

2. AQUATIC HABITAT

We know that estuaries like the Fraser support a rich and diverse assemblage of habitats. Exactly what do we mean when we use the word "habitat"?



What Is a Habitat ?

The habitat of an organism can be simply defined as the place or "home" where it lives or where it is expected to live. Thus, to find and observe a shorebird like Dunlin, we would visit a tidelflat in the estuary.

The physical characteristics of habitats include sediment texture, water salinity (saltiness) and light. The living parts of the habitat consist of many different organisms, from bacteria to bulrushes and birds. Habitats therefore provide everything that a plant or animal needs to live and reproduce: food, nesting sites, protection for offspring, and resting and shelter sites for adults.

There is usually sufficient local variation in a habitat to support many different species, and indeed a whole community of plants and animals. Small, local habitats are referred to as micro-habitats.

Habitats also change over time. As plants and animals modify their physical environment, new and different plants and animals will gradually replace them. For example, new trees will modify a habitat by gradually shading out the sun-loving plants.

This natural process of change in the habitat is called succession. Once the habitat has changed as far as it can, it is called a mature or climax habitat. At this final stage of succession, the habitat can exist for hundreds or thousands of years — provided, of course, that humans don't damage or destroy it. Eventually, a climax habitat will be altered by natural forces such as fire, extreme flooding or drought.

Habitat Types

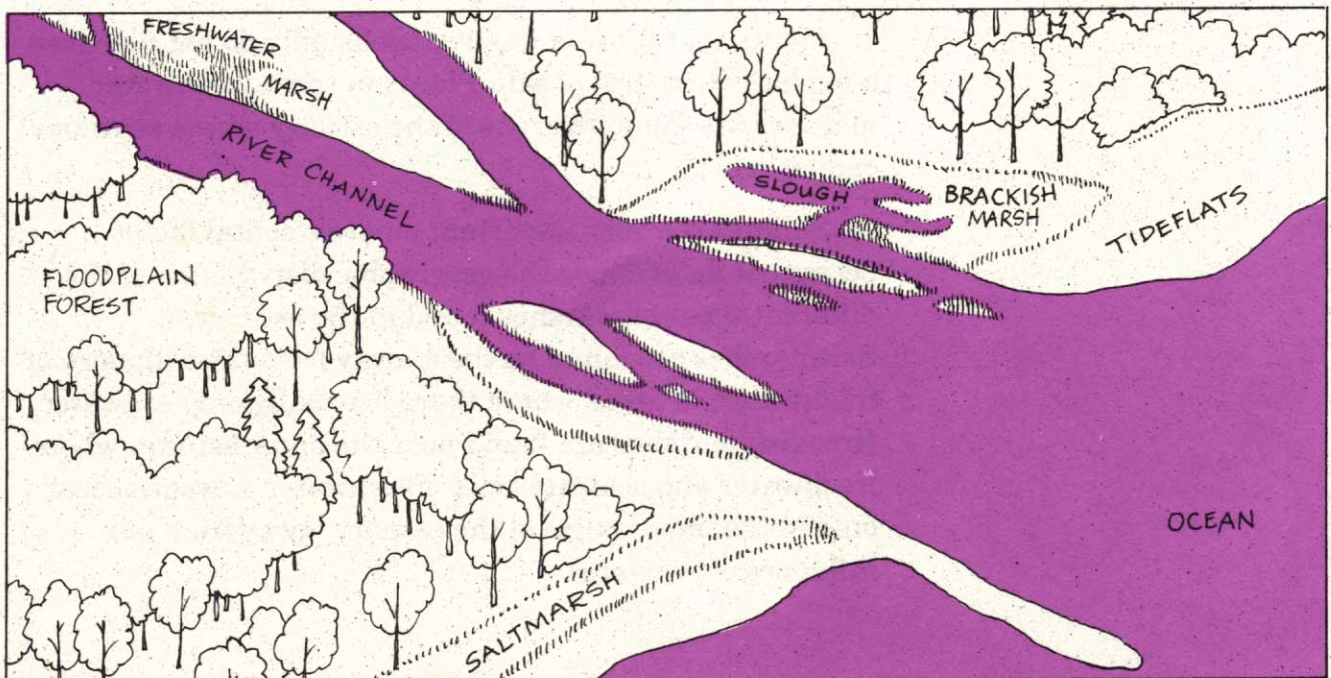
Habitats are generally classified according to the type of vegetation growing in an area. Animals are not usually used to classify habitats since birds, fish and other animals move from place to place, and are often inconspicuous and difficult to observe.

In this section, we'll describe four habitat types common to the Fraser River Estuary. We'll also describe where you can visit them, and suggest some appropriate field activities. The four habitats are:

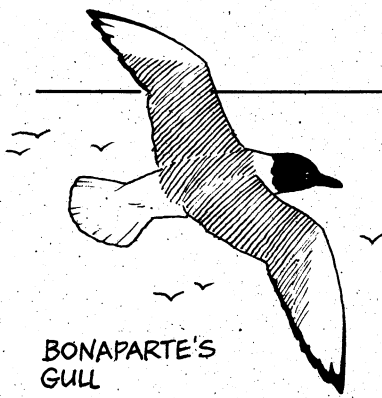
- Brackish and Freshwater Marsh
- Saltmarsh and Tideflat
- Active Floodplain Forest
- Sloughs and River Channels

The first three habitat types can be easily recognized in the field by their distinct vegetation community. What is perhaps less obvious are the environmental factors that create just the right conditions for certain species of plants to grow and propagate. Environmental factors can be physical (light, temperature) or chemical (nutrients, salinity). The relationship between plants and environmental factors is one of the most important aspects of the estuary's habitat ecology.

FIGURE 2-1
Major Habitats
of the Estuary



Physical Influences on Habitats



Although there are many different environmental factors influencing the growth and distribution of plants in the estuary, we shall discuss only two of the most important factors: salinity and flooding.

Salinity

Two of the habitat classifications listed above (brackish and freshwater marsh, and saltmarsh) are based on salinity. Plants are very sensitive to salinity, which is the amount of salt in their environment. Salt can make it difficult for some plants to nourish themselves and to maintain a balanced water level in their tissue.

Only certain kinds of plants can tolerate high levels of salt. Such salt-tolerant plants are present in saltmarshes. Many saltmarsh plants get rid of the salt they take up by releasing it through special salt pores on their leaf surfaces.

In Chapter 1, an estuary was defined as the place where the freshwater of the river mixes with the saltwater of the ocean. This mixing of fresh and saltwater creates a condition called brackish water, which contains some salt, but much less than seawater. Plants adapted to these brackish conditions are found in brackish marshes.

Plants that grow in freshwater usually do not like even a moderate amount of salt. Plants in these freshwater marshes are found in areas of the estuary where seawater cannot reach.

Salinity is a very important environmental factor because it determines the geographic distribution of the different types of marshes found in the estuary. Saltmarshes are found farthest away from the influence of freshwater, in areas where there is usually only seawater. Brackish marshes are found near the outer estuary where freshwater and seawater mix. Freshwater marshes occur only in the upper parts of the estuary, away from any influence of seawater.

Flooding

Plants are also very sensitive to flooding. The longer and deeper an area is flooded, the less oxygen is available in the soil. Plant roots need oxygen to grow and survive. To overcome the shortage of oxygen in flooded soils, some species of plants have special oxygen storage cells and are able to bring this oxygen from their leaves and stems to their roots. However, when flooding is too deep or too long in duration, most rooted plants can no longer survive.

The degree of flooding depends on the elevation at which a plant is located. On higher areas of the outer delta, near the estuary's dikes, a plant would be flooded for a relatively short time, and perhaps only during the highest tides. Farther down the delta slope toward the lower intertidal zone, tidal flooding is longer in duration and greater in depth.

The outer delta certainly looks flat when viewed from the dikes. This is because the slope is very slight. Nevertheless, five or ten centimetres of rise or fall on the delta slope can begin to make a difference as to what type of plant can grow. Tidal marshes consist of distinct patterns of different types of plants, since their growth and distribution is easily influenced by small changes in soil elevation and flooding.

ACTIVITY 3: CRITICAL TIDAL ELEVATIONS

Tides are an important feature of the estuary. The purpose of this activity is to become familiar with tides and to learn how to read tide tables. Figure 2-2 is based on data obtained from ecological studies of marshes in the outer Fraser River Estuary. The figure represents a profile view of a tidal marsh showing tidal elevations from the dike to the outer edge of the marsh.

Procedure:

1. Align a ruler with the bottom of Figure 2-2. Keeping the ruler horizontally aligned, move it upwards and read the numbers on the vertical scale labeled "Tidal Elevation - Point Atkinson Datum".



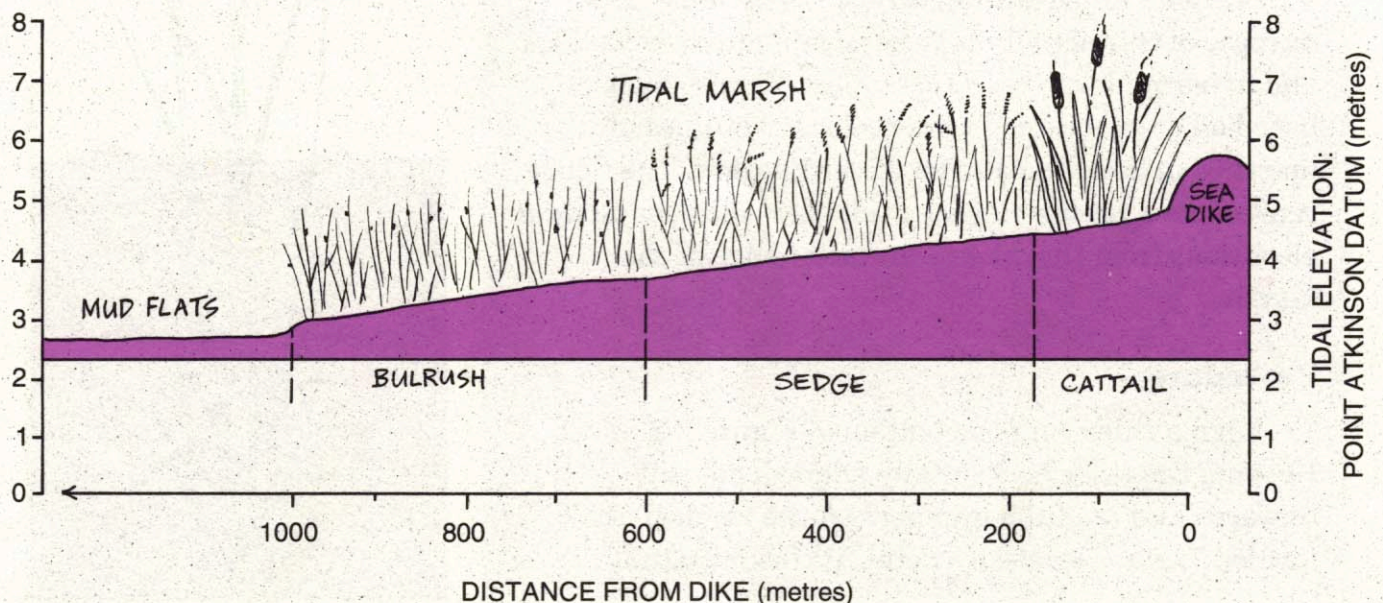
2. Note the tidal elevations of the following locations in the marsh:

- Start of the mudflat and end of the marsh
- Beginning and end of bulrush growth
- Beginning and end of sedge growth
- Beginning and end of cat-tail growth
- Top of the dike

3. Obtain a copy of the *Canadian Tide and Current Tables, Vol. 5.*, Fisheries & Oceans Canada, available at marine supply centres. Refer to the tide table for Point Atkinson. In the table find today's date. Mark the three or four tidal elevations for this date on the figure. Now you will know today's locations of the low and high tides in the delta marsh. Helpful hints for using the Tides and Currents Tables are provided in Appendix 1, page 110.

4. Refer again to the same tide table and date and make a note of the time for each tide. If you had wanted to walk into the marsh today to sample bulrush plants, when would you have been able to do so? How much time would you have had for your work? If it had not been possible today, when would be the next possible date for your sampling? Scan through the tide table and determine the best time of year to see the intertidal zone in daylight. Is there a pattern (daily, monthly, seasonal) to the tides?

FIGURE 2-2
Elevation Profile
of a Tidal Marsh



A Primer for Field Trips

The best way to learn about the aquatic habitats of the Fraser River Estuary is to visit and explore them.

However, to make the field trip successful and enjoyable, it is well worth taking time to make some basic preparations. This is especially true of group field trips with children.

Selecting Your Destination

In selecting your destination, the following may be helpful:

1. Prior to the field trip, decide on your objectives and learning outcomes, although you should also leave some room for open-ended discoveries. You might also want to study the activities in this book which are specifically intended for field trips.
2. For suggestions and descriptions of field trip destinations, refer to Table 2-3 and Figure 2-3 which provide additional information.
3. If you're planning to explore intertidal areas, you'll need to find out when low tide occurs, if the area to be visited will be exposed, and for how long. Some areas are relatively inaccessible even at low tide, due to muddy conditions or other hazards. It is important to find this out before a trip is undertaken.



WARNING

Watch out for narrow and deeply cut tidal channels which are sometimes covered by vegetation. It is best to stay away from densely vegetated tideflats where the ground is hidden from view.

FIGURE 2-3 Location of Suggested Field Trip Destinations

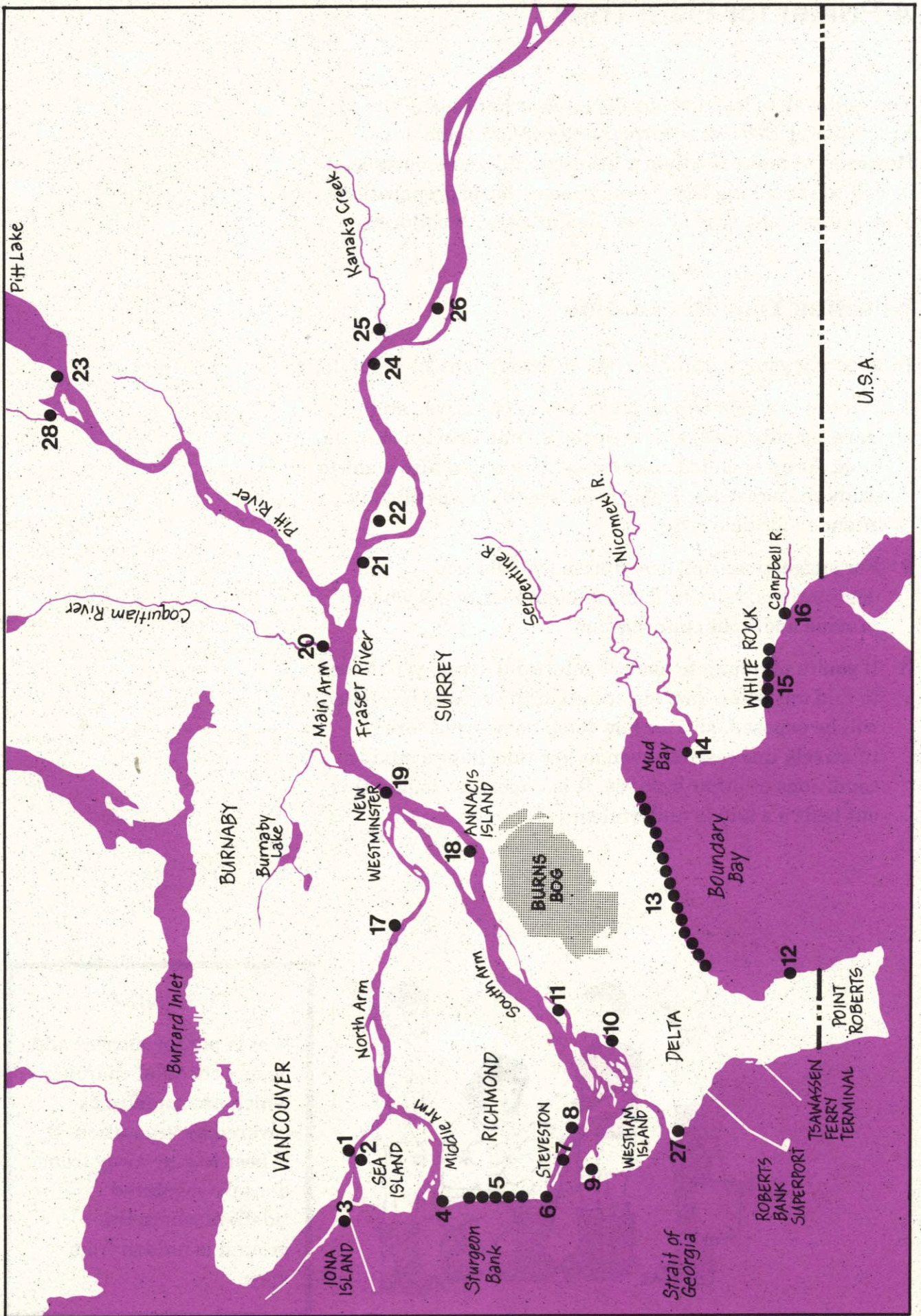


TABLE 2-3 List of Suggested Field Trip Destinations

#	FIELD TRIP DESTINATION	A	B	C	D	NOTES
1	Fraser River Park	X			X	Marsh restoration site
2	McDonald Beach Park	X			X	Boat launch & picnic area
3	Iona Beach Park	X				Pond restoration site; excellent birding
4	Terra Nova	X			X	Described in this book on page 41
5	Richmond Dikes	X				Described in this book on page 37
6	Garry Point Park	X			X	Marsh restoration site
7	Steveston Island	X		X	X	Difficult access, and only at low tide
8	Gilbert Beach	X			X	Easily reached from dike
9	Reifel Island Bird Sanctuary	X				Excellent birding
10	Ladner Harbour Park	X			X	Described in this book on page 59
11	Deas Island Regional Park	X		X	X	Described in this book on page 71
12	Centennial Beach			X		Great for exploring the tideflats
13	Boundary Bay (64th to 112th St.)			X		Described in this book on page 47
14	Blackie's Spit Park			X		Close to large eelgrass beds
15	White Rock Beach			X		Great for exploring tideflats
16	Semiahmoo Park			X		Explore the Campbell R. Estuary
17	Fraser Foreshore Park	X		X	X	Described in this book on page 59
18	South Annacis Island Park	X		X	X	Good reptile and amphibian habitat
19	Westminster Quay				X	Great place to watch boat traffic
20	Coquitlam River Estuary	X		X	X	Explore the Coquitlam River Estuary
21	Surrey Bend	X		X	X	The largest undiked floodplain
22	Barnston Island	X		X	X	Access via ferry, great biking route
23	Grant Narrows Regional Park	X			X	Nearby elevated observation platform
24	Derby Reach Park	X			X	Popular bar fishing location
25	Kanaka Creek Regional Park	X		X	X	Explore Kanaka Creek Estuary
26	McMillan Island	X		X	X	Camping and nearby floodplain forest
27	Brunswick Point	X		X		Brackish - Saltmarsh transition zone
28	Widgeon Marsh Park Reserve	X		X	X	Access with permission from GVRD

A = Brackish & Freshwater
 B = Saltmarsh & Tideflat
 C = Active Floodplain Forest
 D = Slough & River Channel

4. Intertidal plants and animals are sensitive to trampling, and considerable damage can be done by a large group of people. Some valuable and sensitive intertidal habitat areas, or habitat sites which have been restored, should not be walked into at all. It is always a good idea to check these things out first.
5. A half-day field trip will probably be sufficient, especially for children in elementary grades. Therefore, no more than one or two different types of habitat should be visited and studied. It is essential that children bring rubber boots and are dressed appropriately for what could be a wet, cold and muddy field trip.
6. Parent or other adult volunteers will be needed to accompany children on the field trip. It is best to select only those volunteers who are not squeamish about mud, insects, snakes, frogs, and anything else that the children will present and ask questions about. A minimum of 1 adult for every 8 children is recommended.
7. Parent volunteers should be given a Parent Information Sheet which indicates the objectives of the field trip and describes their responsibilities. Before the trip, the class or group should be divided into teams of 8 children (or fewer, depending on the number of adult supervisors). The parent volunteer will be attached to one of the groups as an adult supervisor. A list of names should be provided so the parents can get to know the children.

Pre-Trip Activities

If you prepare your group before the trip, the whole experience will be more interesting and rewarding, and there will be fewer demands on you and your volunteer supervisors. If the children already have some vocabulary and knowledge, they will look forward to discovering and finding interesting things. If children know where to look, they will find more on their own. What they find on their own, they register as discoveries — and what they discover, they will remember.

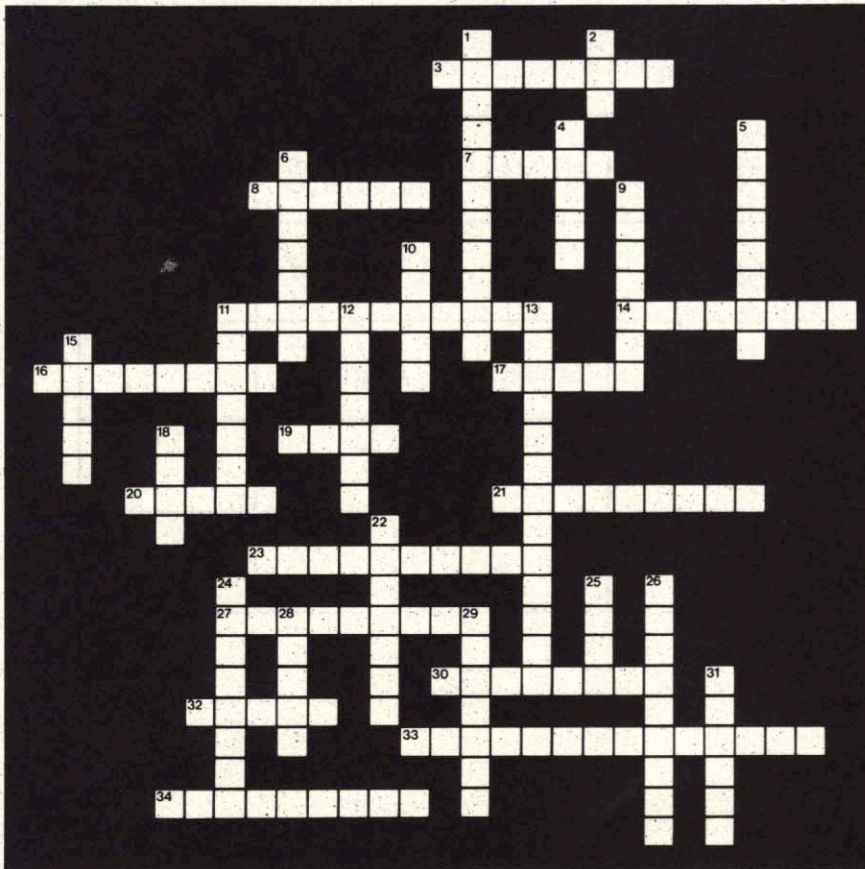
The following pre-trip activities can help you prepare for your trip to the estuary:

ACTIVITY 4: PRE-TRIP FUN

1. Give everyone a vocabulary list and the **Estuary Crossword Puzzle** provided in Figure 2-4. The crossword establishes basic vocabulary in an enjoyable way. As a supplementary activity, have everyone make up their own simple 7-word crossword. They can select their own words from the vocabulary list.

For answers see Appendix 1, page 111

FIGURE 2-4
Estuary Crossword Puzzle



ACROSS:

3. Eroded material which is deposited in an estuary
7. Large flowing body of water
8. Salt water environment
11. Biggest river in British Columbia
14. Human activity related to work
16. Small floating or swimming organisms
17. Simple organisms which contain chlorophyll
19. Two shelled animal living in marine sediments
20. An investigation
21. Waste substances which interfere with life
23. Animals which will consume anything which is edible
27. In-coming water in the daily changes in sea level (2 words)
30. Organisms which must eat other things for food
32. Organism which is the major pollutant on earth
33. The process used by plants to make their food
34. Birds which inhabit water environments

DOWN:

1. Forces which break down the natural relationships between organisms
2. Salt water marine environment
4. Islands and other land built in an estuary
5. Living thing
6. Place where an organism lives
9. Out-going water in the daily changes in sea level (2 words)
10. First in time
11. The relationship between food organisms in a natural community (2 words)
12. Area where fresh water from a river meets the salt water of the sea
13. The connections between organisms
15. An environment which is not polluted
18. Place where ships dock to take on or put off cargo
22. Organisms which inhabit the bottom sediments
24. Liquid by-products of industry
25. Unit of weight
26. Movement of organisms from one place to another
28. Enormous body of salt water
29. The study of relationships between living things and their environment
31. Needed for the ability to move and to grow or produce materials

WORDS TO SELECT FROM:

waterfowl	migration	clean	destructive	organism
consumer	flood tide	ocean	algae	river
industry	early	ebb tide	clam	Fraser River
sediment	scavengers	human	relationships	benthic
habitat	effluent	plankton	energy	probe
marine	port	ecology	estuary	pollution
photosynthesis	sea	delta	food web	gram

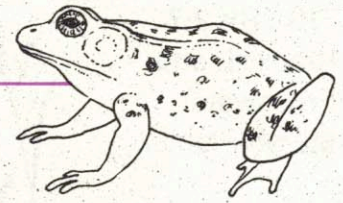
2. **Estuary Word Challenge** (adapted from the Federation of B.C. Naturalists booklet, *From Sidewalk to Seashore*) is another good game for building vocabulary skills. Each player is given a chart such as in the example of Figure 2-5.

Any word can be chosen to make up the letters in the rows. The word is revealed by the group leader at the start of the game. Children then fill the chart with acceptable estuarine vocabulary. If a group is doing this you might want to assign scores to the right answer and create a time limit for completing the answers. The winner is the one who can fill the chart first or who can score the highest. Two points are given to a word that only one person used; one point is given to words used by more than one person.

FIGURE 2-5
Estuary Word Challenge

	PLANTS	ANIMALS	HUMAN ACTIVITIES	THINK OF YOUR OWN CATEGORIES!
S	Saltwort	Seal	Sailing	
A	Algae	Amphipod	Angling	
L				
T				

Brackish and Freshwater Marsh



Where is this habitat located?

Because the Fraser is such a large river, the huge amount of freshwater it discharges creates a vast area of brackish water along the outer delta. Figure 2-6 shows that large areas of the brackish tidal marsh occur along Sturgeon Bank, Roberts Bank and the islands in the lower estuary. Freshwater tidal marshes are found upstream of New Westminster, where saltwater does not occur. Some of the most extensive freshwater tidal marshes are along the banks of the Pitt River.

In the smaller estuaries along the east coast of Vancouver Island, brackish and freshwater marshes occupy intertidal areas in the inner estuary. These estuaries do not have the extensive delta formations of the Fraser Estuary.

FIGURE 2-6
Location of major Brackish and Freshwater Marshes

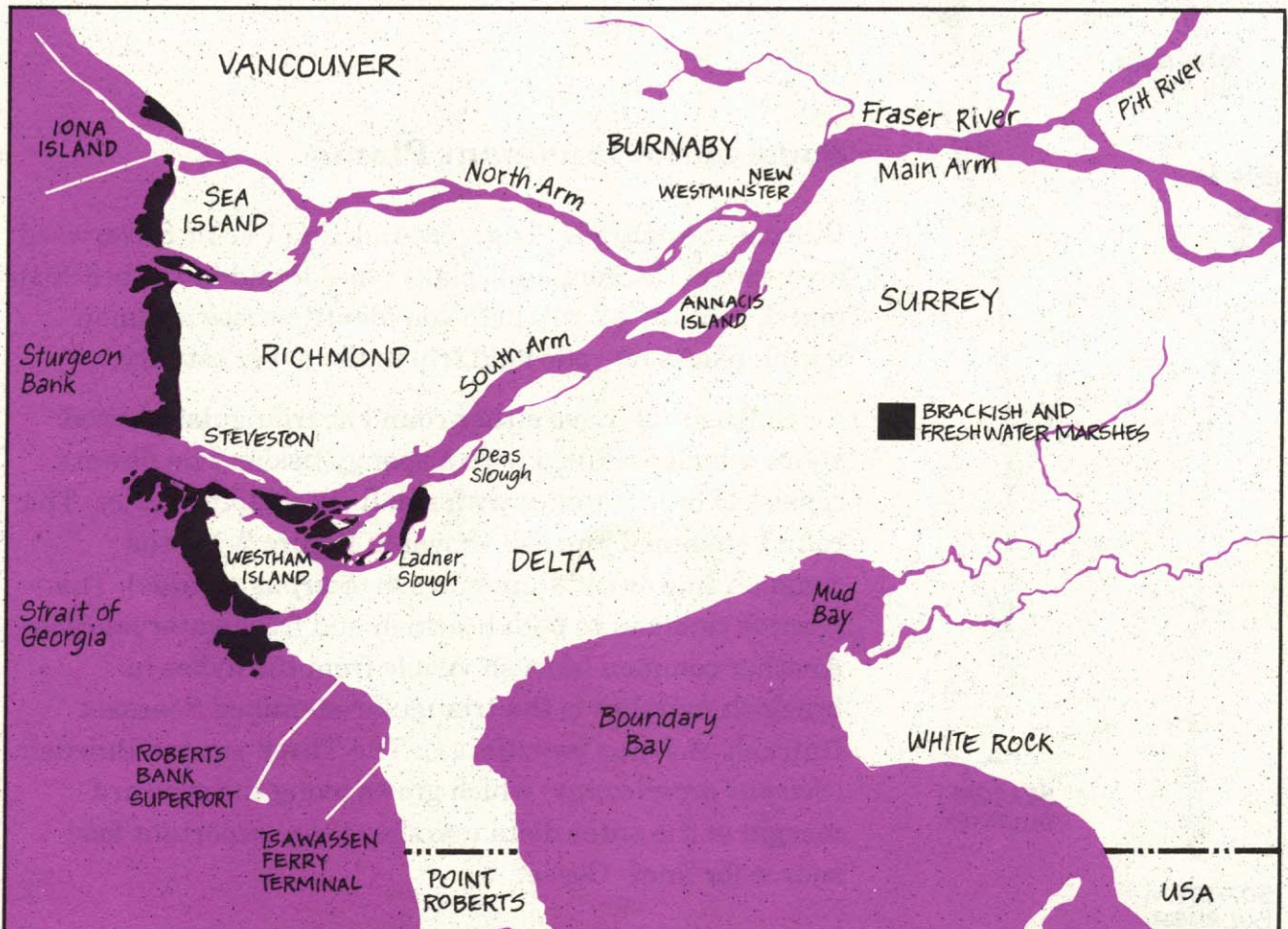
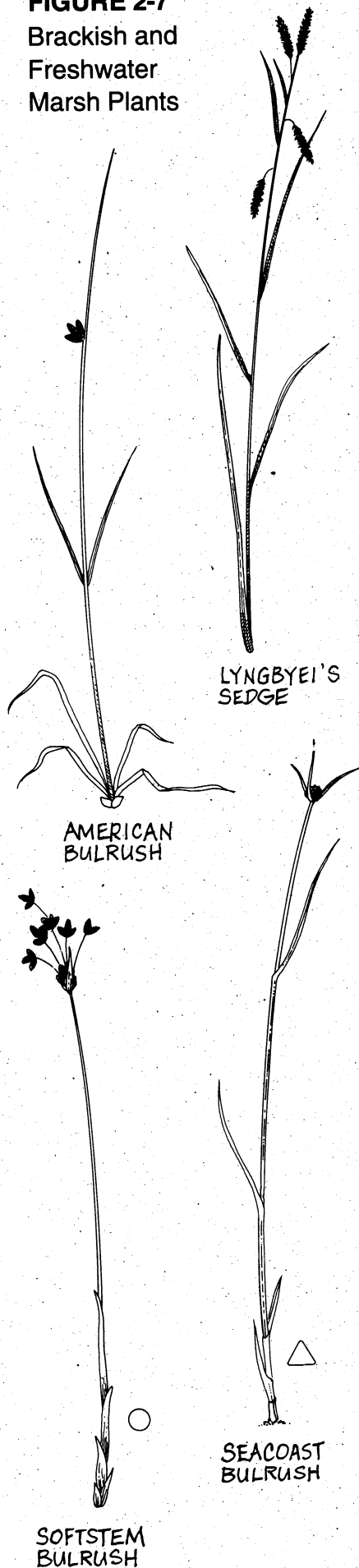


FIGURE 2-7
Brackish and
Freshwater
Marsh Plants



What are the features of this marsh?

Brackish and freshwater marshes are being discussed under the same heading because they are difficult to distinguish unless you are a biologist or experienced naturalist. Brackish marsh plants can tolerate freshwater for some periods of the year. As a result, there is considerable overlap between brackish and freshwater plant species.

Not only are these the most extensive marshes in the estuary, but they are also the most productive. Each year, our brackish and freshwater marshes produce an average of five metric tons of plant material per hectare. This amount of plant production is three times greater than that produced in saltmarshes.

At the end of the growing season, this plant production creates a huge supply of organic detritus, much of which is flushed out of the marshes with each tide. The organic detritus provides a nutritious food source which sustains life in tidal channels, sloughs and throughout the estuary.

Some of the Dominant Plants

Bulrush, Lyngbyei's Sedge, cat-tail, and Pacific Silverweed are some of the dominant plant types found in the brackish marsh. Figure 2-7 will help you identify these common marsh plants on your field trip to the lower estuary.

Bulrush can have either round or triangular shaped stems which are filled with a spongy tissue. The flowers consist of brown spikes with small overlapping scales. The round-stemmed bulrush shown in Figure 2-7 is the common tule or softstem bulrush (*Scirpus validus*). This plant is common to both brackish and freshwater marshes. Another common bulrush visible from the dykes in brackish marshes is the triangular-stemmed Seacoast Bulrush (*Scirpus maritimus*). The Three-square Bulrush (*Scirpus americanus*) which grows along the seaward margin of the outer delta marshes is an important food source for Snow Geese.

The most common sedge in the brackish environment is Lyngbyei's Sedge (*Carex lyngbyei*). Sedges tend to look much like grasses; however, there is a simple way to tell them apart. Sedges have stems with three sharp edges and soft joints (nodes), whereas grasses have round hollow stems with hard joints. Remember, "sedges have edges."

Cat-tails (*Typha latifolia*) are conspicuous tall plants with brown velvety heads. These plants are found near the dike, in ditches, and just about anywhere where there is fresh or brackish stagnant water. What you can't see are the massive root stocks, containing a core of almost pure starch, as much as corn but with less fat.

Pacific Silverweed (*Potentilla pacifica*) is often visible from a distance because of its feathery, silver leaves. This is a plant that can be found in brackish marshes, but it can also tolerate the higher salinities found in saltmarshes.



PACIFIC SILVERWEED



CAT-TAILS

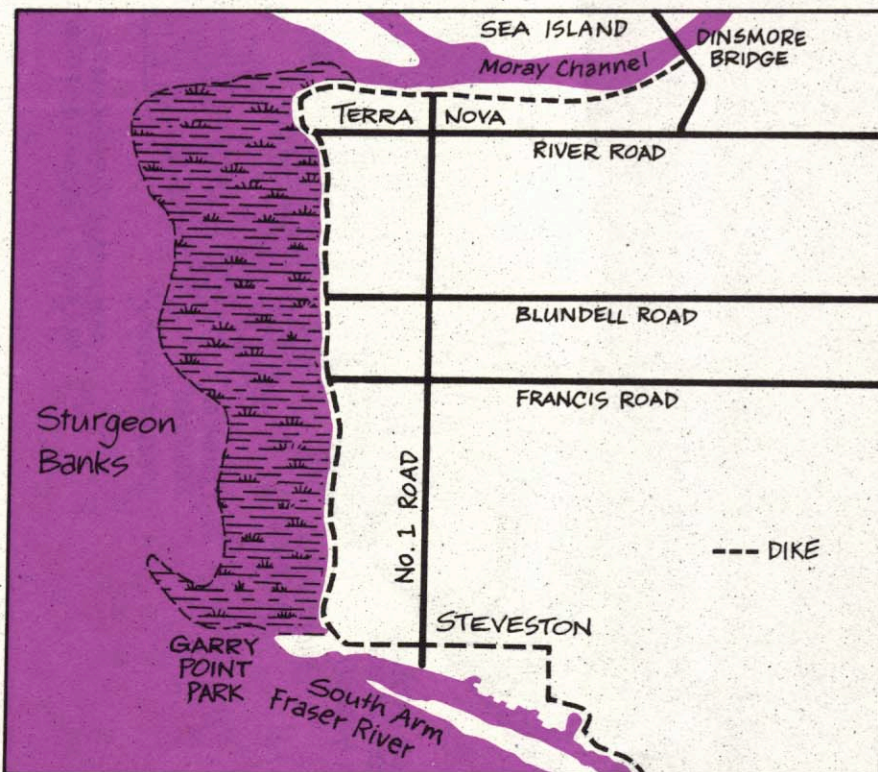
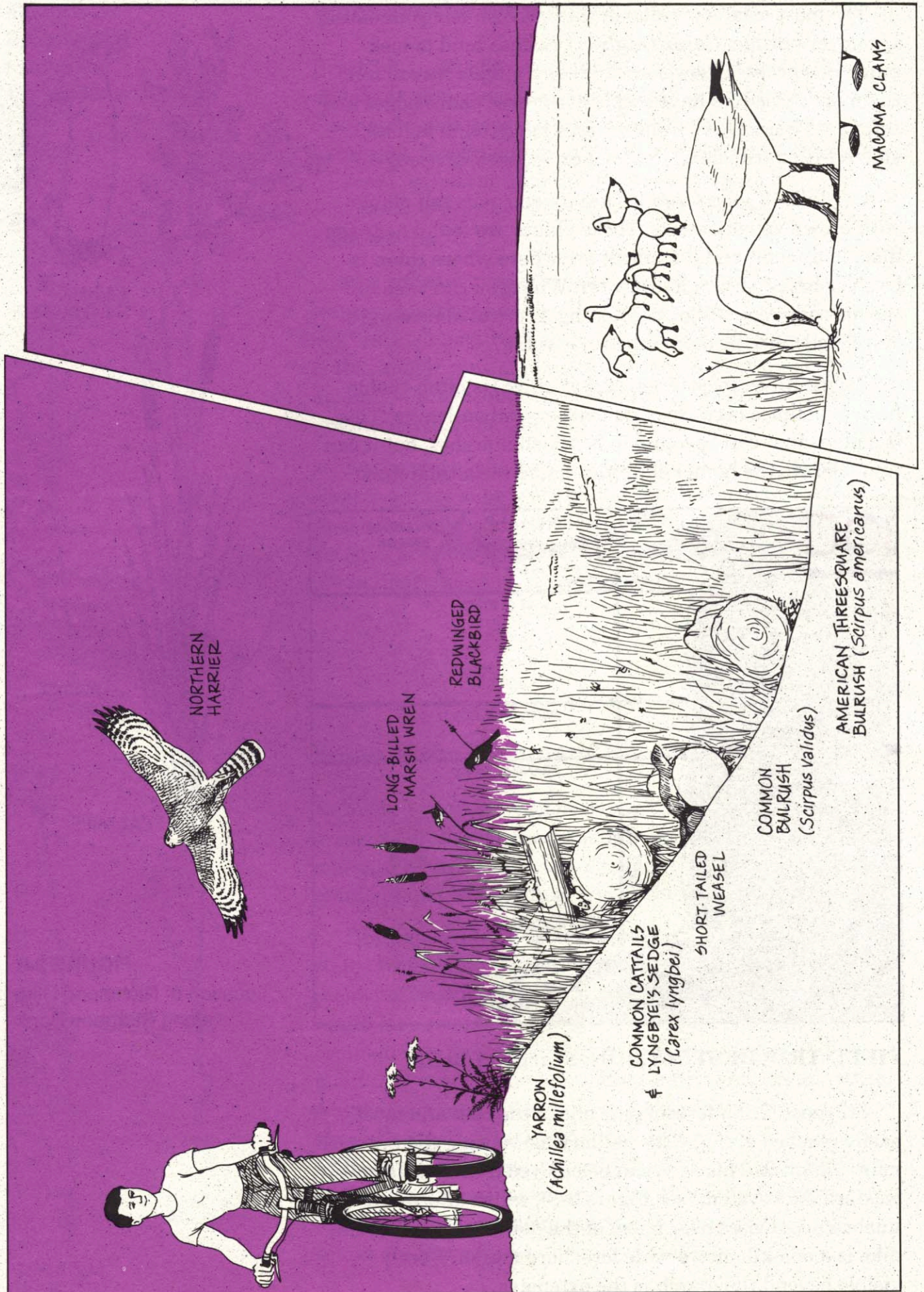


FIGURE 2-8
Location of Richmond Dike along Sturgeon Bank

FIELD TRIP DESTINATION: Sturgeon Bank

Sturgeon Bank foreshore is one of the best and most easily reached areas in the estuary for viewing the brackish marsh habitat. This area can be enjoyed from Richmond's western dike system (see Figure 2-8), which affords an unobstructed vista over much of the delta. Adjacent to the dike is a one-kilometre-wide foreshore marsh. Barely visible beyond the marsh is the extensive

FIGURE 2-9 Life Along Sturgeon Bank Foreshore



tideflat area of the delta. These tidal flats extend another five kilometres to the outer foreslope of the delta in the Strait of Georgia. Figure 2-9 is a combined depiction of a typical inner and outer foreshore community.

Richmond dikes can be accessed from a number of road-ends including Westminster Highway, Blundell Road and Francis Road. The dike connects with Garry Point Park in Steveston (Figure 2-8). This park is a good access point particularly suited for large groups because of its ample parking space.

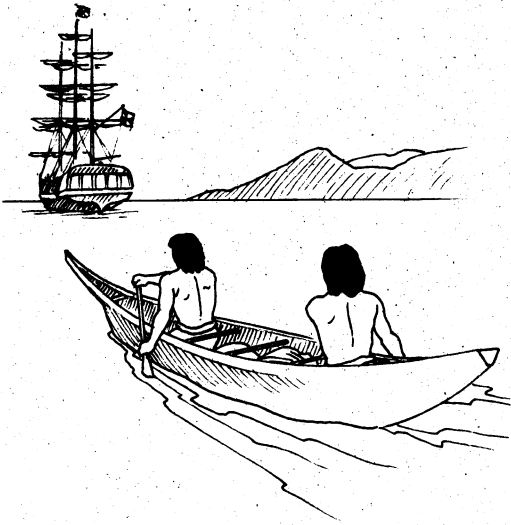
The dikes are well suited for travel by bicycle. A trip can begin at the Middle Arm near the Dinsmore Bridge, continue on to Terra Nova, and south towards Garry Point.

What to Look For

- Figure 2-7 shows some of the common marsh plants seen from the dike. Try to find Lyngbyei's Sedge. Compare this to one of the grasses growing near the dike to see the obvious difference between a sedge and grass.
- The small amount of salt in brackish water can become concentrated in some areas as stagnant water evaporates over the summer. Evidence for this is the presence of saltgrass, a saltmarsh plant described on page 47. See if you can discover one of these sites adjacent to the dike.
- Mice and voles find homes under drift logs, while mink and Short-tailed Weasel prey on these small mammals. You will be really lucky if you spot one of these small mammals.
- You will probably see and hear many Red-winged Blackbirds, especially in the spring, as they feed and nest in the vegetation of the upper marsh. The red-shouldered males are easily recognized.
- In spring, winter and fall, Snow Geese are distinctly heard in outer reaches of the marsh. It is a spectacular sight when hundreds of these geese suddenly take off from the marsh.



OTHER FACTS AND FIGURES

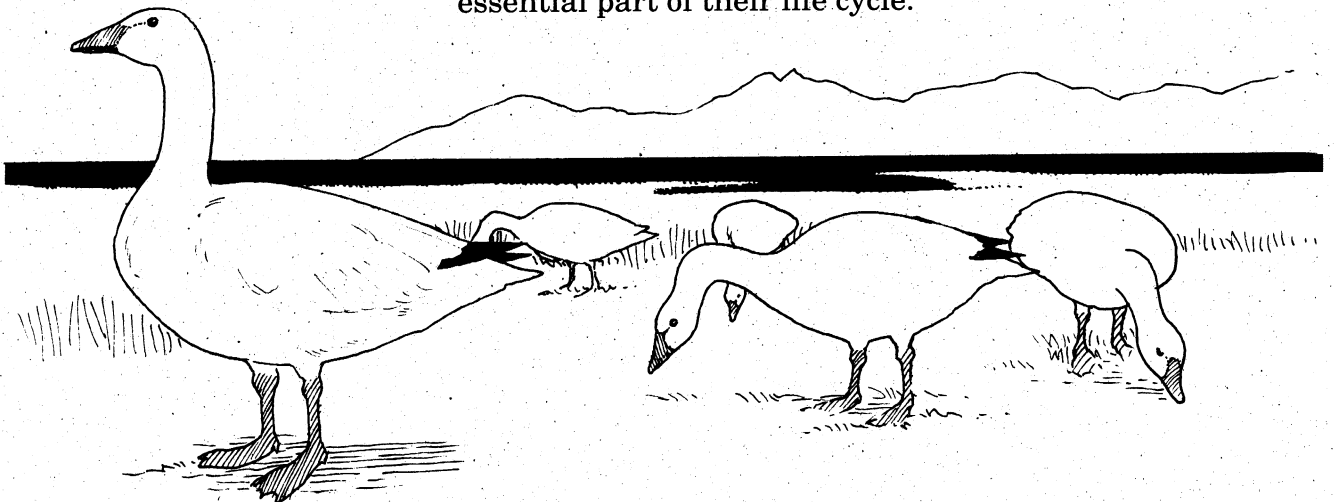


How Sturgeon Bank Got Its Name

In the early 1790s, Captain George Vancouver was commissioned by the British Admiralty to chart the west coast of North America. While searching for the mouth of the Fraser River, he and his crew purchased some "fine sturgeon, of from fourteen to two hundred pounds each" from the Aboriginal people who proceeded across the banks towards their larger ships. Henceforth the shallow area between Point Roberts and Point Grey appeared on nautical charts as Sturgeon Bank. It may not have occurred to Captain Vancouver that sturgeon frequent the mouth of large rivers, so he left the area not knowing he had found the mouth of the great Fraser River.

Snow Geese - A Wonderful Spectacle of White

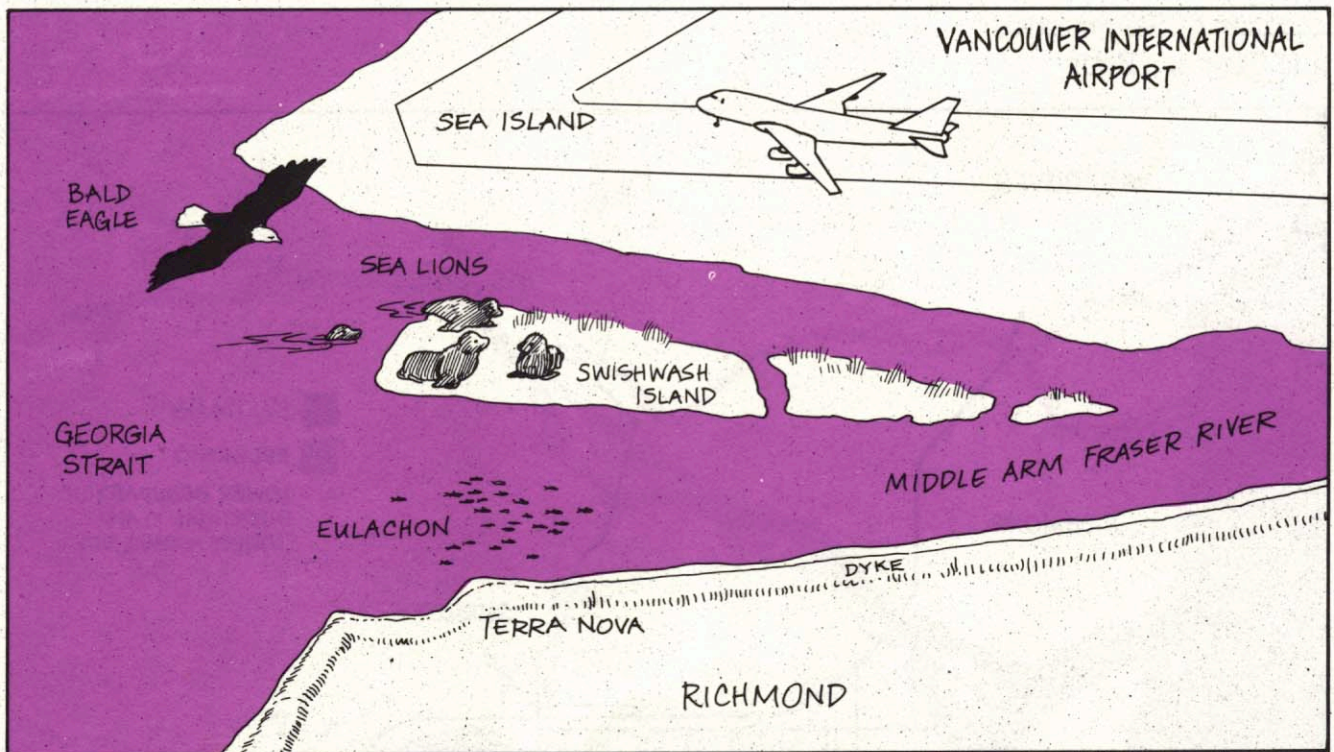
Snow Geese from Siberia travel along the British Columbia coast to winter in the Fraser River Estuary and the Skagit River estuary in Washington State. As many as 40 000 birds gather on the Fraser delta foreshore, where they feed extensively on the below-ground parts of marsh plants (especially bulrush). Flocks also travel a short distance inland to graze on the agricultural land in the upland portion of the estuary's delta. A few agricultural fields on Reifel and Westham Islands are managed by Environment Canada's Canadian Wildlife Service specifically to provide food for Snow Geese and other waterfowl. The Snow Geese are active in the estuary for up to seven months each year, and this winter residence in the Fraser River Estuary is an essential part of their life cycle.



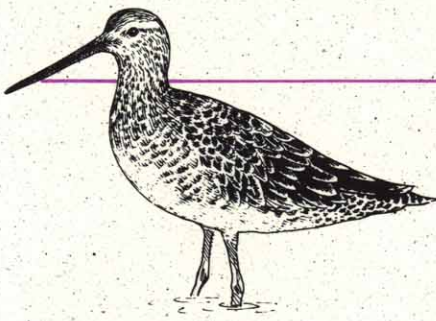
Terra Nova - A Productive Corner of the Estuary

The Middle Arm of the Fraser River flows into the Strait of Georgia past Terra Nova, which is situated in the northwest corner of Lulu Island (Richmond). The dike which curves around this area offers an excellent view of the rich and varied life associated with the estuary's marshes. In the spring, millions of Eulachon fish migrate up the estuary to spawn. One of the predators, the sea lion, can be seen hauled out on Swishwash Island. Bald Eagle and terns also feast on the Eulachon as they become trapped in tidal channels at low tide. Tidal channels and fringe marshes along the Middle Arm are attractive habitat for Mallard and Widgeon ducks as well as Coots. Winter concentrations of Western Grebes, often seen in large, tight flocks are part of the largest flock in Canada. These elegant, long-necked birds dive for small fish.

FIGURE 2-10 Terra Nova



Saltmarsh and Tideflat



LONG-BILLED
DOWITCHER

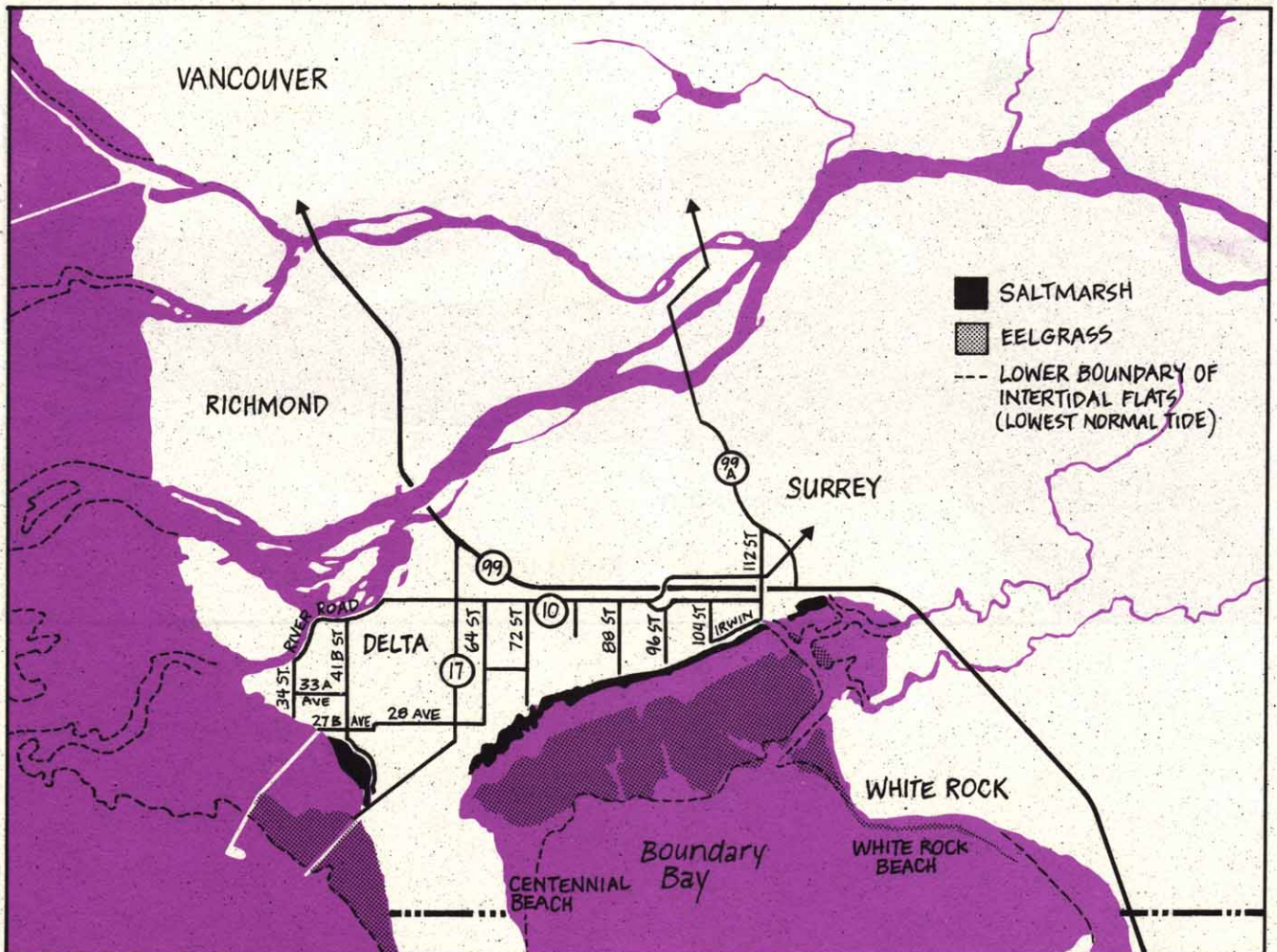
Where is this habitat located ?

Saltmarsh habitat is located in areas of the outer estuary, away from the freshwater influence of the Fraser River discharge. The most extensive saltmarshes occur along the Boundary Bay foreshore. There is also a saltmarsh on the foreshore of the Tsawwassen Indian Reserve, between the coal port jetty and the jetty leading to the ferry terminal (Figure 2-11).

Smaller estuaries along coastal British Columbia are almost entirely dominated by saltmarsh and tideflat habitat. This is because the volume of freshwater flooding in these smaller estuaries is much less than in the Fraser River. As a result, only saltmarsh vegetation can grow on the estuarine tideflats.

FIGURE 2-11

Location of Saltmarshes
and Eelgrass Beds



What are the features of the saltmarsh ?

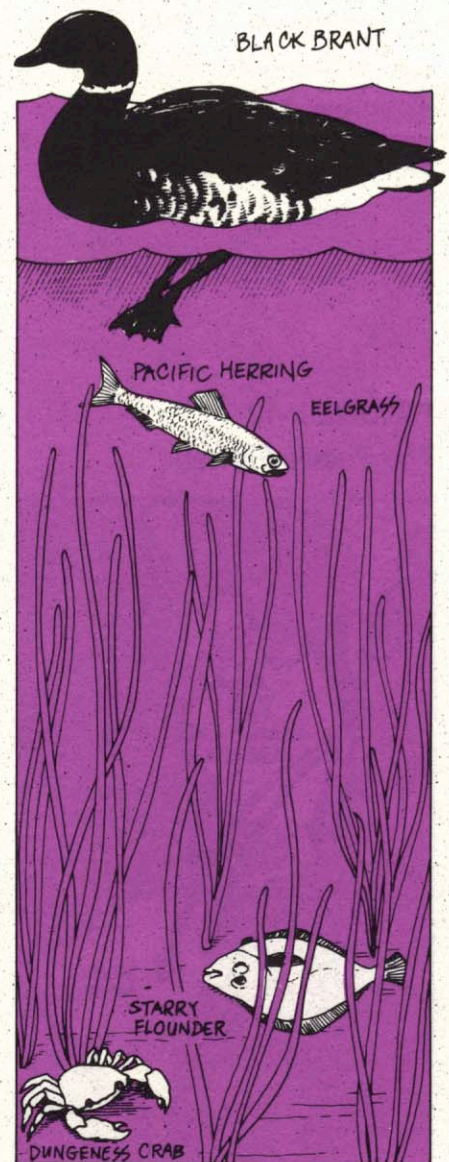
As with the brackish and freshwater marshes in the Fraser River Estuary, a large unvegetated tideflat extends seaward from where the saltmarsh ends. The tideflat at Boundary Bay is within easy reach, and in most places provides a firm surface to walk on. By contrast, the tideflats off Sturgeon Bank are located far from the dike and are very soft and muddy due to the fine silts originating from the Fraser River. Caution should be exercised wherever a tideflat is explored on foot. In this discussion, the tideflat habitat has been included with the saltmarsh habitat, because both can be easily explored and studied at the same time.

After visiting the brackish/freshwater marshes of Sturgeon Bank, the different appearance of the saltmarsh habitat will be quite obvious. Much of this difference is because the saltmarsh is constantly exposed to the salty effects of seawater. The salt tolerant plants growing in the saltmarsh are smaller and less productive than the plants of brackish/freshwater marshes. Also, the saltmarsh does not extend as far seaward from the dike as do the marshes of Sturgeon Bank.

What lives on the extensive tideflats ?

The tideflats beyond the saltmarsh habitat support large beds of eelgrass. Because these submerged aquatic plants can tolerate only brief exposure to the air, they occur near and below the lowest tide level. The eelgrass beds are too far away from the dike to be seen; but in winter, large piles of dead eelgrass leaves are washed inshore. In summer, eelgrass is easily seen after a short walk across the tideflat at, for example, Centennial Beach or White Rock Beach. Eelgrass beds are an important habitat for many small marine invertebrates as well as feeding Black Brant, flounder, Dungeness Crab and spawning Pacific Herring.

Large numbers of small marine invertebrates also live in the surface sediments of the tideflats. These invertebrates consist of marine worms such as Ragworms and Lugworms, burrowing shrimp and mollusks. So, although the tideflats look rather lifeless, there are actually hundreds of small invertebrates living below each square metre of sediment surface.





ROUGH-LEGGED
HAWK

Why are there so many birds ?

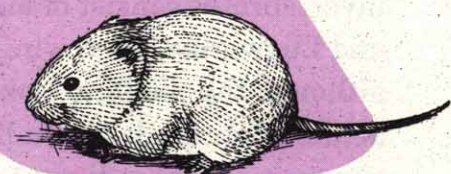
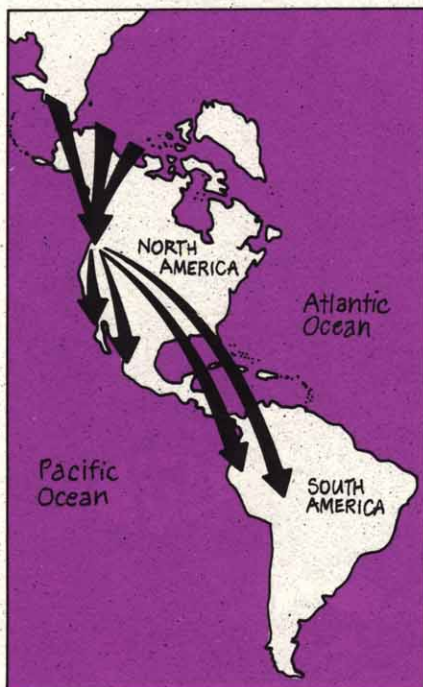
All of this invertebrate food supply doesn't go unnoticed by birds. The tideflats are used by the largest numbers of shorebirds on the British Columbia coast. The most commonly occurring shorebirds are sandpipers (Western and Least) and Dunlin. More information on shorebirds is provided later in this chapter.

About one million birds use Boundary Bay each year because it is located on a major bird migration route, the Pacific Flyway (Figure 2-12). These birds, many of them ducks and shorebirds, arrive in late summer and autumn from northern breeding grounds and remain throughout the winter.

Farmlands in the Fraser River Estuary are also an important resting and feeding habitat for birds. Overwintering swan and geese populations grub for remnant root crops in agricultural fields. In uncultivated farmland, commonly known as old fields, birds of prey such as hawks and owls are more abundant than anywhere else along the British Columbia coast.

Uncultivated farmland supports large populations of small rodents such as the Townsend Vole. These voles make up the majority of the prey caught by Common Barn-Owls, Short-eared Owls, and Roughlegged Hawks. In winter, even Great Blue Herons feed on these voles when fish are hard to catch. Few of these so-called "old field" habitats remain, since many have already been lost to urban and industrial developments.

FIGURE 2-12
The Pacific Flyway



TOWNSEND'S
VOLE

ACTIVITY 5: LIFE BENEATH THE TIDEFLAT

It is well worth exploring the sand and mud of the tideflat because it is a habitat that most people are completely unfamiliar with. It is also a habitat that should be appreciated for its abundance of invertebrate life and activity. You will be surprised at what the tideflat has to reveal.

Objectives:

The objective of this activity is to closely inspect the surface of the tideflat and to dig up a small square area (quadrat) so as to observe and examine the bottom dwelling invertebrates (Figure 2-13)

Equipment:

To do this activity you will need a small shovel or trowel, and a flat tray and magnifying glass for studying the collected invertebrate specimens. A kitchen colander and coarse sieve will be needed to separate the smaller specimens from the sediment. To do this, you will need a source of water to wash the sediments, revealing the invertebrates which are too large to go through the holes of the colander or sieve.



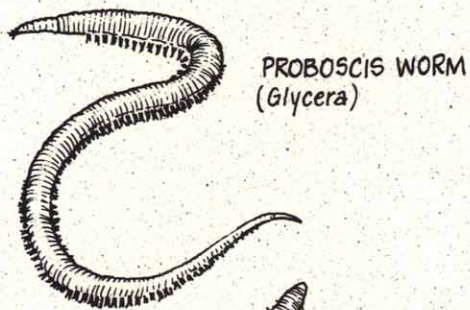
FIGURE 2-13
Sampling on the Tideflat

Procedure:

1. Find an open area in the saltmarsh or walk to the open tideflat. Examine the mud surface very closely — find and identify the following:

FIGURE 2-14

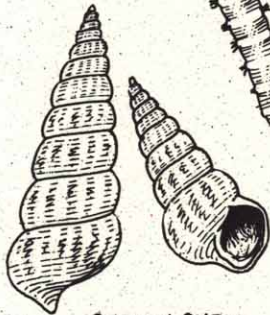
Tideflat Invertebrates



PROBOSCIS WORM
(*Glycera*)



LUGWORM
(*Aarenicola*)



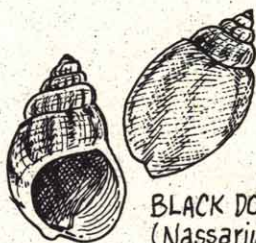
SCREW SHELL
(*Batillaria*)



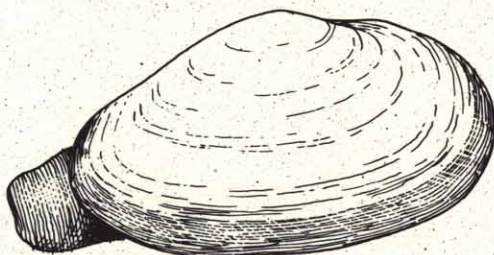
FECAL CASTS



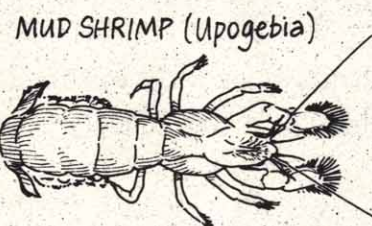
EDIBLE BLUE
MUSSEL
(*Mytilus*)



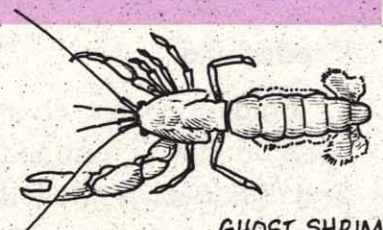
BLACK DOG WHELK
(*Nassarius*)



SOFT-SHELLED CLAM (*Mya*)



MUD SHRIMP (*Upogebia*)



GHOST SHRIMP
(*Callinassa*)

ALGAL MATS: Blue-green algae form rubbery mats on the tideflat. On the mud surface you may also see brownish layers of diatoms (a microscopic alga).

GRAZING TRAILS: A grazing trail is a linear mark made in the mud by small snails (gastropods) as they graze on diatoms living on the mud surface. You may even find one of these small snails as it is grazing or resting on the tideflat.

FECAL CASTS: Many of the small tideflat invertebrates live in tubes or burrows. To keep their burrow clean, anything that is excreted (fecal matter) is pushed into a small pile around the tube entrance. These small piles are called fecal casts. You will notice many small conspicuous-looking piles all over the tideflat.

2. From your inspections of the tideflat surface, find a location with a lot of evidence of invertebrate activity. Dig up a small area to a depth of 10 - 20 cm and examine the sediments for large invertebrates such as clams or mussels. Sift through the remaining mud and sand (using your colander and sieve) to find smaller invertebrates such as burrowing shrimp and marine worms.

3. If you dig up an exact area of mud (e.g. 25 x 25 cm) and count the total number of different animals collected, you can calculate the density of animals. See if you can figure out how many invertebrates would occupy a square metre, or the entire tidal flats of Boundary Bay (6 000 hectares).

4. Use the illustrations in Figure 2-14 to help you identify the invertebrates you have collected. If you find something not shown in Figure 2-14, measure the animal's size and make a clear drawing. Later you can contact a biologist or naturalist to help you identify your drawing. Also, refer to suggested identification guides given on page 119.

Some of the Dominant Plants

The saltwort (*Salicornia virginica*) is one of the most common saltmarsh plants in the Fraser River Estuary, and in smaller estuaries and protected bays of coastal British Columbia. Commercial harvesting of this plant in the Strait of Georgia amounts to about 20 metric tons a year. It is sold to restaurants where it is served as "Sea Asparagus."

Figure 2-15 shows an illustration of saltwort, along with three other common saltmarsh plants: saltgrass (*Distichlis stricta*), saltbush (*Atriplex patula*), and arrowgrass (*Triglochin maritimum*). These plants possess adaptations typical of the saltmarsh environment: wiry structure and a tough outer covering.

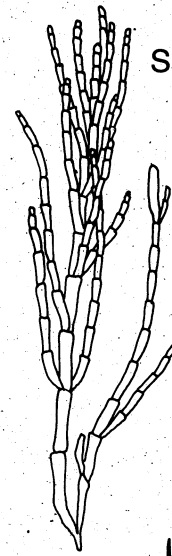
Eelgrass (*Zostera marina*) is a common submerged aquatic plant growing throughout the lower intertidal and shallow subtidal area of Boundary Bay and Roberts Bank. Since eelgrass beds are rooted in a soft and flat bottom, and provide a thick canopy of leaves, these underwater meadows significantly enhance the nearshore marine environment. Eelgrass meadows stabilize sediment and provide good cover for aquatic animals. This results in a much greater diversity of animals within the meadow than in adjacent unvegetated areas.

FIELD TRIP DESTINATION: Boundary Bay

Boundary Bay is the best and most accessible location for exploring and studying the saltmarsh and tideflat habitat. Most of the major roads between and including 64th and 112th Streets south of Highway 10 in South Delta end at the dike (Figure 2-11). There is pedestrian access to the dikes and a good view over the saltmarsh.

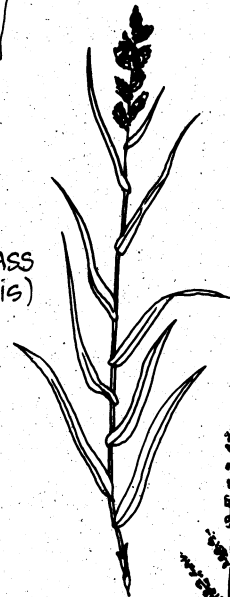
It is relatively safe and easy to walk into the saltmarsh for a closer look at the vegetation and tideflats. Make sure your field trip coincides with a low tide. Any tide below 3.0 m at Point Atkinson will provide good access to the saltmarsh and tideflat. Daily tide levels are published in the daily newspaper, and in the *Canadian Tide and Current Tables, Volume 5*, which can be purchased at most boating supply stores.

FIGURE 2-15
Saltmarsh Plants

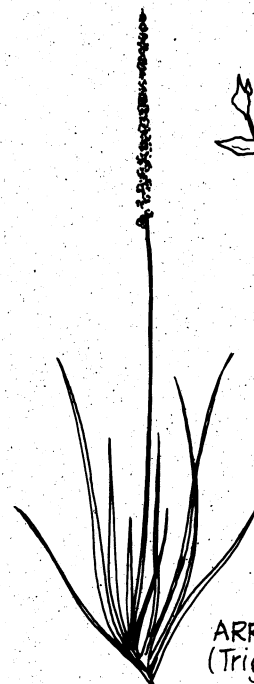


SALTWORT
(*Salicornia*)

SALTGRASS
(*Distichlis*)



SALTBUSH
(*Atriplex*)

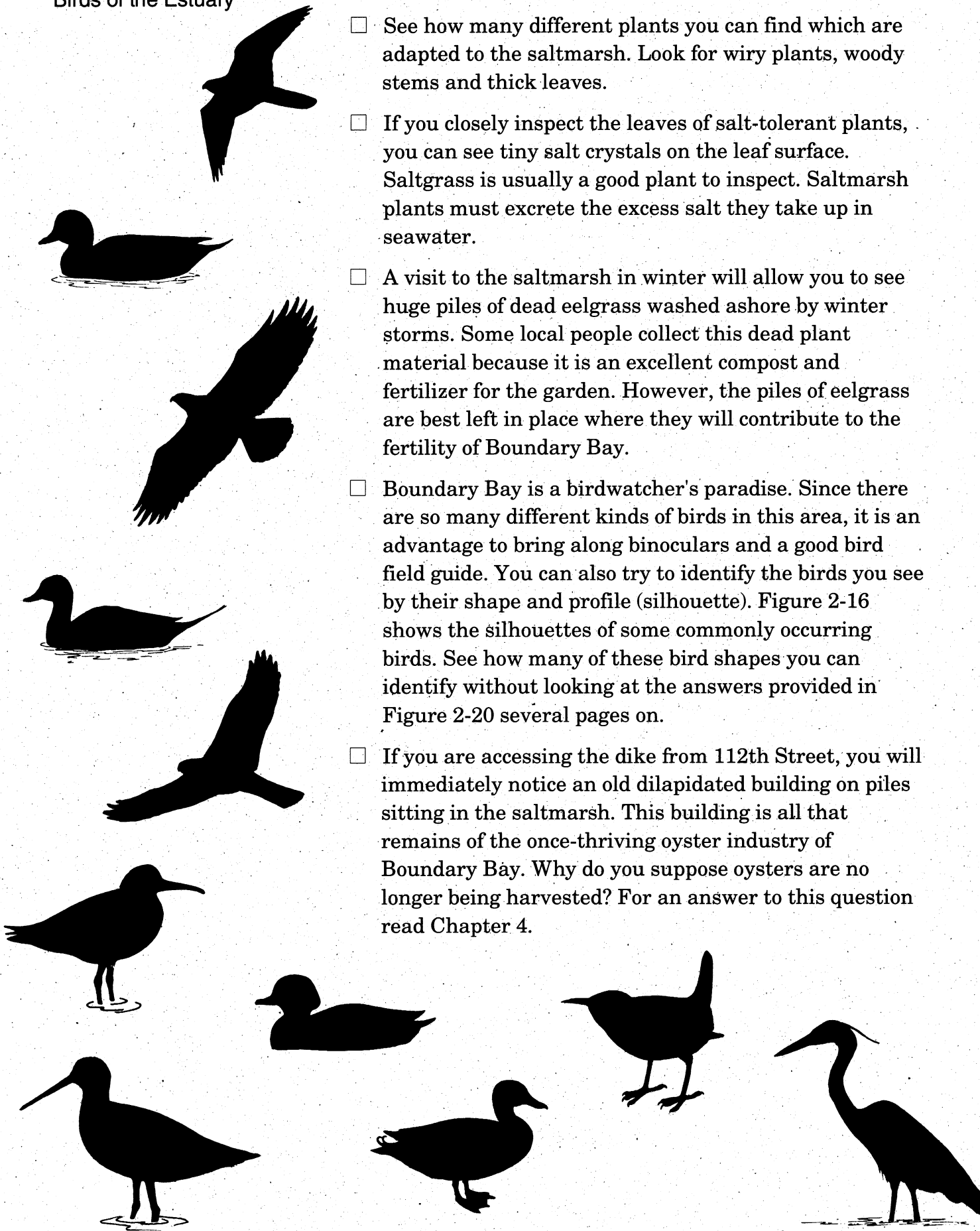


ARROWGRASS
(*Triglochin*)

FIGURE 2-16
Birds of the Estuary

What to Look For

- See how many different plants you can find which are adapted to the saltmarsh. Look for wiry plants, woody stems and thick leaves.
- If you closely inspect the leaves of salt-tolerant plants, you can see tiny salt crystals on the leaf surface. Saltgrass is usually a good plant to inspect. Saltmarsh plants must excrete the excess salt they take up in seawater.
- A visit to the saltmarsh in winter will allow you to see huge piles of dead eelgrass washed ashore by winter storms. Some local people collect this dead plant material because it is an excellent compost and fertilizer for the garden. However, the piles of eelgrass are best left in place where they will contribute to the fertility of Boundary Bay.
- Boundary Bay is a birdwatcher's paradise. Since there are so many different kinds of birds in this area, it is an advantage to bring along binoculars and a good bird field guide. You can also try to identify the birds you see by their shape and profile (silhouette). Figure 2-16 shows the silhouettes of some commonly occurring birds. See how many of these bird shapes you can identify without looking at the answers provided in Figure 2-20 several pages on.
- If you are accessing the dike from 112th Street, you will immediately notice an old dilapidated building on piles sitting in the saltmarsh. This building is all that remains of the once-thriving oyster industry of Boundary Bay. Why do you suppose oysters are no longer being harvested? For an answer to this question read Chapter 4.

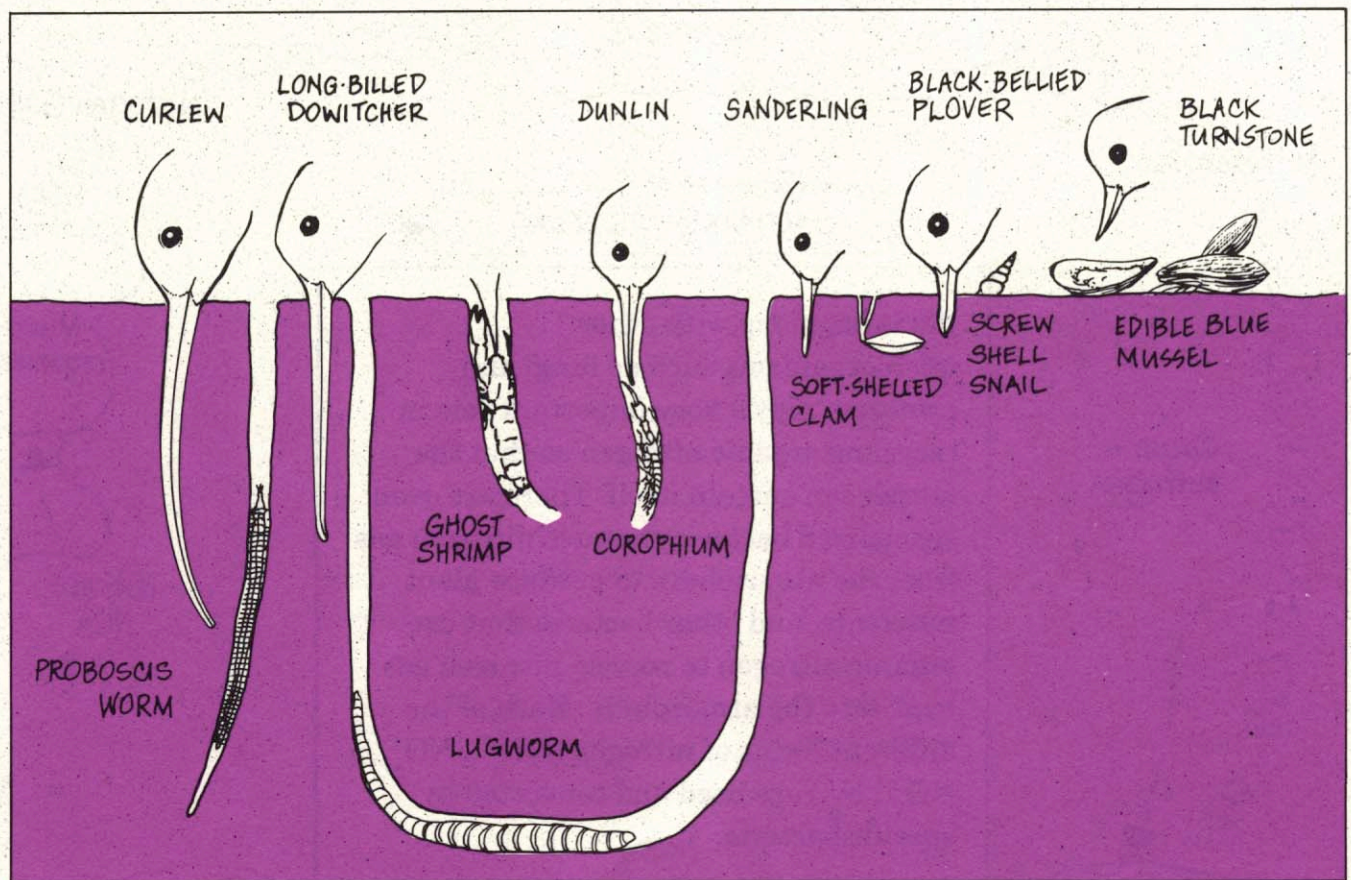


OTHER FACTS AND FIGURES

Shorebirds - The Mud Probers of the Tideflat

Several million shorebirds migrate through the Fraser River Estuary, and many remain all winter. These birds feed on the tideflats by probing and searching in the mud with their beaks. There are many different kinds of bottom-dwelling invertebrates to choose from; some live on the surface while others live at different depths in the mud. Shorebirds have evolved a variety of different beak shapes and lengths, each specialized to probe for and handle a particular kind of invertebrate (Figure 2-17).

FIGURE 2-17
Feeding Habits of Shorebirds



Medium-sized sandpipers, like Dunlin, are very abundant in the fall, winter and spring. Look for them probing for invertebrates that make comparatively shallow burrows, such as the burrowing shrimp (*Corophium*). Long-billed Dowitchers can probe for deeper organisms in muddy brackish areas and along the shores of shallow ponds and sloughs.

Bacteria and Algae - The Unnoticed Heroes

Coastal marshes and mudflats are an ideal habitat for many different kinds of bacteria. These are natural and beneficial bacteria, not the types that are harmful to humans. By decomposing the rich supply of organic matter in the saltmarsh and tideflat habitat, bacteria create a nutritious source of the important detritus that supports the estuarine food web. The decomposition of organic matter also recycles important plant nutrients, such as nitrogen, back to the marsh (Figure 2-18).

FIGURE 2-18
The Nitrogen Cycle

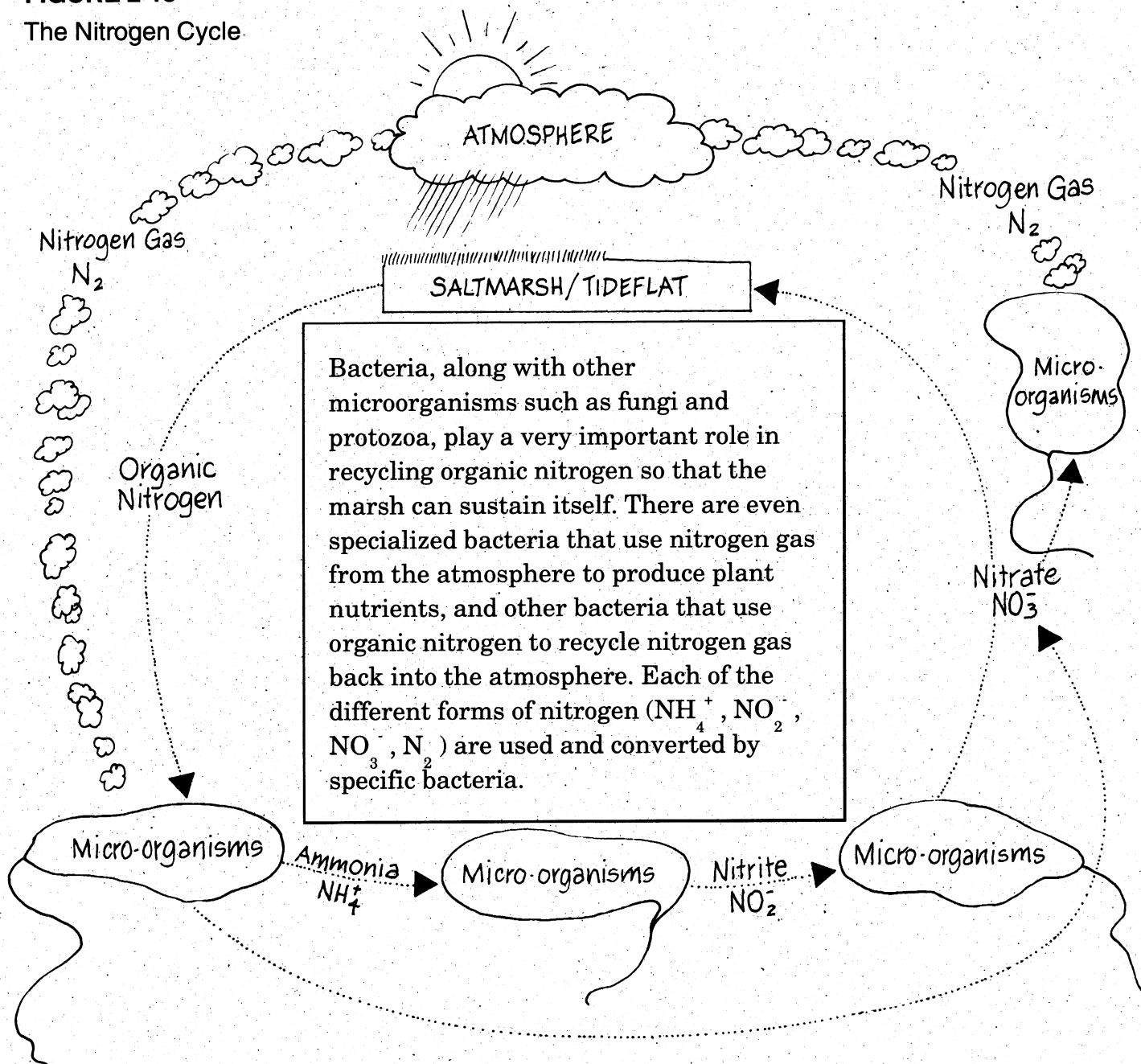


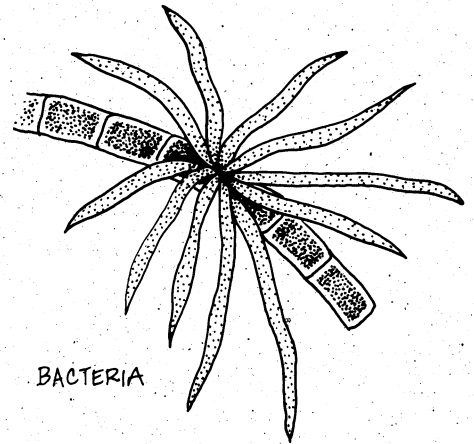
FIGURE 2-19
Bacteria and Algae
of the Estuary

There are many different kinds of specialized bacteria, such as those that create the foul smelling marsh gas you'll probably notice when you walk into a muddy area of the saltmarsh and tideflat habitat. This "rotten egg" smell is due to hydrogen sulfide gas produced by bacteria living in mud where there is no oxygen. Nitrogen gas is produced by another type of bacteria that thrives in oxygen-free zones of the saltmarsh and tideflat habitat (Figure 2-19). These specialized bacteria are extremely important because they help maintain a global chemical balance in the air, water and soil (the biosphere).

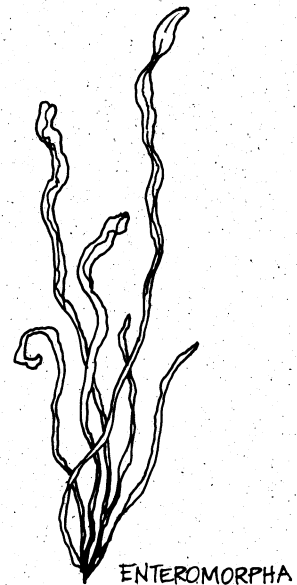
In some locations of the tideflat, you may notice dark-colored mats which have been formed by blue-green algae. These strange-looking mats are generally not recognized as algae because of their odd color and rubbery texture. In fact, scientists think that blue-green algae are in some ways related to bacteria. By trapping sediments, these blue-green algae mats are the first important step in providing stable and nutrient-rich sites for marsh plants to colonize, thus contributing to the development of new saltmarsh habitat.

Other important groups of algae that live on the tideflat habitat are microscopic in size. These algae, called diatoms, can often be detected by the brownish to golden layer they form on the mud surface. Since many different surface-dwelling invertebrates graze on diatoms, these algae are a vital food source on the open tideflat.

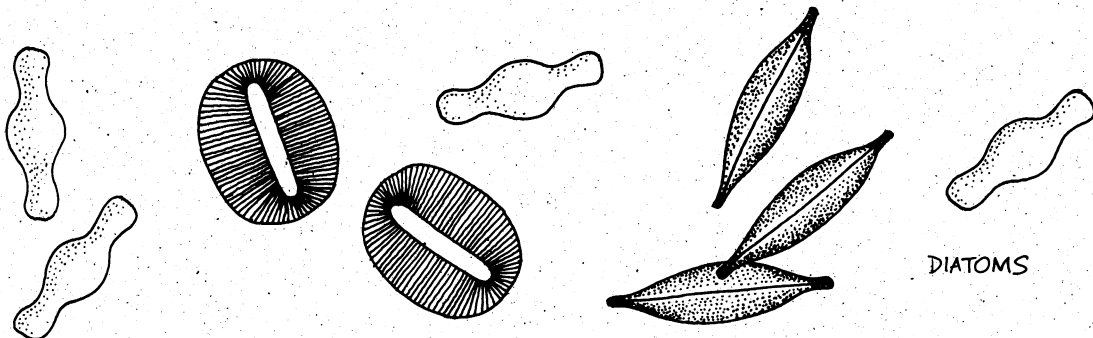
Much larger and more visible is the green alga (*Enteromorpha*) which grows in bundles of slender hollow tubes. When this alga is dead, it becomes bleached and can look like animal guts. In fact, a species of this alga is called *Enteromorpha intestinalis*.



BACTERIA



ENTEROMORPHA



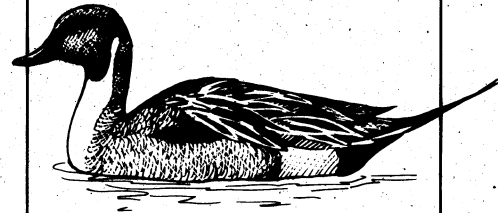
DIATOMS

FIGURE 2-20 Birds of the Estuary (answer to silhouettes)

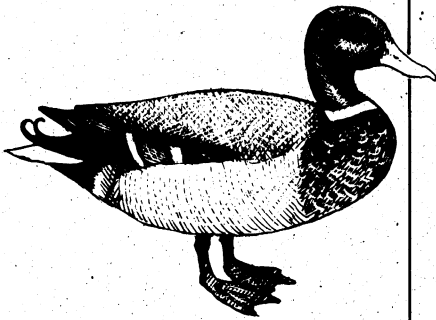
**BIRDS
COMMONLY
SEEN**



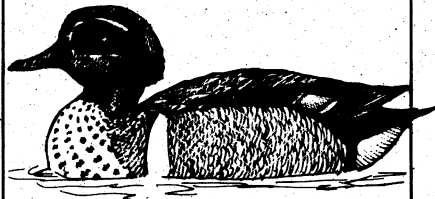
American Widgeon



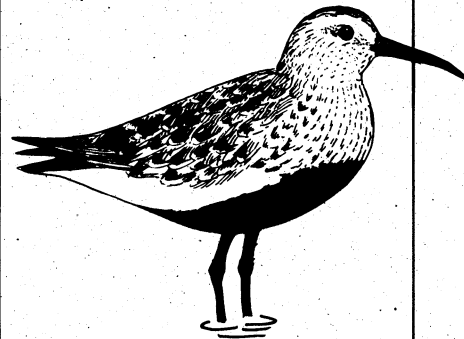
Northern Pintail



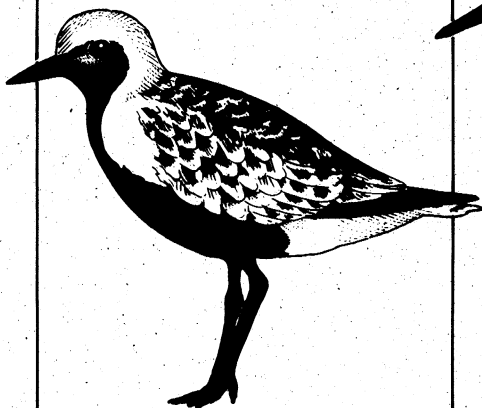
Mallard



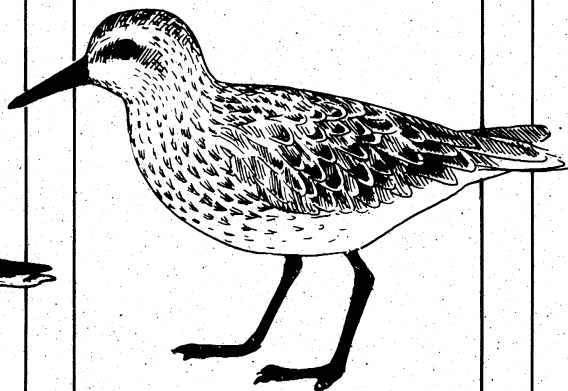
Green-winged Teal



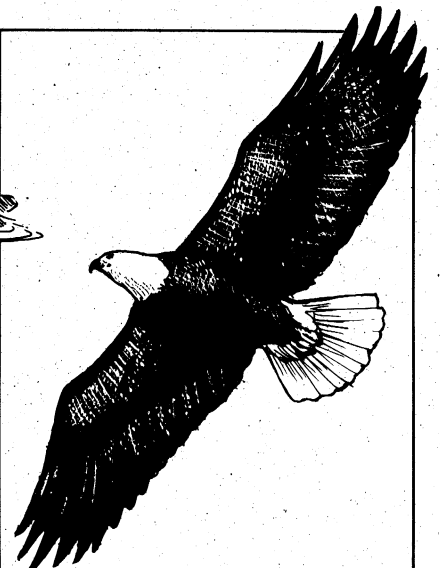
Dunlin



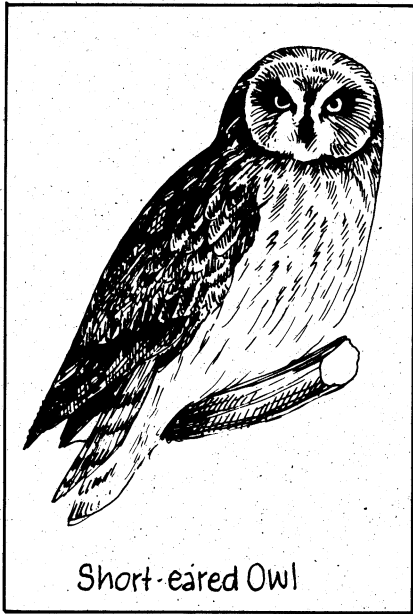
Black-bellied Plover



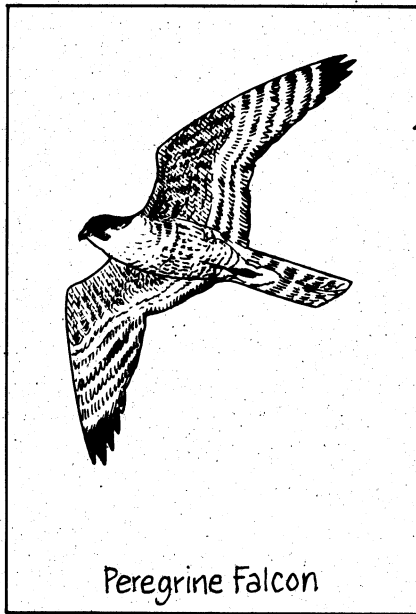
Western Sandpiper



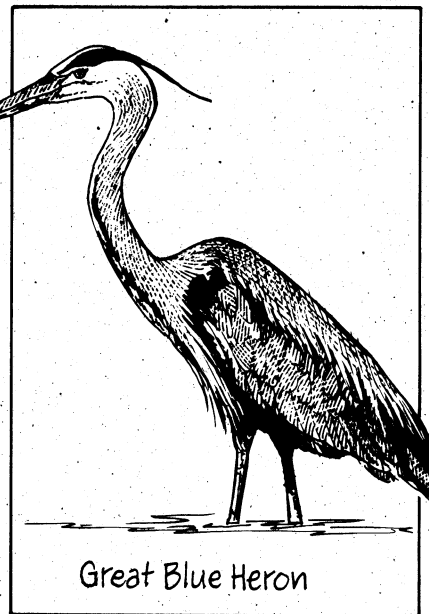
Bald Eagle



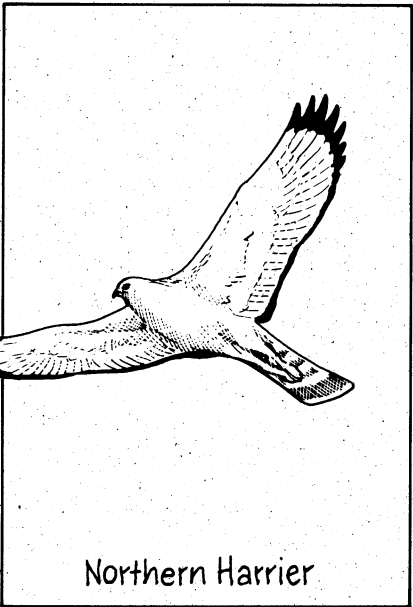
Short-eared Owl



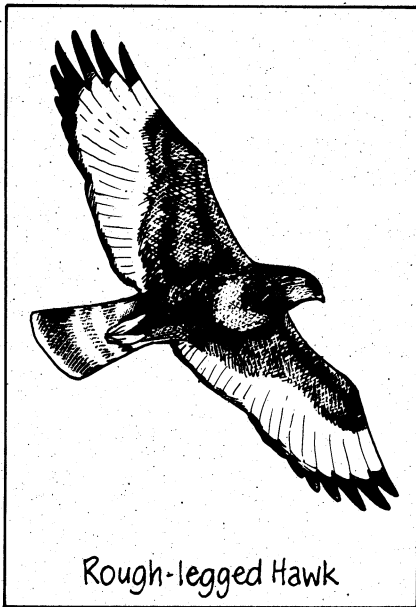
Peregrine Falcon



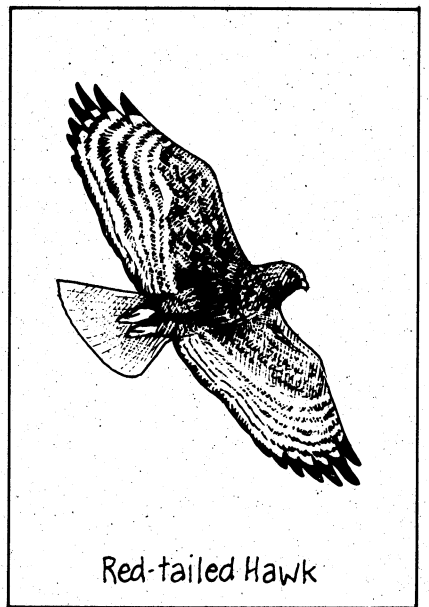
Great Blue Heron



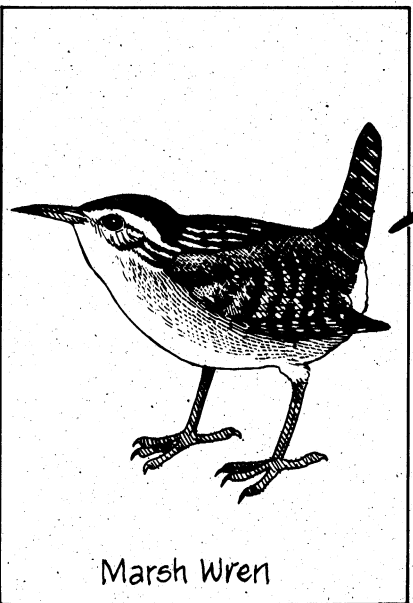
Northern Harrier



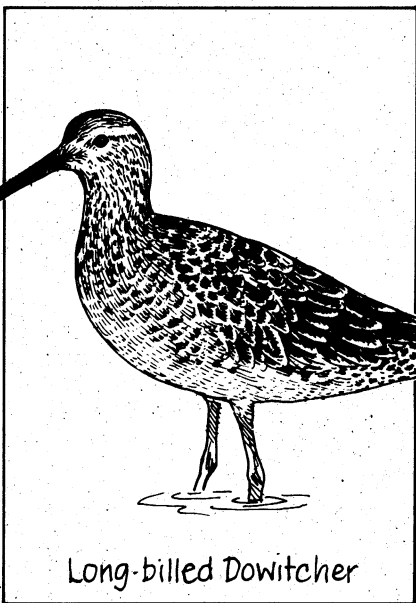
Rough-legged Hawk



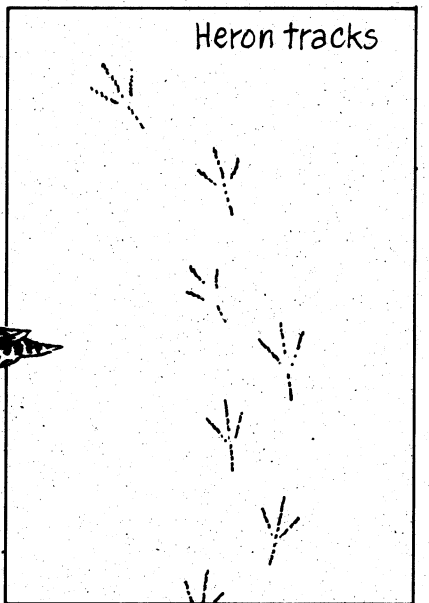
Red-tailed Hawk



Marsh Wren



Long-billed Dowitcher



Heron tracks