DX'ing During Periods of Low Sunspot Activity
(From a Vintage Gear, Little Pistol's Point of View)

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Before going any further, if you think this write-up contains a magic spell or incantation to enable QRP-DXCC in a weekend, you might want to skip to the next article. However, if you are interested in the observations and opinions of newbie DX'er, trying desperately to get to 200 confirmed with limited equipment and antennas, please continue on. Then the obligatory disclosure statement: Your Mileage May Vary (YMMV), void where prohibited, taxed, licensed, yada, yada, yada.

About 5 years ago, and after approaching 50 years in ham radio, almost 100% NTS CW traffic handling, my work schedule changed and began to put a real "crimp" into my hobby, especially availability at scheduled net times. These changes also seemed to indicate that maybe it would also be a good time for a change. Thus came to fruition the idea to add a new way to create some excitement and a new chapter, into my ham radio journal. That idea was a hybrid effort combining two elements; a passion for the restoration and usage of 1960's vintage Novice/General-class gear, (in this case, a fully restored Heathkit DX-60 transmitter and Drake 2-B receiver combination), and then using that older equipment to attempt to make DXCC CW!

Thoughts on DX'ing with Vintage Gear

Before going on, it's probably good to note some of the "special considerations" discovered so far, when chasing DX with vintage gear. First and foremost, your rig should be stable and have nearly zero drift. With tubes, that obviously means that the gear needs to have been on long enough to have fully warmed up and thus settled down before beginning each session. Another is to make sure the rig is properly tuned up and the antenna is properly loaded for the section of the band that is to be searched. Vintage rigs are not, with only a few exceptions, (e.g. Central Electronics 100V, 200V) broadband with "no tune-up required." Oh yes, and generally you can forget the computer/internet and DX spotting sites. With vintage gear, low power and simple antennas, unless you are a very seasoned and skilled DX'er, and have a bit of luck, chances of getting through the pile-ups, which those "spots" usually create on the rarer DX, are kinda slim. The best method for vintage gear operators is to stay away from the "spots" and "do it the old fashioned way": listen, listen and then listen some more! The good news about the big pile-ups for the vintage gang is that it means that most of the stronger stations will be chasing the "big fish," giving you the chance to work the "smaller fish." Also, try getting on the air at "off" times, when the folks with the latest super transceiver, legal limit amps, big antenna arrays, etc. etc. are still sleeping!

Additionally, here are some thoughts on fighting the pile-ups – if you must. Since vintage gear won't enable listening to the DX station in one ear and the

pileup in the other, and the transmitter, also being on the 2nd pile-up frequency, here is an example of a way to mitigate that limitation. First, spend a bit of time learning the DX operator's listening pattern. For instance, maybe the DX starts his sequence listening up 1, and then each following QSO is up a little, say around 300 Hz, until reaching up 3 then goes back and starts over. Using this example, zero-beat your VFO on the next station that is up only about 1, back at the start of the sequence. Then move your VFO up 600 Hz and wait till the QSO on the +300 Hz mark is over and then call. The reason is, with all that has to be done with a vintage transmitter and VFO, it's virtually impossible to be as fast as those with more modern gear to track your VFO moves and this method provides just enough "slack." This has worked more than a few times when luck also favored the vintage station.

Getting Started

When starting this chase, and initially knowing very little about DX'ing, the first order of business was to evaluate if this were a reasonably "doable" endeavor. Once established as a possibility, the second was to read/study all that was available from people who had actually accomplished something similar. Luckily it didn't take much searching to identify that "The" definitive guide could be found in *The Complete DX'er* by Bob Locher, W9KNI[1]. This superb tome (and a really fun "read") starts with the basics and guides you through intermediate and advanced techniques, all of which are geared to getting a lot more DX into your log and confirmed. The book contains so much valuable information that it has continued to be a reference, even after multiple readings. Bob's other book, *A Year of DX*[2], is not only a chronicle of his chase in one of the year-long CQ DX marathons[3] but is another valuable information resource in its own right. Both of these books along with countless other articles/reports, etc., provided a wealth of information, and frankly encouragement. Thus also began a regular weekly regimen to review the data in the ARRL DX Bulletins[4] and Tad Cook's *The K7RA Solar Update*[5] from the ARRL, as well as bulletins from DX-World[6] and DX News[7]. All of this lead to the conclusion that the goal of DXCC CW with simple equipment was not only achievable, but would also be a lot of fun. Fortunately, better solar conditions and the fact that the initial 100 DX contacts were of the more easily obtained variety, the DXCC CW award was completed in December of 2016. As well might be imagined, after the investment of this amount of time and effort, the DX quest had now become more than just a fun ham radio "bucket list" goal, but had become a truly engaging and addictive adventure! You never know what new signal might appear on the bands from far away and exotic places, and then upon completing the contact, realizing that it was possible, vacuum tubes and a wire! The special challenge, as the DXCC totals got higher and the DX more rare, was that solar conditions were descending into another solar minimum.

Thus it was that chapter 23 in *Propagation in a Time of Low Sunspots,* written by Jim Henderson (KF7E) in *A Year of DX*[2] became so relevant. In reviewing the list of contacts that had been gathered towards the initial DXCC CW award and re-reading this chapter (yet again), a plan to create a detailed set of observational records for each

following DX contact was developed. This was to be a central part of the (now completed) quests for DXCC 40 meters (all CW and DX-60/Drake 2-B) and then DXCC CW 150. With some luck, a bit of diligent listening and a continually developing understanding of the DX propagation mechanisms, there will eventually be a submittal at the 200 level.

The Scientific Approach

The plan is, that with a more scientific and data-based approach, and as the volume of data increased, continuing analysis would indicate what solar and geomagnetic mechanisms were "working" that would enable DX contacts, and thus provide more predictive guidelines as the DX hunt continued. Also, as a reference, the very well regarded VOACAP[9] online HF predictions for *Circuit Reliability* was to be captured with each entry. Circuit reliability is the predicted percentage of days in the month when the signal to noise ratio (SNR) value will equal, or exceed, the threshold value for the given transmit mode to enable reliable communications. For example, the threshold value for CW is 24 (dB-Hz). Other elements recorded from the VOACAP site include the short path direction and distance to the contact as well as the potential for greyline enhancement at both the local and DX station. General data captured are, date, time (UTC), call sign, frequency band, and mode, power, DX stations "real" RST (the S-meter reading). Additional solar and geomagnetic data from the space weather site[8] are also recorded.

A Reference

Before continuing, it's appropriate to give a little information about the VOACAP program that is being used as a reference. The VOACAP software uses a number of elements in its predictions, including a local noise value, smoothed sunspot number (SSN) and the antenna take-off angle (TOA). Note that all of the predictions that were reported for the data gathered is with the *method* set to *auto*, where the program acquires the smoothed SSN value from the WDC-SILSO, Royal Observatory of Belgium. These values are the predicted SSN value and are calculated many months in advance, but are re-adjusted at regular intervals. Lots more information and links are provided to explain all of this at the official VOCAP blog site[13].

The other elements used with the VOACAP program are user selectable settings for the mode, location of the transmitting and DX stations, power output and basic antenna configuration. The location used for the transmitter was set to "W Los Angeles CA" using the pull-down menu, which is close enough to this QTH (approx. 35 mi west) rather than the grid designation. The power setting was chosen based upon the rig used for the contact. After finishing DXCC 40 meters, this was no longer just the DX 60 (set at 50 as this is the closest value to the actual 40 watts output) but would also include the station's Elecraft K2 at 5 or 50 watts (with the companion amplifier). The K2, besides being a super rig, also allowed for contacts on the WARC bands that the other gear does not. The old reliable Drake C-Line twins (R-4C/T-4XC) at 120 watts was employed when the DX station was just not responding to the lower power CW call, which as can be noted, was not very often, **and** it was not a new country/entity needed for the endorsement chase. The anomaly in the data is the single LSB contact at 100 watts, which was a contact

with a South African station using a Collins KWM-2A that is in the process of being fully restored. The TX antenna chosen for all bands was a dipole at 10M (33 ft.) as this is closest to the actual 450 ohm ladder line fed inverted V antenna at 40 feet at this QTH. The RX antenna settings were left to the default values.

Solar Data Definitions

The propagation related solar and geomagnetic data recorded has all been gathered from the space weather site[8]. This includes the current solar flux, sunspot number, solar wind, proton density, and the Kp value. Although most reading this will already understand why these various data points were recorded, especially the old standby element, 10.7 cm solar flux, for those others, some definitions are probably in order.

The sun spot number (SSN) is a rather strange number as it is not exactly what the title suggests. Roughly the number is developed by taking the number of sunspot groups and multiplying by 10 and then adding in to total number of all sunspots. Thus, if there is just 1 sunspot group, which is comprised of only 1 spot, the SSN would be 11. Note that this is not exactly what the VOCAP program uses, as its SSN is based upon the Lincoln-McNish smoothing function obtained from WDC-SILSO as noted above.

Solar wind speed is another element recorded, and one that Jim (KF7E) notes in his chapter in *A Year of DX*, may have an effect on propagation when the SSN and solar flux are at or near minimums. This value, representing the speed of energized and charged particles (electrons, protons and alpha particles: 2 neutrons and 2 protons combined) from the Sun vary dynamically, in speed (high = 800 km/s, low= 300 km/s) temperature and composition. A normal solar wind speed, as it leaves the sun, is around 400 km/s. When "Earth directed" they interact with the Earth's magnetic field and can produce storms in the magnetosphere.

Average proton density for the solar wind is 8.7 protons per cubic centimeter. This too may have had a direct positive effect during solar minimums, as with the solar wind, that being that in times of higher solar activity, the very limited effect of this, and the solar wind, is completely overshadowed by the higher 10.7 cm solar flux.

The Kp value is computed every 3 hours and is a near-real-time indicator for the geomagnetic conditions of the planet. It is computed using data from 13 geomagnetic observatories around the world. The values range from zero to 9 and represent the magnetic effects of solar particle radiation and its potential for geomagnetic disturbances. The verbal descriptions of the various levels within that 0-9 range are as follows:

0 -> 2 = Quiet,
3 = Unsettled,
4 = Active,
5 = Minor Storm,
6 = Moderate Storm,
7 = Strong Storm,
8 = Severe Storm and
9 = Extreme Storm.

Hopefully this brief overview and simplification will help, but more complete information can be obtained by starting your reading with Carl Luetzelschwab's (K9LA) article *The Sun, the Earth, the Ionosphere* [10] on the ARRL website. Another source would be the Australian government's *Space Weather Services* site[11]. As an aside, if you're major operating is more locally oriented, i.e., HF nets, check out their *Hourly Area*

Prediction (HAP) charts in **reference 12**, and then select the major city closest to you. These charts show, using colors, to represent the recommended HF frequencies, those that are optimum for base to mobile communications over that distance at the current hour. These have been found, over a number of years, to be very accurate when verified against actual conditions on a number of HF, CW traffic nets.

Preliminary Data Analysis

OK, now with all of the techno-babble defined, it's time to take a look at the data and see if it's possible to glean any insights from it. As of the start of writing this article, the data includes 165 DX contacts, of which there are 48 where the VOACAP software had a prediction of less than 50%. Additionally, there are 25 of those (**See table 1**) that are particularity interesting where the VOCAP percentage was below 20%. The time period is from June of 2017 to the end of November 2018 (18 months). As many will have noticed, this is still a very small number of contacts with which to infer results, however, it does illustrate what elements and patterns are being examined. By the way, if you would like a copy of the entire spreadsheet, including updates as more DX contacts are added, just send an email to the author.

Starting with the solar flux (SFI) and the daily sunspot number (SSN), the general rule is the higher the better because having a SFI increases ionization which also increases the maximum useable frequency which makes longer distance communications possible. Also, a higher SSN also generally indicates a higher SFI. The 1st anomaly with these indicators was a contact on July 12th, 2017, with the TX5EG (French Polynesia) DX'pedition where the SFI was 91 and a SSN of 27, which clearly did much better than the predicted (9%). The other contact in this category was with Jaime, EA6NB (Balearic Islands, Spain) on July 16th, 2017, where the SFI was a good 94 and SSN was at 34 but the VOACAP prediction was even lower at 2% . Additionally, the contact with Jaime may also have been possible due to the fact that the Balearic Islands were in the greyline enhancement period.

The contacts on 7/24/17 (P4/DL4HG, Aruba) and on 8/20/18 (TX5T, Austral Islands) seem to confirm Jim's (KF7E) idea that absent other factors, that being low values for SFI and/or SSN, proton density and absent greyline effects, a higher solar wind can enhance propagation. The other two contacts that are similar, 9/18/17 (PV8ADI, Brazil) and 1/14/18 (HK1MW, Columbia) for high solar wind speeds but differ in that both of those could also have been enhanced with the greyline effect.

A possible indicator for enhancement (VOACAP 5%) based upon high proton density can be seen with the 12/31/17 contact with John (ON4UN) on 20 meters. The SFI was marginal (70), the SSN was 0, and the solar wind was low (354) and neither station was within the greyline enhancement zone. The proton density however, was well above normal (which is 8.7) at 24.7. Contacts on 10/30/18 (PZ5K, Suriname) and 11/18/18 (LU8DPM, Argentina) would also fall into this category.

Other similar higher than average proton density contacts that also had average or higher than average solar wind speed can be seen on 11/01/17 (TZ4AM, Mali), 1/22/18 (RI50ANO, South Shetland Islands), 03/23/18 (T3COW,

Date	Time (UTC)	Station	Band Mhz	Mode	Power	Solar Flux	Sunspot Number	Solar Wind	Proton Density	Kp	VOCAP %	Signal Direction Short Path	Short Path Distance (MILES)	Local Grey Line	DX Grey Line
06/19/17	00:28	TX5EG	21	CW	40	73	27	536	4.2	2	11	216	4126		
07/12/17	10:33	TX5EG	3.5	CW	40	91	27	516	3.8	1	9	216	4126		
07/16/17	04:08	EA6NB	7	CW	40	94	34	314	4.8	2	2	43	6117		X
07/24/17	10:34	P4/DL4HG	7	CW	120	71	0	601	5.3	3	19	106	3368		X
07/26/17	10:43	DU3LA	7	CW	40	71	0	403	4.8	2	12	301	7235		
08/29/17	04:15	HA8RM	7	CW	40	78	17	325	1	1	1	28	6252		X
08/29/17	04:44	9J2BO	7	CW	40	78	17	325	1	1	0	67	9779		X
09/18/17	02:07	PV8ADI	7	CW	40	72	13	681	5.4	2	2	118	6154	X	
11/01/17	03:22	TZ4AM	7	CW	40	76	11	282	12.1	1	8	68	6849		
11/03/17	18:50	ON4UN	14	CW	40	74	0	433	7	1	9	33	5615		
12/10/17	06:00	ZL2AIM	7	CW	40	68	0	333	2.7	1	18	224	6730		
12/23/17	20:19	OJ9X	14	CW	40	76	18	358	8.6	0	11	16	5487		
12/31/17	18:45	ON4UN	14	CW	40	70	0	354	24.7	1	5	33	5615		
01/14/18	10:52	HK1MW	7	CW	40	69	0	581	5.6	2	11	116	3484		X
01/22/18	02:27	RI50ANO	7	CW	40	71	0	533	9.8	3	1	155	7440		
02/09/18	19:22	PJ2/KB7Q	14	CW	50	78	22	325	6.9	0	2	104	3440		
03/18/18	07:20	VK2IA	7	CW	50	69	15	481	4.7	3	6	241	7529		
03/23/18	00:39	T3C0W	10	CW	50	69	0	424	13.5	3	1	71	8186		
08/20/18	10:53	TX5T	3.5	CW	120	67	15	645	5.2	2	13	213	4532		
08/25/18	03:41	UA4HBW	14	CW	50	68	29	378	6.8	1	14	7	6380		
09/24/18	10:36	LU7YS	3.5	CW	120	68	0	427	7.2	2	0	135	6124		
09/30/18	03:58	ZS6CCY	7	LSB	100	69	13	465	4.7	1	0	102	9977		X
10/29/18	04:10	Z23MD	7	CW	50	69	0	315	3.6	1	1	71	10237		
10/30/18	10:30	PZ5K	7	CW	5	68	0	305	9.4	1	6	101	4461		
11/18/18	23:56	LU8DPM	7	CW	50	67	13	333	19.6	0	0	135	6124		

Table 1, See the Text

Tuvalu). This could be another set of complimentary index values to watch for when evaluating if a DX contact will be possible.

Some Final Points

It's always possible to learn, and then learn to utilize, new (to you) and better techniques for getting that ATNO (All

Time New One) in the log and confirmed. As noted at the beginning of this article, read and study all you can.

What this continuing experiment has also shown is that it's probably best to take the "glass half full" approach concerning the VOACAP results when using it as a planning tool for chasing the latest DX'pedition.

Where possible, try and utilize that old favorite, Greyline. This might mean that you are up, and out of a nice warm bed, way too early in the morning to catch the sunrise Greyline for that much needed contact with Nasir, AP2NK (Pakistan).

Even in these brief few years, there have been a number of instances when contact was completed even though the DX stations signal was not registering S-9, or even S-6. If you have a reasonable clear "shot," give it a try! The contact might have a lower signal strength because it's actually long-path, even if your simple wire antenna cannot tell the difference.

Never give up before you start just because the geomagnetic forecasts are supposed to be high. These are just predictions; keep tabs on the current Kp value at all times. This also goes for all the other predictive elements. As seen in even this limited dataset, there have been reliable, and sometimes spectacular contacts made when the software gave a very low, or even no, possibility of success.

Vintage gear and low power is every bit as capable of working DX as the most modern equipment, albeit with some unique challenges. However, even modern equipment cannot make up for poor procedures and limited skills. Remember, it's the knowledge, skill and persistence of the operator that makes the difference!

Hopefully this will encourage more of you to try DX'ing with vintage gear, and also to contribute to your understanding of the still, somewhat of an art form, practice of propagation forecasting.

Footnotes:

1. Bob Locher, W9KNI, The Complete DX'er, by Idiom Press

2. Bob Locher, W9KNI, A Year of DX, by Idiom Press

3. CQ DX marathon, http://www.dxmarathon.com/

4. W1AW Bulletins Archive (DX), http://www.arrl.org/w1aw-bulletins-archive-dx

5. W1AW Bulletins Archive (Propagation), http://www.arrl.org/w1aw-bulletins-archive-propagation

6. DX-World, https://dx-world.net/

7. DX News, https://dxnews.com/

8. Spaceweather, http://www.spaceweather.com/ (note the site does not auto-update so make sure that a page refresh was done before taking down data each time)

9. Voice of America Coverage Analysis Program for HF Propagation Prediction and Ionospheric Communications Analysis, http://www.voacap.com/hf/

10. "The Sun, the Earth, the Ionosphere" by Carl Luetzelschwab, K9LA, http://www.arrl.org/the-sun-the-earth-the-ionosphere

11. Australian government's Space Weather Services, http://www.sws.bom.gov.au/

12. Australian government's Space Weather Services, Hourly Area Predictions, http://www.sws.bom.gov.au/HF_Systems/6/6/1

13. VOACAP Blog, https://voacap.blogspot.com/2018/06/voacap-online-hf-predictions-users.html

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