How much is a dB ?

You would like to double your QSO-rate in your favorite contest?
Here's how much power or antenna gain you will need.

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Being a little pistol and looking through the results of various international contests makes you wonder, how those big guns get their tremendous scores. They seem to work as many QSO in one hour, as a little pistol is making in the entire contest. If you are a little pistol and would like to become a big gun, you might like to know, how much you have to improve your station to get those QSO-rates you are dreaming of. Or you are already a big gun and would like to find out, if that extra dB from a new antenna will be worth the effort. Well, then read on. This article will show you, how you can find out the answers to your questions.

The author is mainly working in contests. While not being a real little pistol, he is far away from being a big gun. Better being some kind of a big pistol or little gun, we wanted to know, what we could expect when we build a new linear for our club-station with a bit more output. Therefore we tried to find out, how much our QSO-rate will improve with power.

The contest

The score in almost any contest is calculated from the number of contacts and the number of multipliers one has worked during the contest-period. The multiplier is in many cases the number of countries you have worked per band, in some others it is the number of zones or a combination of zones and countries worked per band. In these contests the achieved result, your score, is not only determined by the number of contacts but is also very much depending upon your ability to find new countries on different bands and work them quickly. But there is at least one major contest, where scoring is somewhat different. This is the CQ WW WPX Contest, where the multiplier is the number of prefixes worked, regardless of band. In this contest it is not so much important to search for new multipliers, as more or less they come by themselves. The number of prefixes worked is mainly depending of the number of contacts one makes. And therefore the score is mainly determined by the number of QSOs, although the relationship between the score and number of contacts is not linear. Dr. Sylvan Katz, VE5KZ has done an extensive study on contest-scores [1]. Analyzing the WPX CW Contest in 2000 for the Single Operator All Band category he found the following relationship between the number of contacts and the score:

$$S = 6{,}55 * Q^{1{,}74} \qquad (1)$$

S......Score
Q .....Number of contacts

This relationship was found by analyzing the scores and number of contacts for 588 participants and fits the analyzed data very well, as the coefficient of determination (R^2) is 0,99. The coefficient of determination is a value to measure how well an equation fits the data. The coefficient of determination can have only positive values ranging from $\mathbf{R}^2$ = +1.0 for a perfect correlation (positive or negative) down to $\mathbf{r}^2$ = 0.0 for a complete absence of correlation. It is the square of the correlation coefficient, which indicates an association between two variables.

Therefore we can assume, that achieving a reasonable score in the WPX-contest is mainly a result of the ability to have a reasonable QSO-rate. For our investigation we will now try to find out, how much the QSO-rate depends upon the effective radiated power.

There is one other point, where the WPX-contest is different from most other contests. The operating time is limited for single operators to 36 hours within the 48 hour time period of the entire contest. That makes sure, that everybody can get some sleep, and on the other hand we can assume for our investigation that top-scoring stations really worked 36 hours, while in other contests you can not be that sure that the entire contest period - 48 h - was operating time.

For these reasons the author choose the WPX contest to analyze the influence of output power to the score or the QSO-rate.

Analyzing contest results

In the first part of our investigation we will try to find out, if there is some correlation between output power and the QSO-rate. We analyzed the WPX results for 2001, using the single operator, all band entries. There are three possible power levels for SOAB in this contest: in the QRP-category output shall not exceed 5 watt, in low power 100 watt and in the high power category the maximum output allowed is 1500 watt.

We now took the continental leaders for each of these categories (table 1) and divided their total number of QSO by 36 hours, to calculate the average QSO-rate for the entire contest. When we are comparing QSO-rates is essential to keep in mind, over which period the QSO-rate is determined. You can calculate the QSO-rate for your best hour, the best 10 minutes or the entire contest-period. In our example the QSO-rate is observed over the entire 36 hours. We will use other values later.

In this first step we are comparing different stations with different operators, different antennas and different locations within the same continent. So there are many possible influences to the score and QSO-rate, which are not under our control. The only thing we can assume is, that every station that is a continental winner uses the best antennas he can afford and runs the power level as defined by the rules of the contest.

We will analyze the SSB-part of the WPX contest first. When we take a look at table one we see, that for Europe, North- and South- America and Asia we have an entry in all three possible power categories, for Africa and Oceania there was no entry in the QRP-category.

CQ-WW-WPX Contest SSB 2001 - Continental Leaders						
High Power	**Call**	**Score**	**QSO**	**Prefix**	**QSO/h**	**Pts/QSO**
Europe	OK1RI	10844592	3787	1034	105,2	2,77
S-America	HC8A	25180199	6537	1199	181,6	3,21
Africa	CN2R	20530495	5831	1115	162	3,16
Oceania	KH6ND	15498798	4528	1029	125,8	3,33
Asia	JY9NX	15463485	4980	1017	138,3	3,05
N-America	KQ2M	9668020	3547	1055	98,5	2,58
Low Power						
Europe	GW7X	6225688	2718	856	75,5	2,68
S-America	P40A	12547872	4287	927	119,1	3,16
Africa	SU9ZZ	9411864	3615	847	100,4	3,07
Oceania	KH0/JM1LRQ	6685416	3084	724	85,7	3
Asia	ZC4BS	3690756	2096	653	58,2	2,7
N-America	VA3UZ	7994840	2867	980	79,6	2,85
QRP						
Europe	LY5A	1971592	1393	646	38,7	2,19
S-America	PQ2Q	1801785	1135	565	31,5	2,81
Africa						
Oceania						
Asia	JR4DAH	286425	363	285	10,1	2,77
N-America	K3WW	1091168	863	488	24	2,59

Table 1: Continental Leaders in the WPX SSB Contest 2001

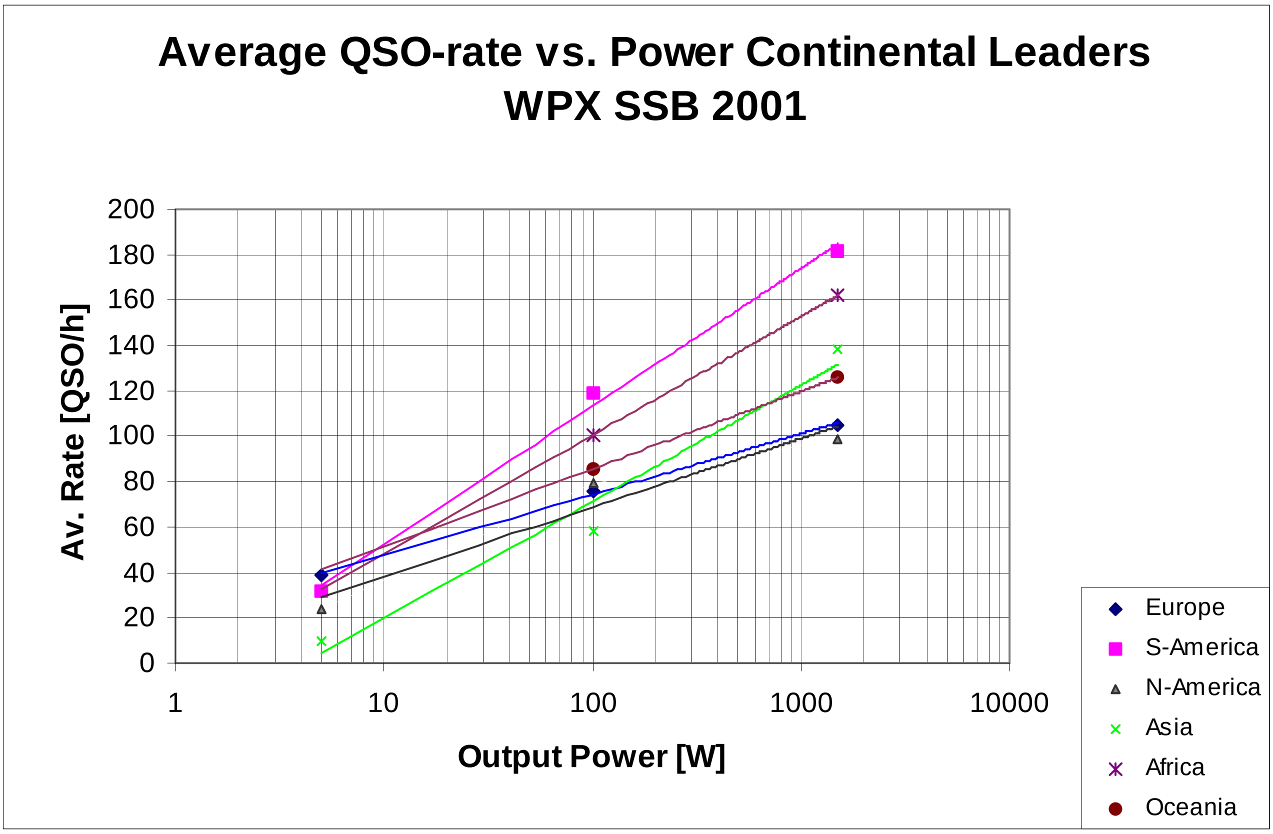

Fig 1.: WPX SSB 2001, QSO-rate vs. output power

To find out, if there is any correlation of the QSO-rate with the output power, it is convenient to show the data graphically as done in Fig. 1. As we are using power as a variable, we use a logarithmic scale for the power level. We then see, that a straight line, which means a logarithmic trend, fits the data quite well. In Fig. 1 we find this trend for each continent. The equation that fits that data is:

$$Q = a + b * \log P \qquad (2)$$

Q .....average QSO-rate [Q/h]
a, b ..coefficients describing the regression, a = intercept, b = slope
P......Output power [W]

You can use any spreadsheet programme or scientific calculator to analyse such a correlation. If you use a calculator you have to enter the logarithm of power (logP) as the x-value and the corresponding rate (QSO per hour) as y-value. Everything else will be done by the programme.

Continent	r	b	a
Europe	0,99947	26,87	20,5064
S-America	0,99776	60,69	-8,1296
N-America	0,96932	30,32	7,9996
Asia	0,98523	51,51	-32,0013
Africa		52,339	-4,2615
Oceania		34,1	17,4563

Table 2: Intercept (a), slope (b) and correlation coefficient (r) for SSB using Eq. (2)

As table 2 shows, the coefficients a and b are somewhat different per continent. The coefficient a is the intercept to the y-axis and is the value of Q when the second term (b*logP) equals zero. As we use a logarithmic scale for power, this is true for an output of one watt. It defines the elevation of the line. The coefficient b quantifies the steepness of the line. It equals the change in Q for each unit change in P. As we use a logarithmic scale the coefficient b is the number of QSOs we get, when we change the power by a factor of 10 (which equals 10 dB). If the slope is positive, Q increases as P increases. If the slope is negative, Q decreases as P increases.

As we can see from table 2 the slope is in all cases positive, so the QSO-rate increases with power. Of course we expected this, but what may be interesting is, that there is a remarkable difference for the slope, depending on which continent you are situated. While for Europe, Oceania and North America the slope is between 26 and 34, the value for the slope for Africa, Asia and South-America is between 51 and 61, almost twice as high as for the other continents. Thus it seems, that increasing power will much more improve your QSO-rate if you are on one of the more rare continents (AF, AS, SA) than if you are in Europe or in North America. We are not too sure, if the improvement in Oceania is really that low. The data seem to indicate this, but we have only two values for Oceania (and also Africa), which makes any prediction very doubtful. For those continents where we have three values (for 5, 100 and 1500 watt) you find the correlation coefficient in table 2. As you can see, this coefficient is pretty close to one, which means, that our regression fits the data very well.

There is also another way of interpretation of this data, which may be more likely than the determination by the continent: for a rare location (callsign) like HC8, P4 or SU you get more QSO per extra Watt than for a common location like GW, VE or the USA. We will see one further possible explanation a bit later.

To see if we get similar results for another contest and in another mode we also analyzed the WPX 2001 CW Contest. Fig. 2, Table 3 and 4 give you the results.

CQ WW WPX Contest CW 2001 - Continental Leaders						
High Power	**Call**	**Score**	**QSO**	**Prefix**	**QSO/h**	**Pts/QSO**
Europe	OH0Z	6514996	3199	862	88,86	2,36
S-America	P40T	11726388	4029	849	111,92	3,43
Africa	3V8BB	13639976	4134	908	114,83	3,63
Oceania	KH6ND	7768297	2959	823	82,19	3,19
Asia	P3A	10723620	3696	870	102,67	3,33
N-America	VP5MM	11035570	3671	905	101,97	3,32
USA/VE	AJ1I	8213226	3352	849	93,11	2,89
Low Power						
Europe	AN7GTF	2946548	2506	697	69,61	1,69
S-America	LQ0F	3910400	1999	650	55,53	3,01
Africa	SU9ZZ	7799260	3061	812	85,03	3,14
Oceania	ZK1EFD	3366927	1747	591	48,53	3,26
Asia	ZC4DW	5314681	2584	673	71,78	3,06
N-America	WE1USA	3956437	2052	713	57,00	2,70
USA/VE	WE1USA	3956437	2052	713	57,00	2,70
QRP						
Europe	LY5A	2331414	1591	646	44,19	2,27
S-America						
Africa						
Oceania						
Asia	UN4L	1751703	1127	479	31,31	3,24
N-America	TI5X	2568470	1597	615	44,36	2,62
USA/VE	K3WW	1662210	1133	506	31,47	2,90

Table 3: Continental Leaders in the WPX CW Contest 2001

Continent	r	b	a
Europe	0,9987	18,06	32,19
S-America		47,95	-40,36
N-America	0,9419	23,02	22,7
Asia	0,9988	28,85	12,09
Africa		25,34	34,35
Oceania		28,62	-8,71
USA/VE	0,9918	24,79	11,98

Table 4: Intercept (a), slope (b) and correlation coefficient (r) for CW using Eq. (2)

While CW should be the best mode for going QRP, there is no QRP-entry for Africa, South-America and Oceania. This limits our data somewhat, as we have only three values for three continents. Somewhat different from the results for the SSB-part of the contest the winners for North-America in the QRP and High-Power category do not come from USA/Canada, but are from rather rare spots. VP5MM won the High-Power trophy and TI9X won QRP. Therefore we also analyzed the best score for these categories from USA/Canada.

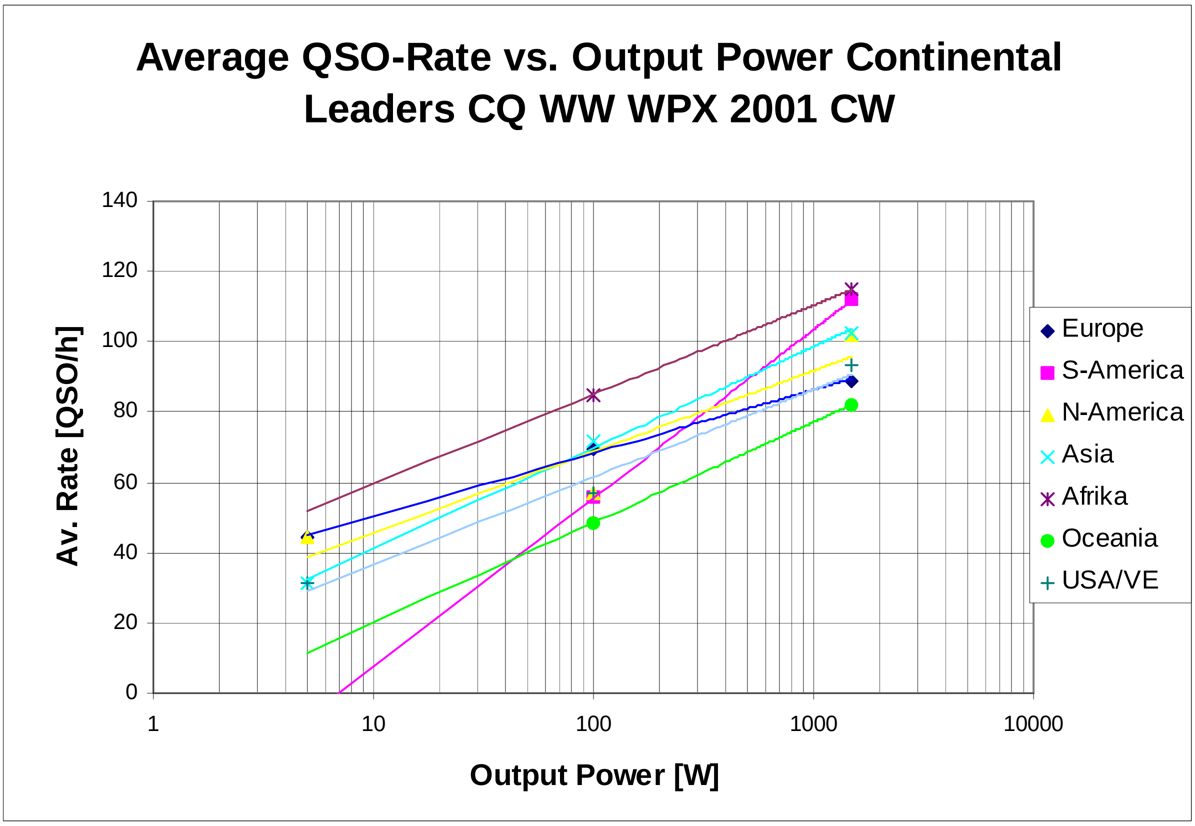

Fig 2.: WPX CW 2001, QSO-rate vs. output power

The results in CW are certainly different from what we got investigating the SSB top scores. The coefficient b, which describes the steepness of our curve, is for almost all cases between 18 and 29. Only for South-America we get a coefficient of 47,95, but remember, we have only two values for South-America, so this result is not very reliable. For those groups of data where we have three values, we see that the correlation coefficient is very close to one, except for North-America. But here we have the influence, that the value for the low-power category comes from an US-station, while the other values come from stations in rather rare locations. Therefore you find one further curve only for W/VE-stations.

It is interesting to see, that in CW the influence of power is not that much pronounced as on phone. In both modes Europe gets the lowest benefit from increasing power, followed by North America. And in both modes it seems that increasing power really pushes you forward if you are in South America.

Some words of caution

Although our regression fits the date quite well, we do not have any data for power levels above 1500 watt or below 5 watt. Therefore we can not be sure that the regression would be the same beyond those limits. When analyzing data like this, you always should consider what could happen at the maximum and minimum possible values.

For our test the minimum possible level would be zero output. Well, it's obvious that with no output at all you will not make any QSO. Therefore the rate is also zero. Our regression fits this condition very well as the corresponding value of power is in most cases just a few milliwatt. Nevertheless we should not use our regression for possible QSO-rates for very low output below 5 watt.

The second end of the curve is when you have infinite power. Here it's not that easy to find a reliable value for the rate. Of course you could work any station as far as propagation permits. But your rate will nevertheless be limited by the activity in the contest, your ability to handle such a pile-up and most of all by the time you need to exchange reports and every now and then to give your callsign. We can assume that the maximum rate will be somewhere between 300 and 400 QSO/h. That´s about 10 seconds per QSO and still demands that you never run out of stations calling you because of lacking activity. But whatever the value will be, it's important to notice that your rate cannot improve beyond a specific limit. There will be some sort of saturation in your QSO-rate. Here our regression is not true, as with power approaching infinite also the rate approaches infinite. We have to keep this in mind, when we are going to use our data, as our regression will not apply to stations already near to some saturation.

There is one further point we have to consider: now we have only analyzed the data of 3 continental winners per regression. To use our study for our own situation we need more reliable data and we need some data of our own station including the abilities of our operator. But before we will show how we can find these data, let's first take a look on what we could do with a reliable correlation.

How much power do I need?

With our investigation we have found, that there seems to be a correlation between the QSO-rate and the output power. This is described by Eq. (2). Now you might ask, what can I expect by increasing my output. The relationship between two power-levels is determined by the relative power unit called the decibel (dB). The number of decibels corresponding to a given power ratio is given by:

$$dB = 10 \cdot \log_{10}\left(\frac{P_2}{P_1}\right) \quad (3)$$

Now let's use Eq. (2) to calculate the QSO-rate we can expect for two power levels P_1 and P_2:

$$Q_1 = a + b * \log P_1$$
$$Q_2 = a + b * \log P_2$$

Therefore the difference in the QSO-rate will be:

$$\Delta Q = Q_2 - Q_1 = b * (\log P_2 - \log P_1)$$

As $\log A - \log B = \log \frac{A}{B}$ we can state:

$$\Delta Q = b * \log \frac{P_2}{P_1}$$

and using Eq. (3) we get:

$$\Delta Q = b * \frac{dB}{10} \qquad (4)$$

When we know, how much gain in dB we get from our improvement, and when we know the slope (b) of our QSO-rate, we will be able to estimate how much our QSO-rate will increase. You can also put this equation in another way:

$$dB = 10 * \frac{\Delta Q}{b} \qquad (5)$$

where you now have a formula which gives you how many dB you have to improve your signal to get the improvement in the QSO-rate (ΔQ) you would like to have.

Let's look how we can use this formulas for our own benefit. We assume, that for an European Station we have found a slope of 18, and the average rate this station gets with an output of 100 watts is 35 QSO/h. What can this station expect from improving his station by 3 dB? Using Eq. (4) we find, that the rate will be raised by 18*3/10 = 5,4 QSO/h to an average rate of 40,4 QSO/h. This may seem to be not that much, but over the entire contest period of 36 hours the difference is almost 200 QSO. Now what would the same station have to do to double his rate and get an average rate of 70 QSO/h. Using Eq. (4) we find, that we would have to improve the station by 10*35/18 = 19,4 dB.

There are some points which we have to consider using this formulas. First, as you have seen above, the formula is only true for a certain part of our curve. When you are already at a very high QSO-rate you might get in an area of the curve, where you notice some saturation. Increasing power does not necessarily mean, that your QSO-rate will improve the same way. Of course you can not run much more than maybe 300 Qph.

On the other hand we have evaluated the steepness in the rate by using different output power levels. Improving your output power by 10 dB may be different to improving your antenna by 10 dB. Of course for the strength of your signal there will be no difference for 10 dB from a linear or a better antenna. But with the better antenna your receiving capabilities will also increase by 10 dB, while with the linear they stay the same. Therefore you will be able to work weaker stations with the better antenna and your rate may improve more than just with the big linear.

There is one further point we have to consider: the data we have analyzed so far are from the continental leaders in the WPX 2001 contest. These are top operators, using the best equipment and antennas affordable. The situation for them might be different from yours. Not everybody will be able to manage a pile-up at a high rate. The author himself has to admit, that even with the best signal, he will not be able to achieve results as the top operators do. Not yet, maybe later.

The situation may also be different for various contests. Maybe in the CQ WW DX power is more important, than in the WPX. The influence of power may even vary with conditions. Nevertheless for the station the author used the last years, there seems to have been little influence of that kind. The average QSO-rate was very stable, somewhat around 40 Qph.

So if you want to know, how much your own QSO-rate can be increased by that extra dB, it's necessary to find out, what the slope in the rate, the coefficient b, for your own station is. Let's see how we can find it out.

Playing the power lottery

We are facing some problems, when we would like to find out what the slope in our QSO-rate is. We have to get comparable results for different power levels for our station. But we only can compare the results, if they are made under the same situation. Now what changes our situation, what may have an influence on our QSO-rate? As we have seen above the location and/or callsign used may have some influence. That is easy to control, as we only have to compare results with the same callsign and from the same location. The same is true for the next influence on the rate. The equipment used, the antennas and the operator have to be the same for the results we will compare. But there are some other influences, which are not that easy to control. That is changing conditions and maybe also changing participation in a contest. If you compare the ARRL DX Test from 2003 and 2002 it's obvious that the dramatic change in solar activity within one year will also have a dramatic influence on the rate. Therefore it will not deliver very reliable data, if you compare your low power activity in one contest to the high power entry you made in this contest a year later.

The only solution for this problem is, to analyze your QSO-rate within the same contest. For the weekend of one specific contest you are at a comparable part of the solar cycle and at the activity-level this contest raises in this specific year. Nevertheless conditions will change during the contest as well as activity will be different for different times within the contest. We have no influence on that, so we have to try to minimize this influence to get reliable data. To run 100 watt on Saturday and 1500 watt on Sunday, will not really help.

To find a solution for our problem, remember what we learned about the statistical treatment of signal reports in the last issue. If we have a reasonable sample we will be able to minimize the mentioned effects. So our sample size should be as high as possible. On the other hand there should be no influence from the operator on sampling. The operator for example could decide to run high-power on the first day and low power on the second, as he knows things are rougher on the first day. We have to keep such an influence out of our investigation. The decision which power to use for which sample (time period) has do be done by random. Remember what we said about random sampling: we have two conditions necessary to speak of a random sample:

> a.) each member of the population is just as likely to be included in the sample as any other member
>
> b.)the likelihood that any given member of the population will be included in the sample is affected equally by the inclusion of any other particular member

Therefore we found the following procedure for our evaluation: we divided one specific contest into many subcontests, each one only 30 minutes. For each of these 30 minute-periods we used different output power in 3 dB steps between 19 and 600 Watt. The decision, which power had to be used in which time-segment could not be influenced by the operator but was done by random. For this we had a big opaque pot with 6 identical lots, each one with a specific power level between 19 and 600 watts. From this pot the operator drew one lot that decided the power level for the next time segment. That´s why we called it the „power lottery“. Of course it would have been nice to have a child to do the drawing as they are doing on commercial lotteries. But somehow the madness of an amateur radio operator engaged in a worldwide contest combined with some kind of lottery does not seem to be very attractive to children.

To avoid any influence on the operator by knowing that after 30 minutes working with only 19 watt he will again be at the 600 watt level, the drawing was done shortly after the previous time-segment had ended. Between two time segments there was a short break and frequency had to be changed. This was to avoid keeping a clear frequency after a high power segment and to go on with low power working the pile-up produced by the higher power. The power was measured with a Drake wattmeter WH7, which has three different scales (20, 200, 2000 Watt). Therefore it was possible to tune in the correct power level within this wide range from 19 to 600 watt.

By this means we tried to keep the influences mentioned above as low as possible. We choose the WPX-contest 2002 for our evaluation. We did this test in the SSB-part of the contest as well as in CW. As the author is mainly operating SOAB also this evaluation was done in the all band category. The object was to work as many stations as possible during each time segment. In the SSB part we were not able to operate the full 36 hour period, because of other obligations. Operation was nevertheless on both days. So for each of the six power levels we got 5 values. In CW we had some more time and got 9 values per power level. We have to admit, that when we started this test we were not sure, if we get any reasonable results. We discussed the situation with some other local amateurs and they all said „no, that won’t work“. Well, after doing the analysis all were astonished to see the results. Now let’s take a look at them: For each time segment we get a specific rate. Here it is important to clarify the value „rate“. For our analysis of continental leaders above, we have used an average rate over the entire contest period of 36 hours. We are not able to do this here. The rate we are using now is the rate in QSO/h over a 30 minute period. Of course this is

Power Watt	SSB Min. Rate QSO/h	SSB Max. Rate QSO/h	SSB Av. Rate QSO/h	CW Min. Rate QSO/h	CW Max. Rate QSO/h	CW Av. Rate QSO/h
19	19,20	32,00	27,24	22,00	49,09	31,17
37,5	20,63	39,31	33,99	20,63	69,68	41,02
75	27,27	55,86	43,94	30,00	50,00	38,52
150	32,73	60,00	40,68	32,00	61,94	43,52
300	38,00	104,62	59,44	34,00	74,59	54,08
600	42,00	91,30	59,95	35,17	79,35	65,40

Table 5: Minimum, maximum and average rate for different power levels in the CQ WW WPX contest 2002 for OE5XWM (OE5CWL op)

completely different from a 36-h-rate. From the data we got for each mode we have in table 5 the maximum and the minimum rate achieved per power level. In table 5 you also find an average rate, which is the mean value for all data for one specific power level. On phone it is the mean value for 5 periods of 30 minutes, so it is a 2,5h-rate. On CW it is a 4,5h-rate, as we had 9 periods of 30 minutes.

The first experience that was really astonishing for the author was that you can get reasonable results with low power. Since we have a linear at our club station, we always have used it during contests. It was very interesting to learn, that with only 19 watt and a Tribander it is still possible to keep a frequency and work station in the CQ-mode, especially in CW. Calling CQ with 19 watt produced during one time segment a rate almost as high as our usual average rate running high power. Our feeling was that we do not gain that much from the linear what we expected. The best contact with 19 watt was getting a call from ZL on 40 long path with a simple dipole, a new country on this band after 30 years being a ham.

Fig. 3 and 4 gives you the graphical representation of our rate on phone and CW, again versus a logarithmic power scale. It is interesting to see, that you can very clearly notice the correlation between power and QSO rate not only for the average rate, but also for the minimum and maximum rate. In table 6 you find the data for the

Rate	r	b	a
Minimum SSB	0,99	16,34	-3,13
Maximum SSB	0,93	47,27	-31,95
Average SSB	0,95	22,52	-1,43
Minimum CW	0,93	10,27	8,13
Maximum CW	0,75	16,93	29,79
Average CW	0,94	20,50	4,08

Table 6: Intercept (a), slope (b) and correlation coefficient (r) for OE5CWL at the club station OE5XWM in the WPX 2002

regression line, as we did above for the continental leaders. As you may see the correlation coefficient for the average rate is above 0,9 which indicates the curve still fits the data quite well. Nevertheless it would be interesting to gather a larger sample. This could be done by operating the entire 36 hours in this contest, which was not possible for us in 2002.

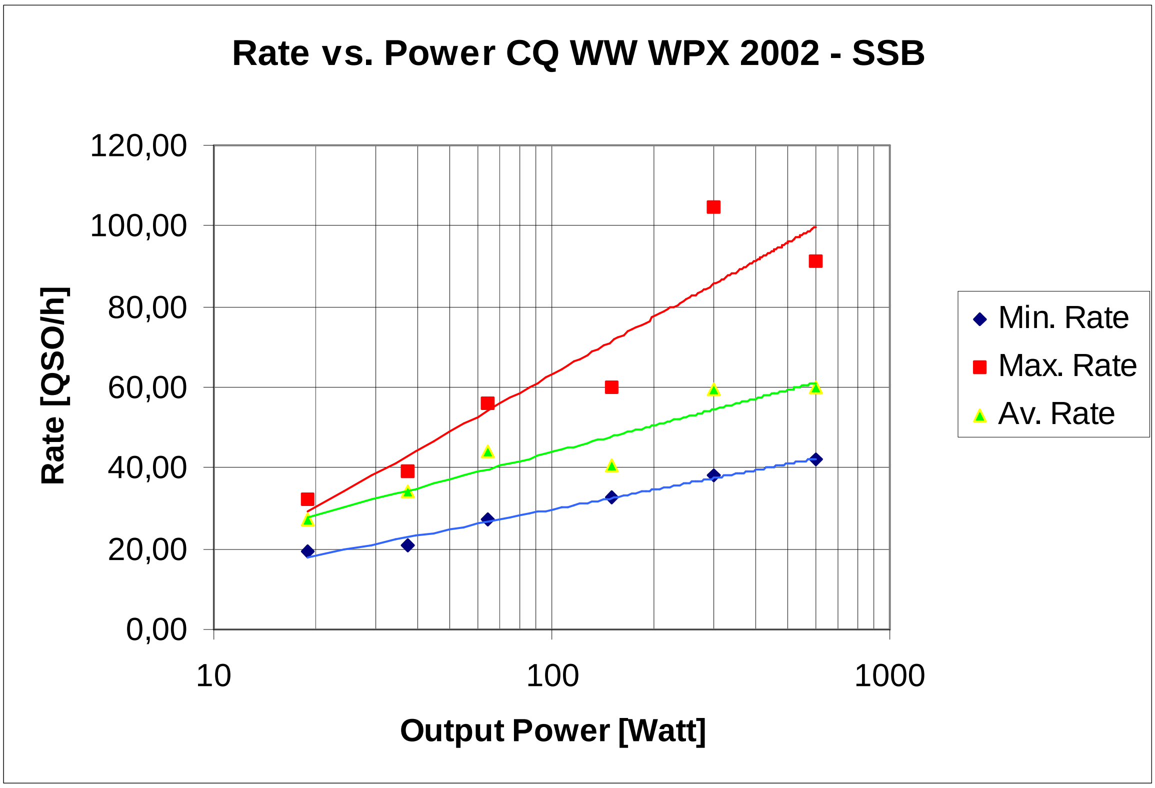

Fig 3: Contest power lottery at OE5XWM, SSB

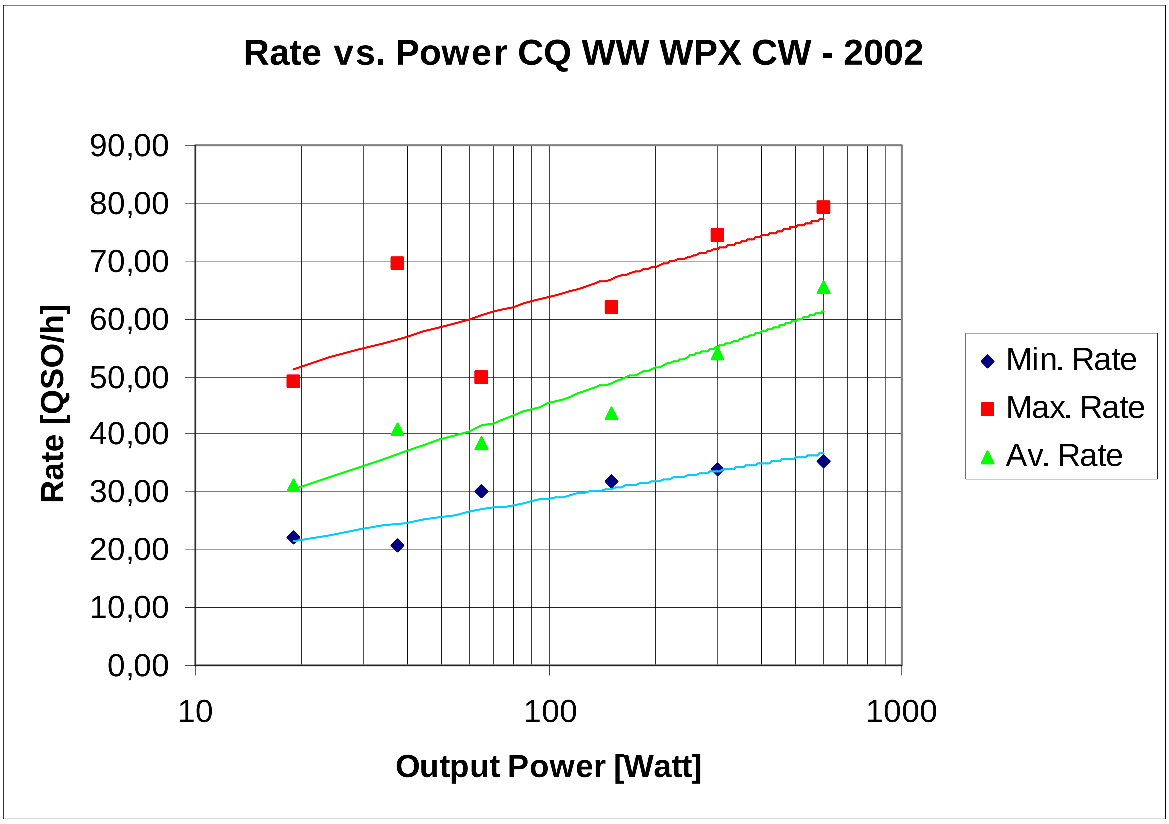

Fig 4: Contest power lottery at OE5XWM, CW

What are the conclusions from this data: First we see, that the steepness of our rate (the coefficient b indicating the slope) is higher for the average and maximum rate than that for the minimum rate. This means you get much more for your power during the good hours than you do during the low hours. This is more pronounced on phone than in CW. It seems contradictionary to what we believed so far. When the rate is low you sit there at your station and think about improvements: „If I only could get that new antenna up, then I would do much better.“ When you are working stations at a reasonable rate (whatever this is for you), you may be satisfied and not thinking of improvements. The data we have so far seem to indicate that an improvement in your station will improve your high-rates more than the low rate during the low hours. But remember this is only true for the linear part of the curve and therefore applies for the average amateur like the author, but maybe different for a big gun in a rare location, who is in good hours already near to saturation regarding his rate. Nevertheless this fact may be a possible explanation for what we experienced analyzing the continental leaders. Stations close to the equator will have more good hours than those more up in the North. This maybe the reason why we found a greater influence of power for locations in South America and Africa.

The second conclusion for our test is that you seem to get more for your power on phone than on CW. This confirms what we have found out analyzing the results of the continental winners.

As we now know the relationship between output power and our rate, we can calculate which improvement we have to make, to achieve results comparable to the winners. For this purpose you find in table 7 the necessary gain in dB we need at OE5XWM to be a winner in that category. As we can not do any improvements at the antennas of OE5XWM, the first thought is increasing output power, which is now 600 watt. For this you find in table 7 the comparable output we would need for a winning rate. Of course the corresponding output is far beyond the power limits in each category.

	EU-winner 2002	Rate Winner	Rate OE5XWM @ Contest power limit	Gain dB	Power limit Watt	necessary power @ OE5XWM Watt
SSB						
QRP	S54AA	34,3	14,3	8,9	5,0	38,6
low power	YL/RZ3BY	48,9	43,6	2,4	100,0	172,0
high power	S50A	85,7	70,1	6,9	1500,0	7370,0
Tribander	HA8JV	80,2	70,1	4,5	1500,0	4200,0
CW						
QRP	HG5Z	42,3	18,4	11,7	5,0	73,3
low power	OK2PP	59,9	45,1	7,2	100,0	525,0
high power	SN7Q	84,4	69,2	7,4	1500,0	8270,0
Tribander	HA8JV	69,6	69,2	0,2	1500,0	1570,0

Table 7: Improvement (gain) and output necessary at OE5XWM to get a winning rate for the possible categories in WPX

Just as an example in the high power category we would need an output of 7,4 kW on phone and 8,3 kW in CW to get the same rate as the winner had! As the demand for OE seems to be the same as for S5, YL, HA or OK we can not assume that his better score comes from a rarer location. Improving our output from 600 to 1000 watt (the legal limit for club stations in Austria) will bring us only 2,2 dB. As we also do not have the chance to get the necessary extra dB from a better antenna (if that is possible at all) the only conclusion is, that we have to get those extra dB´s from the operator. We are convinced that much of the „decibels“ the winners are better than OE5XWM comes from better operators. Therefore our main conclusion from this evaluation is, that at first we have to find ways to improve our operating. We already have found some failures where we can do better. But that is another story.

There is one further interesting conclusion from table 7: the necessary gain at OE5XWM is the lowest for SSB in the low-power-category. There we „only“ need to improve by 2,4 dB while we would need 8,9 dB in the QRP category. The author has to admit, that since we have a linear at the club station we never even thought about entering the 100 watt category, especially on phone. We usually enter the Tribander category, where we would need 4,5 dB, based on an output of 1500 watt. Because of the legal situation in Austria we are only able to run 1000 watt, so we need further 1,8 dB when running 1000 watts. It's surprising that, that our chances are much better in the low-power-category. In CW we are rather close to a winning score in the Tribander category, based on an output of 1500 watt. Using 1000 watt we are only 2 dB from the winner HA8JV. Actually the score achieved in 2002 placed us on the 11th place in Europe and the 17th place DX, although we did not operate the full 36 hours and the average output power was only about 200 watt. So perhaps it´s time to make a serious effort. Comparing the results in the tribander category for both modes, shows that we are closer to the winning score in CW. The author always thought he is a poor CW-operator but quite good on phone. Astonishing to see that the analysed data seem to indicate the contrary.

Conclusion

Our study shows that there is a clear (logarithmic) relationship between radiated power and your QSO-rate, except for some saturation at the limits of the curve. In CW the influence of power is not that much pronounced as on phone. In both modes Europe gets the lowest benefit from increasing power, followed by North America. And in both modes it seems that the influence of increased output is the highest in South America. Again this seems to be less pronounced in CW.

By a simple test, which we called the „power lottery“, you can evaluate how much your rate will increase with power. Based on the data from this test, you can find out how much gain you will need for a winning score. Doing such a test you may get some interesting results you never thought of. The data we have so far seem to indicate that an improvement in your station will more improve your high-rates than the low rate during the low hours. This is again more pronounced on phone than in CW. With our test you may also find out in which category and mode your chances are the best. We have done our test only in the SOAB category. But doing this analysis per band, which certainly will be somewhat time-consuming, will also show you on which band you have the best chances. Nevertheless calculating the regression and really winning the contest will be different, as you can not calculate the human factor and that extra dB from the operator.

It would be interesting to see the results for this test from other stations. Please feel free to contact the author.

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Literature:

[1] Katz, S., A novel perspective of amateur radio contesting, www.dynamicforesight.com/~ve5zx