GNOME Plankton Activity

GNOME is the General NOAA Oil Modeling Environment. It is the oil spill trajectory model used by NOAA HAZMAT responders to prepare for oil spills. Some club members used the GNOME model in last year's challenge to predict where the oil from the Pete's Bay oil spill might go. While that's the usual use for GNOME, we're going to explore another possible application for the GNOME model.

In this exercise we will be using GNOME to model dispersal of planktonic larvae. Many marine organisms (fish, crab, sea urchin, shrimp, barnacles, sea stars, and many others) have planktonic larvae. Plankton is anything that cannot swim against the current, making the GNOME model a way to model plankton movement.

Why Model Plankton movement?

Understanding how plankton move around in the ocean is important to know to help make good decisions about fisheries management. Many types of plankton are food for larger fish, and many fish have planktonic larvae. Knowing where fish larvae are likely to go would be useful to a community who is looking to set aside a protected area or sanctuary for all or part of the year. One argument for setting aside protected areas of the ocean is that these areas will become fertile breeding grounds that will 'seed' the surrounding areas where fishing is still allowed. If this is the reason for setting aside a protected area, then is would be good to know where these larvae might go so that the protected area is upstream from the fishing areas.

Objective:

Use the GNOME Model of the Santa Barbara Basin to determine good areas to place a protected area so that the fish larvae will stay in the basin and will travel toward the fishing grounds. NOTE: this is just a model that we are using for a different purpose than it was intended to, so beware that this may not be what actually happens with fish larvae.

GNOME Model Basics:

The GNOME can be run on either a Mac or a PC, both are included on the CD. The Mac version runs in the classic Mac environment, so you only need OS 7 or above. If you have a Mac with OS X opening GNOME will start the classic environment.

It is probably best to run GNOME off of the computer, and not off of the CD.

Installing GNOME
(from the NOAA Response & Restoration page to download GNOME)
On a Windows PC

In Windows Explorer, double-click the "GnomeSetup.exe" file icon, then follow the directions you'll see on your screen.

On a Macintosh

GNOME has been compressed so that you can download it from the Internet. Some browsers are configured to automatically uncompact compressed files. If yours is, look for a folder called "GNOME 1.2.6" on your desktop.

To uncompact GNOME, use your decoding utility (if you are using StuffIt Expander, either (1) drag the file onto the StuffIt Expander icon on your desktop, or (2) start StuffIt Expander, then from its File menu, choose Expand, then select the file). Once you have uncompacted GNOME, look for a folder called "GNOME 1.2.6" on your desktop.

Running GNOME

In Windows

To start GNOME, from the Start menu, under Programs, choose "GNOME".

On a Macintosh

Open the folder for your computer type and drag the entire file folder within onto the desktop. Or you can download GNOME and the Santa Barbara Environment folder from the NOAA web site (type NOAA GNOME into Google and pick the first site that comes up, the url is really long.) Open GNOME and follow directions on the screen. Choose the Santa Barbara Channel location file. Click next.

The **Welcome to Santa Barbara** box will show up. Click Next.

Model Settings Pick a date for your experiment. Refer to the chart that gives spawning times of different marine organisms. Choose 3 days for the model duration time. This is the longest the model will run. Select both check boxes. If you don't know yet just leave it as it is for the date. Click Next.

Selecting a Circulation Pattern The Santa Barbara Basin has three major **circulation patterns**, choose one now by consulting the rest of the exercise, or just click next to get to the modeling environment. Click Next.

Choosing wind type Choose constant winds. Click Next.

Constant Wind Set wind speed and direction. Click next.

Please Note this explains in more detail the specifics of the model. Click next.

Almost Done this screen identifies the buttons in the modeling environment and explains their uses.

The Modeling Environment

The Tanker The tanker allows you to place concentrated spills either in a single point or in a line. Hold your mouse button down to create a longer dispersal area.   When you release the mouse button a dialog box will appear to help you set up the 'spill'. Choose non-weathering for the type of oil (you could experiment with other types of oil, the weathering could be used to model the mortality of larvae). Set the size of the larval release. It should be a pretty small number, maybe on the order of a few to a few hundred gallons. You can fine-tune the location of your larval release in this window too. When you're done, click ok.

Spray Can If you want a more diffuse larval dispersal you can select the spray can instead of the tanker and proceed from there. The spray can method takes more time, but it might give more realistic results. Select the appropriate variables in the dialog box. Choose the large spray can. 'Spray' the dots to get the concentration you want. Hold down the mouse button to get more dots. Click on the arrow to go back to the modeling environment.

Run the Model Press the play button at the top of the screen and let the GNOME model run. It will go slowly at first, but once the movie is created it can be run again and again and slowed down or speeded up, as you want.

Choosing a current state and wind strength and direction

The 3 current states. This table should help you decide which current state to choose based on when the organisms you're interested in usually spawn. For this exercise, it will be easiest to choose the current state based on the season you're using. If your club is really interested in how to choose the current state they can click on the "Help choose the current state" button when the choice is given (in the box where you choose the current state).

Current State	UPWELLING	CONVERGENT	RELAXATION
Season	Spring	Summer	Autumn or Winter
Winds	Strong, > 8 m/s, NW	Strong, > 7 m/s, NW	Weak, < 4 m/s, SE
Sea Surface Temp.	11 - 12° C	17 - 20° C	17 - 20° C

If you didn't set the parameters when you were starting up GNOME, or if you want to change things after running one model run, you can change any parameter by double clicking on it in the box on the left hand side of the screen. This should bring up the dialog box and you can make any necessary changes.

Links to actual wind data from the Santa Barbara Channel:
If you want to run the model with today's conditions check out the marine weather forecast at http://www.wunderground.com/MAR/PZ/650.html for current information or http://www.wunderground.com/MAR/buoy/46053.html for the Eastern part of the Santa Barbara Channel or http://www.wunderground.com/MAR/buoy/46054.html for the Western part of the Santa Barbara Channel. These second links will work to get both data from the past and the present.

Spawning times

Different fish and crustaceans spawn at different times and this might alter where you would put a marine reserve. Here are spawning times for 2 types of fish and one type of crustacean these data come from Alan Shanks & Ginny Eckert's 2005 paper "Population Persistence of California Current Fishes and Benthic Crustaceans: A Marine Drift Paradox" in *Ecological Monographs* Vol. 75, No. 4, pp. 505–524.

These are species that are commercially fished. There are many species of rockfish that people eat that spawn at different times. There are hundreds of species of rockfish, the spawning dates listed above are a representative sample for real species found in the California Current system.

Common Name	Scientific name	Start date of spawning	End date of spawning
Ling cod	*Ophiodon elongates*	337 (Dec. 3)	91 (April 1)
Dungeness crab	*Cancer magister*	1 (Jan. 1)	121 (May 1)
Rockfish A	*Sebastes spp.*	1 (Jan. 1)	152 (June 1)
Rockfish B	*Sebastes spp.*	337 (Dec. 3)	91 (April 1)
Rockfish C	*Sebastes spp.*	32 (Feb. 1)	213 (Aug. 1)

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Run the GNOME model in the different states and for different days when these species would be spawning. Do the different current states change where you would put a marine reserve? What about if you were only interested in one species? Have club members compare different results.