

# **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.

<b>Environmental circumstance</b>	<b>How plants interact with this circumstance</b>
Groundwater	<p>Plant root systems consume surrounding groundwater. The water enters into the plant's 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, a floatation medium – allowing complex molecules to maintain their operational shapes, and a chemical participant in the cell's ongoing biochemistry. When groundwater is in short supply, cells contain less water, reducing, or halting cellular operations due to crowded and flattened molecules.</p>
Molecular oxygen (O <sub>2</sub> ) in the soil.	<p>Molecular oxygen is consumed by all the plant's living cells at all times. That includes all the living cells in the roots, trunk, stems, branches, leaves, and flowers. Roots normally get their O<sub>2</sub> from the tiny pockets of air that surround them in the soil. Above ground, plants get their O<sub>2</sub> 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.</p> <p>If O<sub>2</sub> is in short supply, then there is a short supply of ATP energy in the cell (energy starvation). As a result, cellular operations are reduced or come to a halt.</p>
Salt in the soil	<p>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 flattened. As a result, cellular operations are reduced and eventually come to a halt – cell death.</p>
Space (underground, and aboveground)	<p>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, mineral nutrients, and O<sub>2</sub>. 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.</p> <p>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.</p>
Light	<p>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 the plant's important biological molecules like DNA, proteins, cell membranes and sugars – making growth possible.</p> <p>If light is in short supply, photosynthesis is reduced. This reduces the amount of chemical energy available to power cellular operations (energy starvation). Without energy, cellular operations come to a halt.</p>

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

<b>Plant</b>	<b>Environmental sensitivities and relevant traits</b>
Trees	<p>Groundwater. Trees grow in soils that have abundant (not saturated and not salty) groundwater all year long. They are not drought tolerant.</p> <p>Soil O<sub>2</sub>. Tree roots must have access to plentiful supplies of O<sub>2</sub> in the soil. Roots absorb O<sub>2</sub> that diffuses into the tiny air spaces present in the soil.</p> <p>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.</p> <p>Light. Trees do best when they have access to abundant, direct sunlight. They can survive in shaded environments, but at reduced operational levels.</p> <p>Traits. Trees have deep and broad underground root systems that dominate the surrounding territory, pulling in groundwater, O<sub>2</sub>, and mineral nutrients. The root cells use these resources directly. Excess absorbed water and mineral nutrients are shipped upward through the xylem tubes and made available to the rest of the plant. Trees grow tall. Their height helps them to get access to direct sunlight, especially when surrounded by other tall trees. Their height also produces shade that makes it harder for shorter plants to succeed. Generally, trees are not drought-tolerant because they do not have water conservation traits.</p>
Salt grass and pickleweed	<p>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.</p> <p>Soil O<sub>2</sub>. These plants' roots must have access to plentiful supplies of O<sub>2</sub> in the soil. Roots absorb O<sub>2</sub> that diffuses into the tiny air spaces present in the soil.</p> <p>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.</p> <p>Light. These plants do best when they have access to abundant, direct sunlight. They can survive in shaded environments, but at reduced operational levels.</p> <p>Traits. Salt grass is tolerant of salty soils and salty water because it can excrete excess salt absorbed from salty groundwater. Pickleweed is tolerant of salty soils and salty water because it diverts excess salt to the tips of its stems, where the salt accumulates. Both plants can tolerate dry soils because they have effective water conservation traits.</p>

Cattails and sedge grass	<p>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. These plants are not drought tolerant.</p> <p>Soil O<sub>2</sub>. Although these plants would thrive in soils that are high in O<sub>2</sub>, they can persist in soils that have little or no O<sub>2</sub>.</p> <p>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.</p> <p>Light. These plants do best when they have access to abundant, direct sunlight. They can survive in shaded environments, but at reduced operational levels.</p> <p>Traits. Cattails and sedge grasses have air-filled hollow tubes in their stems. These tubes run down the plant into the roots, delivering O<sub>2</sub> to the root cells by diffusion. So, the roots of these plants get their O<sub>2</sub> by taking it in, not from the surrounding soil, but from the tubes above, sort of like a snorkel. These grasses are not drought-tolerant because they do not have water conservation traits.</p>
Cord grass	<p>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. These plants are not drought tolerant.</p> <p>Soil O<sub>2</sub>. Although these plants would thrive in soils that are high in O<sub>2</sub>, they can persist in soils that have little or no O<sub>2</sub>.</p> <p>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.</p> <p>Light. These plants do best when they have access to abundant, direct sunlight. They can survive in shaded environments, but at reduced operational levels.</p> <p>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<sub>2</sub> to the root cells by diffusion. So, the roots of cord grass get their O<sub>2</sub> by taking it in, not from the surrounding soil, but from the tubes above, sort of like a snorkel. Cord grass is not drought-tolerant because it does not have water conservation traits.</p>

**Task No. 1:**

**Complete the below Physical Environmental Circumstances checklists (4 points).**

<b>Riparian / Woodland Checklist</b>	<b>Physical Environmental Circumstances</b>
Groundwater	<input type="checkbox"/> Abundant – near the surface <input type="checkbox"/> Abundant – deep <input type="checkbox"/> Scarce
Soil O <sub>2</sub>	<input type="checkbox"/> High <input type="checkbox"/> Low <input type="checkbox"/> None
Soil salt	<input type="checkbox"/> High <input type="checkbox"/> Moderate <input type="checkbox"/> Low
Access to unfiltered light	<input type="checkbox"/> Above 20 feet <input type="checkbox"/> Above 10 feet <input type="checkbox"/> Above 3 feet <input type="checkbox"/> Above 1 foot
<p>Excluded by the physical environment.</p> <p>If all existing plants were removed from this community, plants from which other communities would be excluded from this territory – because of stresses caused by the physical environment alone?</p>	<input type="checkbox"/> Salt Barren plants excluded <input type="checkbox"/> Freshwater Marsh plants excluded <input type="checkbox"/> Salt Marsh plants excluded

<b>Salt Barren Checklist</b>	<b>Physical Environmental Circumstances</b>
Groundwater	<input type="checkbox"/> Abundant – near the surface <input type="checkbox"/> Abundant – deep <input type="checkbox"/> Scarce
Soil O <sub>2</sub>	<input type="checkbox"/> High <input type="checkbox"/> Low <input type="checkbox"/> None
Soil salt	<input type="checkbox"/> High <input type="checkbox"/> Moderate <input type="checkbox"/> Low
Access to unfiltered light	<input type="checkbox"/> Above 20 feet <input type="checkbox"/> Above 10 feet <input type="checkbox"/> Above 3 feet <input type="checkbox"/> Above 1 foot
<p>Excluded by the physical environment.</p> <p>If all existing plants were removed from this community, plants from which other communities would be excluded from this territory – because of stresses caused by the physical environment alone?</p>	<input type="checkbox"/> Riparian/woodland plants excluded <input type="checkbox"/> Freshwater Marsh plants excluded <input type="checkbox"/> Salt Marsh plants excluded

<b>Freshwater Marsh Checklist</b>	<b>Physical Environmental Circumstances</b>
Groundwater	<input type="checkbox"/> Abundant – near the surface <input type="checkbox"/> Abundant – deep <input type="checkbox"/> Scarce
Soil O <sub>2</sub>	<input type="checkbox"/> High <input type="checkbox"/> Low <input type="checkbox"/> None
Soil salt	<input type="checkbox"/> High <input type="checkbox"/> Moderate <input type="checkbox"/> Low
Access to unfiltered light	<input type="checkbox"/> Above 20 feet <input type="checkbox"/> Above 10 feet <input type="checkbox"/> Above 3 feet <input type="checkbox"/> Above 1 foot
<p>Excluded by the physical environment.</p> <p>If all existing plants were removed from this community, plants from which other communities would be excluded from this territory – because of stresses caused by the physical environment alone?</p>	<input type="checkbox"/> Salt Barren plants excluded <input type="checkbox"/> Riparian/woodland plants excluded <input type="checkbox"/> Salt Marsh plants excluded

<b>Salt Marsh Checklist</b>	<b>Physical Environmental Circumstances</b>
Groundwater	<input type="checkbox"/> Abundant – near the surface <input type="checkbox"/> Abundant – deep <input type="checkbox"/> Scarce
Soil O <sub>2</sub>	<input type="checkbox"/> High <input type="checkbox"/> Low <input type="checkbox"/> None
Soil salt	<input type="checkbox"/> High <input type="checkbox"/> Moderate <input type="checkbox"/> Low
Access to unfiltered light	<input type="checkbox"/> Above 20 feet <input type="checkbox"/> Above 10 feet <input type="checkbox"/> Above 3 feet <input type="checkbox"/> Above 1 foot
<p>Excluded by the physical environment.</p> <p>If all existing plants were removed from this community, plants from which other communities would be excluded from this territory – because of stresses caused by the physical environment alone?</p>	<input type="checkbox"/> Salt Barren plants excluded <input type="checkbox"/> Freshwater Marsh plants excluded <input type="checkbox"/> Riparian/woodland excluded

**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