Kayak Navigation Kit
Instruction Booklet

Thank you for purchasing the Blue Dog Kayaking Kayak Navigation Kit which contains: Square Plotter with string, ruler, pencil, rite in the rain note pad and time/distance calculator.

Use the kit to prepare charts in advance and eliminate errors when deducing 'ded' reckoning plots.

Getting lost or confused about your location can be a very worrying even for experienced kayakers. To make things worse, not knowing where we are makes hazards difficult or impossible to avoid. Navigation is not some mystical skill possessed by only a few, we navigate every day, driving to the shops or a friend's house for dinner is a good example. In everyday life we use landmarks such as roads, road signs and traffic lights to navigate in our own community.

This type of navigation is called Piloting and together with another type of navigation called Ded Reckoning makes up the two primary forms of navigation for paddlers. Everyone arrives at a Paddle Canada Sea Kayaking course with some ability and skill at navigation. The difference is the environment in which we kayak can be significantly more challenging and offer less indication or where we are than our city environment. The principles, however, are the same.

Tools of Navigation

When we leave our city and travel to an unfamiliar location we typically seek out a tool to help us with our navigation in this new area – a road map. When we go to paddle a new area, we also need to take with us a similar tool to help understand and recognize the new landmarks. This is typically a topographic map or more appropriately for Sea Kayaking, a nautical chart.

There are pros and cons to the use of topographic maps vs. nautical charts. Topographic maps show more detail on land – things like trails, buildings, or water sources that help us find important things like escape routes, access or egress point, pubs or campsites. Nautical Charts can show these things as well but with less detail. What they do show is significantly more detail on and in the water – things like submerged rocks, tidal currents, and shipping channels – things that help us avoid hazards and assist us with marine navigation. In a marine environment a topographical map is a poor substitute for a nautical chart. Another reason for resistance to using nautical charts comes from the many symbols used to describe real world features on charts. Topographic maps put the symbol descriptions on the back of the map. This is impractical with nautical charts since the number of symbols on charts could fill a book – and it does, a book called Chart 1.

More about Charts

The goal of navigation is to match the symbols on the chart to the objects they represent in the real world. We do the same thing with a road map by looking for intersections and street names. Charts are maps for mariners so; the first step to interpreting the information is getting to grip with what the colors represent. Charts have six colors'; ***White*** represents water deeper than 10meters, ***Blue*** represents shallow water less than 10 meters, ***Green*** represents the intertidal zone which is the area that covers and uncovers with water as the tide comes in and out. ***Beige*** represents the land and ***Black*** is used for text and symbols. ***A purple symbol represents*** aids to navigation.

Most kayakers choose to paddle close to shore and keep track of their position using landmarks or features, as we paddle features can be identified on the chart; participants will practice identifying landmarks and marking them on the chart, the ability to identify hazards such as drying rocks, sand bars and turbulent water and from the chart and visualize where they appear on the route is essential.

Checkpoints

There are four useful ways to use landmarks to navigate in the real world. These techniques are called check pointing, hand railing, back stopping (also referred to as using catching features) and transiting (also referred to as using ranges).If we pick a section of coastline and plan a route along it, we will inevitably see symbols on the chart representing objects we will pass in the real world. The chart tells us a story of what we will see if we paddle this shoreline. A rock becomes visible as we round a point, a small brook flows down a hill. These elements of our story are called checkpoints or fixes. Once we reach the checkpoint we know exactly where we are in relation to other features around us. Keeping track of these checkpoints is an effective way to keep track of your location and navigate.

Hand-Railing

As we follow the shoreline, our direction is maintained by keeping the land on our left or right hand side. We use the shoreline as a 'handrail' to keep us moving in the right direction. Hand railing is especially useful when trying to find water sources or campsites, paddling close to shore and using the shoreline as a handrail helps greatly with this task.

Backstops

Some features are easy to miss when hand railing. A rock may blend into the shore at low tide, a brook may have dried up during the summer or there may even be an inaccuracy in the chart. If we paddle past our intended destination or checkpoint, the use of a backstop can tell us we have gone too far. A large bay, point of land or any other significant landmark that is past our intended checkpoint can be used to indicate we have gone too far. When such landmarks do not exist we can create our own backstop by using time. All things being equal, it generally takes an average group of paddlers 10 minutes to paddle half of a nautical mile, 20 minutes to travel one nautical mile and so on. A scale on the bottom of your chart indicates a nautical mile or you can find the latitude scale on the chart, where one degree of latitude is equal to one nautical mile. If your intended landing spot is half a nautical mile away and you have been traveling for 15 minutes, you have probably passed your intended destination.

Transits or Ranges

Sometimes when there is no immediate landmark to determine your location, you can use two separate landmarks away from you position but still in your field of view to form an imaginary line called a transit. Any two objects can be used and more than one transit can be created to give a fairly accurate position. As you paddle, watch for the two objects you have selected to come into alignment. When this happens you are somewhere on the transit line drawn on your chart. A useful technique is to actually draw transits on your chart for areas you know you may need them before heading out.

Ded Reckoning

The second type of navigation is called ded reckoning and is done without the use of landmarks or in low visibility conditions such as fog. It involves the creation of a line with a compass and the use of time as a backstop. The term "dead" comes from the word deduced; meaning this type of navigation involves deducing your position as opposed to actually accurately pinpointing your position. It is inherently inaccurate but useful over short distances in good conditions.

To undertake navigation by Dead Reckoning you need 5 things:

1. Accurate knowledge of where you are - taken from a chart
2. A direction to where you want to go – taken from a chart with a compass or protractor
3. A distance between where you are and where you want to go – measured off a chart
4. Your average paddling speed – taken from past experience or a measurement with GPS
5. The time it will take to get there – calculated using the formula 60 D = S T (sixty D Street) where D = distance, S = paddling speed and T = Time to object. The number 60 is used to convert the number into minutes.

A ded reckoning plot is inherently inaccurate. There are several variables that will, by themselves, contribute to create inaccuracy. When all these inaccuracies are combined there can be significant error. Because of this Dead reckoning plots are inherently inaccurate, the goal of doing dead reckoning plots should be to reduce these errors as much as is possible.

Reducing Ded Reckoning Errors

Errors from the spacing of lines of longitude:
The lines of longitude are spaced far apart on a chart and it can be difficult to find a line running through the compass housing to align the compass housing lines with the longitude lines. The compass may have to be moved around or slid while maintaining the correct orientation of the compass in order to take a bearing. Again, accuracy can be lost.
Solution:
Draw in additional lines on the chart in the proper orientation. Space the lines half a nautical mile apart and you have an additional quick measurement for distance. You should draw the lines parallel to the direction of magnetic north, as this will reduce another error described next that deals with magnetic declination.

Errors from adding (or is it subtracting?) magnetic declination:
Most experienced kayakers are aware that they have to add or subtract magnetic declination depending on where they are in the world in order to get a correct bearing to follow on a compass course. Unfortunately the commonly taught rhyme to remember that is, "east is least and west is best" often confuses people more than it helps. This is because in eastern North America, declination is west and in western North America declination is east. People get confused about which east and which west to use and will often use the wrong east or west to fulfill the rhyme. Confused yet? It is very common for a paddler to add declination where he or she should have subtracted and subtract declination where he or she should have added. In BC declination can be 19 degrees which if not added or subtracted properly could introduce an error of 38 degrees into your bearing – scary stuff!
Solution:
Work in magnetic. Draw lines on your chart, as described earlier, running parallel to the magnetic north line on the chart's compass rose. If bearings are taken from these lines and not the lines of longitude on the chart, there is no need to add or subtract declination when going from the chart to the real world with a bearing. This completely removes the error.

Errors in distance scale:
There are two scales for measuring distance on a nautical chart. One is a scale with kilometers and nautical miles that can often be out of view depending on how the chart is folded. The other is the measure of latitude on the side of the chart (where one minute of latitude equals one nautical mile), which again could be out of site depending on how the chart is folded. When using the measure of latitude, unfamiliarity with the scale could cause a mistake, as it is not readily apparent what marks represent a nautical mile.
Solution: Measure distance using the lines of longitude that you drew earlier on your chart to deal with the spacing problems when using orienteering compasses. You can also cut out the scale on the chart and glue it to the area you will actually be using on the chart.

Errors in average paddling speed:
An average paddling speed for a group of kayakers is 3 knots. This means that a group, all things being equal, will travel three nautical miles in one hour. Head wind, tail wind, ebb tide, flow tide, eddies, beam wind, sea state, rest breaks, depth of water and even the anxiety of your group will alter this average.
Solution:
Make a habit of measuring your average paddling speed in varying conditions. A GPS unit is the most accurate method to use. This will give you an idea of what speed to use for dead reckoning in different conditions. It is not entirely accurate but much better than guessing. This information is only useful if you have a log of this information readily available during your paddle.
Errors in calculating time or 60D = ST:
Math causes difficulty for many of us. This simple formula for determining time is a combination of multiplication and division sometimes with decimal points. Trying to do this calculation in your head while being tossed around in a sea is not as simple as one would like. Experience has shown that using this formula to calculate time is a huge source of dead reckoning error. It must be eliminated or at the very least reduced.
Solutions:
Think about distance in terms of time and not in terms of a variable to plug into a formula. If the average speed of a group of paddlers is 3 knots (and it typically is), it will take that group one hour to paddle 3 nautical miles. Following this logic it will take 20 minutes to paddle one mile or 10 minutes to paddle half a mile or 5 minutes to paddle a quarter of a mile. If the distance you have to paddle is 2.25 miles then the time to paddle that distance should be 20min. + 20min. + 5min. or 45 minutes. This type of distance/time logic seems to be much easier for human brains to do accurately while being tossed about in a sea. It is also less prone to errors in mathematics as it is simple addition.
A second solution is to use a paddling times calculator with the time and distance calculations already done for various paddling speeds and distances. This table is included in your kit and can be laminated and carried in your PFD or glued onto the chart itself. The advantage of this solution is you have all the calculations done in advance and for every possible speed and distance you could have a need for. It completely removes the human error of calculation.

Paddling Times Calculator

	Speed-Knts	1.5	2	2.5	3	3.5	4	4.5
Distence-NM	Time-Min							
1		40	30	24	20	17	15	13
1.25		50	38	30	25	21	19	17
1.5		45	45	36	30	26	23	20
1.75		70	53	42	35	30	26	23
2		80	60	48	40	34	30	27
2.25		90	68	54	45	39	34	30
2.5		100	75	60	50	43	38	33
2.75		110	83	66	55	47	41	37
3		120	90	72	60	51	45	40

Even after taking all the above-mentioned solutions for errors there is still some chance of missing your intended target. A common solution is to create an intentional error in the bearing to hit a backstop where you can then pilot to your target. This is called aiming off and is done whenever possible. By intentionally aiming to one side of the target, once the shore is reached, the paddler will know exactly which direction to turn and handrail the shoreline and hit the target. If the bearing was taken directly to the target and an error forced the paddler to one side or the other, he or she would not know which way to handrail to find the target once the shore was reached.

Compensating for wind and current

Wind Speed	10knts	15knts	20knts
Correction	10°	15°	25°
Current Speed	1knt	2knts	3knts
Correction	15°	30°	45°

Navigation is both a skill and an art. You need to practice using the techniques explained above and tools in this kit until they are second nature. The goal is to navigate without having to think about it. Good paddlers are navigating constantly and always know where they are.