A significant challenge for fisheries management has been understanding the impacts of spatial and temporal heterogeneity on population dynamics. Fisheries data are often spatial in nature and recent computational advances have resulted in new methodologies that better utilize this spatial information. We developed temporally variable species distribution models for Yellowtail Flounder (Limanda ferruginea) and Atlantic Cod (Gadus morhua) on Georges Bank. These models identified seasonal and long-term shifts in the distribution of both stocks with the average sea surface temperature (SST; average from 1997-2008) and depth being significant predictors. Shifts in the distributions of these stocks were observed at 3 or 5 year intervals with the core areas shifting northeast throughout the study period. For Atlantic Cod, there was a decline in the size of the core area within the U.S. waters but minimal change was observed in Canadian waters. In U.S. waters, the size of the Yellowtail Flounder core area started to decline in the late 1970s but rebounded in the 1990s-2000s; minimal change was observed in Canadian waters. Simplified models using the random field for prediction performed similarly to models that included environmental covariates. Incorporating this spatial information into science advice will facilitate sustainable management of these stocks.