Modeled Connectivity Between Northern Rock Sole (*Lepidopsetta polyxystra*) Spawning and Nursery Areas in the Eastern Bering Sea

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BACKGROUND

- Spawning areas, and connectivity between spawning and nursery areas, are unknown for northern rock sole in the eastern Bering Sea.
- Larvae have been reported in the eastern Bering Sea near Unimak Island. Larvae are likely transported by eastward flowing currents along the Alaska Peninsula or by northward flowing currents to the Pribilof Islands (Figure 1).
- Northern rock sole spawn in late winter/early spring. By summer, age-0 fish have settled on sandy sediment, usually at depths < 50 m (Norcross *et al*. 1999).

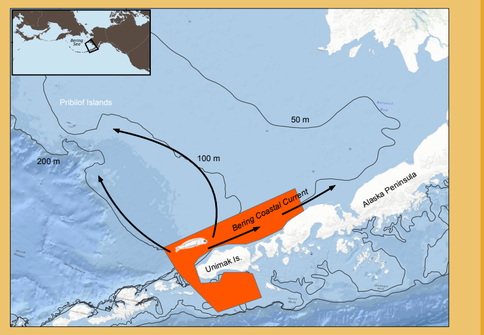

Figure 1. Area of concentration of northern rock sole larvae in the eastern Bering Sea and Gulf of Alaska (orange) and predominant currents (From Lanksbury *et al*. 2007).

OBJECTIVES

- Use historical ichthyoplankton data (1981- present) to identify spawning areas.
- Model connectivity between spawning and nursery areas in the eastern Bering Sea.

METHODS

- Larval transport is modeled by the DISpersal Model for Early Life Stages (DISMELS), a biophysical-coupled, individual based model (Table 1).
- Larval source areas (spawning areas) were determined from densities of small larvae (<4 mm) in historical plankton tows in April and May (Figure 2).
- The eastern Bering Sea was divided into potential settlement areas from 0-50 m and 50-80 m depth. An additional area extending 50 km from the Pribilof Islands was also identified as a potential settlement area.

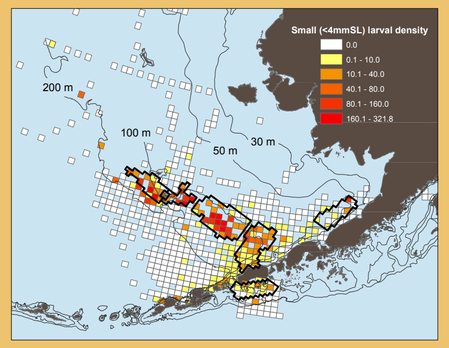

Figure 2. Mean density (# fish/100 m^2) of small (<4 mm) northern rock sole larvae in the eastern Bering Sea and south of Unimak Island in April and May from historical records. Polygons represent model larvae source areas.

Table 1. Parameters* used in the DISMELS model

Model years	**1979 - 2004**
Start date	**15 April**
Initial size	**3.8 mm SL**
Growth rate	**0.25 mm/day**
Settlement size	**20 mm SL**
Pelagic larval duration	**65 days**
Vertical position from hatch to 8.5 mm SL	**10 – 20 meters day and night**
Vertical position > 8.5 mm SL	**20 – 30 meters day; 0 – 10 meters night**

* Data sources: Hurst and Abookire 2006, Ichthyoplankton Information System (http://access.afsc.noaa.gov/ichthyo/index.cfm)

CONNECTIVITY AND TRANSPORT PATHWAYS

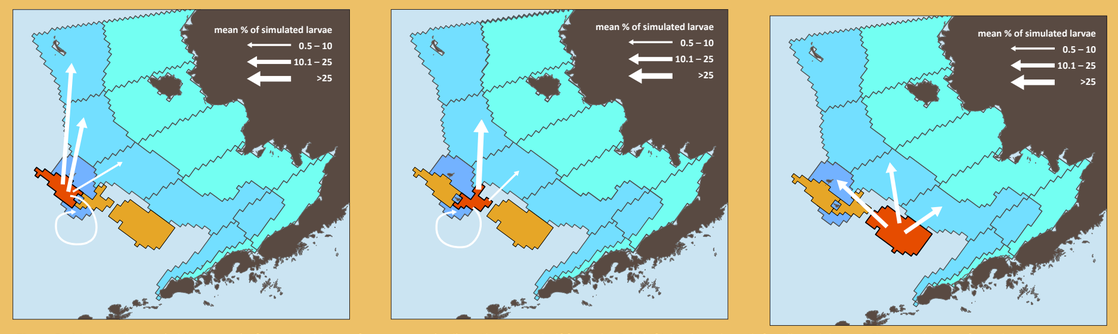

Figure 3. Mean pathways (white arrows) of simulated larvae from sources (red) on the outer shelf from the Pribilof Islands and south for all model years. Simulated larvae from these source areas were transported primarily to the north.

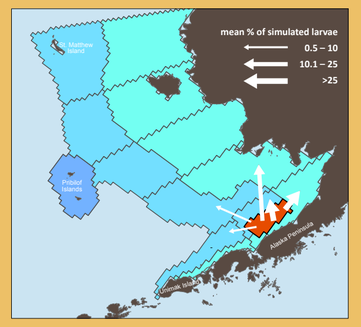

Figure 4. Mean pathways of simulated larvae from the source along the Alaska Peninsula for all model years. Simulated larvae were generally transported northeast along the Alaska Peninsula.

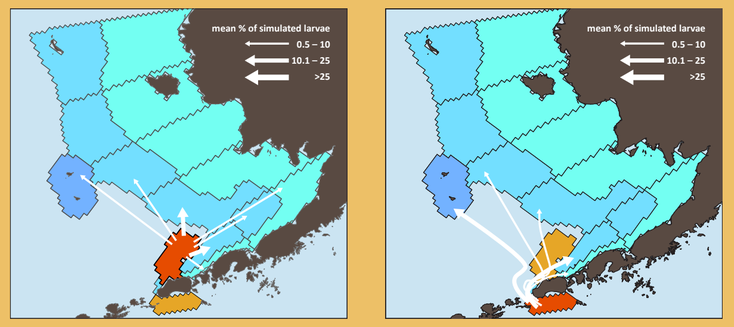

Figure 5. Mean pathways of simulated larvae from two sources near Unimak Island. Most simulated larvae from south of Unimak Island moved through Unimak Pass into the eastern Bering Sea. Simulated larvae from these sources were advected along one of major two pathways, either north towards the Pribilof Islands, or to the northeast along the Alaska Peninsula.

FIELD DATA COMPARISON

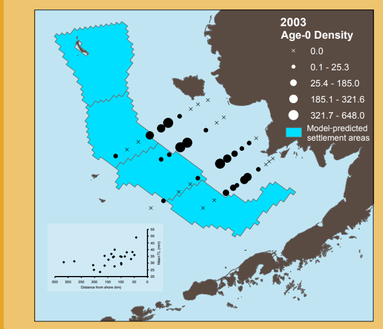

Figure 6. Densities (# fish/1000 m^2) of age-0 demersal northern rock sole collected in August 2003. Model-predicted settlement areas shown in blue. Age-0 demersal fish are present inshore of the 50 m isobath, but not near the shore. Length data indicate fish in this area may have settled farther from shore and then moved shoreward after settlement (inset).

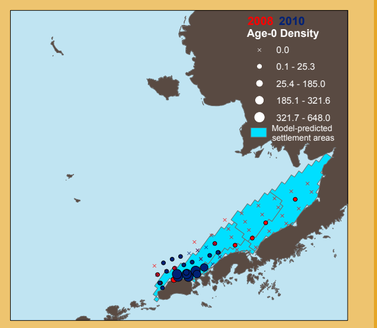

Figure 7. Densities (# fish/1000 m^2) of age-0 demersal northern rock sole in September 2008 (red) and 2010 (blue). Field data and simulated larvae show settled fish in the 0-50 m depth range.

IMPLICATIONS

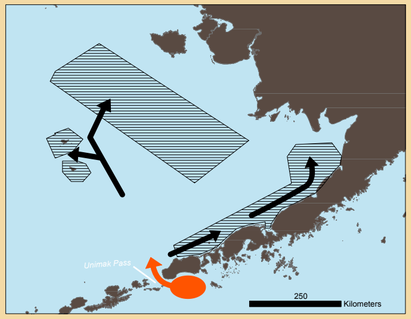

Figure 8. Schematic of pathways and settlement areas in the eastern Bering Sea (black). Multiple pathways and settlement areas imply possible stock structure within the eastern Bering Sea. Schematic of larval transport from the Gulf of Alaska to the eastern Bering Sea (orange). Currently northern rock sole in the eastern Bering Sea and the Gulf of Alaska are managed as separate stocks, however the Gulf of Alaska may be a source of northern rock sole larvae to the eastern Bering Sea.

Literature Cited

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