

# Navigation and Route-finding

Alan Trick

Alpine Club of Canada – Vancouver Section

Prepared 2019 April 26





# 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





# Scale

| Name          | Unit | Description   |
|---------------|------|---|
| Macro-terrain | 100m | The scale that planning happens at, maps aren't really much good below this scale.  |
| Micro-terrain | 10m  | The scale that most routefinding happens. Significant obstacles like cliff bands or avalanche-prone slopes are at this level. |
| Nano-terrain  | 1m   | The scale that you actually move at. Things like "how do I get over this log?".   |

Trying to keep track of 2 or 3 different scales at the same time can be difficult.



# 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





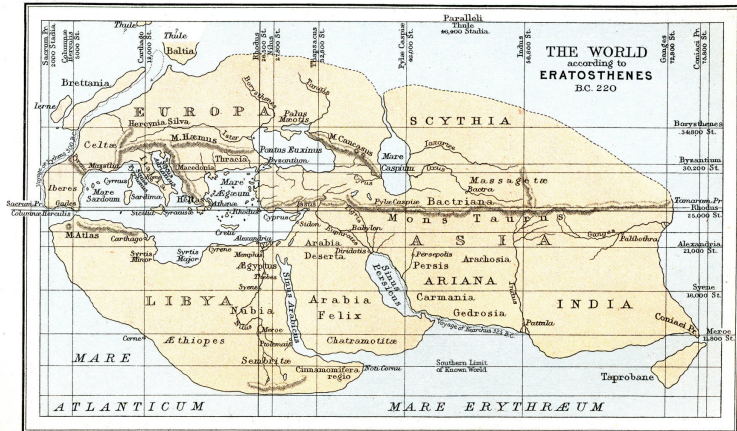
# Maps

- 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





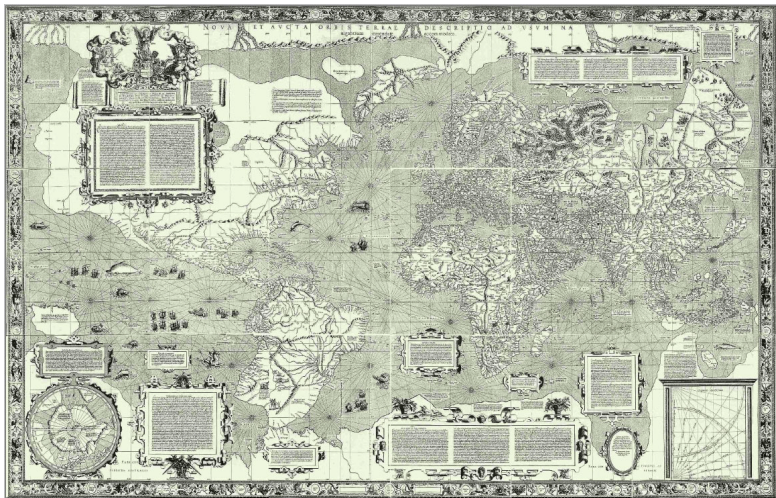
# Known World (Eratosthenes, 194 BCE)







# Known World (Mercator, 1569 CE)





# Geographic coordinate systems

## Latitude & Longitude

- Works globally
- 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"

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



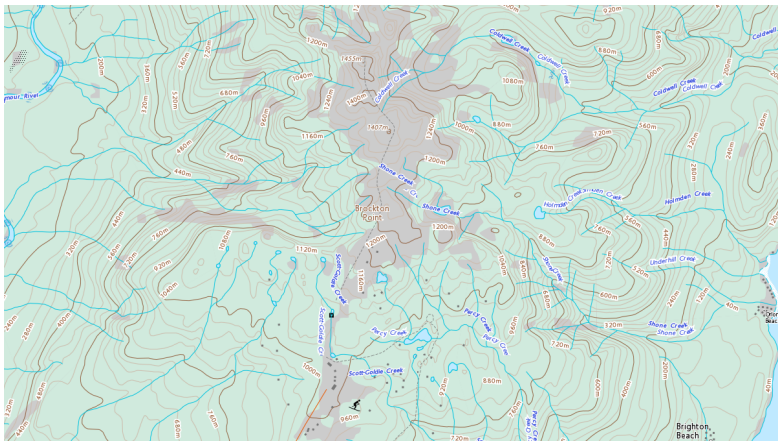


# Seymour (Canvec)



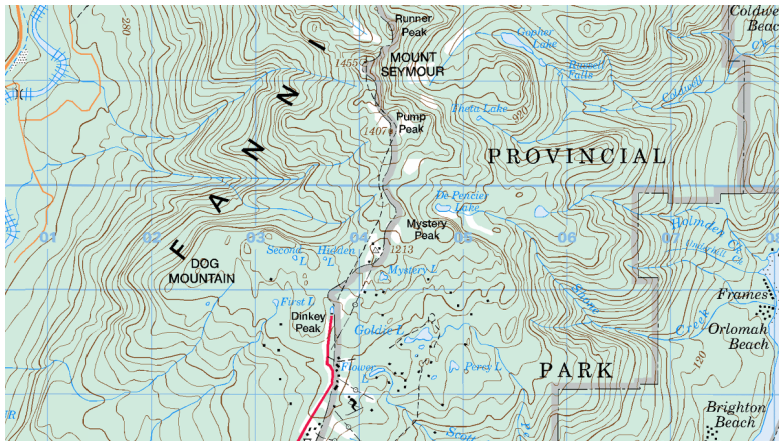


# Seymour (NRCa)



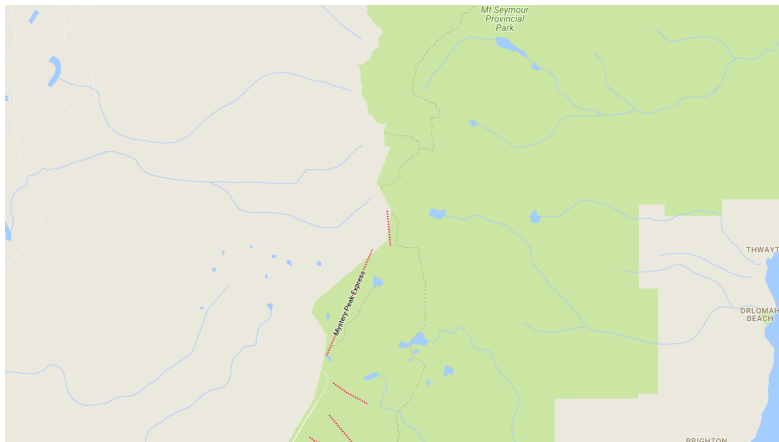


# Seymour (CanMatrix)



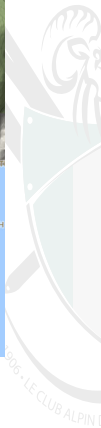
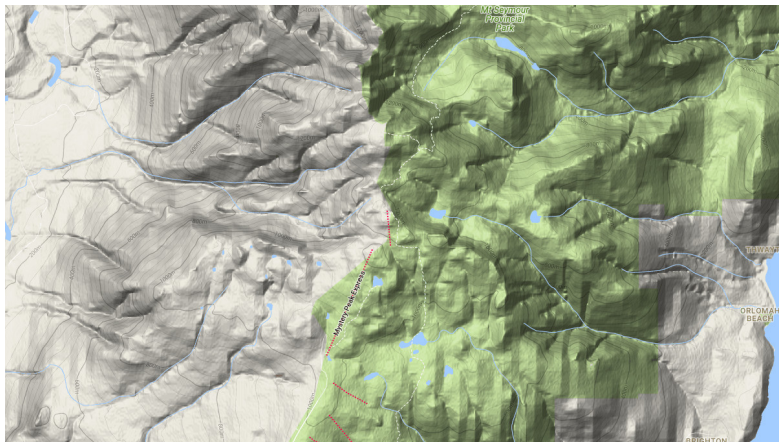


# Seymour (Google Map)





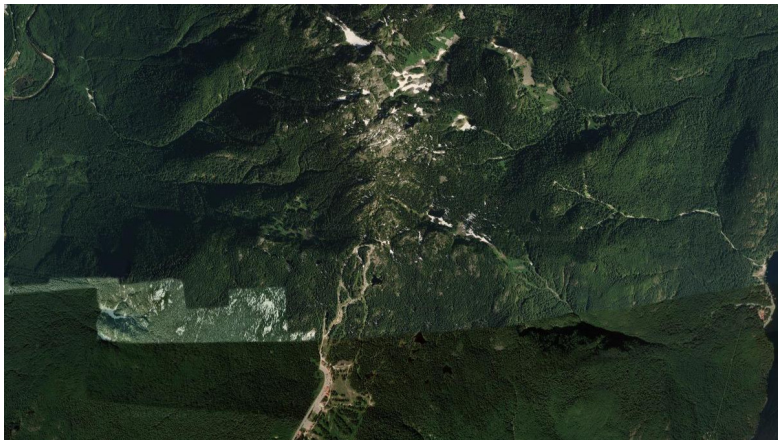
# Seymour (Google Terrain)







# Seymour (Google Satellite)



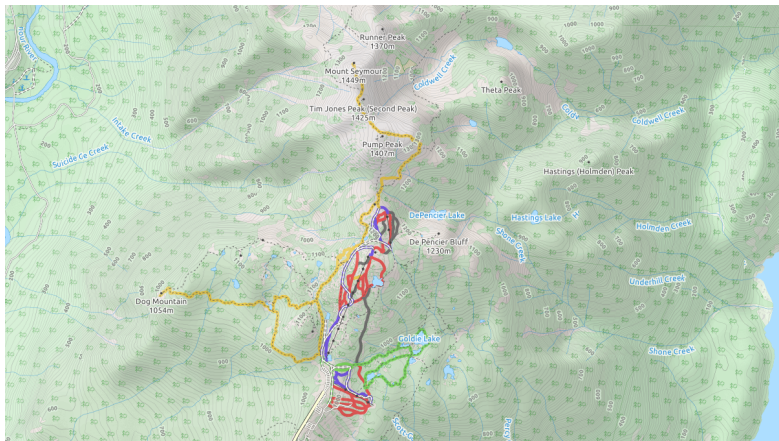


# Seymour (openstreetmap.org, OSM)





# Seymour (ThunderForest, OSM)





# Trails/paths

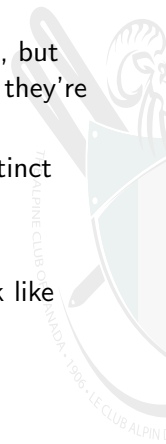
- What counts as a path can vary significantly (paved cycleway, non-motorized gravel road, 30 year old mining trail, route over an icy lake, scrambling route).
- Usually details about the amount of climbing, bushwacking, or routefinding involved are absent.





# Peaks, ridges, and waterways

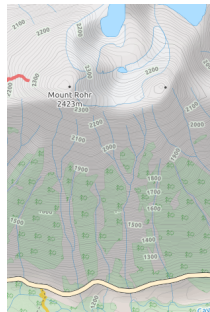
- Waterways a good way to figure out where the valleys are located.
- Ridges and valleys are usually not represented on maps, but they can be used for getting a sense of the elevation if they're there.
- Peaks are really useful for orientation, they're fairly distinct and usually the easiest things to spot.
- Waterways are also useful if you're thirsty.
- Dry waterway, especially when they're small, often look like paths. This is a very common way to get lost.





## Land-cover: forest, glaciers, etc

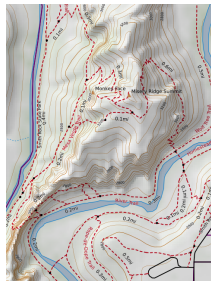
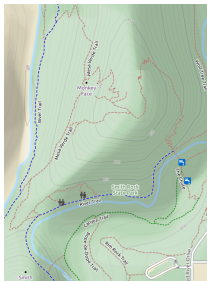
- Knowing where the forests are is useful both for bushwhacking & avalanche mitigation.
- Avoid entering & exiting a forest too much unless the undergrowth is covered (like it is by the snow in the winter)
- Forests vary significantly with the biome.
- Glaciers are useful for obvious reasons: hazards,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





# Cliffs and elevation

- Accuracy of elevation is somewhat important.
- Cliffs are rarely marked directly on a map, but if they are they are often useful as they are typically more precise.





# 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

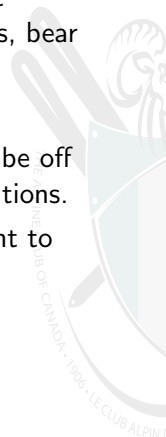




# Navigating by the seat of your pants

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 only works 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 you don't want to look stupid.



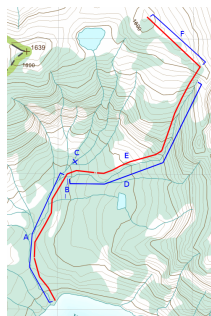


# Handrails, Landmarks, & Backstops

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.

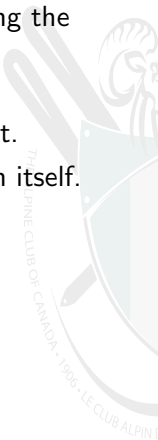
Note that reversing this should be relatively straightforward.





# Orientation

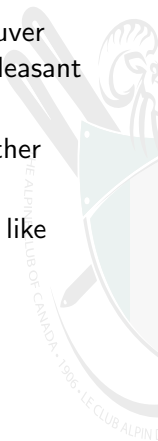
- Whether it's from a compass, some electronics, analyzing the moss on trees, or just familiarity with an area; orienting yourself is important.
- Dis-orientation generally happens over time—don't let it.
- “Sense of direction” is largely a trick your mind plays on itself. Sometimes it works.
- Practice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





# Orientation without tools

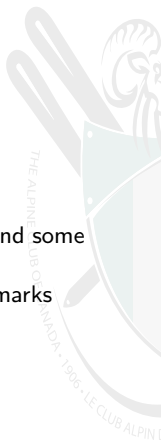
- Use prior knowledge.
- Use the sun: it's due south about 1–1:30 PM in Vancouver (12:30–1 PM in Golden). Note that it might be more pleasant to use the direction of a shadow than the sun itself.
- In the night, there's the North Star (requires good weather and good eyes).
- In the alpine you can sometimes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

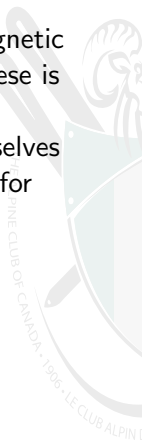






# Compasses

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

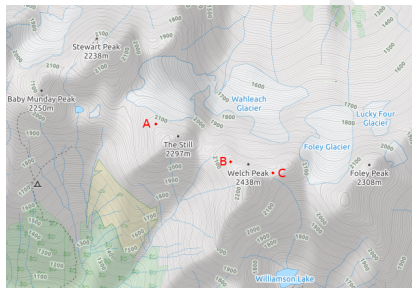
- GPS
  - Shiny (e.g. glass) buildings
  - Steep slopes
  - Tree cover
  - Cloud cover
- Compass
  - Needle sticking
  - Incorrect declination
  - North/south mix-up
  - Mismatched north/south lines
- Other
  - Visual misidentification
  - Error in guess-work
  - Barometric altimeter: changes in weather





# Sample Map Plots

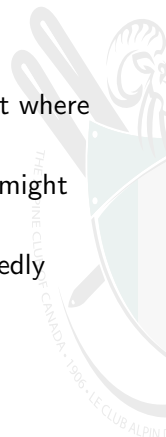
- All points: elevation about 2150 m
- Point A & B: 1 peak directly ESE
- Point A
  - 2 peaks about 1 km WNW
  - Small lake W (possibly hidden)
- Point B: 1 peak about 500 m WNW
- Point C
  - 1 peak directly W
  - Small lake about 1 km south & 500 m down
  - 1 peak about 1 km E





# How to not get lost

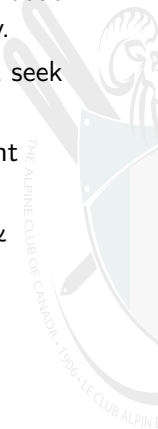
- Don't push your limits too hard without appropriate preparation: “The tall pine's more often shaken by the wind. . .” (Horace).
- While on route, regularly take a moment to think about where you are.
- Maintain good communication with your party, others might notice things that you don't.
- Pay attention 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 BC

## Information

- [forums.clubtread.com](https://forums.clubtread.com)
- [cascadeclimbers.com](https://cascadeclimbers.com)
- [mountain-forecast.com](https://mountain-forecast.com)
- Your favourite search engine
- [bivouac.com](https://bivouac.com)

## Maps

- [caltopo.com](https://caltopo.com)
- [opentopomap.org](https://opentopomap.org)
- [opencyclemap.org](https://opencyclemap.org)
- [maps.google.com](https://maps.google.com)
- [www.bing.com/maps](https://www.bing.com/maps)
- [www.trailforks.com](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

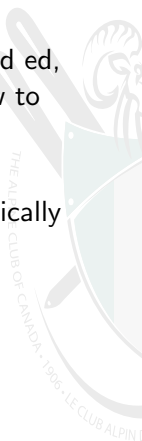




## Appendix 3: Recommended Reading

You can find these titles at many outdoor stores.

- Bob Burns, Mike Burns, *Wilderness Navigation*, 2015, 3rd ed, ISBN 9781594859458. A fairly technical book about how to use maps & compasses and other tools.
- Tristan Gooley, *The Natural Navigator*, 2012, ISBN 9781615190461. An in-depth description of how to practically navigate using the terrain around you.





## Appendix 4: 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

