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ARRL
The national association for
Amateur Radio®
CENTENNIAL

ARRL National Convention 2014

DXpedition in a Backpack

B. Scott Andersen, NE1RD

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A little about me

First licensed in 2002
Very small station for first few years
Lots of QRP work
Got the DXpedition itch early:
St. John
Montserrat
St. Kitts
St. Thomas
Boston Harbor Islands

Questions?

DXpedition

DX = Distance

Expedition = a journey or voyage undertaken by a group of people with a particular purpose, especially that of exploration, scientific research, or war


The 100 Pound DXpedition
Go Light · Work the World
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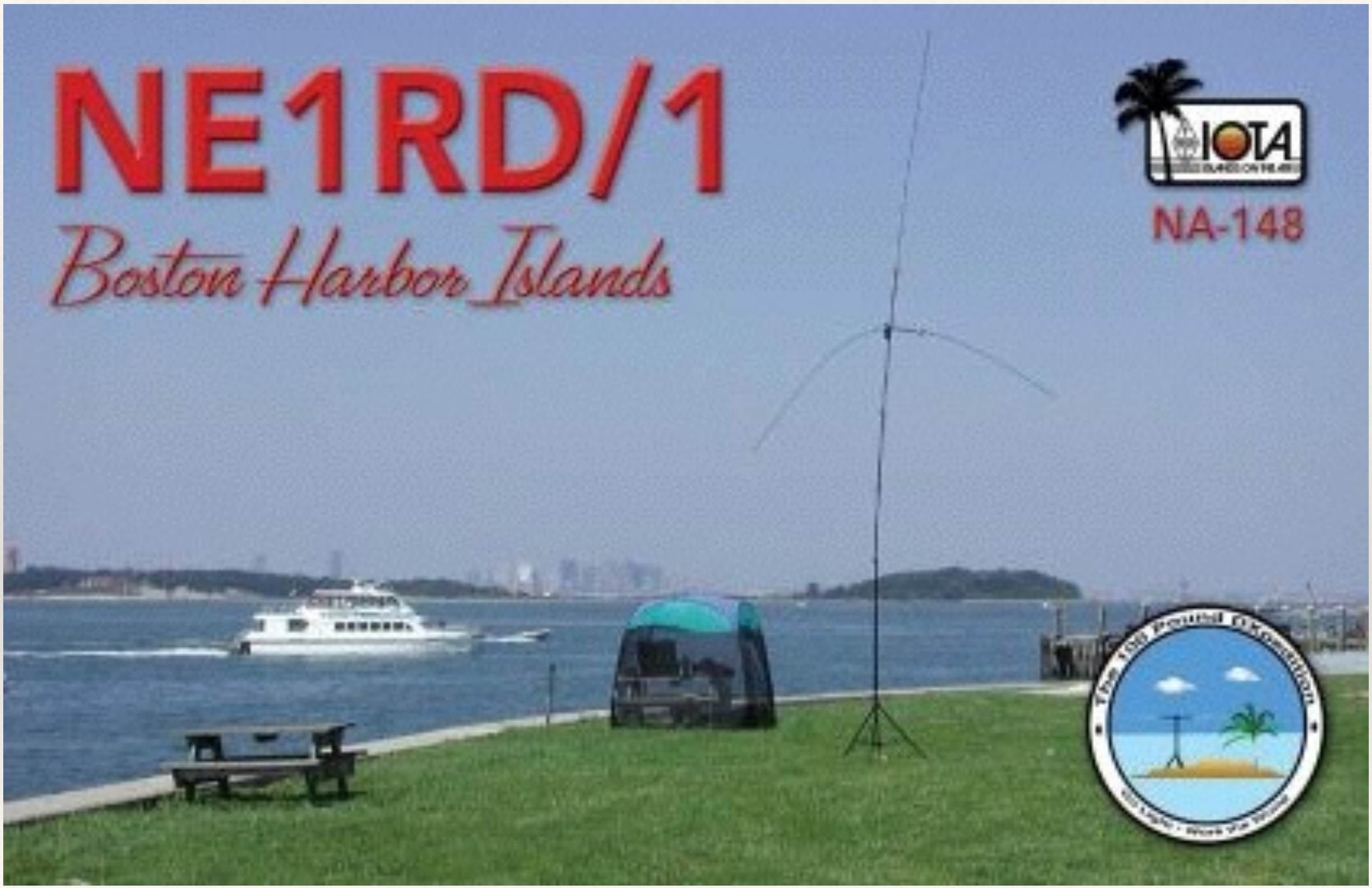

NE1RD/1
Boston Harbor Islands
IOTA
NA-148

From the 100 Pound DXpedition
to
a DXpedition in a Backpack

Power and Weight

Power

Radios	Receive current	Max power out
ICOM IC-7000	1300 mA	100 watts
ICOM IC-703	450 mA	10 watts
Yaesu FT-857	550mA - 1000mA	100 watts
Yaesu FT-817	450 mA	5 watts
Elecraft KX3	150 mA	12 watts
Elecraft K2	150 mA	12 watts
Elecraft KX1	~35 mA	3 watts

All numbers are approximate and representative of power requirements

Radios	Transmit current	Power output
ICOM IC-7000	8-10A	25 watts
ICOM IC-703	3 A	10 watts
Yaesu FT-857	5 A	10 watts
Yaesu FT-817	2 A	5 watts
Elecraft KX3	2 A	10 watts
Elecraft K2	2 A	10 watts
Elecraft KX1	0.7 A	3 watts

All numbers are approximate and representative of power requirements

Power budget

Average power = receive current X %time listening + transmit current X %time sending

Elecraft KX3 power budget

Average current draw = 0.150A X 75% + 2A X 25%

Average current draw = 0.1125A + 0.50A

Average current draw = 0.6125A

The assumptions are 3:1 listening vs transmitting

Remember: this is a BUDGET

Battery, power generation, or both

Generators

- Heavy
- Bulky
- Loud
- Sometimes forbidden
- Requires fuel

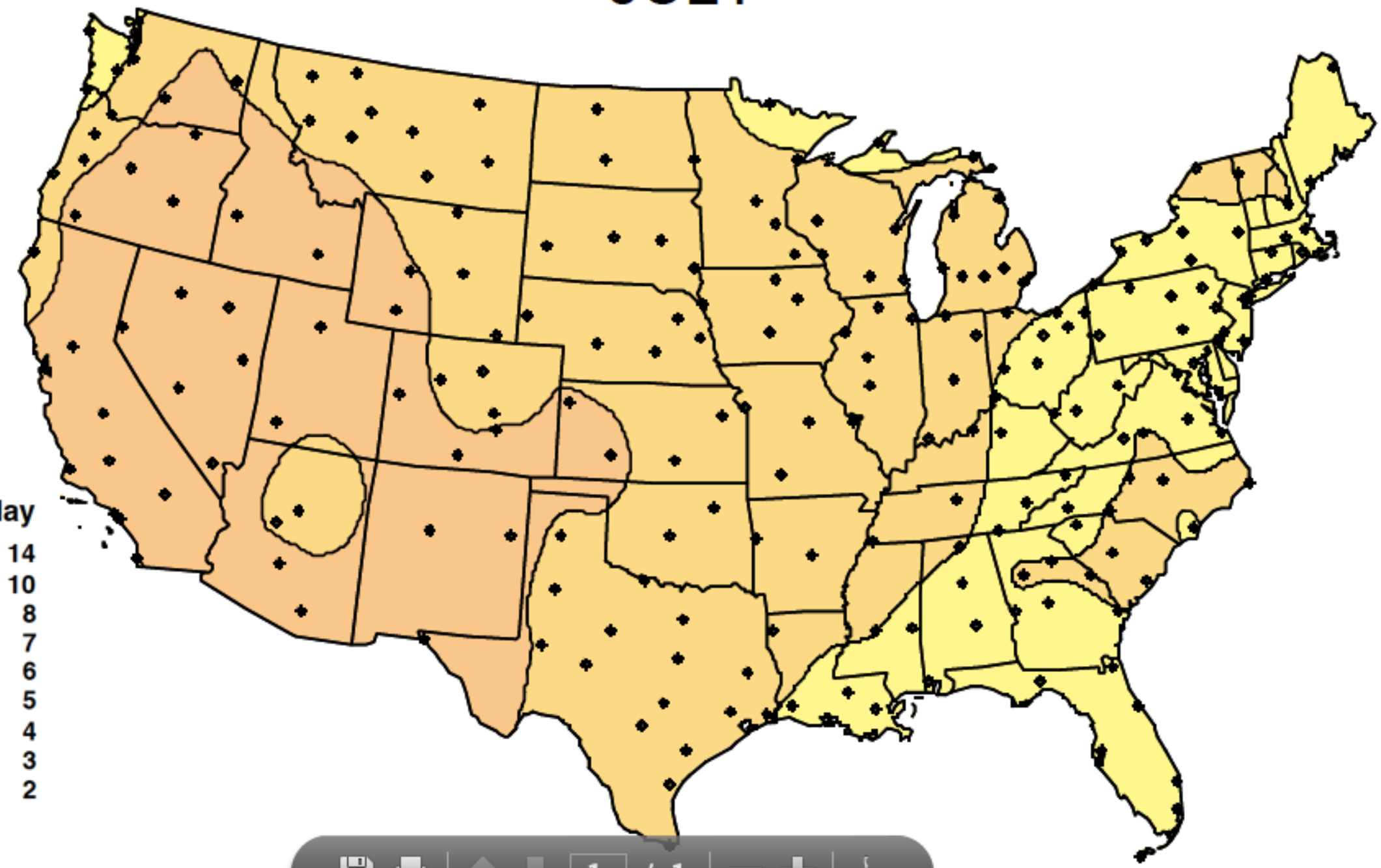
Sunforce 22010 12-Watt Folding Solar Panel

Solar Panels

Power ranges from just a few watts to 65 watts or more in foldable, manageable sizes

Average Daily Solar Radiation Per Month

JULY



Horizontal Flat Plate

Technology	What?	Efficiency	Notes
CIGS	Copper indium gallium (di)selenide	13%	Flexible, very robust, military choice
Monocrystalline silicon	Crystalized silicon based	18%	Good efficiency, brittle
CdTe	Cadmium telluride	16%	Needs rare element
DSSC	Dye-sensitized solar cell	11%	

Efficiencies are estimates. They are improving all the time.

Best Research-Cell Efficiencies

NREL

Multijunction Cells (2-terminal, monolithic)
LM = lattice matched
MM = metamorphic
IMM = inverted, metamorphic
- Three-junction (concentrator)
- Three-junction (non-concentrator)
- Two-junction (concentrator)
- Two-junction (non-concentrator)
- Four-junction or more (concentrator)
- Four-junction or more (non-concentrator)

Single-Junction GaAs
- Single crystal
- Concentrator
- Thin-film crystal

Crystalline Si Cells
- Single crystal (concentrator)
- Single crystal (non-concentrator)
- Multicrystalline
- Thick Si film
- Silicon heterostructures (HIT)
- Thin-film crystal

Thin-Film Technologies
- CIGS (concentrator)
- CIGS
- CdTe
- Amorphous Si:H (stabilized)
- Nano-, micro-, poly-Si

Emerging PV
- Dye-sensitized cells
- Perovskite cells
- Organic cells (various types)
- Organic tandem cells
- Inorganic cells (CZTSSe)
- Quantum dot cells

Efficiency (%)

50, 48, 44, 40, 36, 32, 28, 24, 20, 16, 12, 8, 4, 0

1975, 1980, 1985, 1990, 1995, 2000, 2005, 2010, 2015

Sharp (IMM, 302x)
Soitec (4-J, 297x)
44.7%
44.4%
Boeing-Spectrolab (5-J)
38.8%
Sharp (IMM)
37.9%
NREL (467x)
34.1%
FhG-ISE (117x)
31.1%
NREL
29.1%
28.8%
Panasonic
27.6%
SunPower (large-area)
26.4%
25.6%
25.0%
NREL (14.7x)
23.3%
ZSW
21.2%
Solexel
First Solar
20.8%
20.4%
20.4%
KRICT
17.9%
LG Electronics
13.4%
Sharp
UCLA-Sumitomo Chem.
MIT
8.6%

CIGS technology

P3-62 Watt Desert Camo Flexible Solar Panel

This is available on Amazon for less than $1000. It provides a maximum of 62 watts of power. It folds up small, is light, and very rugged.

mono-crystalline

GoalZero Nomad 27

Sturdy, folds to a small size, just 3.3 pounds, has USB output, daisy-chaining port, and power output

Orienting solar panels

Capturing the sun's power

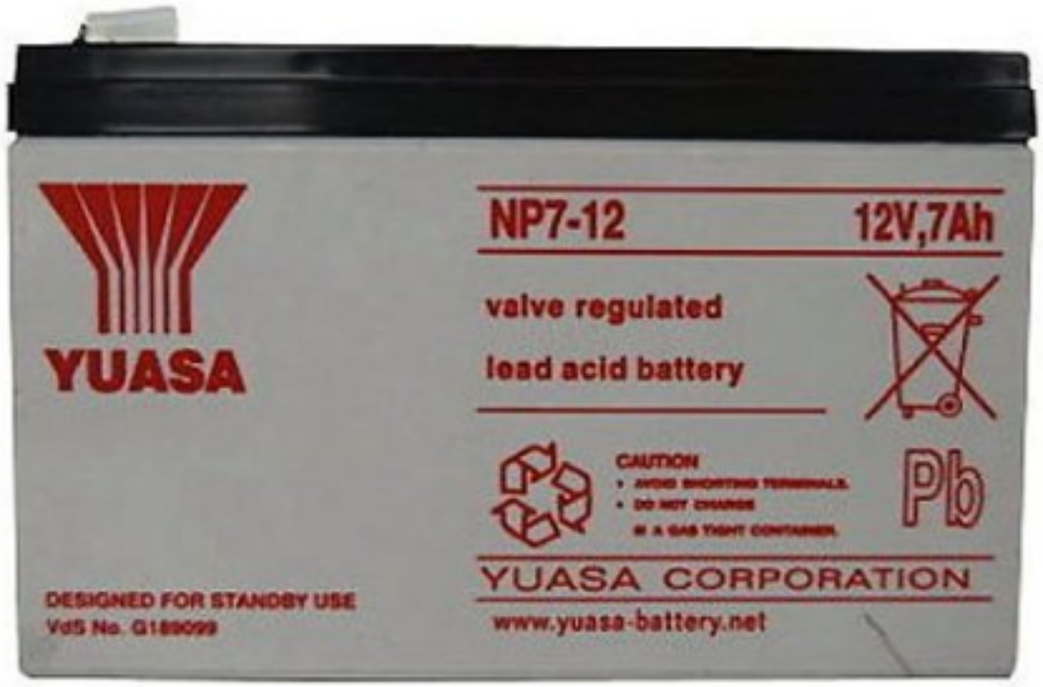
It is important to have the panels face the sun squarely as much as possible.

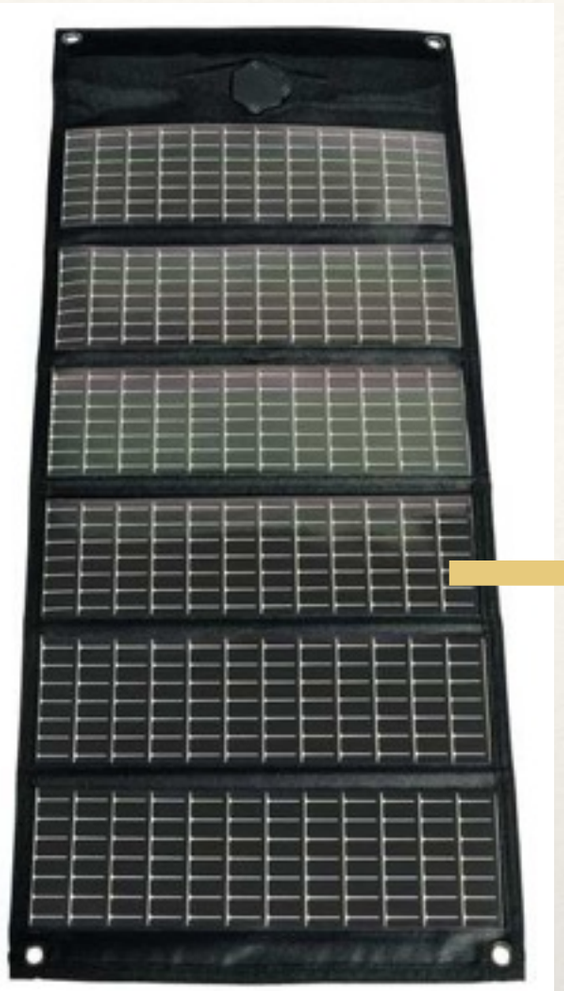
Battery technology

Sealed Lead acid batteries

SLA

There are regular sealed lead acid batteries like this one (SLA), or you can get deep cycle marine batteries that can withstand more of a discharge without damage.





12v regulated

LI-MCO lithium nickel manganese cobalt oxide

Goal Zero Sherpa 50

All in one power pack includes battery, charge controller, USB output, and 12v regulated output

Lithium Ion Nanophosphate

Goal Zero Sherpa 120

Highly rated system that had 120 watt hours of capacity, and offered AC inverters beefy enough to charge computers and other items

INPUT

POWER

DC5V 0.5A

OUTPUT

DC12V 10A

INPUT

OUTPUT

DC5V 0.5A

A123 system Lithium Ion Nanophosphate

Buddipole A123 packs

Terrific power density, but requires specialized chargers to keep the pack healthy. Comes in various configurations for different power needs. Note this is the technology used in some electric cars.

Buddipole A123 portable power solutions

Pack type	Voltage	Capacity	Weight
4S1P	13.2 volts	2.3 Ah	13 oz (370 grams)
4S2P	13.2 volts	4.6 Ah	26oz (737 grams)
4S3P	13.2 volts	6.9 Ah	39 oz (1100 grams)
4S4P	13.2 volts	9.2 Ah	50 oz (1414 grams)

Weight

Budgeting weight and bulk

- Radio
- Battery
- Solar panel (and charge controller, if needed)
- Antenna
- Feedline
- Accessories: headphones, key, antenna analyzer, etc.

Portable operation

Portable operating options

- Picnic table after arriving by car
- Bed and breakfast or hotel operating
- Camping from a vehicle
- Hiking with the gear on your back
- Field Day operation (or similar) with multiple operators
- DXpedition with airplanes and luggage

Antennas

Physics are the same for big contest stations run by experts, and your portable operation. Mother nature doesn't give you a break just because you're portable.

If you are using some antenna or antenna setup that no self-respecting permanent station operator would even consider, maybe you should rethink your strategy.

"Why do you need all those fancy antennas? Why don't you just hang a dipole?"

– Typical critic

"Because, sometimes I'm the tallest thing on the island!"

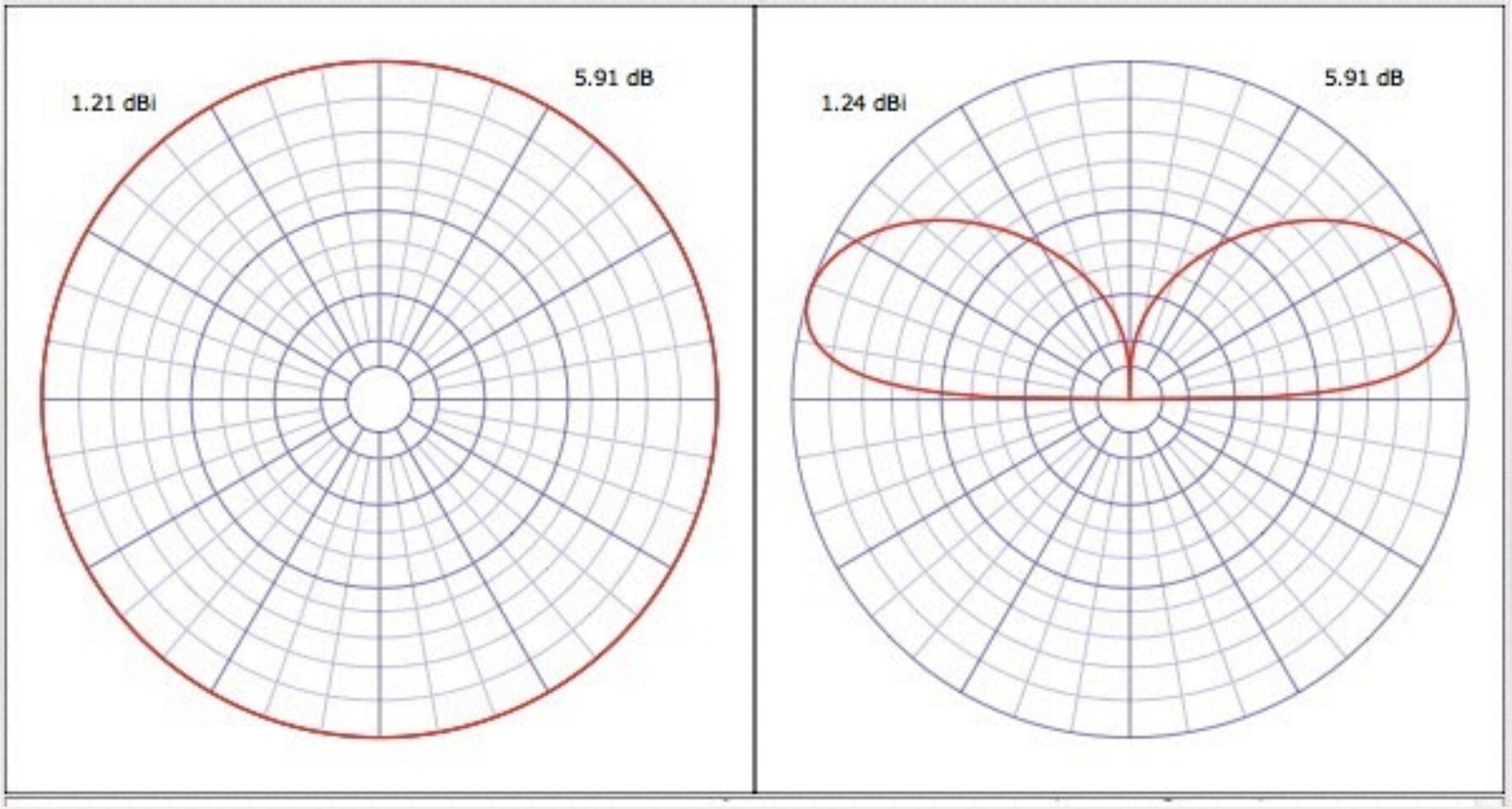
– Scott, NE1RD

Vertical antenna and solar panels

Deployment

Here are some shots of portable operations

Science: Model



LNR Precision

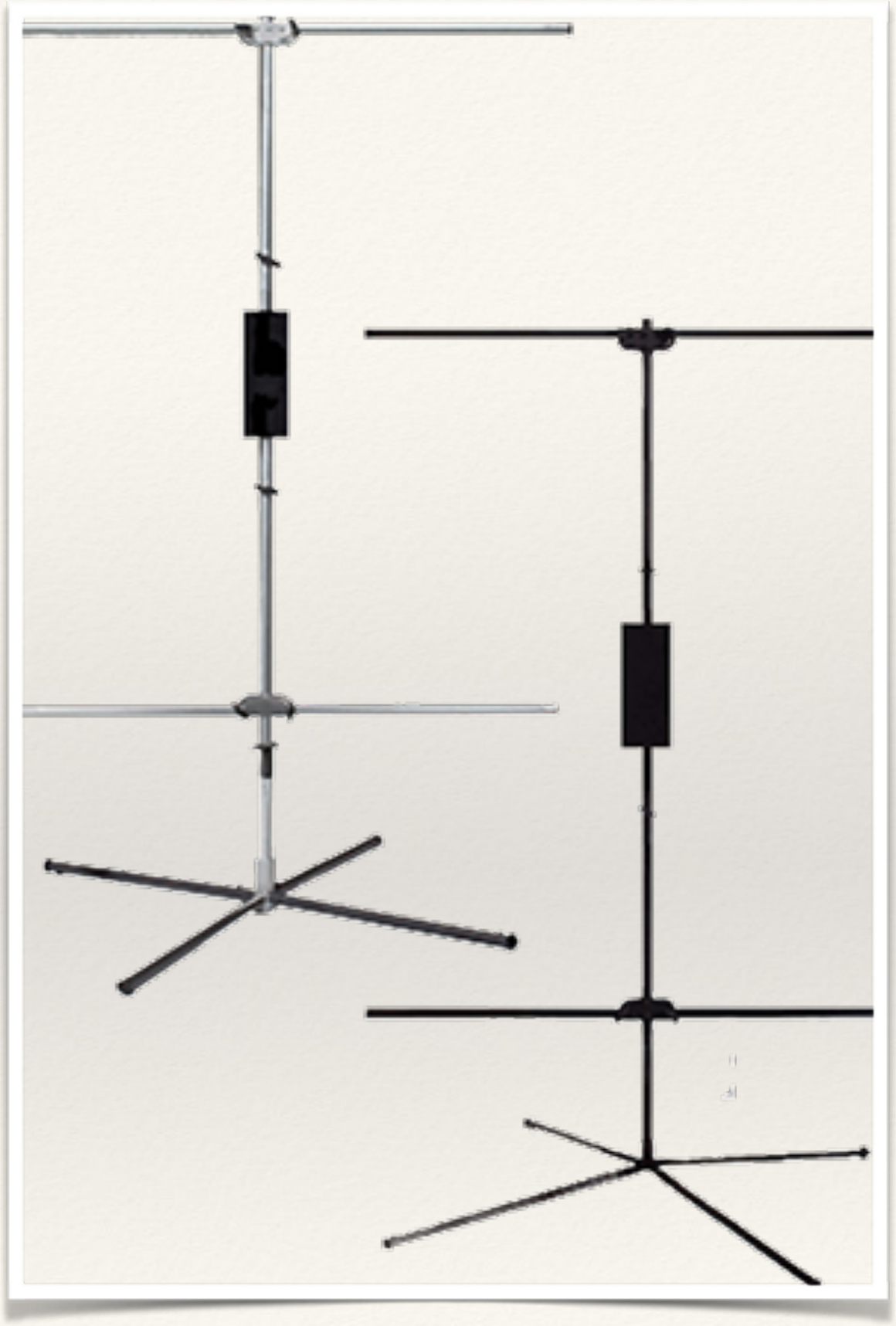
Par End Fedz

This is an end fed vertical dipole. Just one support at height needed.

TW Antennas

Halfwave Vertical Dipole

Multiband antenna with remote band switching, good efficiency, easy setup.




ELECRAFT
www.elecraft.co

RigExpert AA-54

Analyzer

"Island time" is precious. Bring tools to help you establish your station quickly, even if it means adding a little extra bulk.

Practice


ELECRAFT K2 TRANSCEIVER
18,140.13
COAXIAL


New England Aquarium

North Acton Recreation Area

Afternoon operation

Ten minutes up, three down.


14.207.01
M1 SPL A/B

Georges Island, Boston Harbor

Use available infrastructure

Trees and tables can be very handy.


SCREW TERMINALS
SCREW TERMINALS
LBC-03


ELECRAFT
HANDS-ON HAM RADIO

All the other stuff, presented randomly

Licensing

Getting a foreign license

- Try to find somebody who has gone there before. What did they do? This is absolutely your best option.
- There are several books and websites that have the latest details on how to get licensed.
- If you are thinking of going someplace, apply for the license. It may take months. Don’t wait.
- If you don’t get the license, or didn’t get a version of the license you wanted, GO SOMEPLACE ELSE.


RSGB
IOTA
ISLANDS ON THE AIR
50th Anniversary


SOTA

QSLing

- Your contact brought joy to you, the other op, or maybe both. It is a happy thing. Keep it happy by being a good QSLer.
- Upload to LoTW, eQSL, ClubLog, QRZ. Some subset of your contacts will want one or more of these. Once you have an ADIF file, it really only takes a few minutes to do EVERYTHING.
- Consider using online QSL request system on ClubLog.

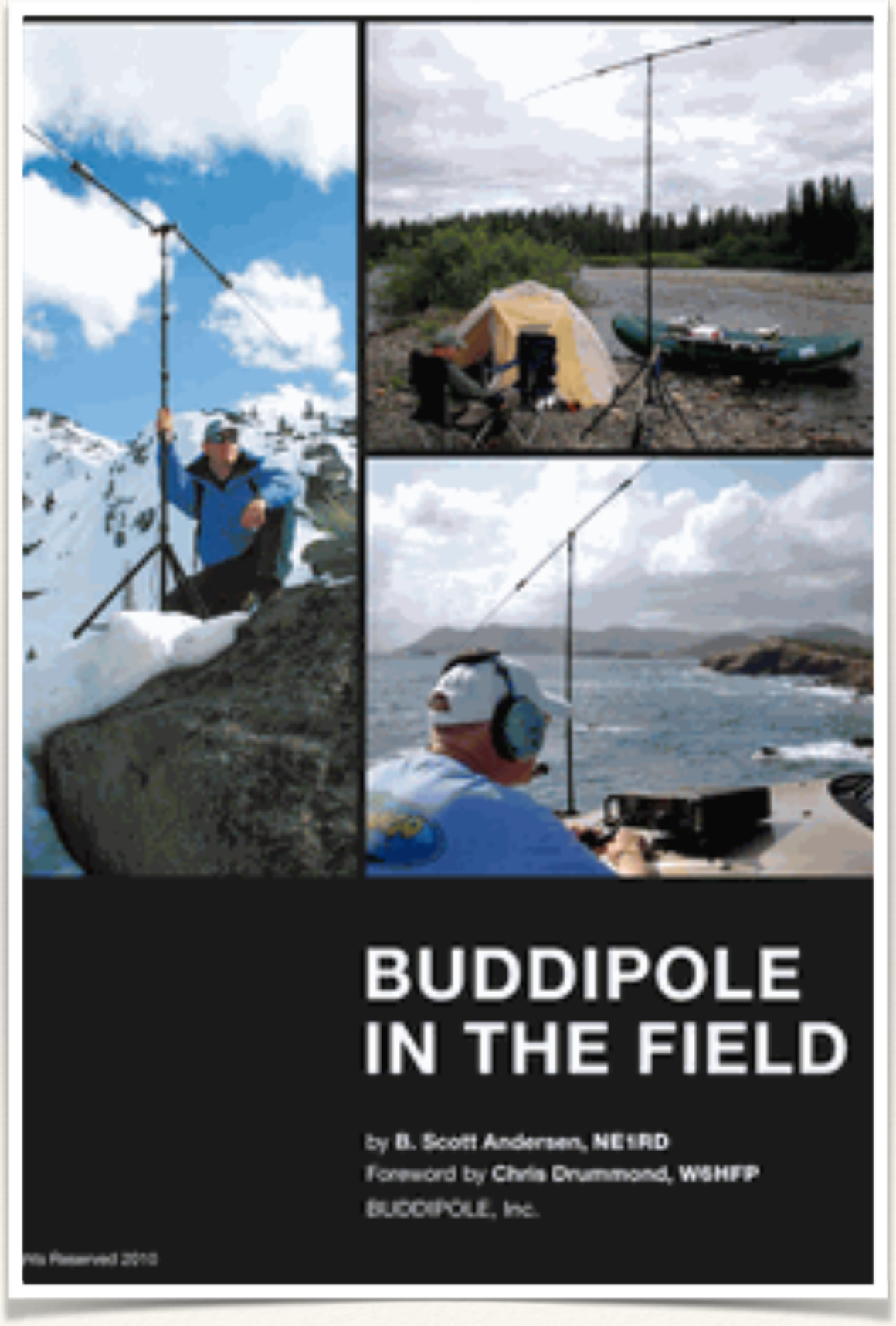
Use computer logging

Buddipole, Inc.

Buddipole in the Field

I use Buddipole systems in many of my trips. I like the flexibility of the product.

This is a book that I wrote about the Buddipole antenna system.



www.bsandersen.com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Q & A