

Navigation and Route-finding

The Alpine Club of Canada

Alan Trick

Alpine Club of Canada – Vancouver Section

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Outline

Introduction

Route Planning

- Maps

- Important Features

- The Plan Itself

- Homework

Following a Route

- Navigation

- Finding Yourself

- Tools

Getting Lost

Ad-hoc Routes

Appendix





Introduction

Goal

To teach basic navigation skills so that trip organizers feel confident that they can plan safe and appropriate trips.

Prerequisites

This workshop assumes a basic knowledge of mountaineering.



Stages of navigation

- Route Planning: what you do at home or at camp, typically involves maps, the internet, and maybe books
- Following a planned route
- Recovering after losing a planned route
- Making an ad-hoc route





How to get information

- The Internet: info can be sporadic and arbitrary, but it's the most convenient and often high quality info, skews towards popular and overcrowded areas
- Guidebooks: less common, but still pretty relevant, especially for less common routes
- Maps
- Reconnaissance trips





Maps

- Different maps prioritize different information
- Maps can be inaccurate or misleading
- Humans are prone to biases when we see things and may misidentify features on a map



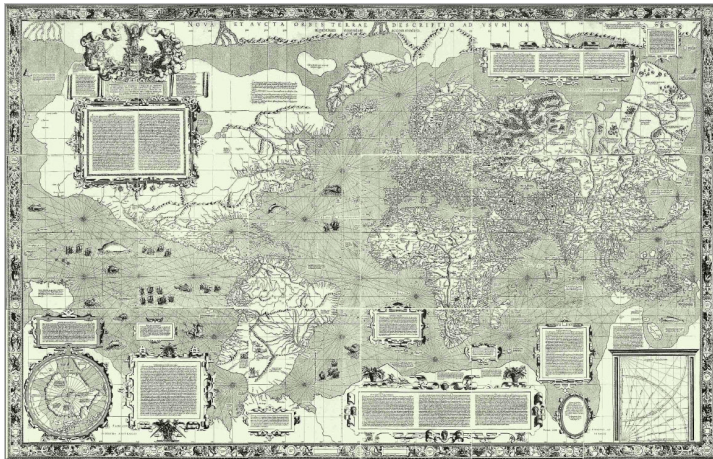


Known World (Eratosthenes, 194 BCE)





Known World (Mercator, 1569 CE)





Geographic coordinate systems

Latitude & Longitude

- Works globally
- Easy-ish to comprehend
- Hard to use on paper maps (size changes with latitude)
- Different datums (WGS 84, NAD 27, GCS-02)
- E.g. $49^{\circ} 3' 0''$ N, $122^{\circ} 19' 0''$ W or 49.05, -122.316667

UTM "Projection"

- Works based on meters East & North of some point, has 60 zones
- Typically given in an abbreviated form that specifies an area in a 100 km^2 area
- Useful on paper maps
- E.g. 3496 (1 km^2 grid), 345692 (100 m^2 grid), or 34536921 (10 m^2 grid)

There are others (but we're ignoring them)



Maps for outdoor recreation

- Important features
 - 1 trails/paths
 - 2 peaks
 - 3 waterways
 - 4 land-cover: forest/glaciers
 - 5 cliffs/elevation
 - 6 campsites
- Ways of handling elevation & slope
 - topographic lines
 - hill-shading
 - relief (by height or by slope)



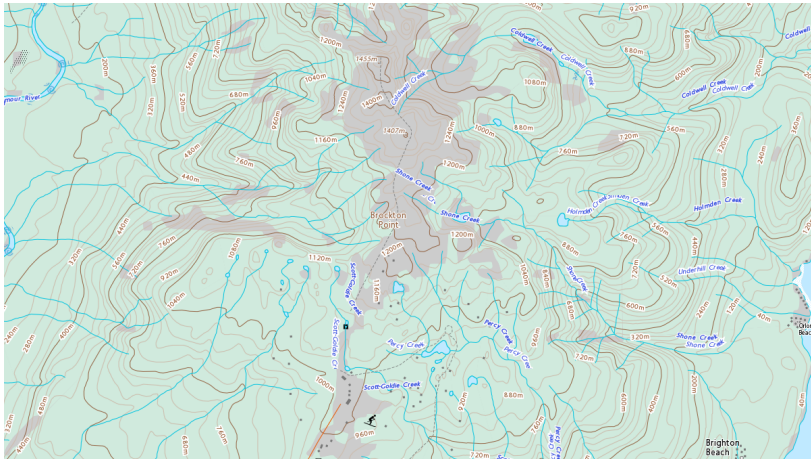


Seymour (Canvec)



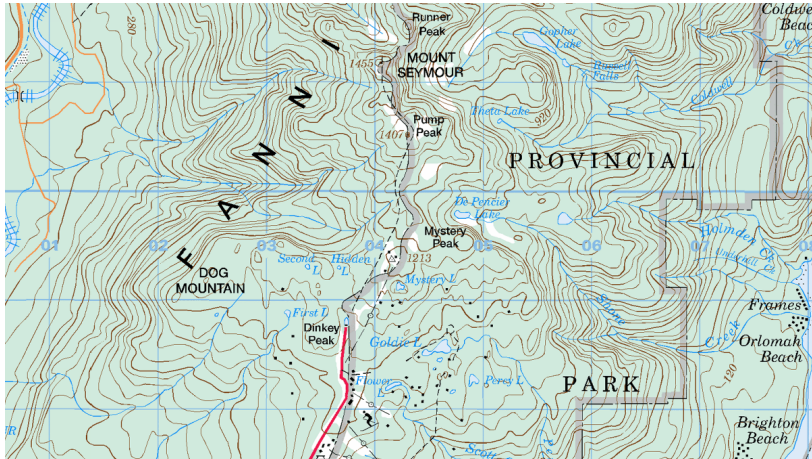


Seymour (NRCan)



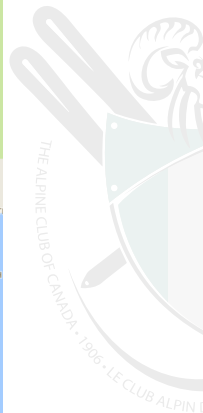
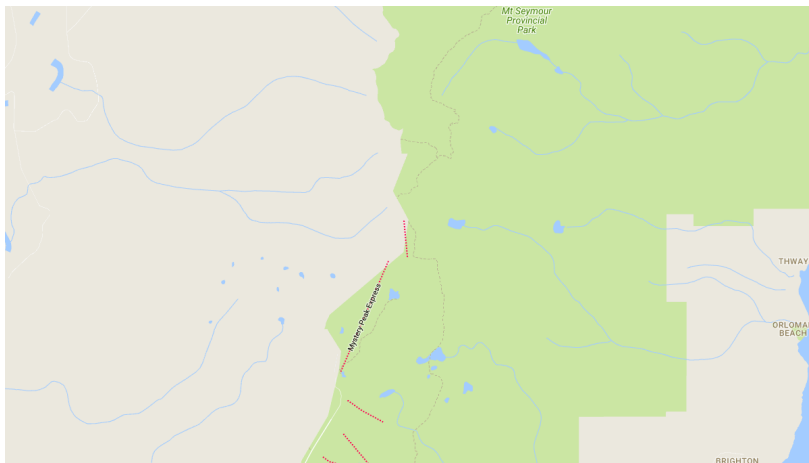


Seymour (CanMatrix)



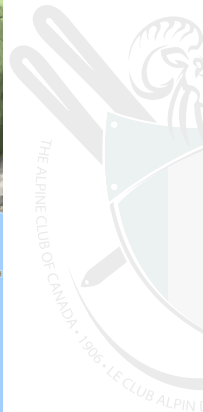
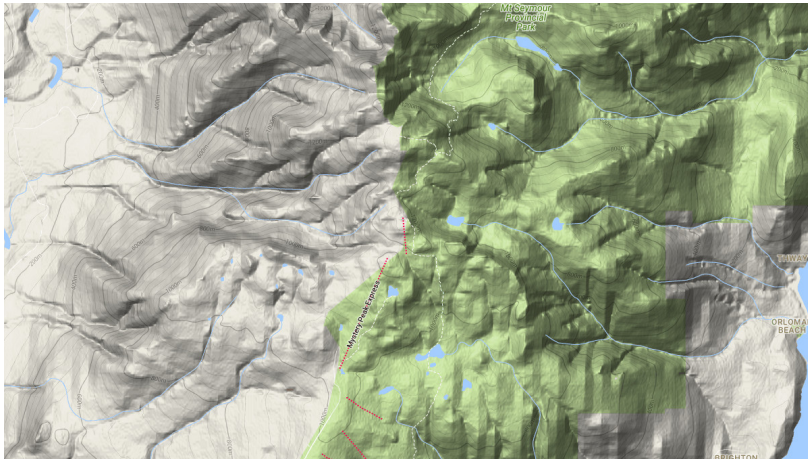


Seymour (Google Map)



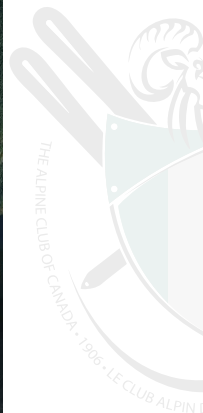
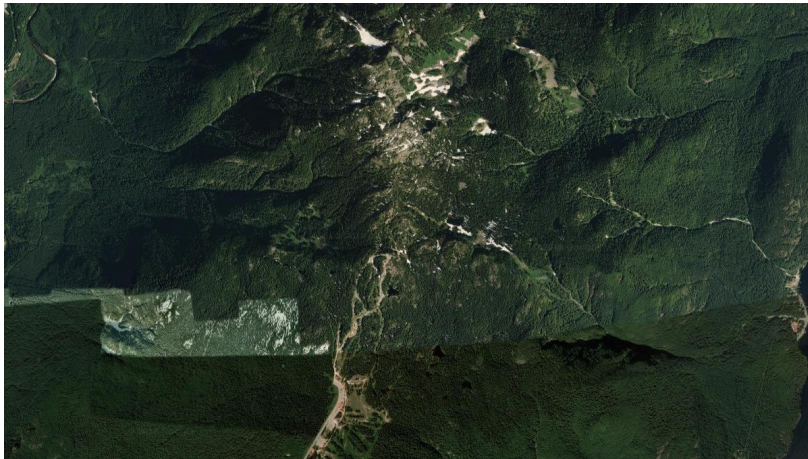


Seymour (Google Terrain)





Seymour (Google Satellite)



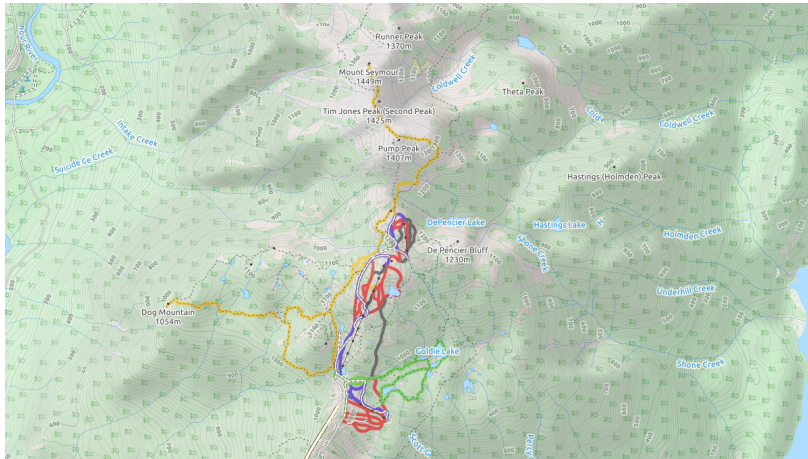


Seymour (openstreetmap.org, OSM)





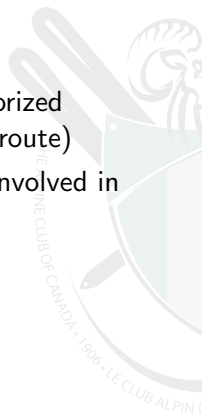
Seymour (ThunderForest, OSM)





Trails/paths

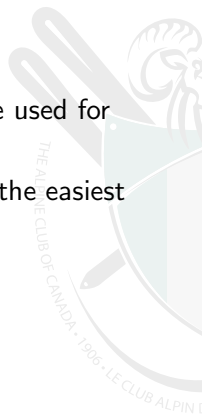
- What counts as a path can vary significantly (paved cycleway, non-motorized gravel road, 30 year old mining trail, route over an icy lake, scrambling route)
- Usually details about how much climbing/bushwacking/routefinding is involved in following route are absent





Peaks, ridges, and waterways

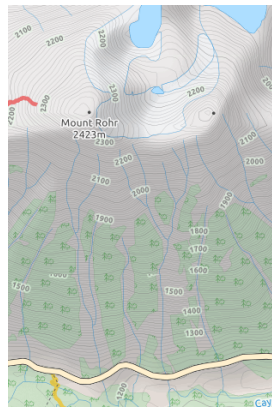
- Waterways a good way to figure out where the valleys are located.
- Ridges and valleys are usually not represented on maps, but they can be used for getting a sense of the elevation if they're there.
- Peaks are really useful for orientation, they're fairly distinct and usually the easiest things to spot.
- Waterways are also useful if you're thirsty.





Land-cover: forest, glaciers, etc

- Knowing where the forests are is useful both for bushwhacking & avalanche mitigation.
- Avoid entering & exiting a forest too much unless the undergrowth is covered (like it is by the snow in the winter)
- Forests vary significantly with the biome.
- Glaciers are useful for obvious reasons: hazards, water source. They may be significantly receded if based on old data, though.
- Wetlands (if mapped) are generally something you want to avoid.



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Campsites

- What counts as a campsite can vary significantly (fully furnished with a hot tub vs small bivy site for 2 people)
- Marking of back-country camping areas on maps is often quite limited.





Other landmarks

- Power lines (and their accompanying towers)
- Pipeline cutlines
- Communication towers (often covered in 'soda bottle'-like shelters in the mountains)
- Cabins/shelters





The plan itself

An actual plan could or should contain:

- Starting & ending locations; and how to get there
- Required gear & supplies
- Outline of way-points & ETAs
- Required technical skills
- Difficulty
- Minimum & maximum number of people
- Bailing options
- Plan B





Homework

- Research the various trailheads for McKee Peak
- Research details about a particular (predefined) objective, come up with a plan

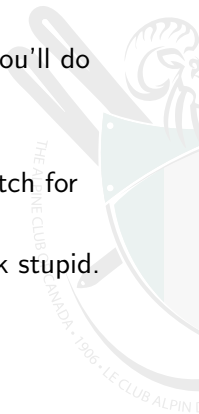




Navigating by the seat of your pants

Going by the seat of your pants is a legitimate technique. It probably what you'll do most of the time. When you do this, bear a few things in mind:

- It works better when you're familiar with an area.
- It's important to be able to recognize when you might be off route—watch for things that don't match your expectations.
- Don't do this just because you're lazy or because you don't want to look stupid.



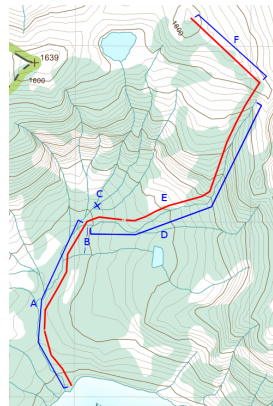


Simple navigation

If you look at a map ahead of time, you can often identify features that you can use as navigation queues.

- Handrails: contour along creek (A & D) and follow ridgeline (F) from top of gulley to peak.
- Landmarks: cross two creeks (B) before turning right, go along side of large bolder field (E).
- Backstops: if you come to a junction of 3 streams (C), you've gone too far.

Note that reversing this should be relatively straightforward.





Orientation

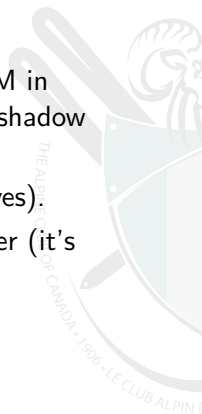
- Whether it's from a compass, some electronics, analyzing the moss on trees, or just familiarity with an area; orienting yourself is important.
- Dis-orientation generally happens over time—don't let it.
- “Sense of direction” is largely a trick your mind plays on itself. Sometimes it works.
- Practice regularly





Orientation without tools

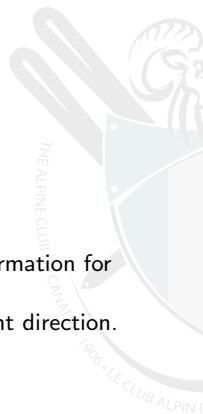
- Use prior knowledge.
- Use the sun: it's due south about 1–1:30 PM in Vancouver (12:30–1 PM in Golden). Note that it might be more pleasant to use the direction of a shadow than the sun itself.
- In the night, there's the North Star (requires good weather and good eyes).
- In the alpine you can sometimes use tall, distinct peaks like Mount Baker (it's tricky though).
- Sometimes the direction of the ocean works.





Orientation with tools

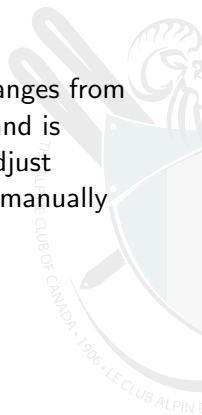
- Common tools: map, GPS, compass, barometric altimeter
- General technique
 - With GPS: Hope you don't run out of batteries.
 - Without GPS
 - ① Find & determine direction (and possibly distance) of landmarks.
 - ② Plot points on map and draw lines based on direction.
 - ③ Location is at intersection.
 - ④ Ideally you have at least 3 landmarks or 2 landmarks and some other information for error checking. More is better.
 - ⑤ Orient the map, so that north faces north or the landmarks are in the right direction.





Compasses

Compasses use magnetic north and maps use true north. Magnetic north changes from time to time. The differences between these is called magnetic declination, and is currently about 16 °W in Southwest BC. Nice compasses will allow you to adjust themselves to account for declination. If you don't have this, you'll have to manually account for the difference.





Compasses: Orienting a Map

- 1 Line the “orienting lines” on the back of the “compass housing” to match the north-south lines on the map.
- 2 Line the red north needle with the red arrow on the back of the housing.





Compasses: Finding a bearing

- 1 Point front of compass toward target.
- 2 Rotate compass housing so that the red north needle.
- 3 Lines up with the red arrow on the back of the housing.
- 4 The bearing at the front of the compass is your bearing.

If you have a mirror, you can use this to watch your needle alignment while holding the compass level with your eyes.





Sources of error in orientation

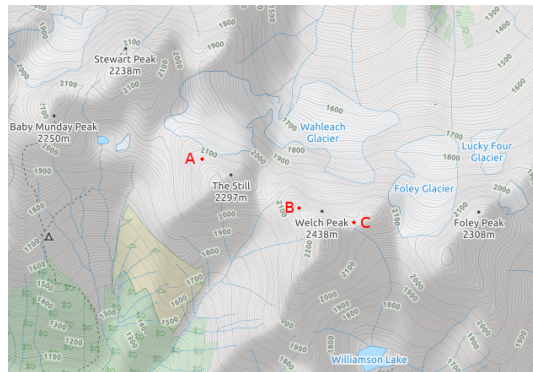
- GPS
 - Shiny (e.g. glass) buildings
 - Steep slopes
 - Tree cover
 - Cloud cover
- Compass
 - Needle sticking
 - Incorrect declination
 - North/south mix-up
- Other
 - Visual misidentification
 - Error in guess-work
 - Barometric altimeter: changes in weather





Sample Map Plots

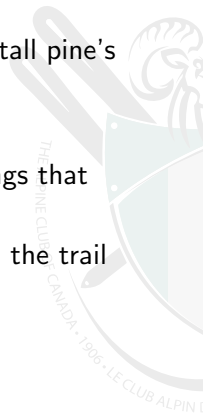
- All points: elevation about 2150 m
- Point A & B: 1 peak directly ESE
- Point A
 - 2 peaks about 1 km WNW
 - Small lake W (possibly hidden)
- Point B: 1 peak about 500 m WNW
- Point C
 - 1 peak directly W
 - Small lake about 1 km south & 500 m down
 - 1 peak about 1 km E





How to not get lost

- Don't push your limits too hard without appropriate preparation: "The tall pine's more often shaken by the wind. . .".
- While on route, regularly take a moment to think about where you are.
- Maintain good communication with your party, others might notice things that you don't.
- Take particular notice when important details change unexpectedly (like the trail becomes overgrown).





What to do when you're lost

- Take short break to take stock of the situation. Think about how you got yourself here, both literally and figuratively.
- Decide whether to find your way back or call for help & seek shelter.
- Prefer objective facts over intuition when trying to orient yourself.
- Try to get on top of a ridge or follow natural features & landmarks. Try to match these features to your map.





Bushwacking

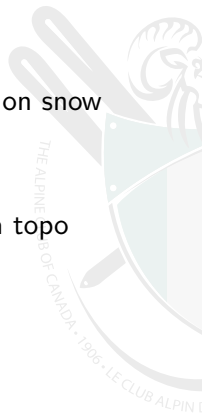
- Generally easier:
 - In old growth forest
 - On gentle ridgelines
 - With good snow cover
- Generally harder:
 - In snow-less avalanche paths (thick bush)
 - Going uphill on steep terrain
 - When you're carrying lots of gear





In the alpine

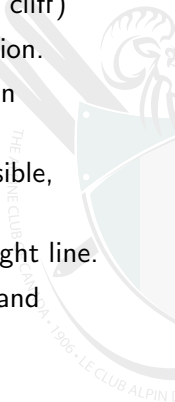
- Fortunately, you typically don't have thick bush.
- Unfortunately, you typically have lots of cliffs or crevasses.
- Rock typically doesn't leave much evidence of human traffic and tracks on snow can disappear with a little wind/snow.
- Too much micro-terrain makes most maps only marginally useful.
- On difficult rock routes, try to find a "topo" (not to be confused with a topo map).
- Always plan for bail options.
- Always climb below your ability level.





Dealing with low visibility

- If possible, find a feature that you can contour along (like a lake, stream, cliff)
- Take bearings as regularly as possible to get a sense of your general direction.
- The above is especially true when following a trail in a forest, as they often meander and individual readings may vary a lot.
- Have your partner (or the other end of the rope team) as far away as possible, and then take their position.
- It's more important to stay on safe & easy terrain than to maintain a straight line.
- In snow, use wands. It's best to place these before visibility is a problem, and make sure they won't get blown over by the wind.





Appendix 1: Online Resources for British Columbia

Information

- <http://forums.clubtread.com>
- <https://cascadeclimbers.com/>
- <https://mountain-forecast.com>
- Your favourite search engine
- <https://bivouac.com>

Maps

- <https://caltopo.com>
- <https://opentopomap.org>
- <https://opencyclemap.org>
- <https://maps.google.com>
- <https://www.bing.com/maps>
- <https://www.trailforks.com/>





Appendix 2: Mobile Software

This list is pretty short. There are probably many other fine options, these are just the one's I've heard of that are half-decent.

- OsmAnd (with contour lines plugin)
- Gaia GPS
- Komoot
- OruxMaps





Appendix 3: Miscellaneous

- Radios: can be nice, but recreational ones don't work in a lot of cases
- Splitting up: don't (unless you need to)
- Mobile devices with touch screens suck in storms

