

Nematostella vectensis, the Burrowing Anemone
An Exploratory in Coos Bay, Oregon

INTRODUCTION:

Background:

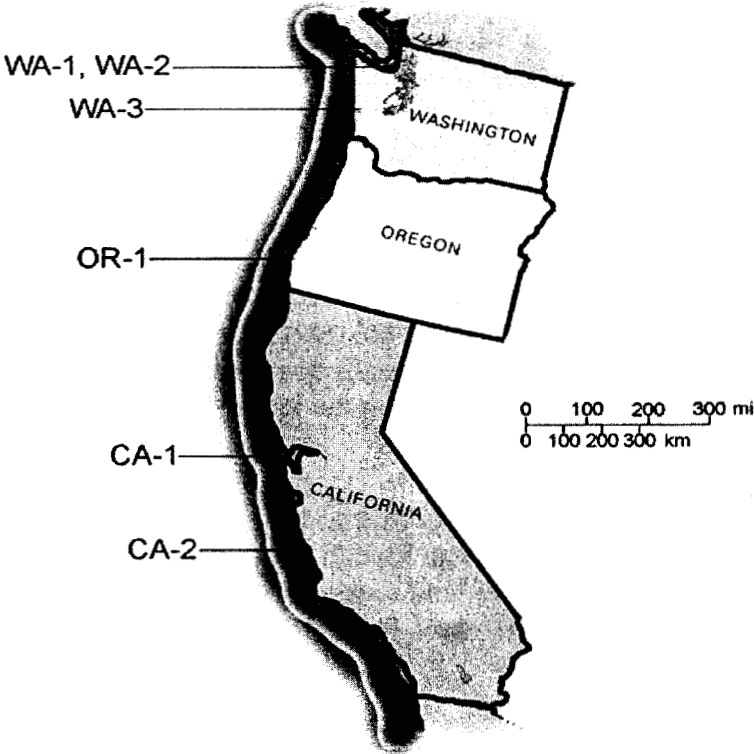
Nematostella vectensis is a member of the Phylum Cnidaria, the Class Anthozoa, and the Family Edwardsiidae. Its range is patchy, occurring within a few scattered areas of the United States on the Pacific Northwest coast and several areas in the southeastern coast. (Finnerty, J. 2004-2007) It also occurs in England, where it is considered rare and is legally protected. (UK Biodiversity Action Plan, updated 2007) *Nematostella* in the United States is thought to be introduced from England. (Darling, J.A. et al. 2004)

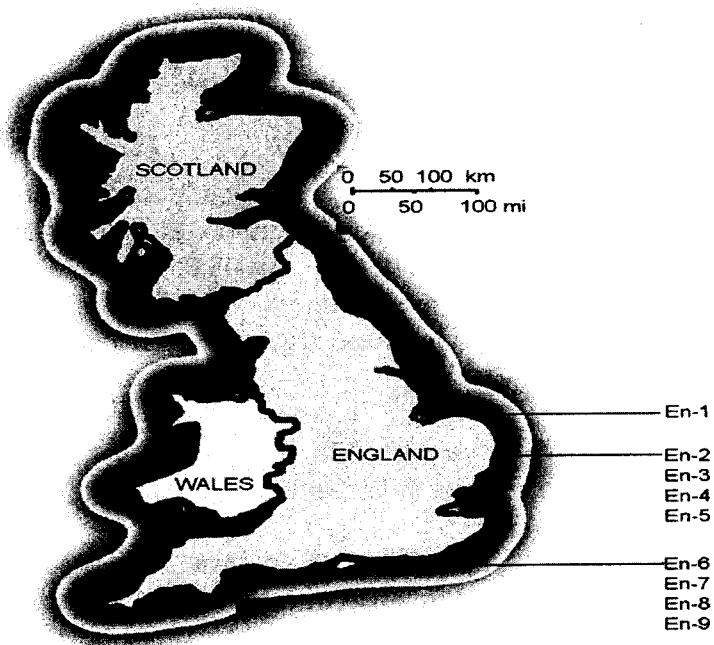
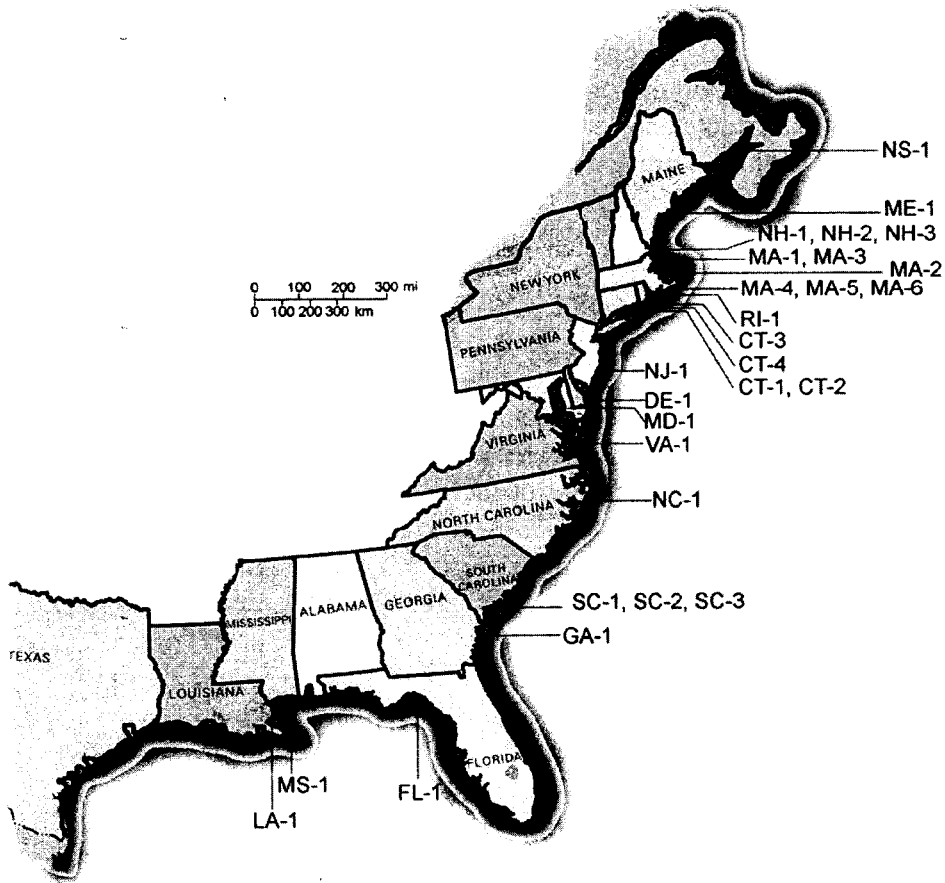
Within the Coos Bay region of Oregon, the anemone has been reported at several locations in the past, including Metclaf Marsh, Southern areas of the South Slough, near downtown Coos Bay, off Crawford Point, and near the fork of the Coos River and Catching Slough. (Inouye, 1976) No extensive recent surveys have been undertaken for the Coos Bay region. This would be an interesting project for a future date.

Distribution within the Metcalf salt marsh was, however, studied fairly recently (1990). Within the Metcalf marsh area, there were shifts in the density and distribution of the anemone, both within a particular panne, and within the general intertidal flooding area, with the anemone moving significant distances between flooding episodes. It was speculated that it moves towards the areas of highest prey concentrations. (Sibbald, G. 1990)

Nematostella is a small, white anemone that is approximately 10 to 15 mm long, less than 1.5mm in diameter, mostly transparent, and has 12 to 18 tentacles. (Inouye, S. 1976) *Nematostella* prefers stable depressions in the soft mud bottoms of brackish water salt marsh channel areas. It often co-occurs with *Salicornia*, an edible salt marsh plant. Also found in association with *Nematostella* among the salt marsh pools of Coos Bay are numerous species of diatoms, and invertebrates such as paramecium, nemertean, flatworms, harpacticoid copepods, ciliates, and polychaetes. (Madsen, K. 1978) The diet of *Nematostella* includes harpacticoid copepods, ostracods, polychaete and nematode worms, snails, insects, larvae, rotifers, and egg masses. (Asson, M. 1979) Organisms living in the salt marshes must be able to tolerate a wide range of many factors, including temperature and salinity. *Nematostella* has been observed in salinities ranging from 8 ppt to 38 ppt. In order for this anemone to tolerate the highly variable saline conditions, this animal is an osmoconformer with a very high permeability rate. (Inouye, S. 1976)

(Images are from Nematostella.org by Finnerty, John)





The Exploratory:

Salt marshes are beautiful and intriguing transitional areas between the forest and the ocean. They are also highly productive areas, important for birds, crabs, invertebrates, and other organisms. I chose to do my exploratory on the particularly unique sea anemone, *Nematostella vectensis*, in order to learn more about this animal, and also the salt marsh ecosystems that it inhabits.

HYPOTHESIS/QUESTIONS:

My hypothesis was that density and distribution would be affected by one or more of these factors: salinity, temperature, dissolved oxygen, and pH.

Several observations lead to this hypothesis. One was that distribution of the anemone was patchy not only regionally, but also within a given area. Distribution appeared to be picky. What factors limit where the anemone is found? Which possible factor would have the greatest influence? Another observation was that the anemones seemed to prefer pools that were not too deep (generally no more than 8mm) nor too shallow (at least 1-3mm). Did this have to do with temperature or salinity? There also seemed to be a range of algal cover preferred; not too much nor too little. Did this have to do with dissolved oxygen?

MATERIALS AND METHODS:

To measure water quality parameters, I used a refractometer (to measure salinity), a pH meter (which measured temperature as well), and a dissolved oxygen meter (which also measured temperature). For density estimates I used a small survey PVC square which was quartered into a small grid. It was approximately 10mm x 10mm. The spot in the pool in which to lay the grid and count the anemones within it was chosen by using coordinates generated by a random numbers program. I laid 2 meter sticks across the panne and used these to locate the coordinates.

Surveys were taken at 3 different locations in the Coos Bay, Oregon region: Metcalf Marsh, Hidden Creek Marsh, and the Hinch Road Bridge area of the South Slough Marsh, near Wasson Creek.

The same 4 pannes in Metcalf marsh were visited and surveyed on 3 separate occasions. The first visit was on 08.03.07, at 10.00PST; again on 08.10.07, 18.00 PST, and again on 08.12.07, 10.00 PST. The Hinch Road Bridge area of the South Slough was visited twice; on 08.05.07, 10.00 PST, and again on 08.13.07, 18.45 PST. Hidden marsh was surveyed once, on 08.12.07 at 17.30 PST. If anemones were present, they were counted within the grid and recorded. If no anemones were present, then water quality measurements were taken.

Pools were chosen for water quality measurements and surveys if

- 1) I saw anemones, or if all of the following factors were present:
- 2) Salicornia was present
- 3) The panne was submerged beneath between 1 and 12 mm of clear water
- 4) The bottom substrate of the panne looked similar to those with anemones (i.e., soft muddy substrate largely free of debris or plant growth)

I also decided to record how quickly the anemones moved in the laboratory, and in what way. For that, I gathered 4 anemones from Metcalf marsh using a turkey baster, and stored them in centrifuge tubes until I got back to the lab. There, I placed them in seawater in a finger bowl, measured them, and observed them for 2 hours.

RESULTS:

The average water quality data for the Metcalf Marsh and Hidden Creek Marsh salt pannes that HAD anemones present was as follows:

Salinity: 30.4 ppt

pH: 7.63

Temp: 21.03 C

D.O.: 7.53 mg/L

The average water quality data where anemones were NOT present in Hidden Creek and Hinch Road Marsh areas was as follows:

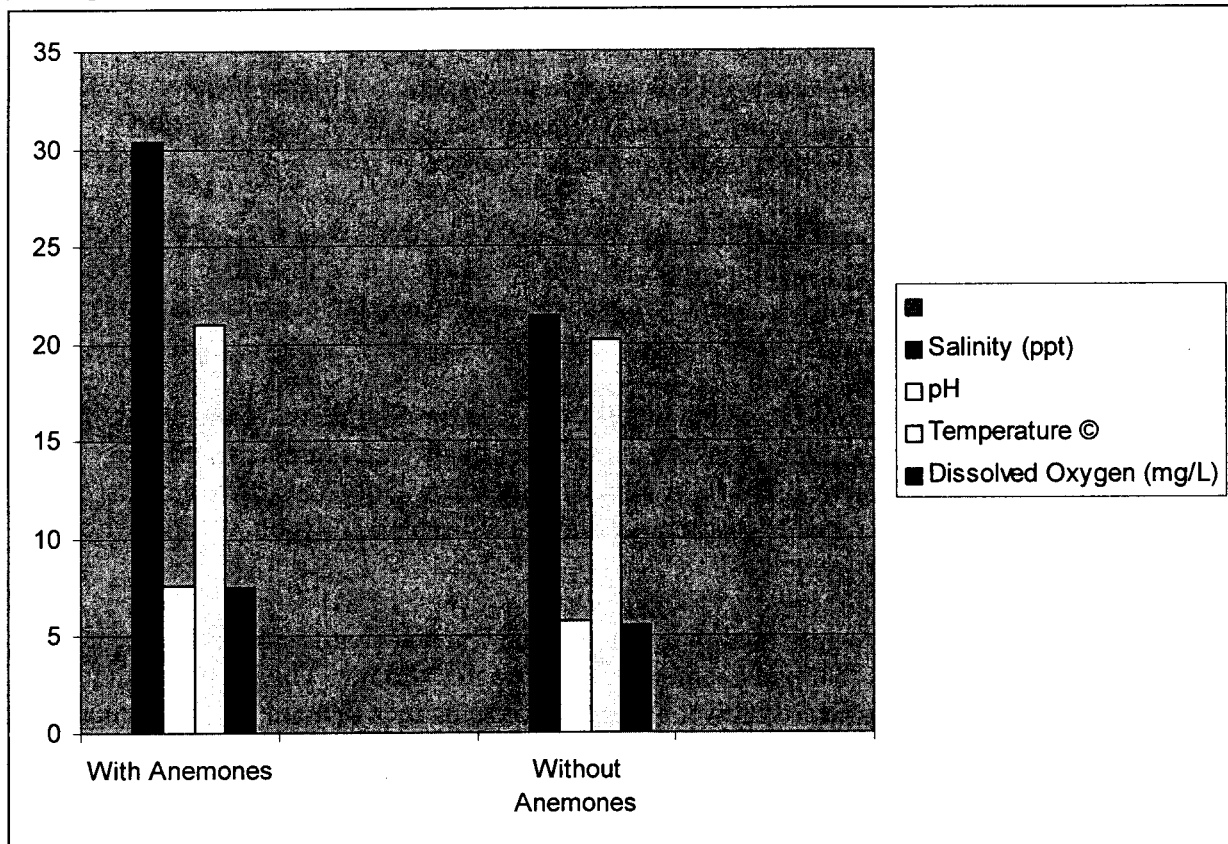
Salinity: 21.4

pH: 5.75

Temp: 20.2

D.O.: 5.51

Water Quality Data Comparing Salt Pannes With Anemones vs Salt Pannes Without Anemones:
(A Graph Showing the above results)



Also, the *Nematostella* in the finger bowls in the lab were, on average, 10.2mm in length, had 16 tentacles, and moved an average of 2.5cm in 2 hours. They used elongation and contraction of their bodies, as well as constriction of certain points along their bodies to move. They did not attach to the finger bowl, as most anemones do, but instead lay lengthwise along the bowl, rotating their tentacles up more vertically to feed. They were also observed to eat by moving small prey very quickly to their mouths with their tentacles.

DISCUSSION:

All of the pannes in Metcalf marsh that I collected data on had anemones present. I meant to pick one of the 4 that did not have anemones, but on the last visit I discovered several anemones in the panne that I had chosen precisely because I thought it had none.

One of the biggest problems I encountered in this exploratory was the realization that the anemones seem to burrow under the mud and become invisible at odd and irregular times, possibly due to sun or heat. As a consequence of this, I soon discovered that density surveys from casual observation were almost useless, as I really could not be sure how many anemones might be present. This was dramatically illustrated by all but a few of the anemones seeming to disappear on the second visit to Metcalf Marsh. For this reason, I decided simply to split the data comparison into pannes with anemones present vs. pannes without anemones present. Even though it was possible that the observed lack of anemone presence was a potentially an incorrect observation, I became much more careful about declaring a panne anemone-free, and the chances of being wrong about anemone absence were less than that of simply getting density estimates off.

The amount of algal cover in the pannes did not seem to play a role in whether anemones were present or not. It was difficult to tell if they played a role in density, as the algal growth compounded the already problematic issue of observing densities.

Pool size seemed to be a mostly incidental factor. In other words, the panne needed to be big enough to keep water and not let it totally evaporate, but small enough so that there was about 1 to 10 mm of water covering it. Further investigations would be needed to see what the limits of this apparent limiting factor are.

As I had felt sure that salinity would have the biggest role as a limiting factor at the beginning of the study, I did not do a very good job of taking many water quality measurements besides salinity in pannes without anemones. This was a flaw in my study. Only 3 pools without anemones were used in the averages of pH, temperature, and dissolved oxygen. 9 pools without anemones were used for salinity averages.

Salinity did seem to be the only water quality parameter that showed significant difference in measurements between pannes that had anemones and those that did not. The pannes without anemones seemed to have significantly lower salinity than the pannes that did have anemones. The anemones tolerate a huge range of fluctuations of salinity, but perhaps they do prefer an overall higher salinity concentration. Temperature, dissolved oxygen, and pH did not seem to make much difference on average, though I did notice that some of the outside pH measurements

for panes with anemones in them tended to be more basic, and the outside pH measurements for panes without anemones tended to be more acidic.

Inconclusively, it does seem as if the anemones may prefer more saline, basic environments.

The main correlation that was very consistent in my observations was that anemones were only present in areas that were dominated by *Salicornia*. More than just a little *Salicornia* had to be present, I would say at least 80% *Salicornia* presence was typical for anemone presence. Soil composition also seemed to be a determining factor for the presence of *Nematostella*. Even if *Salicornia* was present, the pool had to have a soft, smooth, fine sediment mud that was usually light brown on top and very dark black underneath. It would be interesting to investigate this further.

My study raised more questions than it answered, and many further investigations of *Nematostella* could be pursued. Some possible future studies could include:

- Burrowing/locomotion movements within the sediment
- Investigation of what triggers burrowing; when they burrow as well as how deeply they burrow. Is there a cycle?
- Soil composition
- More extensive surveys of the organisms coexisting with *Nematostella*
- Further study of panne size and depth

REFERENCES:

Asson, M.A. 1979. The Biology of *Nematostella vectensis* with Special Reference to its Habitat, Distribution,, and Reproduction. OIMB Library, Student Reports. Fall 1979, Book 1.

Darling, J.A.; Reitzel, A.M.; Finnerty, J.R. 2004. Regional population structure of a widely introduced estuarine invertebrate; *Nematostella vectensis*. Blackwell Synergy. Accessed online 08.14.07.

<http://www.blackwell-synergy.com/doi/abs/10.1111/j.1365-294X.2004.02313.x>

Finnerty, John, R. 2004-2007. Website information. Boston University. Accessed 08.14.07. <http://www.nematostella.org/>

Inouye, Sharon. 1976. Tolerance of Salinity Fluctuation by the Estuarine Sea Anemone, *Nematostella vectensis*. OIMB Library, Student Reports. Summer 1976, Book 1.

Madsen, K. 1978. A Descriptive Study of a Salt Pan Ecosystem. OIMB Library, Student Reports. Fall 1978, Book 1.

Sibbald, Garth. 1990. Density and Distribution of the Sea Anemone *Nematostella vectensis* in a Salt Marsh Panne. OIMB Library, Student Reports. Summer 1990, Book 2.

UK Biodiversity Action Plan. Updated 2007. A government run site. <http://www.ukbap.org.uk/UKPlans.aspx?ID=471>