastern and northwestern Chatham Rise, Ritchie Banks off Hawke Bay, East Cape, several areas of the Bay of Plenty, and off the Auckland Islands. Spawning fisheries also used to occur on the Challenger Plateau, Cook Canyon, and Puysegur Bank, but stocks on these grounds were overfished in the 1980s and early 1990s. Several winter hotspots do not occur in other seasons, as fish disperse after spawning has finished (e.g. Spawning Box, ‘Northwest Hills’ of the Chatham Rise). Spawning aggregations

usually occur at depths of 750–950 m, which is a narrower depth range than when dispersed at other times of the year.

e. Winter, for the purposes of NABIS, is defined as being the months of July, August and September. 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). Note that orange roughy aggregate for spawning in June–August, a period which spans both autumn and winter. However, because spawning hotspots are absent during most of autumn, they have been included only in the winter map.

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.

Clark, M.R. (2001). Are deepwater fisheries sustainable? – the example of orange roughy (*Hoplostethus atlanticus*) in New Zealand. *Fisheries Research 1195*: 1-13.

Clark, M.R.; King, K.J. (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 No. 11*. 56 p.

Clark, M.R.; O'Driscoll, R.L. (2002). Descriptive analysis of orange roughy fisheries in the Tasman Sea outside the New Zealand EEZ: Lord Howe Rise, Northwest Challenger Plateau, and South Tasman Rise from 1986–87 to the end of the 2000–01 fishing year. *New Zealand Fisheries Assessment Report 2002/59*. 26 p.

Clark, M.R.; Taylor, P.R.; Anderson, O.F.; O'Driscoll, R.L. (2002). Descriptive analysis of catch and effort data from New Zealand orange roughy fisheries in ORH 1, 2A, 2B, 3A, 3B, and 7B to the end of the 2000–01 fishing year. *New Zealand Fisheries Assessment Report 2002/62*. 69 p.

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.

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.