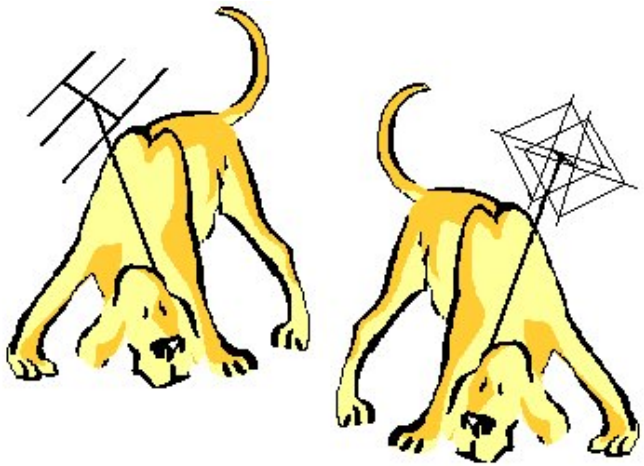
XARC Fox Hunts



Overview

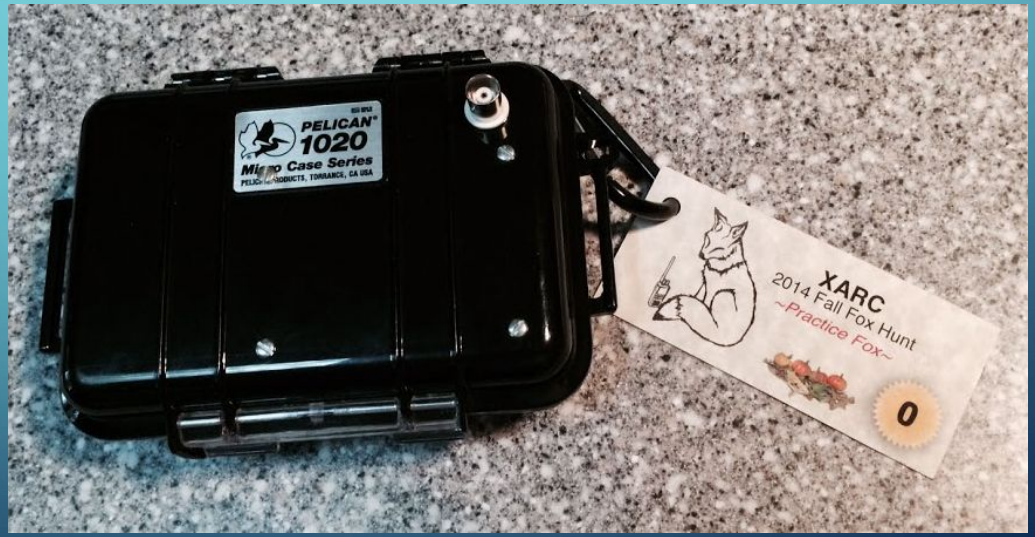
- The XARC Hunt
- Focus on Strategy
- Minimal Equipment for Starters
- Better Tools Will Help
- Advanced Tools May Help
- Fall Hunt – mid October

The XARC Hunt

- Characteristics
  - Meet at a common location (about 9:00am)
  - Hunters usually work in teams of 2 or 3.
  - Find as many hidden transmitters as possible, within allotted time (about 3 hours)
- XARC hidden transmitters – FOXmitters…
  - Transmit on two meter simplex frequencies
  - Signals are morse code tones on an FM signal
  - Typical message: RRR FOXMITTER NR 1 DE W2XRX
  - Transmission repeats once per minute
- Each hunt comprises
  - Three or four FOXmitters on different frequencies.
  - Numbered tags attached to each
  - Upon discovery, select highest number tag
  - Team with the highest sum of tag numbers is the winner

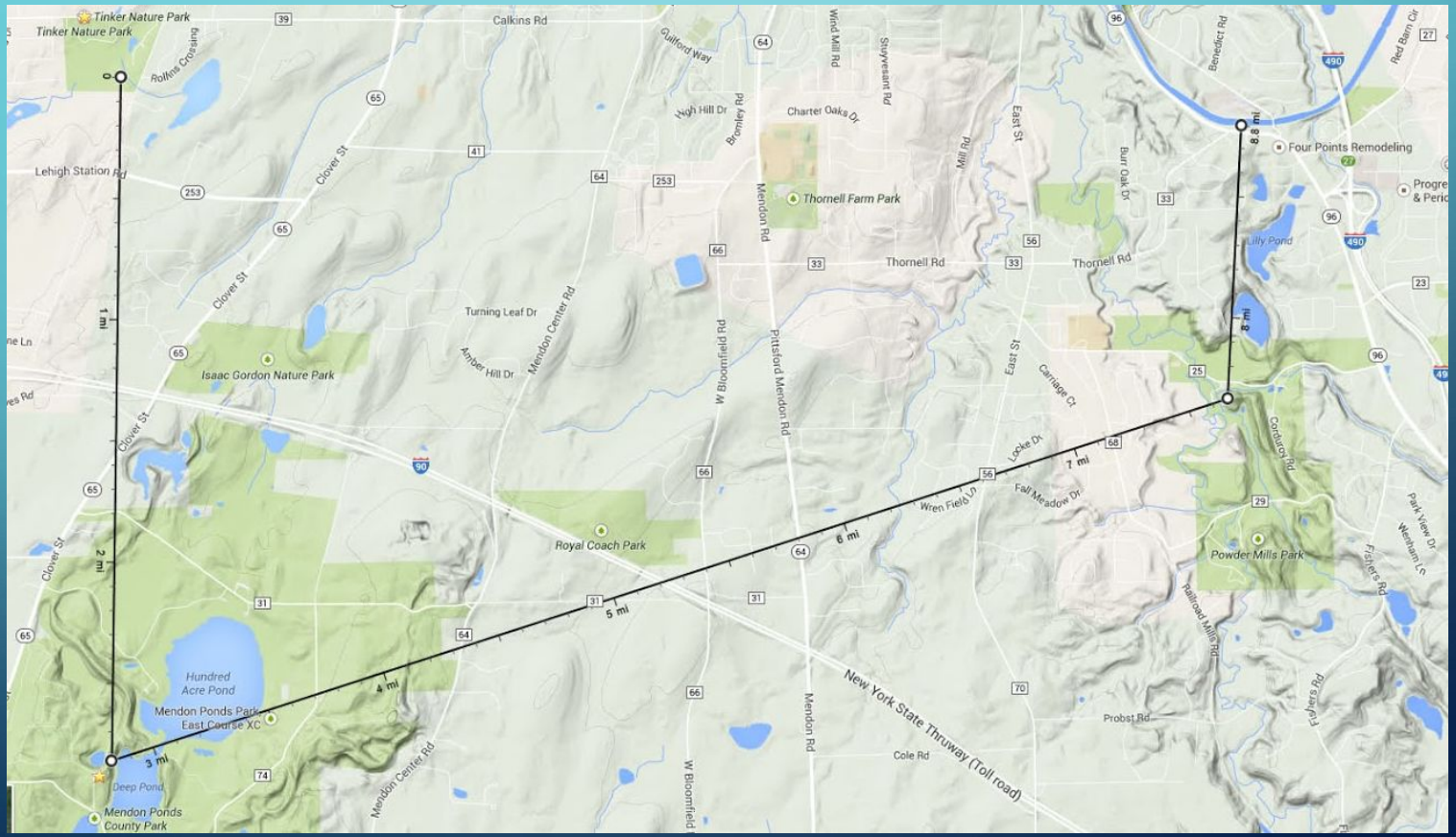
THE FOXMITTER

AN ARDUINO BASED FOX CONTROLLER



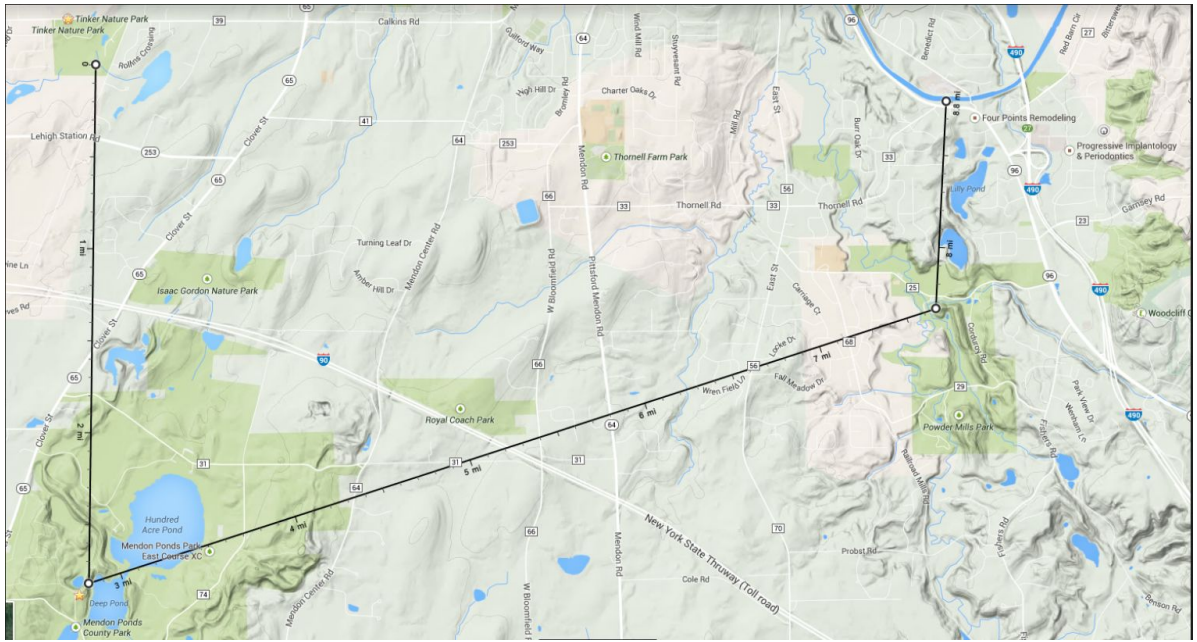
THE 2014 FALL FOX HUNT

A walk Through…



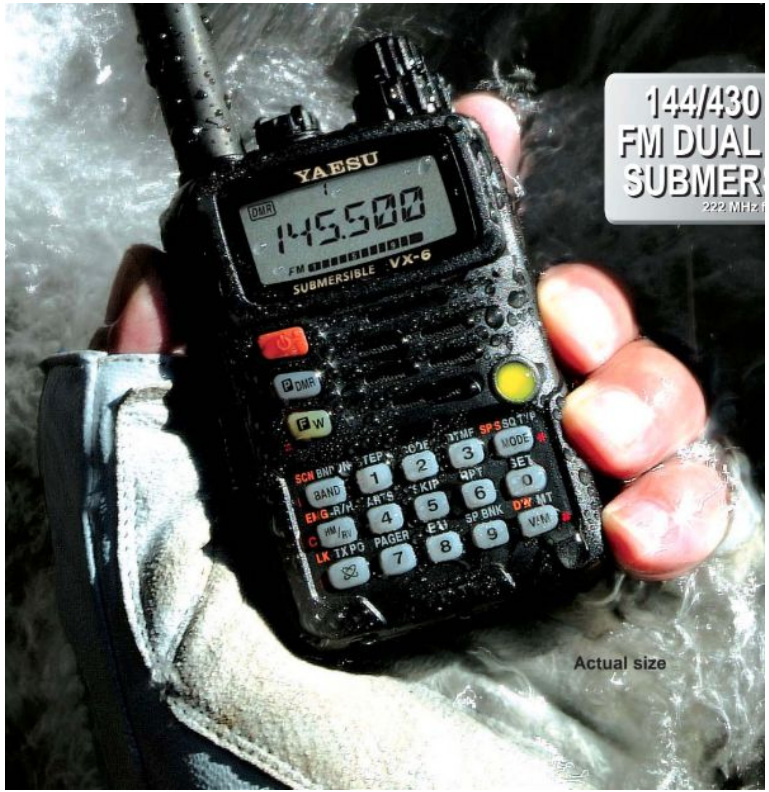
Focus on Strategy

- Be Methodical
- Use a good compass & map
- Get accurate bearings
- Triangulate
- Avoid just trying to follow the strongest signal.



Getting Started – a Two Meter Hand-held Receiver

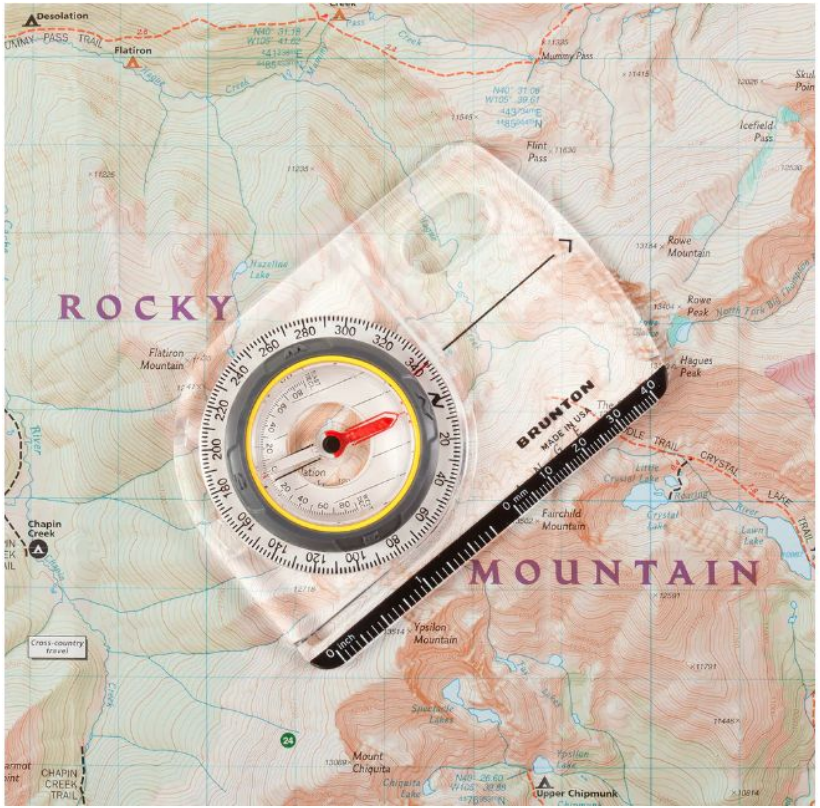
- Sensitivity
- Aluminum casting case
- Good dynamic range
- Set to Narrow Band FM
- Pre-store FOXmitter frequencies
- Use body fading to determine bearings
- Reverse compass to determine bearing before turning around.



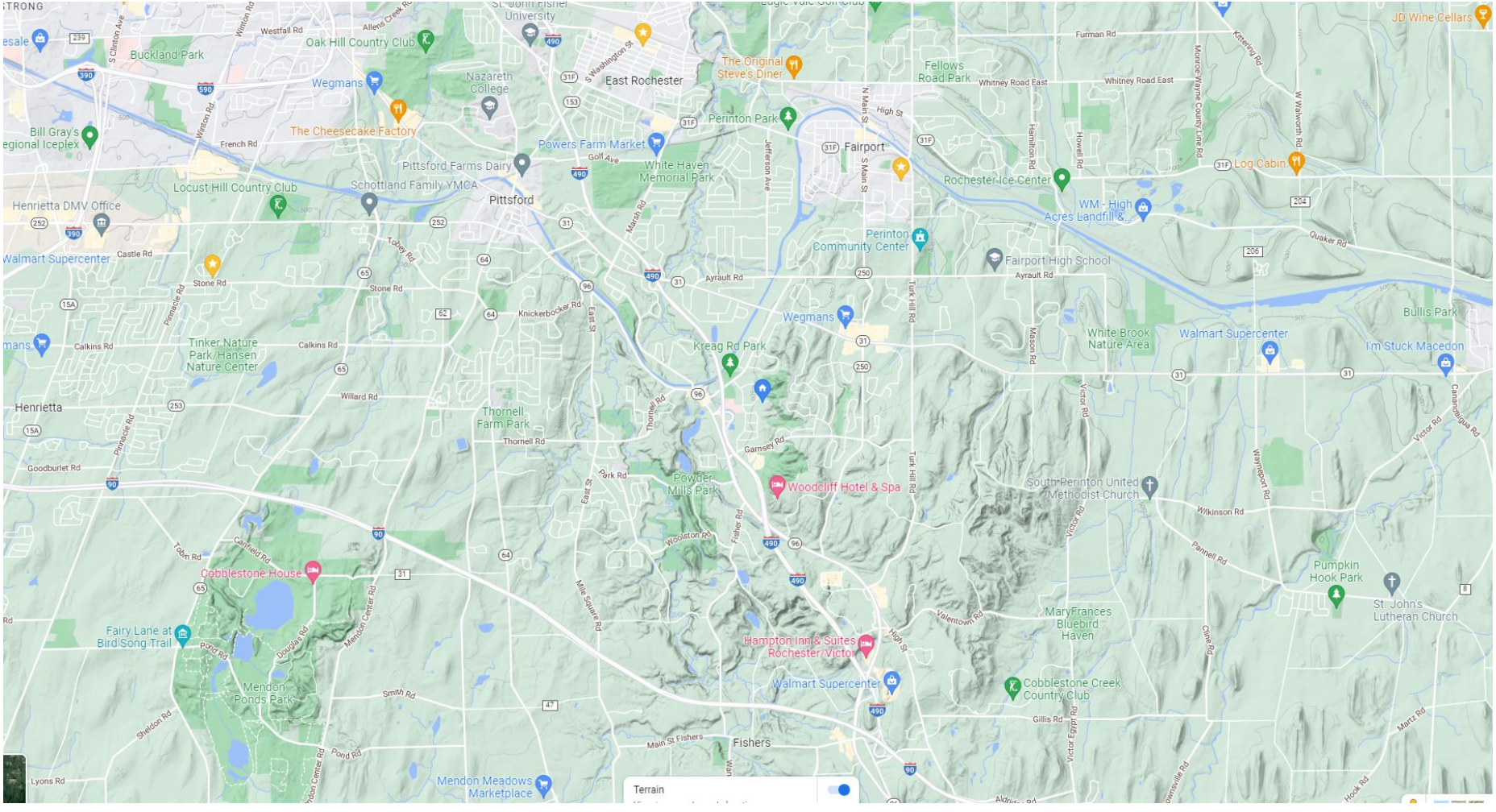
Getting Started – Good Compass and Map

- The Compass – What's important
  - Large enough to read easily
  - Responsive / good damping
  - Large base plate – good triangulation
  - Can preset declination

- Map & flat surface
  - Show parks, hiking trails, etc.
  - Terrain & roads
  - Straight edge and pencil – draw bearings
  - Could use Google Maps – terrain view



Google maps – Terrain View



Getting Started – Lensatic Compass (just so you know)

- Official US Military Tritium Lensatic Compass
- Generally considered to be more accurate…
- Angles calibrated in radians and degrees.
- Outer radian scale – each small division = 20 milliradian (mrad)

Getting Started – Do Not Ignore Magnetic Declination

- Magnetic Declination is the difference:
  - True north on a map
  - Magnetic north on a compass
- West Declination: true < magnetic
- East Declination: true > magnetic
- At 1 Km, a **10 degrees ⇒ 174 meters** [1]

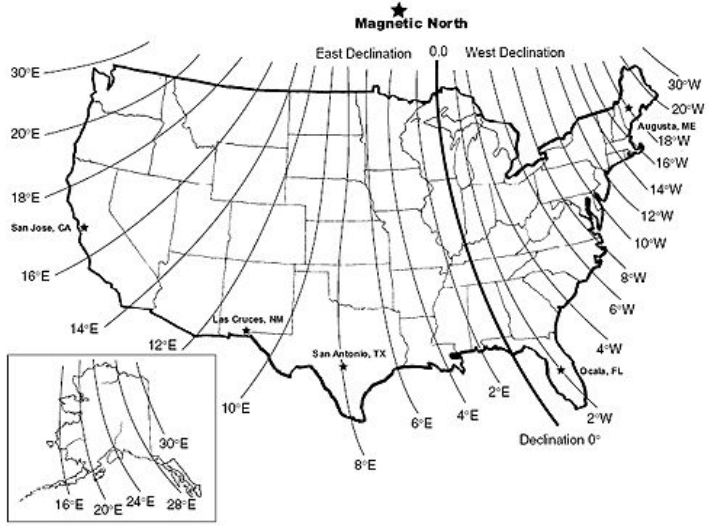


Figure 6.2—Map shows declination of the compass in North America.

[1] Error (meters) = R*sin(a) ~= R*a = (1000 m)*(174 mrad) = 174 meters

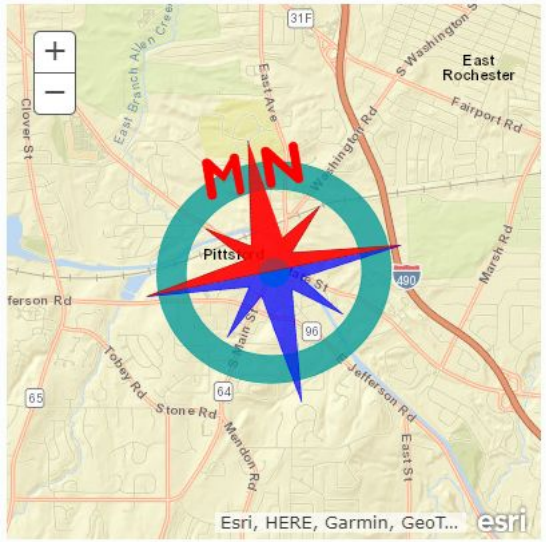
Getting Started – Do Not Ignore Declination!

[NOAA Declination Calculator]

Calculate Declination

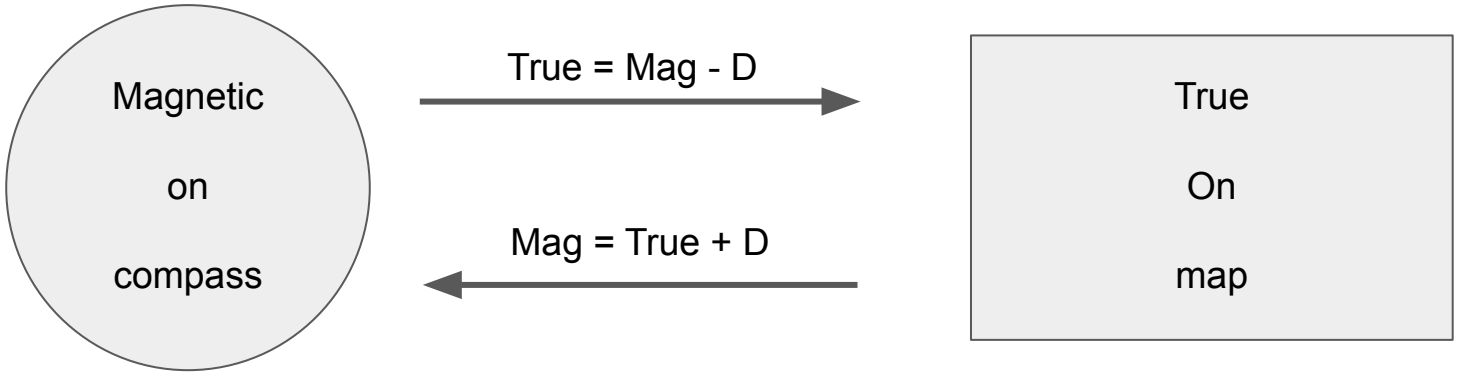
Latitude:	43° 5' 24"	S N
Longitude:	77° 30' 56"	W E
Model:	WMM (2019-2024) IGRF (1590-2024) EMM (2000-2019)	
Date:	Year 2022 Month 9 Day 12	
Result format:	HTML XML CSV JSON PDF	

Model Used:	WMM-2020
Latitude:	43° 5' 24" N
Longitude:	77° 30' 56" W
Date	**Declination**
2022-09-12	11° 17' W ± 0° 23' changing by 0° 2' E per year



11.3 deg W

Getting Started – Adjusting for Declination



- If D= 11.3 degrees or 197 mrad – about 10 divisions on radian scale (20 mrad/div):
- Example for Mag = 360 (N):
  - compass to map: True = 360 (Mag) - 11.3 = 248.7 (True)
  - map to compass: Mag = 248.7 (True) + 11.3 = 360 (Mag)

Getting a Good Magnetic Bearing…

- Body fading with a compass with the DOT arrow toward user
- A directional antenna w/attached compass
  - Yagi
  - Moxon
- Cell phone compass (digital compass)

Better Tools – Tape-measure Yagi

- Three element beam
- Easy to build (QST-2022-10)
- Good gain & F/B ratio

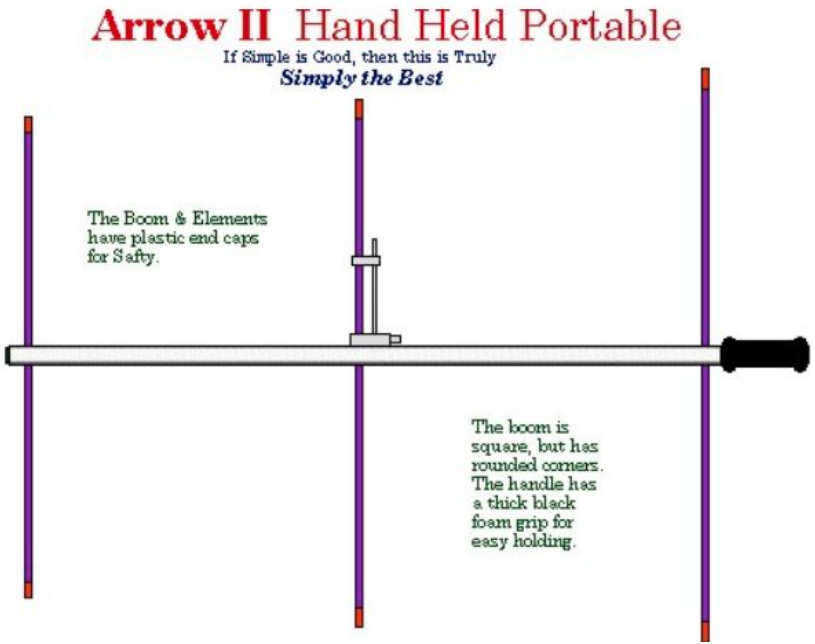
Performance Predicted by YAGI-CAD	
GAIN	7.3 dBd
Front-to-Back Ratio	>50 db
3 db Beamwidth	E = 67.5 degrees
3 db Beamwidth	H = 110 degrees

Better Tools – Arrow Yagi

- Rigid design – not wind sensitive
- Good performance:

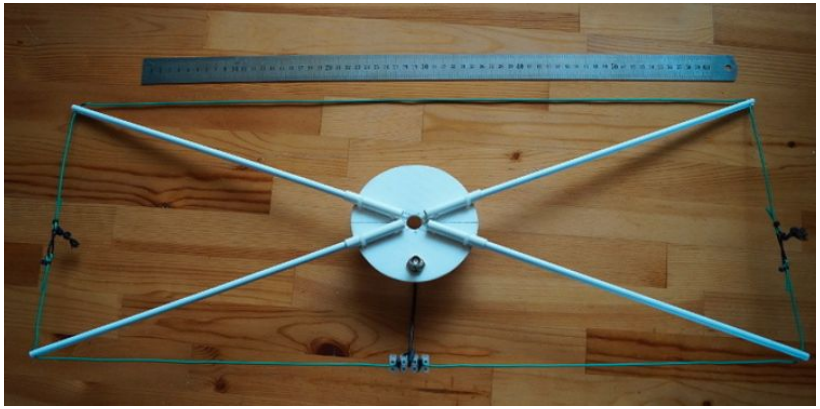
SPECIFICATIONS

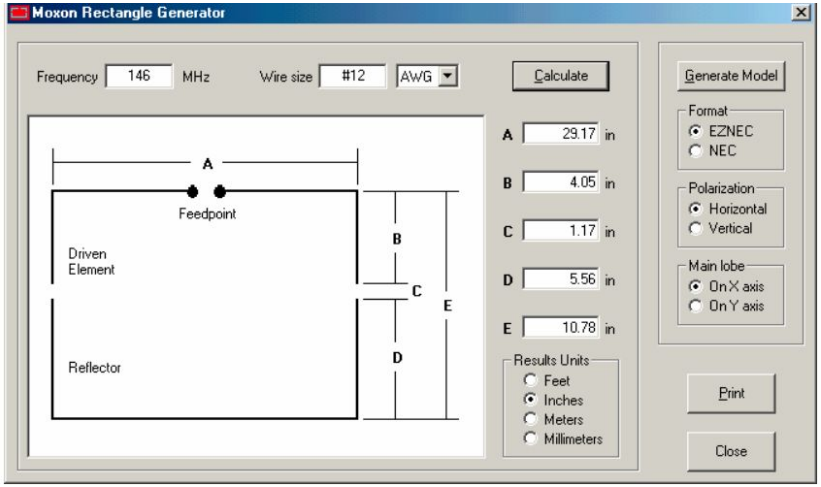
No. Elements 3
Element spacing is .2 wavelength.
SWR 1.2:1
Maximum Power (because the antenna is hand held power should be kept to <20 Watts)
Boom 3/4" Sq. (T6061 Aluminum)
Elements, Easton Aluminum Arrow Shafts
Gamma Match, Is attached to half of the driven element (comes pre-tuned).
Connector, BNC Only



Better Tools –Moxon Antenna

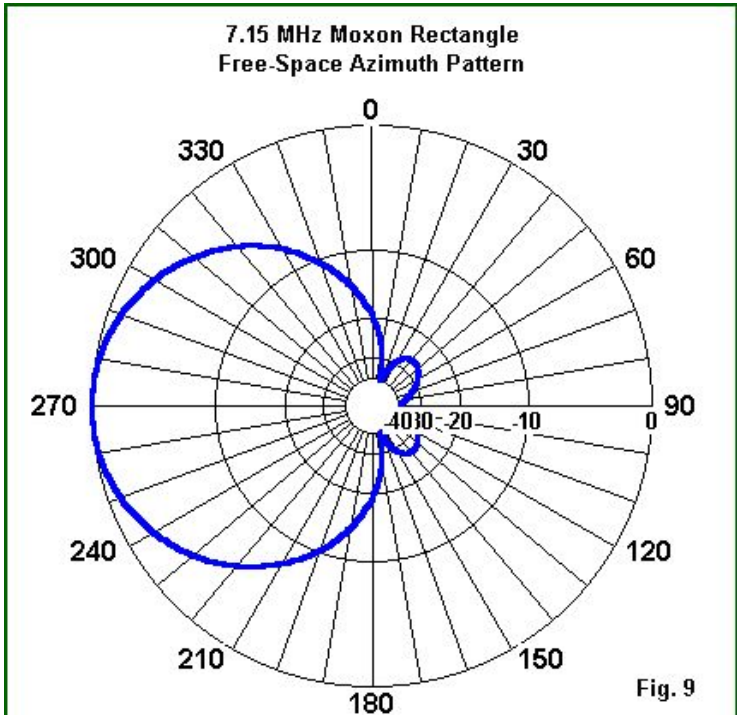
- Easy to build and inexpensive…
- Compact (30x11 in)
- Good candidate for Through-sunroof-use while driving…
- MoxGen Moxon design tool (W4RNL)
- Sharp null – high F/B ratio
- Intrinsic attenuation – but takes practice…





Better Tools – Moxon Azimuth Pattern

- 6 db forward gain - locate signal
- -40 db sharp null
  - To determine bearing
  - To attenuate signal



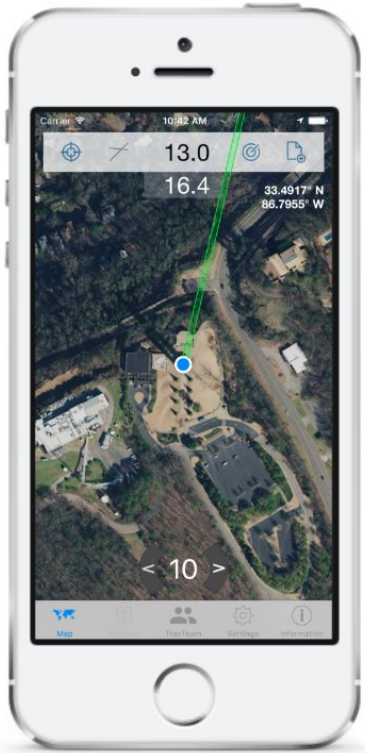
Better Tools – Attenuation is a MUST

- Strive to minimize stray RF input – especially near transmitter…
- Try to shield
  - Handheld receiver and
  - Coax between antenna and receiver
  - Keep cables short
- Experiment with attenuators
  - Loosen handheld antenna
  - Replace with a dummy load
  - Passive attenuators
  - Active attenuators
  - Use Moxon
- Auto-attenuation integrated with receiver is probably best – but expensive…

Advanced Tools May Help

- Bearings while moving
  - Rotating antenna– physically rotate antenna
    - Yagi – not really practical
    - Moxon – might work well through sunroof
  - Doppler Receiver System –
    - no moving parts,
    - but is costly and difficult to use
- VK3YNG Sniffer –
  - receiver with automatic attenuation
  - Works well, but
  - Has idiosyncrasies, and
  - Is costly
- Practice, Practice and more Practice…

Better Tools – SigTrax



- Available for Android and IOS
- Facilitates triangulation
- Utilizes
  - Google maps
  - Internal GPS and
  - Compass (must verify with magnetic compass)
- Maps bearings and tracks intersections
- Very promising app – it should really help, but requires lots of practice before the hunt…

Better Tools – more on SigTrax

- Be sure calibrate internal compass (figure 8s – face up)
- Verify magnetic north with a real compass.
  - Then, if satisfied, set Heading Source to Device Compass,
  - Else, set Heading Source to Shuttle (for manual entry)
- Be sure GPS uncertainty circle is small before each bearing.
- After two or more bearings, intersection is displayed on map.
- As hunter approaches the FOXmitter, intersections become more accurate.
- Be aware of reflections. Take multiple readings from different positions to sort out bad bearings.
- Work with a team member to validate each bearing with magnetic compass.

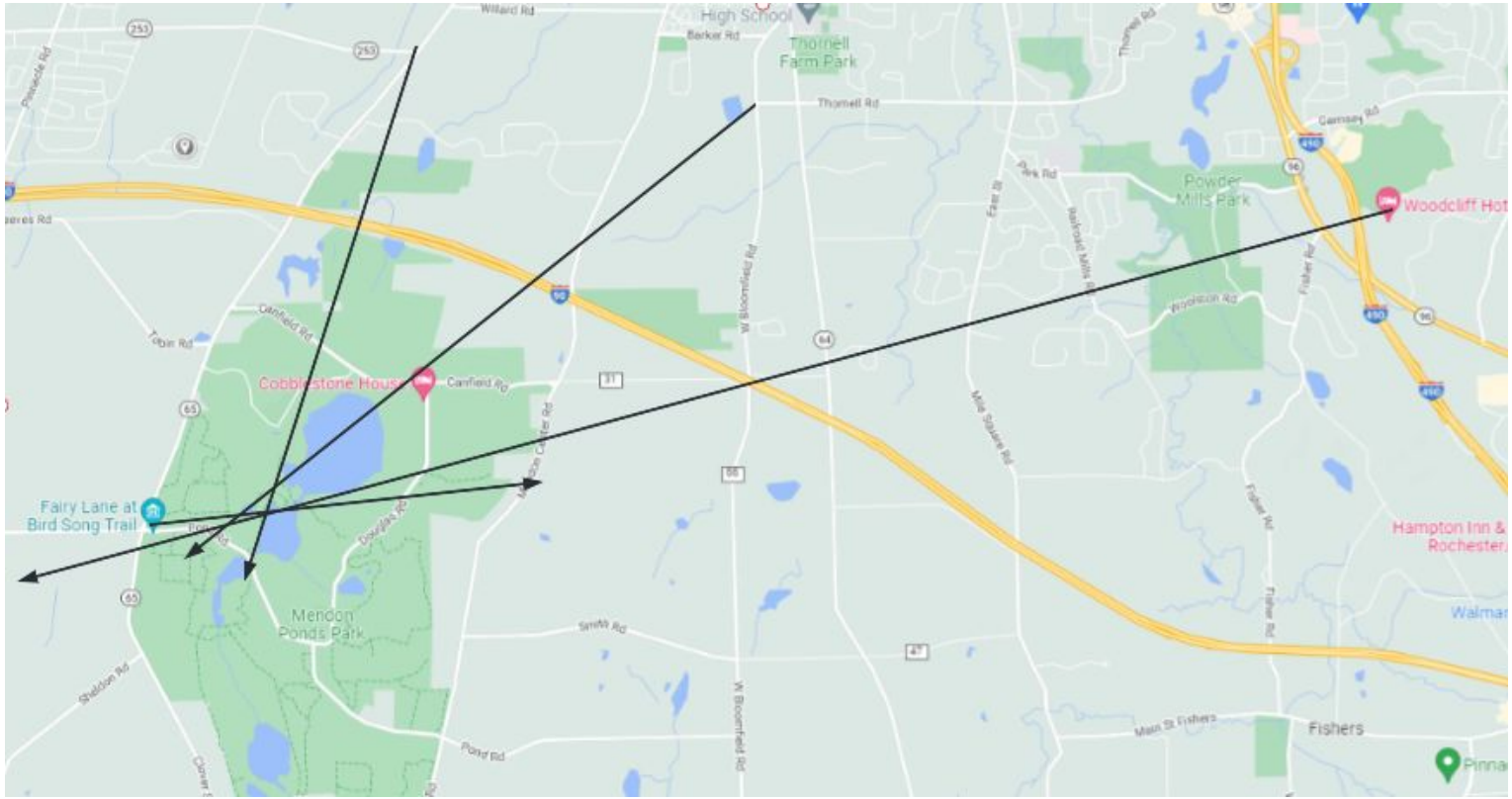
Summary – best and most cost effective approach…

- Good handheld VHF receiver (start with what you already have)
- Tape-measure yagi
- Good compass
- Paper map of hunt area
  - five mile radius around start point
  - print out from Google Maps or
- Or, if well practiced, SigTrax can replace manual triangulation on paper.
- Some form of attenuation for close-in work
  - can use body fading
  - combine with reverse compass to determine bearing

Summary – the Process

- Get the best magnetic bearing possible
- Convert to true bearing
- Plot on map with origin being current location
- Triangulate with multiple bearings
- Repeat at closer ranges

Triangulation Example…



Finally, Remember…

- Be Strategic…
- Be Methodical…
- Triangulate, at first from a distance – then repeat…
- Determine multiple intersecting bearings from a distance…
- Most importantly – Have Fun!!!

Thank You!

Have a fun time at the Hunt!!!