

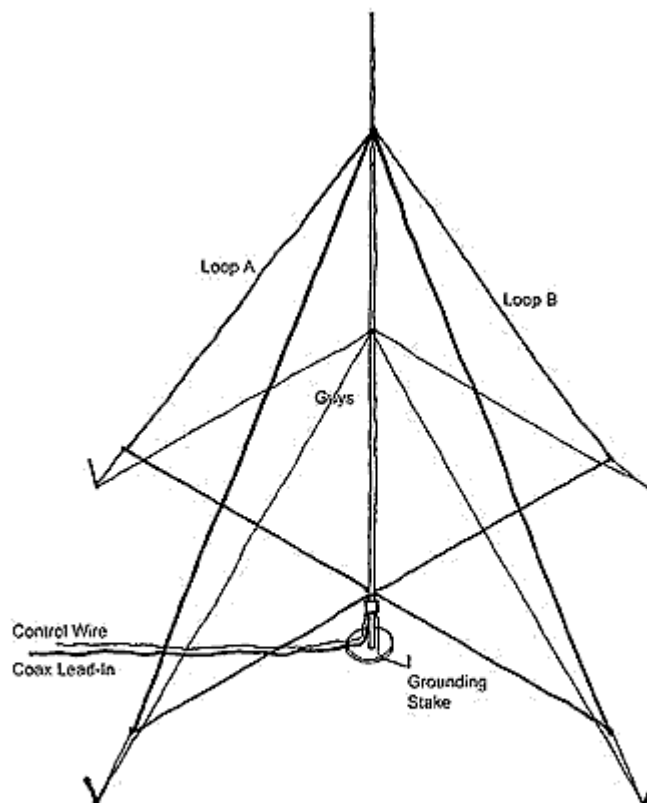
**Impressions and a field test  
K9AY loop antenna  
by Bjarne Mjelde  
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The K9AY loop is with little doubt the "hottest" DX gadget among serious DXers today. The Wellbrook K9AY has been widely acclaimed by many DXers, and several articles have been written about it, among others by Guy Atkins and John Bryant. Having proved brilliant performance despite its size, I felt tempted to buy one of these new toys.

A brief introduction for those not familiar with the Wellbrook Communications K9AY loop: The antenna uses two, or four, delta-shaped loops to provide a steerable cardioid pattern in 90° or 45° steps. A remote controlled variable termination allows the user to optimise the null during changes in the arrival angle of interfering signals, and provides a considerable improvement in reception quality.

The K9AY comprises of an Antenna control unit and two Antenna head units. A 10-15 dB broadband amplifier is selected by a front panel switch on the control unit. In addition, the control unit consists of a direction switch (8 directions, 4 directions for the 2-loop version), an Omni switch to select all loops, and a nulling control.

It is recommended that the loop be erected using a vertical support 7 meters high, the width should be 5 meters from the vertical support.



**TYPICAL K9AY ANTENNA INSTALLATION**

This version is cut for MW and LW, with each of the two loops being 26 feet on a side. Here, the wire of the loops themselves are also used as the upper support guy wires for the central mast. The lower, mid-level support guys are also anchored to the heavy tent pegs. The peak of the loops rises to 26 feet, if the control box is at 3 feet above the ground.

Above is John Bryant's 3D impression of a 2-loop K9AY

My loop was made by Wellbrook Communications. Because I live only 4.5 km from a 250 kW Loran C station on 100 kHz, I asked that the circuit be made especially to meet the challenge from this extremely noisy RF source. I ordered the vertical support from Germany; the radio amateur DK9SQ Walter Spieth manufactures a black fiberglass mast 10 meters high that is just about perfect for this. My loop was made with a height of 8.5 meters, width 5 meters, grounded with a single copper pipe and counterpoises under each loop. The distance to the nearest building (and RF source) is some 30 meters. The coaxes run some 50 meters each (they had to round corners J).

After some trial and error during the setting up of the loop, I finally made it stand rather perfectly vertical. I used guys at 1 meters and 6 meters. In addition, the loops themselves are fastened in a way that brings additional support to the mast. I think it's fairly solid and it has survived its first gale. The truth will emerge with the autumn and winter storms.

### **The shack**

The equipment used for testing and comparison were the following:

The Kneisner & Döring KWZ-30 broadband receiver. This excellent receiver has one feature not found on other receivers in its price segment – a very accurate field effect digital readout in addition to the usual S-meter. Thus I'm able to detect differences in signal levels not measurable when using an S-meter.

A 200-meter bidirectional beverage. It is directed towards ENE-WSW and is very efficient with regards to signals from Asia and Western Europe/South America.

The K9AY loop

A broadband ultra-linear combined 2-way splitter/preamplifier/wave trap made by Stefan Wikander of Sweden.

A broadband ultra-linear combined 4-way splitter/preamplifier made by Wellbrook Communications.

Coffee!

### **Comparison – benefits and drawbacks**

The beverage has a distinct front and back lobe, while it attenuates signals from the sides quite well. Of course, the lobes are not consistent throughout the MW spectrum, as its 1-wavelength lobe at 1500 kHz is considerably sharper than its ½-wavelength lobe at 750 kHz. Since the K9AY have consistent lobes, this indicates that comparisons be made with that in mind.

Because of the beverage's lobe properties, any comparison between that and the K9AY has to be done with stations being within the beverage's front or back lobes. Comparing the K9AY with the beverage in the latter's side null would be nonsense.

Of course one should have had 3 or 4 beverages to compare with. Since that is not the case, we can only do the best out of it.

All comparisons are made with the loop's amplifier ON, unless notified.

For those not familiar with how field effect in dBm is related to the usual S-meter readings: Approx. 6dB is one S-unit. The table below may serve as a guide:

<i>S-Units</i>	<i>Field Effect</i>
S 9+30	-43 dBm
S 9	-73 dBm
S 5	-98 dBm
S 1	-123 dBm
S 0	-130 dBm

### Signal Pattern

It has been said that the K9AY has a uniform nearly 270-degree main lobe, and a sharp, V-shaped back null. Mark Connelly once described it as "heart-shaped". This may be true for the 2-loop K9AY, but the 4-loop K9AY seems to have a different signal pattern.

Nulls are present not only in the back of the loop, but on the sides too. The below table shows the signal levels of daytime signals from NRK Vadsø 702 and Radio Rossii Murmansk 657 when using the null control to minimise signal level:

<b>Direction</b>	<b>R. Rossii Murmansk 657</b>	<b>NRK Vadsø 702</b>
North	-98 dBm	-100 dBm
North-East	-95 dBm	-103 dBm
East	-80 dBm	-84 dBm
South-East	-75 dBm	-80 dBm
South	-77 dBm	-84 dBm
South-West	-84 dBm	-95 dBm
West	-90 dBm	-98 dBm
North-West	-103 dBm	-110 dBm

This not only shows that one can null a signal on the 90° and 135° sides of the loop (in addition to the 180° null), but it seems to confirm a finding made at a Grayland, WA DX-pediton, namely that the loop has a distinct and relatively sharp front lobe that is more sensitive than settings 45° away. The South-East position (in bold) is the approximate bearing of the stations. We see that 45° away, the signal is 3-5 dB weaker. Not a substantial amount I admit, but nevertheless quite interesting. The difference in gain seems to increase with wavelength, as tests on stations below 600 kHz suggested even greater differences. Above 1300 kHz the difference is difficult to measure. So, does the loop have consistent lobes as stated under "Comparison - ..."? Evidently not! It seems to have a narrower lobe with increasing wavelength, contrary to the beverage which has a narrower lobe with decreasing wavelength.

The table seems to suggest that using the nulling control, the loop has a 90° (or possibly even <90°) front lobe, approximate nulls of 15-20dB at 90°, approximate nulls of >20dB at 135°, and nulls >25dB at 180°. In other words, nulling increases with angle from the loop's plane.

The null levels 90° away from the bearing are not uniform, as one would expect them to be. This could be because the bearing of the stations are not exactly aligned with the plane of the loops, and that the side null is rather sharp. To find the antenna's exact azimuth one would have to place it on a rotor and measure every few degrees. The coarse 45-degree steps are insufficient in finding exact null values or any "hidden" side/back lobes (except if using mean values of a large number of stations covering all directions. That project would be too ambitious for me to enter).

### **Noise**

The K9AY is claimed to be as silent as a T2FD, and more silent than an ordinary longwire. To find out about this, I first measured the signal reading of the KWZ-30 with no antenna load. This read as -123 dBm. I then connected the beverage on an empty frequency (1500 kHz) at daylight. The readout was -122 dBm. When I connected the K9AY, readout varied between -119 and -120 dBm on the 8 directions. Considering that the 10-15 dB amp was on, this is truly excellent. With amp off, it was down to -123 dBm. In comparison, the beverage connected to Wikander's preamp gave a readout of around -116 dBm.

Another aspect of the noise problem is the Loran C. Some of the readers may be informed about what this 260-meter high tower, equipped with a 250 kW transmitter, operating on 100 kHz only 4.5 km away does to my beverage antennas. The only remedy that partially cures the pain is a wave-trap designed for attenuating signals on 100 and 200 kHz. Several attempts to make highpass filters to attenuate signals below 500 kHz have fallen short.

The noise makes DX impossible in the 550-590 kHz range, and is a major disturbance to DX between 890 and 1100 kHz. On other frequencies it's just a pain in the as - sorry, neck. I have noticed that the noise level increases with the length of the antenna. Hence, I had hopes that the short wires of the K9AY could have a positive effect on the Loran C noise. A test of the Wellbrook ALA100 loop (16-meter circumference) in 1999 proved that this could indeed be the case.

And it did. Surely, the Loran C is noticeable on the frequency ranges mentioned above. However, the noise level is significantly lower than with the beverage. And more: It is possible to null the noise completely with some of the direction settings. That alone nearly justified the cost and labour with the K9AY. A test with the Iceland 189 kHz station comes to mind; with the beverage one could barely hear that there was "something" behind the noise. With the loop, Iceland was totally in the clear with practically no noise.

### **Signal level**

Local or semi-local daytime signals are roughly equal level on the loop and the beverage on the lower part of MW, slightly higher advantage loop on the higher part. Now, since local MW stations aren't the reason why I bought the K9AY, I did a sunset/post-sunset comparison with long-distance signals (mainly from Japan, China, Taiwan and The Philippines). Comparison was difficult because the beverage signals fluctuated as much as 10 dB while the loop signals were extremely stable. Conditions were generally poor, with an A-index of 16 and unsettled/minor storm geomagnetic levels.

Generally, the beverage had a 1-4 dB higher signal level on the middle and higher parts of the MW band, while on the lower part the difference was around 6-10 dB or roughly 1 S-unit. Comparing a (although modest length) beverage directed at its main target, and observing the K9AY playing practically at the same level was most rewarding. Of course, one should expect that the difference in signal level would increase with the length of the beverage, and that e.g. a 1000-meter beverage would outperform the K9AY by a solid margin. Will all owners of an array of 1000-meter beverages please stand up...

A difference in signal levels by 1-3 dB is, when using one's ears, nothing. I was unable to detect any differences in audio that would suggest that the two antennas performed differently. Had I not had the measuring equipment to help me, my conclusion would have been that there was no difference at all.

Other users (such as participants to the Newfoundland and Grayland DX-peditions) have reported that a beverage directed to a specific area will perform better than the K9AY for stations from that area. This corresponds with my experience, but will not play a major role until the beverage reaches a length well above 200 meters. However, a long beverage with a narrow lobe will leave areas uncovered. Unless one has a large beverage array (such as Lemmenjoki, Finland), the K9AY will do very nicely in "filling the gaps", so to speak.

There is of course one other advantage with the beverage, as a two-three beverage array towards one area (like North America for a European DXer) will have the ability to separate stations from different parts of the continent, while the K9AY will tend to hear all parts at once. Possible result: Fewer stations to reach a readable level than with the beverages.

Will the K9AY permit further amplification? During winter days here in the Arctic, signal levels are often low, and beverage antennas are often amplified to let that rare DX come through. As far as I can tell, the K9AY can stand another 10 dB amplification in the form of an excellent quality preamp without problems, provided that signal levels in general are on the low side. Intermod. from the Loran C appears very quickly if linearity is compromised; connecting the Wikander 10 dB preamp to the K9AY did not cause any intermodulation problems. There is however a general rule that signal level not be increased unless it's necessary. One should comply with that. For all I know, K9AY users in RF-plagued parts of the world, such as Central Europe or North America, may be best served by having the amp switched off altogether.

The ultimate test, as I see it, would be the K9AY's sensitivity in a low-noise, ultra-low signal level environment, as one often experiences during winter days here in the Arctic. I had a chance to find out as the geomagnetic field finally settled to "quiet" with an A-index of 5. This would enable loggings of North American stations.

I pulled out of bed just at sunrise, to discover that there were weak East Coast signals on frequencies like 1520, 1500, 1200, 1150, 950 and some others. I first used the loop with the KWZ-30 and the beverage with the AR7030+, and then swapped receivers since the AOR is slightly more sensitive than the KWZ-30.

The noise level was so low that I could actually hear stations with 100% readability at a -118 dBm signal level. No European interference was present on the frequencies I checked. I was very surprised to learn that the K9AY played at equal terms with the beverage on all frequencies down to around 900 kHz. Below that the K9AY was less sensitive than the beverage, but still only marginally so. In fact, since I could null the Loran C so effectively, readability was on several occasions better than with the beverage. The stations were audible (though still at a very low signal level) well past sunrise. When connected to the AR7030+, I could use the internal preamp in addition to that of the loop without any problems. Readability improved greatly.

True enough, the beverage isn't optimised for East Coast North America (ECNA) reception with its direction somewhat to the South of the continent. But it was the best ECNA performer in my previous 2-beverage array towards North America, so I feel that the comparison was pretty fair.



## **Nulling**

Wellbrook Communications claims nulls of typically 20 dB, with up to 40 dB nulls in some cases. From what I've learned, a proper ground system is critical for this to take place. This is a problem here where the ground is generally rocky and/or stony beneath a 10-20 cm thin layer of soil. My original ground rod was 40 cm deep, certainly inferior to the 1-1.5 meter rods into moist clay that I've heard some have.

On daytime signals from local stations, I was first able to null around 20 dB. This didn't seem satisfactory, so I recalled an article written by Nick Hall-Patch some years ago about using salt water to enhance short ground rod's grounding abilities. This seemed to help, as I did null the local NRK by 32 dB (and later up to 47 dB) at daytime. However nulls were less profound during darkness.

In general, I'm able to obtain nulls in the 10-20 dB region on skywave signals and 20-35 dB on local/semilocal signals. This is good, but you need to work on the grounding systems to maintain this level. I have heard other K9AY owners having a problem with nulling, and I suspect that insufficient grounding may be the problem. I modified the ground somewhat by introducing another rod, and connected the counterpoises and ground lead to the head unit for two loops onto each rod. I also interconnected the counterpoises at the far end. Anything better than this is hard to get. It remains to test the Bentonite solution suggested on HCDX.

Unlike a phasing system, when you have obtained a null from a station in a specific direction, the null is consistent over a large bandwidth. This means that you don't have to retune the loop when you move to another frequency, given that interference comes from roughly the same direction. Scan the MW band with the null on and the noise level on every frequency is like if you switched on an attenuator. Compared to an antenna phasing system, nulling on the K9AY is much less time consuming.

I have also fed two receivers with output from the K9AY via splitters. I tested two different active splitters with this setup, and there was no noticeable difference from using only one receiver.

## **Phasing**

Phasing? With a K9AY loop? Well yes, actually. The Wellbrook K9AY has an Omni switch to select all loops instead of only one. I thought that in its Omni mode the K9AY should behave rather like a vertical antenna, such as an Inverted-L. To put this "theory" to test I connected the K9AY and the beverage to a Wellbrook APU-100 antenna phaser. And it worked! I nulled the local NRK 702 by >40 dB easily, and had nulls of 10-30dB on several other frequencies.

Since a phaser (like the APU100 or the more widely spread MFJ 1025/1026) is not only capable of nulling, but enhancing as well, I also achieved considerable gain increase on many frequencies. I used the AR7030+ for this test so I have no exact numbers except the general term: It works! The most stunning example was eliminating the semi-local NRK-702 kHz to bring a clear signal from Iran... OK so conditions were extremely auroral at the time but still!

One may ask why one would use an expensive antenna like the K9AY as a noise antenna with a phaser, when one can be perfectly well covered with a simple design like an Inverted-L. That's not really the question. It simply adds versatility to the K9AY and reduces the need for putting up more antennas. On the other hand, adding boxes like the K9AY control unit, the phaser control, preamps, antenna switches etc. really messes up your radio shack. Or so my spouse says.

## **Shortwave**

To be honest, I don't tune the SW bands very much, except for the odd newscast from BBC World Service. Compared to the beverage again, the signal level is very much higher – so high that one should switch off the amplifier. I have detected mild directionality on SW up to the 49 meter band – propagation has left the lower bands empty so there was really nothing much to test.

For most purposes the K9AY is excellent for SWL and probably for DXing too, except it's lack of directionality may give more noise than a beverage antenna directed at a specific area. John Bryant has an extensive discussion on this topic.

## **The support**

A few words if you consider setting up the loop with a fiberglass mast:

The DK9SQ mast have a tendency of de-telescoping if too much load is applied. This may happen with the combination of four loops, guys and heavy wind. It is recommended to use strong tape or hose clamps to fasten the telescope elements. Alternatively, one can go for the fiberglass mast from Von der Ley Kunststofftechnik in Germany; the elements are locked mechanically instead of having to rely on friction alone. Alas, the mast is considerably more expensive than DK9SQ's mast.

## **Conclusions**

This is without doubt THE antenna for those who want to do serious MW DXing and do not have the space to erect multiple long beverage antennas. It will null local or semi-local stations quite effectively, probably far more than any beverage can do, and with an ability to steer the null as well. Its gain makes it very effective for any kind of DX – be it nighttime, greyline or daytime.

It is expensive – currently (latest price update as per June 2002) the two-loop version runs at GBP 200 (plus postage and packing GBP 15). You also need to cash out for wires, coaxes, vertical support (unless you have a nice-fitting tree). But expense is a relative term. It is expensive compared to the random longwire, or one or two beverages, but compared to many active antennas that are commercially available, it's really cheap. The price/performance ratio is truly excellent. And compared to the GBP 1000+ receivers we love to buy, and considering that the antenna system is the truly critical part of our listening station, it's definitely cheap. Go buy yourself a DX-One Pro at double the price and I predict utter disappointment if you compare it with the K9AY (but I admit it takes up a lot less room).

## **Enough said?**

Hardly! I and many other K9AY users will undoubtedly gain a lot of experience during the coming autumn and winter. Hopefully, by the coming spring, we will have found out a lot more about this fabulous tool. Well done, Gary Breed and Andy Ikin!

## *K9AY ADDENDUM: THE "TRUE" BEVERAGE TEST*

Those who have read the article above will have noticed that the K9AY vs. beverage comparison was rather incomplete, in that I only had one relatively short (200 m) beverage to compare with. Hence, the results from that comparison would not necessarily be valid for longer beverages. I discussed this in my paper.

Eager to find out more about how a K9AY loop works compared to beverages, I went to my cottage in Kongsfjord, 34 km SE of Berlevag. The location there is extremely quiet with 250 m to the nearest neighbours (actually only three homes) and no other manmade noise within a 1.5 km radius. Topographically it's only seconded by the endless Arctic inland tundra found in Canada, Northern Scandinavia and Russia.

In Kongsfjord I have erected four beverages: 380 m beamed at the US West Coast, 450 m beamed at Alaska/Hawaii, 570 m beamed at the Far East/Western Pacific, and finally 400m beamed at South East Asia/Australia. Although a comparison with beverages still leave the really long ones (1000m +) untested, I feel that with this array it is possible to make a more valid test. Two reasons: I have four bearings, and the beverages themselves are 2-3 times the length of my Berlevag beverage (which by the way has been discontinued since it was never able to really outperform the loop). The K9AY used in Kongsfjord is more or less identical to that used in Berlevag.

### **Noise level**

One may remember that in my article, I measured the difference in signal level on a no-signal frequency. The beverage was 2-3 dB quieter than the K9AY with the K9AY amplifier on. A comparison in Kongsfjord with the 380 m "US" beverage revealed that the beverage was only 0-1 dB quieter. With the K9AY amplifier off, the loop was 1-2 dB quieter. It would be fair to say that the two antennas play at equal terms in this respect. To control that there was nothing wrong with the "US" beverage I also tested the "Far East" beverage. The signal level was identical with the "US" beverage.

### **High signal level**

During periods of high signal levels, i.e. during darkness, the K9AY compares quite well with beverages. The beverage has the edge with regards to stations in the bearing of the beverage, but the loop plays at equal terms with stations located 30-40° away from the beverage's front lobe.

The beverage lobe is however sharper and produces less interference from stations 30-40° and more from its bearing. The K9AY has a broader pick-up area. In our setting, the beverages made it possible for us to separate stations from Japan and the Philippines by selecting the appropriate beverage, while the K9AY brought both. In several instances, the K9AY was able to reduce interference "from the back", sometimes resulting in increased readability of the desired station.

### **Low signal level**

This is where - not unexpectedly - the beverage excels. As mentioned in my previous paper, local interference is often not a problem during daylight DX, and the desired DX often have signal levels down in the -100 to -110 dBm range. There is really no contest in these instances. If you want to track down these stations, there is no alternative to long beverages. It should be mentioned however, that very few DXers are in the position (geographically speaking) to be able to DX rare stations on MW during daylight. Mostly such DX is confined to areas where the angle of the sun is very low, and the distance to darkness is short. The Polar regions experience this during late autumn, winter and early spring.

### **Conclusion**

The results reported under "Low Signal Level" should not scare anyone from trying the K9AY. It simply states that no antenna will be able to perform best under every circumstance. The K9AY will work brilliantly in a number of settings - though not in every instance.

### **Resources:**

John Bryant  
Guy Atkins  
Mark Connelly  
K9AY Internet mailing list  
HCDX Internet mailing list  
Wellbrook Communications/Andy Ikin  
Karen Milliken  
DK9SQ/Walter Spieth  
Nick Hall-Patch  
W1WCR/Victor Misek (literature)  
ON4UN/John Devoldere (literature)