Analysis of Community Distribution at Upper Newport Bay

Introduction

On a previous visit to Upper Newport Bay, we **observed and characterized** the distribution patterns of ecological communities for a portion of Upper Newport Bay. In that effort we made certain field observations for each community, including: elevation, topography, exposure to tidal influence, main source of soil moisture, and dominant plants.

Mission

In today's outing, we will **analyze and explain** the observed ecological community distribution patterns at Upper Newport Bay.

Technique

We will approach this task in two phases. First, we will critically differentiate the four studied communities based on selected environmental criteria. In this phase, you will complete Environmental Circumstances Checklists for each community.

In the second phase, we will explain the observed distribution patterns. In this phase, you will prepare written answers to questions about the distribution patterns of the plant communities of this study.

Rationale and Value of this Exercise

Patterns exist in many realms of experience, be it biological, social, or economic, for example. By recognizing patterns, we have an opportunity to begin to comprehend the underlying structure of complex phenomena. We see mathematical patterns in nature (fractals). We see patterns in the landscape, in business cycles, in climate zones, in social upheavals and land use. Recognition and analysis of these patterns help us to develop general theories about the behavior of important and complex phenomena.

Although in this exercise we are trying to explain the distribution of ecological communities at Newport Bay, our actual findings are not what is most important. Instead, it is the skills that we practice here that we will take with us going forward – skills that will help us recognize, analyze and understand patterns in different realms as our lives unfold.

What you will turn in for points

1. Physical Environmental Circumstances Checklists = 4 points (combined)
2. Answers to justification questions = 16 points

Biological Background

Our study area has a mix of beneficial and stressful environmental circumstances. These circumstances consist of physical factors (like water availability and salinity), and biological factors (like competition and special traits). Depending upon their particular mix of traits, the plants in a given area interact with these circumstances in different ways. This has resulted in the easily observable pattern of plant distribution that we mapped on our previous visit.

The table below lists a selection of environmental circumstances that are relevant to our study. The table indicates how plants interact with such circumstances.

Environmental circumstance	**How plants interact with this circumstance**
Groundwater	Plant root systems consume surrounding groundwater. The water enters into the xylem tube system and travels up the plant toward the leaves. On the way, some of the water is consumed by the plant's cells. Inside the cell, water behaves as a chemical reaction medium and a chemical participant in the cell's ongoing biochemistry. When groundwater is in short supply, it is harder to fill new cells with it – reducing cellular activity and new growth.
Molecular oxygen (O_2) in the soil.	Molecular oxygen is consumed by all of the plant's living cells at all times. That includes all of the living cells in the roots, trunk, stems, branches, leaves and flowers. Roots normally get their O_2 from the tiny pockets of air that surround them in the soil. Above ground, plants get their O_2 from the surrounding air. Inside the cells, oxygen participates in the perpetual biochemical process of cellular respiration. Cellular respiration makes ATP energy available to power the cell's operations. If O_2 is in short supply, then cellular operations slow or halt, due to reduced ATP energy production by cellular respiration – the cell dies.
Salt in the soil	Salt is a special kind of water soluble substance that tends to draw water towards it. Soils that have moderate to high mounts of salt in them are bad for most plants. This is because salts in the soil pull water out of the plant. As cells lose water, their contained molecules become crowded and deformed. As a result, cellular operations are reduced and eventually come to a halt – cell death.
Space (underground, and aboveground)	Plants occupy space on the ground, first as seeds. As plants grow, their roots spread outwards underground, occupying greater amounts of space. In the underground space, the plant's roots consume available water and mineral nutrients. In addition, as the aboveground portion of the plant grows, the roots provide useful structural support. Aboveground, the plant grows to occupy a larger 3-dimensional space. From this space, the plant absorbs light from the sky. The light is absorbed by the green parts of the plant and is used to fix carbon in the process of photosynthesis. If space is in short supply, new seeds cannot germinate, and new roots and stems cannot expand – making it harder for new plants to become established.
Light	Light is a form of electromagnetic energy that plants consume and use to fix carbon in the process of photosynthesis. The resulting short chains of fixed carbon are used as building materials to make all of the plant's important biological molecules like DNA, proteins, cell membranes and sugars – making growth possible. If light is in short supply, photosynthesis is reduced – causing reductions in growth, and reductions in the amount of chemical energy production that can be used to power cellular operations.

The below table describes the environmental sensitivities and relevant traits of the dominant plants in our study area.

Plant	**Environmental sensitivities and relevant traits**
Trees	Groundwater. Trees grow in soils that have abundant (not saturated and not salty) groundwater all year long. If groundwater is in short supply, it is harder to fill new cells with it – reducing cellular activity and new growth. These plants are not drought-tolerant. Soil O_2. Tree roots must have access to plentiful supplies of O_2 in the soil. If soil O_2 is low or absent, the cells in tree roots will not be able to conduct cellular respiration, causing the root cells to die from energy starvation. If roots are not active, the tree will die from lack of water and mineral nutrients. Soil salt. Trees grow in soils that have low amounts of salt. They are not tolerant of soils that have moderate or high amounts of salt. The soil salt draws moisture out of them, crowding and deforming cell molecules – which can slow or halt cellular operations. Light. Trees do best when they have access to abundant sunlight. If sunlight access is restricted or removed, trees will suffer or die for lack of sufficient production of fixed carbon and chemical energy from photosynthesis. Traits. Trees have large underground root systems that dominate the surrounding territory, pulling in groundwater and mineral nutrients. Trees grow tall. Their height helps them to get access to sunlight, especially when surrounded by other tall trees. Their height also produces shade that makes it harder for shorter plants to succeed.
Salt grass and pickleweed	Groundwater. Although these plants would thrive if groundwater was constantly available, they can persist in soils that are dry for long episodes. They are drought-tolerant. Soil O_2. These plants' roots must have access to plentiful supplies of O_2 in the soil. If soil O_2 is low or absent, the root cells will not be able to conduct cellular respiration, causing the root cells to die from energy starvation. If roots are not active, the plant will die from lack of water and mineral nutrients. Soil salt. Although these plants would thrive in low-salt soils, they are tolerant of salty soils and can persist in soils with high amounts of salt. Light. These plants do best when they have access to abundant sunlight. If sunlight access is restricted or removed, these plants will suffer or die for lack of sufficient production of fixed carbon and chemical energy from photosynthesis. Traits. Salt grass excretes excess salt obtained from the soil. Pickleweed diverts salt to the tips of its stems, where is accumulates. These actions allow these plants to persist in salty soils.

Plant	Environmental sensitivities and relevant traits
Cattails and sedge grass	Groundwater. These plants do best when there is abundant groundwater (non-salty) constantly available near the surface of the soil. If groundwater is more than a foot or two below the surface, these plants will not be able to access it because they do not produce deep roots. Without water it is not possible to fill new cells with it – reducing cellular activity and new growth. These plants are not drought tolerant. Soil O_2. Although these plants would thrive in soils that are high in O_2, they can persist in soils that have little or no O_2. Soil salt. These plants grow in soils that have low amounts of salt. They are not tolerant of soils that have moderate or high amounts of salt. The soil salt draws moisture out of them, crowding and deforming cell molecules – which can slow or halt cellular operations. Light. These plants do best when they have access to abundant sunlight. If sunlight access is restricted or removed, these plants will suffer or die for lack of sufficient production of fixed carbon and chemical energy from photosynthesis. Traits. Cattails and sedge grasses have air-filled hollow tubes in their stems. These tubes run down the plant into the roots, delivering O_2 to the root cells by diffusion.
Cord grass	Groundwater. These plants do best when there is abundant groundwater constantly available near the surface of the soil. If groundwater is more than a foot or two below the surface, these plants will not be able to access it because they do not produce deep roots. Without water it is not possible to fill new cells with it – reducing cellular activity and new growth. These plants are not drought tolerant. Soil O_2. Although these plants would thrive in soils that are high in O_2, they can persist in soils that have little or no O_2. Soil salt. Although these grasses would thrive in low-salt soils, they can persist in soils that have moderate amounts of salt. They are tolerant of soils that have moderate amounts of salt. Light. These plants do best when they have access to abundant sunlight. If sunlight access is restricted or removed, these plants will suffer or die for lack of sufficient production of fixed carbon and chemical energy from photosynthesis. Traits. Cord grass is tolerant to changes in soil and water salinity. Cord grass is tolerant of soil and water that has moderate amounts of salt. Cord grass has air-filled hollow tubes in their stems. These tubes run down the plant into the roots, delivering O_2 to the root cells by diffusion.

Task No. 1:
Complete the below Physical Environmental Circumstances checklists (4 points).

Riparian / Woodland Checklist	**Physical Environmental Circumstances**
Groundwater	☐ Abundant – near the surface ☐ Abundant – deep ☐ Scarce
Soil O_2	☐ High ☐ Low ☐ None
Soil salt	☐ High ☐ Moderate ☐ Low
Access to unfiltered light	☐ Above 20 feet ☐ Above 10 feet ☐ Above 3 feet ☐ Above 1 foot
Restricted Space. If all existing plants were removed, would plants from other communities be able to colonize and occupy this territory? If yes, not restricted. If no, restricted.	☐ Yes (space is not restricted) o Plants from Salt Barren o Plants from Freshwater Marsh o Plants from Salt Marsh ☐ No (space is restricted)

Salt Barren Checklist	**Physical Environmental Circumstances**
Groundwater	☐ Abundant – near the surface ☐ Abundant – deep ☐ Scarce
Soil O_2	☐ High ☐ Low ☐ None
Soil salt	☐ High ☐ Moderate ☐ Low
Access to unfiltered light	☐ Above 20 feet ☐ Above 10 feet ☐ Above 3 feet ☐ Above 1 foot
Restricted Space. If all existing plants were removed, would plants from other communities be able to colonize and occupy this territory? If yes, not restricted. If no, restricted.	☐ Yes (space is not restricted) o Plants from Riparian/Woodland o Plants from Freshwater Marsh o Plants from Salt Marsh ☐ No (space is restricted)

Freshwater Marsh Checklist	**Physical Environmental Circumstances**
Groundwater	☐ Abundant – near the surface ☐ Abundant – deep ☐ Scarce
Soil O_2	☐ High ☐ Low ☐ None
Soil salt	☐ High ☐ Moderate ☐ Low
Access to unfiltered light	☐ Above 20 feet ☐ Above 10 feet ☐ Above 3 feet ☐ Above 1 foot
Restricted Space. If all existing plants were removed, would plants from other communities be able to colonize and occupy this territory? If yes, not restricted. If no, restricted.	☐ Yes (space is not restricted) o Plants from Salt Barren o Plants from Riparian/Woodland o Plants from Salt Marsh ☐ No (space is restricted)

Salt Marsh Checklist	**Physical Environmental Circumstances**
Groundwater	☐ Abundant – near the surface ☐ Abundant – deep ☐ Scarce
Soil O_2	☐ High ☐ Low ☐ None
Soil salt	☐ High ☐ Moderate ☐ Low
Access to unfiltered light	☐ Above 20 feet ☐ Above 10 feet ☐ Above 3 feet ☐ Above 1 foot
Restricted Space. If all existing plants were removed, would plants from other communities be able to colonize and occupy this territory? If yes, not restricted. If no, restricted.	☐ Yes (space is not restricted) o Plants from Salt Barren o Plants from Freshwater Marsh o Plants from Riparian/Woodland ☐ No (space is restricted)

Task No. 2:
Write brief but informative answers to the following questions (16 points).

1. What is one physical environmental circumstance that prevents trees from living in the area occupied by the Freshwater Marsh?

2. Following up from the previous question, what is the biological reason this physical circumstance prevents trees from occupying the area occupied by the Freshwater Marsh?

3. What is one physical environmental circumstance that prevents cattails from living in the area occupied by the Riparian / Woodland?

4. Following up from the previous question, what is the biological reason this physical circumstance prevents cattails from occupying the area occupied by the Riparian / Woodland?

5. What is one physical environmental circumstance that prevents cattails from living in the area occupied by the Salt Marsh?

6. Following up from the previous question, what is the biological reason this physical circumstance prevents cattails from occupying the area occupied by the Salt Marsh?

7. What is one physical environmental circumstance that prevents trees from living in the area occupied by the Salt Barren?

8. Following up from the previous question, what is the biological reason this physical circumstance prevents trees from occupying the area occupied by the Salt Barren?

END