Loligo pealei, Atlantic longfin squid

Background

Atlantic longfin squid is a temperate-tropical, marine, schooling species of the western North Atlantic, inhabiting waters of Newfoundland (Cargnelli et al. 1999), the western Scotian Shelf and Bay of Fundy (Black, Rowell, and Dawe 1987), and south to Venezueula (http://www.cephbase.utmb.edu/). Information on life history and habitat characteristics is from Jacobson (2005) and Hanlon and Messenger (1996, in http://www.mbl.edu/publications/pub_archive/Loligo/squid/eggs.0.html). This squid is a demersal species. Longfins form large schools that make diurnal vertical migrations from bottom waters upward at night, perhaps for feeding on crustaceans (mainly euphausiids,) fishes, and squid. The seasonal migrations of longfin squid apparently are related to bottom temperature. They migrate offshore in late autumn, overwintering in deeper waters of the continental slope when inshore waters are at their coldest. The return migration inshore occurs in spring for mature individuals when water temperatures are rising, beginning in the south and proceeding northward. Mating occurs during this migration. Immatures migrate toward shore in early summer. Longfin range extends further northward in summer. Spawning has been reported as year-round depending on season and geographic area, though most spawning is in May. Reports for Canadian waters are August to September in the Bay of Fundy, and during early spring and late summer on the Scotian Shelf and Georges Bank. Longfins die after first spawning. Females lay clusters of egg capsules, each containing about 200 fertilized eggs, on rocks and aquatic vegetation, usually at less than 50 m depth. The eggs hatch in 11-27 days, depending on temperature, to produce planktonic larvae about which little is known. Surface waters are reported as important to larvae which move deeper as they grow. There are two juvenile stages, the first lasting about one month. During the second stage juveniles migrate offshore in autumn, apparently spend the winter in deeper waters at the shelf edge, and return inshore in summer. Longfin squid are preyed upon by fishes, diving birds, and marine mammals. This species reaches a mantle length of 50 cm, though most are less than 30 cm.

This species is commercially exploited, especially from southern Georges Bank to Cape Hatteras (http://en.wikipedia.org/wiki/Loligo_pealei).

Temperature limits, critical thresholds, vulnerability, and barriers to adaptation

The southern distribution limit of longfin squid is well south of 25°N latitude, the southern margin of our study area. Thus, the lower tolerance limit for this species of -0.3°C was its February minimum in our study area determined from AVHRR data, and an estimated upper thermal tolerance limit of 26°C was chosen based on the literature.

The seasonal inshore-offshore migrations of longfin squid, apparently related to temperature, indicate a preference for warmer waters. Jacobson (2005) summarized temperature data for L. pealei. This species generally is found in waters with surface
temperatures of 9° - 21°C and bottom temperatures of 8° - 16°C. Presence at bottom temperatures down to 4°C and up to 28°C has been recorded. The following temperatures are for bottom waters. Eggs are reported at 10° - 23°C, usually >8°C. Development is optimal at 12°C. Larvae usually are found at 10° - 26°C, though also at lower temperatures with higher salinities. Juveniles also usually are found at 10° - 26°C, with extremes of 4°C and 28°C. Compared to adults, juveniles prefer warmer bottom temperatures and shallower depths in the autumn. Though it is known that juvenile \textit{L. pealei} grow more quickly with temperature in the laboratory (Hatfield \textit{et al.} 2001), detailed thermal criteria on biological functions and mortality for this species were not found in the literature.

Longfin squid ranked as one of the more sensitive species to climate change in our sensitivity ranking due to its relatively low eurythermal capacity and demersal, nonmobile eggs. It appears that one stage of this species is no more thermally critical than another as optimal temperature ranges are similar across life stages.

**Impacts**

A 4°C rise in global temperature will impact the future distribution of longfin squid in the western Atlantic. There will be potential loss of thermal habitat in waters south of somewhere between New York and Maryland as they exceed (Chapter 2) longfin squid’s upper thermal tolerance limit of approximately 26°C. Loss of habitat may negatively impact commercial fishing in those waters.

Individual \textit{L. pealei} need not adapt to increasing water temperatures resulting from global warming because of their short life span. Populations, however, may be adaptable by slowly shifting their distribution to remain in suitable temperatures. This appears possible because of their life history, mobility, and the presence of appropriate habitat where water temperatures will remain suitable. Predicting inter-population dynamics and consequences resulting from shifting distributions in response to global warming is beyond the scope of this project.

**References**

