Table 1. Hypotheses for covariates affecting landings. S_t is quarter 3 (July-September) catch in the current season, S_{t-1} is quarter 3 catch in the previous season. N_t is the post-monsoon October-March catch in the current season and N_{t-1} is the October-March catch in the prior season. Because the fishing season is July-June, N_t spans two calendar years.

Stage	Hypothesis	Resp.	Covariates
Age 2+	DD1. S_t is dominated by mature age 2+ fish, thus abundance of the 1-yr and 2-yr ages in the prior season (Oct-Mar catch) should be correlated with the abundance of mature fish this year.	S_t	N_{t-1}
Age 1-2	DD2. Abundance of 1-yr and 2-yr fish should be correlated with strength of the cohorts from the previous two seasons. The quarter 3 catch, dominated by mature fish, in the prior two years is expected to be correlated with post-monsoon catch.	N_t	S_{t-1} and S_{t-2}
Age 2+	DD3. Because age 2 fish appear in the post-monsoon catch, we also expect the post-monsoon catch (dominated by age 1 and 2) in the previous season to be correlated with the post-monsoon catch in the current season. Post-monsoon catch two seasons prior should be minimally correlated with current post-monsoon catch.	N_t	N_{t-1}
Spawn	S1. The onset of monsoon precipitation triggers movement of adults from offshore to spawning areas due to changes in salinity, turbulence or noise. Spent adults migrate inshore and are exposed to the fishery.	S_t	Seasonal precipitation during Jun-Jul in year t
Spawn	S2. The level of precipitation in pre-monsoon months predicts spawning strength.	S_t	Seasonal precipitation during Apr-May in year t
Spawn	S3. Extremely high upwelling brings poorly oxygenated water and very low temperatures to the surface causing a delayed or poor spawning while optimal upwelling conditions leads to increased spawing. Spawning affects the recruitment of 0-age fish to the fishery and thus the post-monsoon catch.	N_t and S_t	Ave. Jun-Sep upwelling index in year t
Spawn	S4. Extreme heat events in the pre-spawning months cause mature fish to move offshore away from productive feeding areas leading to poor spawning condition. Poor recruitment leads to low 0-age in current season catch and 1-age fish in next season's catch.	N_t	Ave. nearshore Mar-May SST in year t and $t-1$

Table 1. Continued.

Stage	Hypothesis	Resp.	Covariates
Larval	L1. The prior year post-monsoon larval survival and growth is associated with higher future biomass. Larval growth and survival is highest in an intermediate temperature window. Low SST at this time is also indicative of strong upwelling which advects larvae into offshore waters where productivity is lower.	N_t and S_t	Average nearshore SST during Oct-Dec in year t-1
Larval	L2. Upwelling is associated with higher productivity and higher density of zooplankton, which leads to better larval and juvenile growth and survival. The strength of summer upwelling should be associated with higher biomass in future years. However, extremely strong upwelling brings poorly oxygenated water to the surface causing larval mortality and advects larvae offshore.	N_t and S_t	Ave. Jun-Sep upwelling index in year t-1 and t-2
Larval	L3. Chlorophyll blooms are signatures of high productivity from nutrient influx either due to upwelling or coastal inputs. The monsoon bloom intensity in prior years should be associated with 0-year fish abundance in year t and future sardine biomass.	N_t and S_t	Ave. Chl-a density Jun-Sep in year t, $t-1$ and $t-2$
All ages	A1. The changes brought about by the El Niño Southern Oscillation (ENSO) cycle have a variety of effects on environmental parameters (precipitation, SST, thermal fronts, Wind) which impacts spawning and early survival. This in turn impacts the overall abundance.	N_t and S_t	ONI year t-1