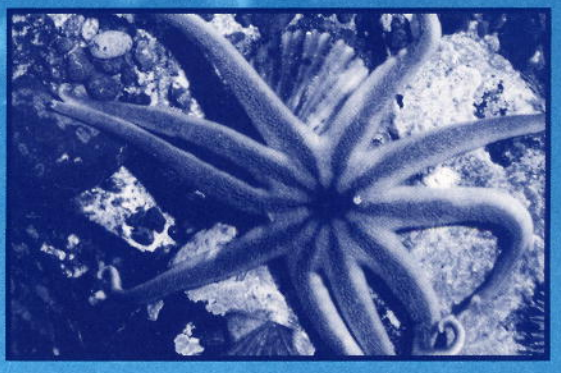
A Study Guide



THE INTERTIDAL ZONE

National Film Board of Canada
Office national du film du Canada

A Study Guide for the Film *The Intertidal Zone*

Introduction

All animals and plants are adapted for the environmental conditions they live with, and this film shows how several species have adapted to the extraordinary environment created by waves crashing against a rocky shore. Although photographed in British Columbia, the film generally applies to the west coast from northern California to Alaska. While the species along east-coast rocky intertidal areas are usually different, there are many similarities in the ecological relationships on both coastlines.

The film first defines the environment, showing how it is a rich and colorful habitat. A generalized food-web for the intertidal zone is then developed, beginning with the abundant source of food suspended in the sea — plankton. The plankton form one fuel source for intertidal food-webs, while seaweeds and diatoms form another. Together they provide the fuel for an impressive array of animals. While many of these animals are residents of the intertidal zone, others are transient visitors, adjusting their activities to the cycle of the tides. Fish, sea mammals, and diving ducks move in when the tide is high, while shorebirds, seagulls, and mammals like the raccoon forage at low tide. The cycle is completed as detritus feeders and bacteria process or recycle the nutrients of dead plants and animals.

Suggested Audiences

With its many scenes of animal activities and its succinct narration, the film is suitable for a wide audience, from the intermediate level upwards. It is particularly useful for science students because it demonstrates how organisms are interdependent and how they have adapted to their specific environments. By outlining the basic ecology of the intertidal zone, the film is useful background for studies of the resource and pollution issues that go hand-in-hand with coastal development.

For biology students the film reveals an exceptional diversity of life. Some of the details shown in the film are useful jumping-off points for studies of adaptation, animal behavior, toxic effects in the environment, animal diversity, classification and taxonomy, and ecological interaction.

For the general audience, *The Intertidal Zone* shows a fascinating perspective of the real value of a healthy intertidal habitat — as a place of great beauty, as a highly productive environment that provides food for humans and a variety of animals, and as a barometer of the health of our coastal waters.

Physical Features of the Intertidal Zone

Wave shock (the force of waves striking a rocky shore) may be equivalent to a wind blowing across land at over 1000 kilometres per hour! Temperature variations (for example, heating up from the sun during low tide), variable submersion times, sand abrasion, drying out, fresh water from rain, occasional freezing conditions, and occasional low salinity from river run-off are also characteristic.

Terms Used in the Film

Byssus threads: the golden-brown threads secreted by a mussell to attach itself to a rock.

Detritus: pieces of organic matter in the ocean derived from dead plants and animals, and the bacterial decomposers associated with this material.

Detritus feeders: animals that feed on detritus that has fallen to the ocean floor.

Diatoms: microscopic, unicellular aquatic algae.

Filter feeders: animals living attached to rocks that eat plankton, using some form of filtration to concentrate the plankton out of sea water.

Grazers: animals that feed on sea weeds and diatoms.

Holdfast: the mass of finger-like tissue at the base of some seaweeds that is held to the rock with glue-like substances.

Intertidal zone: the area along any ocean shoreline that is exposed by the lowest tides and covered by the highest ones; also called the foreshore.

Phytoplankton: a wide variety of single-cell algae that drift in vast numbers in the open sea where they "harvest" the sun's energy. Although microscopic in size, they can reproduce in such numbers as to cause the sea to appear green or red in color.

Plankton: organisms that drift about in the ocean, carried by currents and wave motion. Usually they have only limited abilities to swim, or none at all.

Predators: animals that eat other animals. Usually they have the ability to move about in pursuit of their prey.

Scavengers: animals with a diverse diet, often feeding on other animals, seaweed, or detritus.

Zooplankton: animals that drift about in the sea. They are usually microscopic in size, but even large jellyfish are considered zooplankton because they are incapable of swimming in a directed way, as fish do. Zooplankton includes adult animals and also the larvae of many intertidal and bottom-dwelling animals.

How Organisms are Distributed in the Intertidal Zone: Zonation

An interesting feature of the intertidal zone not covered by this film is the distribution of its inhabitants in horizontal bands along some rocky shores. All organisms are restricted in their ability to survive in different regions of the intertidal zone. The mussel, for example, can only tolerate a certain amount of time out of the water and needs to be covered by sea water to get its plankton food. This tolerance sets the upper limit of the mussel's physical range, while the lower limit is determined mainly by predatory sea stars. With a lower tolerance for heat and dryness, the sea star must venture upward from lower down, thus it feeds only at the lower edge of the mussel's range and only at high tide. Other species have similar tolerance levels.

Several different systems have been devised to describe this "intertidal zonation." One system divides the region into Low Tide Zone, Middle Tide Zone, High Tide Zone, and Splash Zone. Animals and sea weeds can be described as occupying one or more of these zones.

The Tides and Their Causes

Of great importance in defining the intertidal zone is the movement of the tides. Tides are a product of gravitational attractions between the earth, moon and sun. On the northern Pacific coast, the daily tidal cycle is predominantly of the semi-diurnal type — there are two high tides and two low tides each day, and the cycle is delayed from day to day by about forty-five minutes due to the moon's orbit around the earth. The height of each tide is a product of many factors, the most important of which are the relative positions of the sun, moon and earth. Lower and higher tides occur when these three are lined up, as they are during the new-moon and full-moon phases of the 28-day lunar cycle.

The high tides each day are usually not equal in height, and the low tides are also usually different. Since an extremely low tide will expose most of the intertidal zone, the seashore explorer should consult published tide tables to establish the best time for a visit to the seashore.

Pollution and the Intertidal Zone

The Intertidal Zone was produced in the spirit that all resource issues in the coastal environment should be considered in relation to its value and sensitivity. The foreshore is a strikingly dynamic environment, where the interactions between organisms are in a delicate balance. Human activities along the shoreline have the potential to disrupt this balance. Each use of our foreshore or coastal region may damage intertidal ecology on a short- or a long-term basis. Pollution from the dumping of sewage and other wastes, industrial pollution — such as the spilling of oil or other chemicals — and silt-laden run-off from shoreline developments are some of the problems that must be considered. Estuaries are particularly sensitive. (For a detailed look at this issue, see the NFB film *Estuary*.) Even remote intertidal regions may experience fouling from chemical spills; no coastal region is totally isolated.

The film explains how pollution may affect intertidal food chains through the concentration of toxic chemicals or bacteria in filter feeders like clams or mussels. Then it poses a question: How will our industrial and recreational activities affect shorelines? All of the organisms within the food-webs of the intertidal zone are a sensitive measure of our ability to respond to this question.

Organisms Featured in the Film

Diatoms

Comb jelly (sea gooseberry)

Sea palm algae

Sea weeds (red, brown, green)

Barnacle

Giant green anemone

Purple sea urchin

Coastal (California) mussel

Common sea star

Shore crabs

Turban snail

Sea cucumber

Hermit crab

Hairy gilled worm

Abalone

Nudibranch

Porcelain crab

Skeleton shrimp
(caprellid amphipod)

Harlequin duck

Sea gull

Northern (Stellar's) sea lion

Raccoon

Oystercatcher

Bonaparte's gull

Great blue heron

Herring

Sandpiper

Giant sunflower star

Before Screening the Film

• A preliminary discussion of the intertidal zone's environment could focus on the tides. Sun/moon/earth models or diagrams are useful, and tide tables could be examined. Tide graphs will help in understanding the cyclic nature of tides. Students might be asked to calculate how much time an organism would be out of the water during one day living at its particular intertidal level (say, for example, the 1.5 metre level).

• A trip to a local aquarium or museum could serve as background to the film. Students can be directed to make careful observations of the invertebrates displayed, since this group represents the majority of intertidal inhabitants.

• Discuss differences in intertidal environments for different kinds of beaches — a sandy beach, a rocky beach, a boulder-strewn beach, a muddy beach. What would be the difference in wave shock, small habitats, and the ability of organisms to hold on? How does the environment change with each wave? With each tide?

• Discuss the concept of intertidal zonation and then watch the film for evidence of it.

After Screening the Film — Some Suggested Student Activities

• Students could become familiar with one type of animal from the film (possibly researching its feeding habits and characteristics) and observe how it fits into intertidal zone food-webs during a review of the film.

• Using a microscope, examine plankton from a pond. (A simple net made from a nylon stocking can be used to collect plankton.) Compare with ocean plankton. (The book on plankton by Smith is a good reference.)

• Draw up a food-web for the intertidal zone using the organisms from the film. All of the animals and plants in the film can be written down and then arrows drawn between them to show which ones eat which.

• Examine and outline the food-webs in a local environment and compare them with those of the intertidal zone.

• Where possible, a coastal field trip to the intertidal zone can be planned for a suitable low tide or series of low tides. The careful choice of location and strict use of minimum-impact observation techniques (see the discussions in several of the reference books on this subject) can lead to very informative and enjoyable field trips.

• Students could carry out a class project to find out what happens to wastes from their community. Waste-disposal options available to inland and coastal communities could be compared as part of the project.

• A danger for humans who eat seashore life is called Paralytic Shellfish Poisoning (PSP) or "Red Tide." Students can find out what causes Red Tide and write/give a report on it. Sample questions to answer: What causes it? What animals carry PSP? When and where does it occur? How do government officials test for PSP? Does it have adverse effects on animals living on the sea shore?

• Seafood dinner. Prepare a menu or a meal of different seafood. How many are harvested from the intertidal zone and how many are filter feeders? Are the others likely to be linked to the intertidal zone through the food chains?

16 mm: 106C 0185 040
3/4'': 116C 0185 040
VHS: 113C 0185 040
Beta: 114C 0185 040
Screening time: 16 min. 58 sec.

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Related films

Estuary, NFB
Life at Salt Point, Coronet Films
The Invertebrates, Parts 1 and 2, NFB
Triangle Island, NFB

For Further Reading

British Columbia Provincial Museum Handbooks: *#39, Sea Stars; #40, Crabs and Their Relatives; #26, The Intertidal Univalves; #7, Barnacles; #17, The Intertidal Bivalves; #23, Common Marine Fishes; #27, Guide to Common Seaweeds; #21, Guide to Marine Life.* Victoria: British Columbia Provincial Museum Publications. (These are inexpensive guidebooks for each of the groups, some in great detail, others very basic.)

Carefoot, T.H. *Pacific Seashores: A Guide to Intertidal Ecology.* Vancouver: J.J. Douglas; Seattle and London: University of Washington Press, 1977. (Intended as an introductory university/college level text, this book is full of fascinating stories and excellent illustrations that make it an invaluable resource for any level.)

Hay, John and Peter Farb. *The Atlantic Shore: Human and Natural History From Long Island to Labrador.* New York and London: Harper and Row, 1966. (Deals more with the biology of land near the shore, but a few chapters do consider the intertidal zone.)

Kozloff, Eugene N. *Seashore Life of the Northern Pacific Coast.* Vancouver: Douglas and McIntyre, 1983. (This is the most thorough modern guide to this coastal region. It is well written, with sections on basic taxonomy and with many excellent color photographs. Much if its information concerns intertidal ecology.)

Ricketts, E.W. and Jack Calvin. *Between Pacific Tides.* 4th ed., revised by J.W. Hedgepeth. Stanford, Calif.: Stanford University Press, 1968. (The classic guide to west-coast intertidal life, this book makes fascinating reading on the topic of intertidal ecology.)

Smith, Deboyd L. *A Guide to Marine Coastal Plankton and Marine Invertebrate Larvae.* Dubuque, Iowa: Kendall/Hunt Publishing Co., 1977

Snively, Gloria. *Exploring the Seashore in British Columbia, Washington and Oregon — A Guide to the Shorebirds and Intertidal Plants and Animals.* Vancouver: G. Soules Publishers, 1978. (A useful basic guide to west-coast intertidal life.)