Discards and discard mortality

Sea scallops are sometimes discarded on directed scallop trips because they are too small to be economically profitable to shuck, or because of high-grading, particularly during access area trips. Ratios of discard to total catch (by weight) were recorded by sea samplers aboard commercial vessels since 1992, though sampling intensity on non-access area trips was low until 2003; see Appendix II for detailed estimates.

Discarded sea scallops may suffer mortality on deck due to crushing, high temperatures, or desiccation. There may also be mortality after they are thrown back into the water from physiological stress and shock, or from increased predation due to shock and inability to swim or shell damage (Veale et al. 2000, Jenkins and Brand 2001). Murawski and Serchuk (1989) estimated that about 90% of tagged scallops were still living several days after being tagged and placed back in the water. Total discard mortality (including mortality on deck) is uncertain but has been estimated as 20% in previous assessments (e.g., NEFSC 2007); this assessment also makes this assumption. However, discard mortality may be higher during the Mid-Atlantic during the summer due to high water and deck temperatures.

Incidental mortality

Scallop dredges likely kill and injure some scallops that are contacted but not caught, primarily due to damage (e.g., crushing) caused to the shells by the dredge. Caddy (1973) estimated that 15-20% of the scallops remaining in the track of a dredge were killed. Murawski and Serchuk (1989) estimated that less than 5% of the scallops remaining in the track of a dredge suffered non-landed mortality. Caddy's study was done in a relatively hard bottom area in Canada, while the Murawski and Serchuk study was in sandy bottom off the coast of New Jersey. It is possible that the difference in indirect mortality estimated in these two studies was due to different bottom types (Murawski and Serchuk 1989).

In order to use the above estimates to relate landed and non-landed fishing mortality in stock assessment calculations, it is necessary to know the efficiency e of the dredge (the probability that a fully recruited scallop in the path of a dredge is captured). Denote by c the fraction of scallops that suffer mortality among sea scallops in the path of the dredge but not caught. The best available information indicates that c = 0.15-0.2 (Caddy 1973), and c< 0.05 (Murawski and Serchuk 1989). The ratio R of scallops in the path of the dredge that were caught, to those killed but not caught is:

$$R = e/[c(1-e)]$$

If scallops suffer direct (i.e., landed) fishing mortality at rate F_L, then the rate of indirect (non-landed) fishing mortality will be (Hart 2003):

$$F_I = F_L / R = F_L \, c \, (1-e)/e.$$

If, for example, the commercial dredge efficiency e is 50%, then $F_I = F_L \, c$, where F_L is the fully recruited fishing mortality rate for sea scallops. Assuming c = 0.15 to 0.2 (Caddy 1973) gives F_I = 0.15 F_L to 0.2 F_L. With c < 0.05 (Murawski and Serchuk 1989) F_I < 0.05 F_L. Because there may be unobserved damage, actual incidental mortality may be higher than that observed in these studies. For this assessment, incidental mortality was assumed to be 0.2 F_L in Georges Bank and 0.1 F_L in the Mid-Atlantic.