Sardine (*Sardina pilchardus*) larval dispersal in the Iberian Upwelling System, using coupled biophysical techniques

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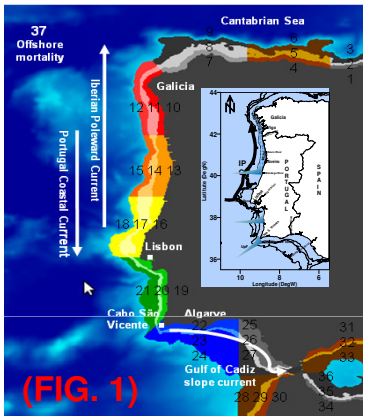
ABSTRACT

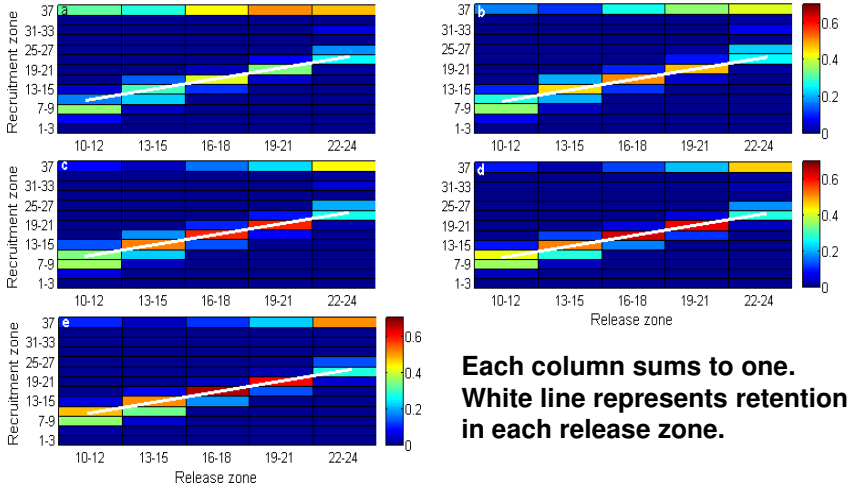
The European sardine (*Sardina pilchardus*) is the most important small pelagic fishery of the Iberian Peninsula. Recently, recruitment of this species has declined due to changing environmental conditions. Furthermore, controversies exist regarding its population structure with barriers thought to exist between the Atlantic-Iberian Peninsula, NW Africa, and the Mediterranean (FIG. 1). Few studies have investigated the distribution and dispersal of sardine eggs and larvae off Iberia and the subsequent impact on recruitment. Here, we examine these issues using a **ROMS-Regional Ocean Modeling System climatology (1989-2008) coupled to the Lagrangian transport model, Ichthyop**. Using biological parameters from the literature, we conduct simulations that investigate the effects of spawning patchiness, diel vertical migration (DVM) behaviors, and egg buoyancy on the transport and recruitment of virtual sardine ichthyoplankton on the continental shelf. We find that **release area, release depth (FIG. 2), and month of release (FIG. 3) all significantly affect recruitment. Patchiness has no effect and DVM causes slightly lower recruitment (FIG. 4). Egg buoyancy effects are significant (FIG. 5) and act similarly to depth of release**. As with other studies, we find that recruitment peaks vary by latitude, explained here by the seasonal variability of offshore transport. We find weak, continuous alongshore transport between release areas, though a large proportion of **simulated ichthyoplankton transport north to the Cantabrian coast (up to 27%).** We also show low level transport into **Morocco (up to 1%)** and the **Mediterranean (up to 8%). The high proportion of local retention and low but consistent alongshore transport supports the idea of a series of metapopulations along this coast.**

Release (10-24), recruitment (1-36), and "mortality" (37; offshore transport) zones for Iberia and NW Africa



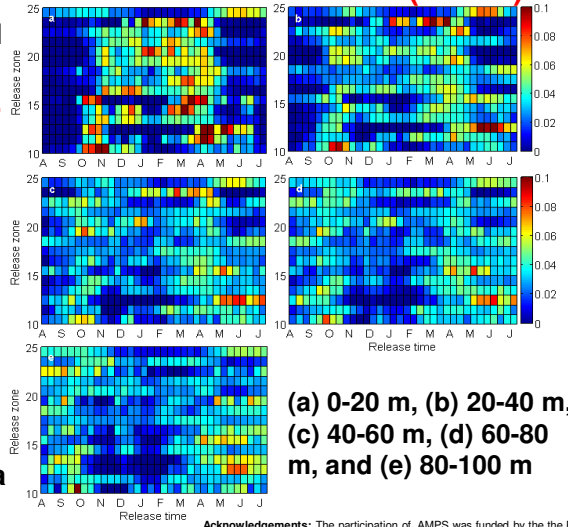
Patchiness of one egg/patch for release depths: (a) 0-20 m, (b) 20-40 m, (c) 40-60 m, (d) 60-80 m, and (e) 80-100 m.

(FIG. 2)



Each column sums to one. White line represents retention in each release zone.

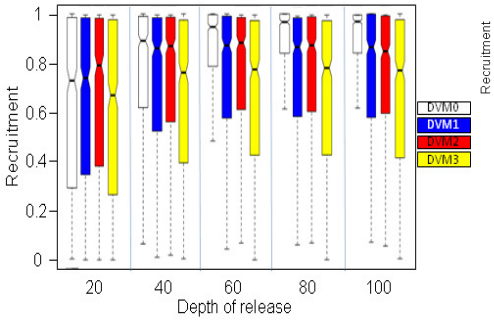
Seasonality of retention for release depths (FIG. 3)



(a) 0-20 m, (b) 20-40 m, (c) 40-60 m, (d) 60-80 m, and (e) 80-100 m

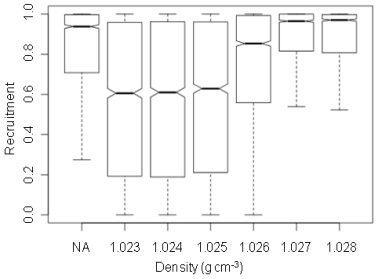
Proportion of larvae that recruited at each depth of release for each DVM

(FIG. 4)



Recruitment for varying egg densities

(FIG. 5)



NA = no egg density assigned

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