NAVIGATION AND MARINE WEATHER

MARINE WEATHER AND SEA CONDITIONS

Sea kayakers must understand the nature of wind, waves and currents, and how they interrelate. A kayak's cruising speed is relatively slow at approximately 3 to 4 knots (knot = nautical miles per hour; a nautical mile is approximately 15% greater than a land mile or approximately 1.8 km). Because of this slow cruising speed, kayaks are often more vulnerable to adverse sea conditions than larger or faster vessels. Though sea kayaks are extremely seaworthy when skillfully handled, always consider that (1) you will be exposed to rougher conditions for a long period of time, perhaps with conditions worsening; and (2) the headway a kayak can make against strong wind and currents can be greatly reduced or stopped altogether.

WIND

Wind is the kayaker's most dangerous adversary. It can increase suddenly, and it can make control of the kayak difficult, if not impossible. Making real headway in winds over 30 knots is not possible. To understand this, you need to comprehend the nature of wind force. The force that the wind applies to you and your kayak is not proportional to the wind speed, it is proportional to the square of the increase in wind speed; e.g., a 21 knot wind does not apply three times as great a force as a 7 knot wind—it applies nine times the force!

This same wind force makes turning and maintaining a course in strong winds very difficult. When you are not paddling, the wind tends to force the kayak sideways and perpendicular to the wind direction. When making headway at an angle to headwinds, kayaks also tend to "weathercock." Weathercocking means that, as you are paddling forward, your kayak will turn into the wind. This turning occurs because, when paddling forward with a sideways pressure on the kayak, there is less water force on the stern of the kayak than on the bow. Less force on the stern causes the stern to swing downwind, thereby forcing the bow to turn into the wind. Rudders can be very helpful for this situation and different kayak hull and keel designs can help to reduce weathercocking effect.

The land contours of the local geography will strongly influence the wind as it flows over, around, and between land masses. In mountainous areas, the terrain can funnel and deflect the wind, creating sudden gusts and downdraughts. Wind is often accelerated as it flows between land masses, such as channels between is-

lands and in inlets. As well, it will be accelerated as it flows over islands. Such gusts can take you by surprise! If they are strong enough, they can tear the paddle from your hands—or worse still, catch the broad surface area of your paddle and capsize you.

The wind is not easy to predict. Before you set off, you must listen to the marine weather forecast, which can be heard on VHF radios, transistor weather radios, the internet, or by calling the marine weather phone number under “weather” in the Government of Canada blue pages of the phone book. It is essential that you listen for the predicted and actual wind speeds and directions for the day. Be aware that forecasts are not 100% reliable and try to err on the side of caution if you are at all in doubt about the conditions.

As a guide for the novice paddler, avoid paddling in wind speeds above 15 knots. Even for the more experienced paddler, once wind speeds exceed 20 knots, the situation can become quite uncomfortable and disconcerting! If you must paddle in the wind, try to travel in the lee of the land as much as possible and avoid exposed crossings between islands where the wind could be accelerated to even higher speeds.

Scale Number	Wind Speed	Common Name	Water Surface	Land Effects	Wave Heights*	Kayaking
0	<1 knot	calm	Mirror-like	None	Flat	Great paddling
1	1-3 knots	light air	Scalelike ripples	Smoke drifts	<1 '	Great paddling
2	4-6 knots	light breeze	Small wavelets, glassy wave crests	Wind felt on face, leaves rustle	<1'	Helps keep kayaker cool
3	7-10 knots	gentle breeze	A few wave peaks begin to break	Leaves in motion, small flags in motion	2'	Slight hindrance to progress
4	11-16 knots	moderate breeze	Half of wave crests break into white horses	Dust swirls, small branches sway	3'	Upper limit for novice paddlers
5	17-21 knots	fresh breeze	Most waves marked by white horses	Small trees begin to sway	4'	Greatly reduces speed in head winds
6	22-27 knots	strong breeze	Extensive white horses, spray common	Large branches sway, whistling heard in wires	5'	Becomes difficult to turn kayak and perform rescues

Scale Number	Wind Speed	Common Name	Water Surface	Land Effects	Wave Heights*	Kayaking
7	28-33 knots	moderate gale	Extensive spray, streaks blown parallel to wind	Whole trees sway, walking against wind unpleasant	6'	Difficult to control kayak
8	34-40 knots	fresh gale	Waves break away from shore, extensive streaks	Small branches break	8'	Like paddling up a wall, dangerous
9	41-47 knots	strong gale	Whole surface rolls, covered by extensive foam	Some structural damage to buildings	9'	Very dangerous
10	48-55 knots	storm	Waves have overhanging crests	Large trees fall	10'+	Huge tumbling seas, survival unlikely
11	56-63 knots	storm	Sea white with spray	Structural damage	10'+	Huge tumbling seas, renew life insurance
12	64+ knots	hurricane /storm	Sea white with spray, visibility nil	Structural damage	10'+	Academic interest only

*Wave heights are for areas with fetch up to 10 nautical miles. Waves will be bigger in open water.

WAVES

When the wind picks up, bigger waves will soon follow. As waves get larger, and particularly when they get steeper, the risk of accidental capsize significantly increases. If you stop paddling or are running with the waves, the waves will tend to cause your kayak to broach or turn sideways. If you are inexperienced in these conditions, you are at an even greater risk of capsizing.

For wind-generated waves, the size of the wave depends on the following factors:

- Wind speed: the stronger the wind, the larger the waves, and the faster they will develop.
- Wind duration: the longer the wind has been blowing, the larger the waves will be.
- Fetch: fetch is the open distance across the water that the wind can blow. The larger the fetch, the larger the wave size.
- Current: where there is current against the waves, the two energies collide and the waves will be larger and steeper.

Waves types that you will likely encounter (beside boat wakes!) include:

Chop: Surface chop is produced by local wind conditions. Chop varies from a little more than a surface ripple to tight steep waves up to several feet high. Slight chop presents little hazard to the novice paddler. However, as chop increases beyond heights of 1.5 feet, the steep face of the wave can grab and lift the broader surface area across the beam of the kayak when you are paddling across the wind. This tilting can reduce stability to the point of capsize. When sideways to waves, rounder, soft-chined hull shapes allow steeper waves to pass under the kayak more easily than the hull of a flat-bottomed kayak. Regardless of hull shape, paddling directly into steeper chop guarantees the most stable and controlled ride, but is sometimes wet due to deflected water spraying into your face! But, keep in mind that paddling into waves may not get you to where you want to go!

Swell: Ocean swells are large, smooth rolling seas found on the exposed ocean. Swells are remnants of distant storms or an indication of an oncoming storm. Swells are generally not a problem for stability because the face of the wave is not very steep. However, swells can greatly reduce the visibility of your kayak and induce sea sickness. Be cautioned that, as swells approach shallow areas, such as reefs and shorelines, they will build up and form breaking waves and surf.

Rebound waves: These waves are created by wind waves or swell rebounding or bouncing off flat cliffs, breakwaters, steep rocky shorelines, etc. They can create very confused sea conditions because there will be waves coming from two different directions. To make matters worse, there is a condition called a klapotis, or ex-

ploding wave, where two waves going in opposite directions meet. Give these areas a wide berth. Rebound waves will dissipate with distance.

Surf: Surf is simply large breaking waves. How the wave breaks is determined by the nature of the shoreline: whether it is gently or steeply sloping. On gently sloping beaches, the waves tend to spill from the top and dissipate their energy gradually as they roll towards shore. On steep beaches, the waves build up sharply and dump right onto the shore, unleashing their energy very quickly. This dumping surf should be avoided at all costs. If you have not practiced surf landings, you can almost be assured of a capsize. Ocean kayaks are large and difficult to control in surf, particularly when fully loaded. Surf landings should only by attempted as a last resort, regardless of your skill. You can often find places to land in the inside corners of bays or behind islands. Look at your charts to find these areas and to check for the steepness of the shoreline. Never rush into a potential surf landing. Instead, wait slightly outside of the surf line and study the patterns of breaking wave sets before choosing a landing site. Time your landing with a small wave set.

Standing waves: These are waves created by moving water (currents) flowing over an irregularly-shaped bottom. They will usually be found in shallow constricted areas, off headlands, and between points of land. Their size will be a function of both water speed and wind conditions, which will be discussed under “currents.”

CURRENTS

Knowledge of currents is essential for the kayaker, particularly if you are going to paddle the southern and eastern waters off Vancouver Island where there can be significant current flow.

As the tide level rises and falls each day along the coast, it causes the waters in bays and inlets to fill or empty, resulting in a horizontal flow of water which creates currents. When the water passes through constrictions, over shallows, and around points of land, the speed of the water is increased. Identifying these hazardous areas is essential for avoiding danger or getting a free ride. Learn to use currents to your advantage when planning a route. The open ocean and waters along the exposed west coast are far less affected by current flow.

Currents present the following general hazards and difficulties for the kayaker:

- Headway against currents can be difficult if not impossible.
- Currents create strong eddylines (the boundary between opposing currents), boils, whirlpools, and standing waves (areas of standing waves on the ocean are referred to as tide rips).
- Current against an opposing wind will create larger and steeper wind waves.
- Wind against standing waves (tide rips) will create larger and steeper standing waves.

CURRENT HAZARDS - Surface Conditions

Tide rips: Tide rips are localized regions of fast, turbulent water that occur wherever the smooth flow of a strong current is abruptly altered by shoals, around points of land, spits, irregular bottom contours in channels, and where opposing currents meet. Tide rips form more readily and can become larger and steeper where there is current flowing against the wind. Tide rips can often be avoided by paddling around them. If they are large and cannot be avoided, wait for slack water. Tide rips, like any wave, are most dangerous when large and steep.

Overfalls: Overfalls are a standing wave that forms along the edge of two colliding currents. The standing wave is formed as one current stream “falls over” the other. These can sometimes occur where strong currents meet strong opposing winds near the mouth of inlets, etc.

Rip Tides or Currents: Rip currents are the outflow currents that form in surf zones to return excess water to the sea. Rip currents usually follow slightly deeper channels through the surf zone. They can provide a quicker ride out through the surf zone, and wave heights may be less in this area. However, for someone capsized and trying to swim to shore, rip currents can provide a significant hazard.

Tidal Rapids and Waterfalls: Tidal rapids and even waterfalls will occur at the mouths of inlets that have very restricted openings. There is considerable delay in filling these inlets and draining them again, resulting in considerable differences in water levels between the main body of water and the water in the inlet. These rapids can be very dangerous to attempt to negotiate.

Eddylines: Eddylines are the boundary between opposing current streams. If the current flow is light, this boundary will be indistinct and should not create problems for the kayaker. However, in faster current streams, eddylines will be more distinct and can create a significant danger to cross if you are not prepared for them. Crossing a strong eddyline at right angles to the current will usually result in a capsize unless you are well prepared with a strong lean downstream and a good solid brace. Capsizing occurs because the main current catches the bow as you cross the eddyline and pushes it downstream. At the same time, the current in the eddy is pushing the stern in the opposite direction. Inertia, momentum, and the loss of your centre of gravity will combine to capsize you.

Whirlpools: Whirlpools form on the edge of strong eddylines, creating a swirling effect, and when large, they can create a depression in the water. Larger whirlpools can be dangerous but are usually marked on charts and are easily seen and avoided.

Rivers Outlets: Bars usually form at the mouths of rivers, creating a shallow area where standing waves will form. When the flow of the river meets an incoming ocean current or strong winds, very large breaking waves can form. Be extremely careful when entering river mouths. In general, be very careful on rivers in ocean kayaks. Even slow moving water is powerful. Rivers can be very narrow, leaving

little room to maneuver a large ocean kayak. It is easy to get hung up on a rock and do significant damage to your kayak.

NEGOTIATING CURRENT CHANNELS

Water moving through a channel generally flows slowest near the shore because of bottom and edge friction. If you are paddling upstream against the current, paddle as close to shore as possible. You will also find eddies along the shore. Eddies are backwaters that form in bays and behind points of land, rocks and islands. Because the water in eddies flows upstream against the main current, eddies will provide the aware paddler a free ride. If you are paddling with the current, you may as well stay in the mainstream and take maximum advantage of the current.

To cross currents, you can use a principle known as “ferrying.” If you attempted to paddle straight across a current from point A to point B, you would lose ground and end up at point C. To actually reach point B without losing ground, you must ferry across the channel. In other words, point the bow of you kayak upstream at an angle as you paddle forward - this upstream angle compensates for the current. The angle you actually point will depend on the speed of the current. Remember, you can average only 3 - 4 knots in a kayak, so crossing currents in excess of 2 knots will be difficult without losing some ground.

In order to maintain a straight course when ferrying over longer distances, use what are called natural ranges. Pick a point that you want to reach and then pick another point fairly far behind it, such as a tree or a hill top. As you paddle across the channel, keep the two points aligned. If you begin to drift with the current or your paddling angle is too steep, the points will begin to separate.

It is usually easier to ferry across a current than to attempt to paddle straight across a channel and then paddle back up to your destination against the current. Stay alert when you are negotiating moving water. As you gain experience, it will be easier to “read” the water and understand what it is doing. By understanding the way the water moves, and where features such as eddies can be found, you will be able to take maximum advantage of currents and make them work for you.

SUMMARY

- Know your route and potential hazards in advance.
- Listen to the marine forecast to determine wind speed, direction, and any predicted changes.
- Check the current tables to determine the current direction, times of change and times of maximum flow.
- If windy, travel in the lee of the shore and where the fetch is the smallest.
- Avoid crossing where the wind and current are in opposition.
- Take extra care on long exposed crossings.

- As a novice try to paddle in wind speeds less than 15 knots.
- As a novice try to avoid paddling in currents greater than 2 knots. Currents above 1.5 knots can be considered strong).

FOG

If you are paddling on the west coast in the summer time, fog will be a constant threat. Fog can reduce visibility to a few meters making knowledge of charts and compass use mandatory.

There are two relevant types of fog:

- Radiation fog forms on land on cool, still nights. Radiation fog will usually burn off fairly quickly once the sun comes up.
- Sea fog is formed over the ocean and is caused by warm air masses flowing over cold water. Unlike radiation fog, sea fog can be associated with high winds and it can remain around for days. Sea fog forms off shore, but as the land warms during the course of the day, it warms the air which begins to rise. As this air rises, the air over the ocean moves in to replace it, bringing the offshore fog banks with it.

If you plan to paddle on the west coast, make sure that you have charts and a compass with you and that you know how to use them.

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BASIC NAVIGATION AND ROUTE PLANNING

Navigation is the art of knowing where you are, choosing a safe and efficient route to where you want to go, and the ability to follow that route to your chosen destination. The key to good navigation is thorough planning before the trip. The trip must

be planned in order to fit into your allotted time frame for the trip. The challenge involves balancing route decisions around your skill, knowledge, and experience level while considering tide levels, current speeds, weather forecasts, and route information. As well, each day's destination must be reached before night falls or unfavourable weather or sea conditions set in. These conditions may cause a benign situation to suddenly become dangerous.

Once underway, navigation consists of keeping track of where you are along your chosen route. On a clear day, navigation is quite straightforward; you merely have to be observant. However, if you get caught out after dark or the fog rolls in, navigation becomes more difficult, and you will have to be proficient in the use of charts and compass. As well, it may become necessary to estimate your paddling speed and the current flow.

Although thorough planning is the key to good navigation, it cannot cover all navigation decisions once underway. Prevailing conditions such as wind, waves and currents may dictate to a large extent which actual route you will decide to take. There are many aspects to navigation, but the crucial element of navigating is always knowing where you are. If you lose track of where you are you will not be able to make any further logical navigation decisions and you will be lost!!

Keep plans flexible and stay alert for changing conditions.

TIDES

Tides are caused by the combined gravitational influence of the sun and moon. However, the effect of the moon is the most important. The gravitational pull of the moon causes a bulge in the oceans girdling the earth. At this point, a high tide will occur. From centrifugal force, another bulge will occur on the opposite side of the earth, causing another high tide there. In between there are two hollows where low tides are occurring. As the earth spins during a 24 hour day, this bulge of water follows the moon across the face of the planet, thus creating two high tides and two low tides during the course of a day. The terms high and low tide are relative to successive water levels in the tide cycle.

Although the effect of the sun is not as significant, it still affects tide heights. During a period of full moon and new moon, called spring tides, the sun and moon will be in line. The combined gravitational pull of the moon and sun creates tides that are higher and lower than average. During periods of quarter moons, called neap tides, the sun and moon will be approximately at right angles to each other. As a result, the influence of the sun reduces the effect of the moon's pull, causing less differential in tide heights. Be aware that extreme weather can also cause greater tidal fluctuations than what is predicted.

Tidal bulges on the oceans are caused by the gravitational attraction of the moon and sun. In many parts of the world, tides occur as in the ideal example explained above. There are two high tides and two low tides per day, at approximately six hours apart, and with approximately equal high tides and equal low tides (repeating

this complete cycle every 24 hours and 50 minutes). This is called a semi-diurnal tide cycle. Most tides on the Pacific coast are a mixed semi-diurnal, meaning there are significant differences in the tide heights (one high tide is higher than the other and the same is true for low tide). In Victoria and the north shore of the Gulf of Mexico, the tides are diurnal. This means that there is usually only one high tide and one low tide per day.

PREDICTING TIDE HEIGHTS - USING TIDE TABLES

Approximate tide heights must be known when planning when and where to launch your kayak because the height of the tide will determine how much beach will be exposed. In many areas, the amount of beach area that may be exposed can be significant and paddling into camp at the wrong time could result in a hike across hundreds of meters of mud flats. As well, a lot of paddling distance can be saved by crossing tidal flats between islands at high water. In areas with a large tide range, knowing the approximate tide level can also help you better know what shoreline features will be easily identified for navigational purposes and possible landing sites. Tide tables provide the predicted heights of the tides for a particular area and the times that they occur.

The Canadian Tide and Current Tables are published each year by the Canadian Hydrographic Service. These tables contain both the tide information and the current information. To begin, you must choose the correct book for the area where you are paddling. The map on the inside front cover will show you which volume to use for each region. There are two volumes for the west coast. Volume 5 covers the lower mainland and lower Vancouver Island. Volume 6 covers the rest of the west coast. Once you have chosen the correct volume, the lower map on the inside front cover and the table of contents will tell you which table to use for your area. For example, the lower map on the inside front cover has a black dot indicating that there is a tide table published for Victoria in Volume 5.

Tide tables give you the following information: Based on the date, they give the time and the height (in feet and meters) of the high and low tides. The actual tide height may deviate from the predictions by a foot or so and the times could be off by an hour or so, but they are, for the most part, quite accurate.

The times listed in the tide tables are in standard time. If daylight savings time is in use, you must add one hour to the times listed (in BC, daylight savings time is in effect from the end of April to the end of October—the summer paddling season!)

The tide heights listed in the tide tables are based on the soundings, or charted water depths, found on nautical charts. By finding a sounding at a point on a nautical chart which is close to a reference port (such as Victoria), and then taking the tide height from the tide table for that reference port, you can then add the height from the tide table to that of the sounding and you will know the actual predicted depth of the water at that location and for a particular time and date. In Canada the reference level on the charts (called chart datum) is based on the lowest normal tides

(in the U.S., chart datum is based on the average of the low tides; as a result you will find many more negative tide heights in U.S. tide tables).

As you move away from the reference port, the times and heights of the tides will vary. There is a table of secondary ports found in the tide tables which will allow you to correct for this variance. Instructions for calculating tide heights for secondary ports can be found in the “Canadian Tide and Current Tables” publication.

Remember, kayaks require only a few inches of water! The objectives of tide time and height calculations are to approximate the water levels for launching/landing, route considerations, and avoiding tent and kayak loss in the middle of the night!

CURRENTS

As the oceans rise and fall along the coast, the water must flow in and out of estuaries. Because of restricted space, estuaries and inlets will not rise and fall in exactly the same time with the open ocean, but the water will fill and drain them much like a bath tub. The up and down motion of the oceans causes the tide height to change. The in and out motion causes the tidal currents to change. As we refer to tides, we will be referring to the vertical rise and fall of water. When we refer to currents, we will be referring to the horizontal flow of water.

In contrast to tidal information, which only needs to be used for special circumstances, knowledge of currents is needed at all times for most coastal areas. For example, you will need to be able to predict when the current is weakest for crossing channels. If you are paddling against currents, they will reduce your paddling speed, thereby affecting your travel times and the distance you can travel. As has already been mentioned, it is imperative to know the direction and speed of currents so that you can avoid crossings where wind and waves are in opposition.

BECOME FAMILIAR WITH THESE TERMS:

- Flood: The current flow into an inlet or estuary (think of “filling the bathtub”).
- Ebb: The current flow out of an inlet or estuary (think of “emptying the bathtub”).
- Turn/Slackwater: The period of slower moving or still water between ebb and flood.
- Maximum Flood: The time at which the flood current reaches maximum flow.
- Maximum Ebb: The time at which the ebb current reaches maximum flow.

READING THE CURRENT TABLES

Unfortunately, currents are not as easy to predict, but the current tables will be a great help. If you are paddling around the southern and eastern side of Vancouver Island, you will use the current tables often and the tide tables rarely. If all you have are tide tables, a rough extrapolation is remembering that currents will be fastest in the middle of the tide cycle. An alternate reference for current information is the

Current Atlas used in conjunction with Washburne's Tables or Murray's Tables. These provide a simple visual representation using arrows on small scale charts for indicating the flow rate, direction, and major eddies of currents in the Juan de Fuca Strait and the Strait of Georgia throughout each 6 hour current cycle. The Current Atlas is used more commonly by sailors, but is a worthwhile tool to familiarize yourself with for paddling in the Gulf Islands. Otherwise, following are the primary steps for using the basic current tables found in the Canadian Tide and Current Tables publication.

First, find the correct current table to use. This is the same as finding the appropriate tide table. Use the map and index at the beginning of the book and look for the current station closest to your paddling destination. The current table presents three important columns of information:

- The time the current turns.
- The time of maximum current flow.
- The speed and direction (ebb or flood) of the current flow. The speed of the current is given in knots or nautical miles per hour, and the direction is indicated by a "+" or "-" sign. The "+" sign indicates that the current is flooding and the "-" sign indicates that the current is ebbing.

Please note that the "turn" time should not be confused with the time of high and low tide. The change in direction of current flow rarely coincides with the time of high and low tides.

Just as with the tide tables, the predictions for current flow can be adjusted for location by using the secondary reference stations tables. Information on calculating current flow at secondary current stations can be found in the Canadian Tide and Current publication.

Remember, kayaks are very vulnerable to changes in current conditions! The objective of using current tables or the Current Atlas is to know both the approximate direction, speed and time of currents flowing throughout a tide cycle so that you can make safe decisions about crossing channels or using the current flow to your advantage. Catch a free ride!

NAUTICAL CHARTS

Nautical charts are designed specifically for marine navigation. They show water depths, shoreline composition, the shoreline tidal range, shallow or exposed inshore rocks, navigational aids, compass directions, etc. Nautical charts can be obtained at retail stores such as Ocean River Sports, marine equipment supply stores, Crown Publications, and from the government.

The most important consideration when choosing charts for kayak navigation is the scale of the chart. The scale is the size of the chart or how much area it covers. A small scale chart covers large tracts of land and sea and, as a result, shows limited

detail. A large scale chart covers smaller areas and shows much more detail. Since most kayaking is done close to shore, shoreline details are essential for determining possible landing sites, camping sites, the composition of the beach (mud, sand, gravel, rock), shoreline steepness, etc. Chart scales of 1:20 000 to 1:40 000 are generally the most practical for kayak touring. A scale of 1:20 000 means that 1 inch on the chart is equal to 20 000 inches or approximately 2 miles of actual distance. The scale is usually printed under the chart title. While choosing too small a scale gives too little detail, choosing too large a scale can be impractical because this covers only small areas and would require a large number of charts for anything longer than a day trip—not a very practical option from the bridge of a kayak!

To choose the appropriate chart for a particular area, refer first to the Master Chart which details all of the charts available for the coast. The Master Chart shows both the area boundaries and the scale of each chart. Once you feel you have identified the appropriate chart, examine it to see if the area you need is covered in an appropriate scale.

Nobody knows all of the symbols and potential information on a chart, but here are a few explanations to better familiarize you with basic features:

SYMBOLS: All of the symbols found on nautical charts are found and explained in a book called “Chart #1” published by the Canadian Hydrographic Service. There are hundreds of symbols, some which you will use more than others and many not at all. The most useful symbols for the kayaker to learn are those which describe the type of shoreline and shoreline composition, rocks, some navigational aids, tide rips, current directions, and chart datum.

COLOURS: There are only a few colours found on charts. The khaki colour indicates dry land, green shows shoreline areas which can be exposed at low tides and covered by water at high tides, a deep blue colour indicates shallow water down to 5 meters deep, and light blue indicates water from 5 to 10 meters deep. Water beyond 10 meters deep is white in colour with blue contour lines. Purple or red marks navigational aids and warnings to mariners such as submerged power lines, etc. Shipping lanes and the compass roses are also coloured purple.

SOUNDINGS: Printed all over the water areas of nautical charts are small numbers called soundings. These are the charted depths of the water at those points. The reference point for these depths is called the chart datum, and in Canada, is the depth of the lowest normal tides. (In the U.S., the chart datum used is the mean lower water level, and can differ from the Canadian data by as much as 1.5 meters.) On newer Canadian charts, the soundings are given in meters. Some of the soundings have subscripts: For example, the depth 52, means 5.2 meters. On U.S. charts, and older Canadian charts, the soundings are in fathoms. A fathom is equal to 6 feet. On these charts, 52 means 5 fathoms and 2 feet or 32 feet. Of course, subscripts on metric charts will run from 1 to 9 and on non-metric charts, only from 1 to 5.

TERRAIN AND PERSPECTIVE: Charts provide a “bird’s-eye view.” This perspective can sometimes be tricky when interpreting land and channel profiles observed from the low vantage point of a kayak. Identifying specific bays, islands, and points can be misleading. This judgement improves with experience, but a compass is invaluable for identifying land or water features.

MEASURING DISTANCE USING LATITUDE AND LONGITUDE: Latitude and longitude are expressed in degrees and minutes where 1 degree = 60 minutes, and 1 minute = 60 seconds. The scale which runs across the top and bottom of the chart is longitude, and this scale runs from 0 to 360 degrees. The lines of longitude run from the north pole to the south pole, diverging from the north pole to the equator and converging again from the equator to the south pole. As such, they divide the planet like slices of an orange. The scale which runs up the sides of the chart is latitude. The lines of latitude run parallel to each across the chart from east to west. This scale begins at the equator and runs from 0 to 90 degrees to the north pole, and from 0 to 90 degrees to the south pole for a total of 180 degrees. Unlike lines of longitude, the distance between lines of latitude is constant: 1 degree of latitude is equal to 60 nautical miles and 1 nautical mile is equal to 1 minute of latitude. (A nautical mile is just over 6000 feet or about 15% greater than a mile. It is exactly equal to 1852 m). The nautical mile is the standard distance unit for marine navigation and is also used to describe speed in terms of nautical miles per hour or “knots”. Because of the relationship between degrees of latitude and nautical miles, the latitude scale can be very easily used to measure distance. (Remember, you cannot use the longitude scale to measure distance because the lines of longitude are not parallel). Using the latitude scale to measure distance is more convenient than using the conventional distance scales published on all maps and charts.

A pair of dividers is very useful for measuring distance in your initial trip planning. Once seated in your kayak, tools such as dividers give way to fingers, which for kayak navigation, work very well!

READING DIRECTIONS: There are a few ways you can read directions from a nautical chart. One involves using a protractor and the lines of longitude. Another involves orienting the chart to point to magnetic north and using an orienteering compass. And the third, most practical option involves using the compass rose, which is usually printed on nautical charts in two or three places. The compass rose shows both True and Magnetic scales. The outer circle points to True North (the same as the lines of longitude). The inner circle points to Magnetic North (which is where a magnetic compass points). By using parallel rulers or some sort of straight edge, you can very conveniently read exact directions off the chart. Because kayaks have very little metal to interfere with our compasses, when taking directions from the chart, we can simply use the magnetic scale of the compass rose. These directional values (in degrees) can then be applied directly to the magnetic compass, eliminating the need to account for variation (the difference between true north and magnetic north), or compass deviation (from large metal or magnetic objects).

BASIC COMPASS NAVIGATION

TERMINOLOGY:

- Heading - The direction the kayak is headed.
- Course - The direction you want to go.
- Bearing - The direction to a landmark.

Steps for calculating a compass course:

To plot a course in you initial trip planning, line up a straight edge between the two points you wish to travel.

Move this straight edge parallel towards a compass rose (parallel rulers make this task simpler and more accurate).

Read the bearing off the furthest edge of the magnetic scale of the compass rose (in the direction in which you want to travel).

Draw a straight line between the points on the chart and write down the magnetic bearing. Recording this information makes it readily available for when you need to use it on the water.

Once you are on the water and need to find additional bearings from the chart, you will generally not use parallel rulers. Since most of the crossings we make in kayaks are short, using your hand or a piece of string to take approximate bearings works very well and is accurate enough - simply hold the side of your hand on the angle between two points and keep this approximate angle as you slide your hand to the magnetic compass rose to read the bearing.

COMPASS USES

Compasses are used for steering, identifying landmarks, finding your position, and monitoring the effects of wind and current. Their primary use is to tell you which way to go when it is not apparent from simply looking around. The best type of compass for kayaking is a marine compass mounted to the deck so that it is always in view for hands-free use. Marine compasses are dome-shaped so they can be read even when the kayak is rolling around, and there is no need to adjust for variation. It is also possible to safely navigate with a hiker's compass, but it is not as convenient or easy to use in the cockpit of a kayak.

Using the compass for steering a course is quite simple:

First, take a bearing off the chart as described earlier. If you have a deck-mounted compass, ensure that the lubber line (centre line) of the compass is mounted in-line with the bow-stern axis of the kayak. Now, simply turn the kayak until the calculated bearing reads under the lubber line on the compass. Paddle in this direction while keeping the lubber line lined-up with the bearing.

If you have a hiker's compass, you must first rotate the housing until the bearing you read off the compass rose is lined up with the direction-of-travel arrow on the compass. Now turn the whole compass until the free-floating needle is lined-up ("housed") with the red arrow on the bezel/compass face (indicating magnetic north). The direction-of-travel arrow points in the direction you will paddle. Place the compass down in front of you and begin paddling on this course while keeping the needle "housed" and pointing to the north. Remember, the hiker's compass must be kept flat to prevent the needle from "sticking", thereby giving an inaccurate reading.

At this point, if you can see your destination, you can paddle toward it visually. However, it is still wise to refer occasionally to your compass to ensure that you are not drifting off course. Whenever in doubt, or whenever in heavy fog, you must always trust your compass - it is easy to get disoriented without it.

To identify landmarks and channels with your compass, this procedure is almost reversed. First, you must know your exact location on the chart. Point your compass in the direction of the landmark you wish to identify and read the magnetic bearing off the compass. Now find this bearing on the chart's magnetic compass rose and line up your straight-edge (hand, stick, or parallel ruler) on this same angle through the centre of the rose. Slide the straight-edge on this same angle across the chart to your known position and the line will intersect with the landmark or channel you want to identify.

If you are unsure of your exact location on the chart, but can identify two or more distinct known landmarks, you can also use your compass to re-determine your position on the chart. Follow the same procedures you would use for identifying landmarks, but instead, draw lines on the chart indicating the reverse-bearing (add 180 degrees to the bearing you read off the compass) from the known landmarks. Your location is approximately where these lines intersect...now don't get lost again! Without local knowledge, it is often necessary to use compass bearings to identify the terrain.

There are a few pitfalls to be aware of when paddling with your compass. You might find that your compass bearing is changing even though your kayak is still pointed at your original target. This means that a current or wind is pushing your kayak off your original line of travel. Alternatively, if you are paddling by compass alone, you could drift unintentionally past your target. There are methods of calculating drift and correcting for it, but they are beyond the scope of an introductory kayaking course. In any event, such detailed calculations will only give you approximations. Fortunately, most of the paddling that you may do in heavy fog will be done on the west coast of Vancouver Island where currents are negligible. But always be wary of other boat traffic whenever you choose to navigate in fog. If you are interested in more advanced navigational techniques, refer to David Burch's Fundamentals of Kayak Navigation.

Learn to love your chart, and always trust your compass! Practice your navigational skills in less-challenging familiar circumstances so that accurate route-planning and route-finding is second nature when it's needed!