Common Cents & The BIG Picture

by William "Dr. Bill" Hanneman

A one piece fly rod is practically unheard of, two and three piece rods are common, and four to seven piece rods are becoming popular.

Since multi-piece rods give you, the rod maker, many more degrees of freedom, it behooves you to better understand how to predict and control the intrinsic properties of any rod you build.

We know that the performance and feel of a rod depends upon its construction and the relative strengths of the rod's tip, mid-section, and butt. In this article I shall show how the Common Cents Approach can be used on several commercial fly rods to gain insights relative to the concepts of their designs. But first, I have to introduce what I call the BIG Picture.

The BIG Picture

In the last issue, my Common Cents Approach to characterizing fly rods was introduced, along with the concept of the Defined Bending Index (DBI). This is expressed in the form of DBI = ERN / AA. Note: This is not a mathematical equation, but rather a shorthand notation where ERN (Effective Rod Number) describes the intrinsic power of the rod, and AA (Action Angle) describes the action of the rod.

The ERN is determined from the number of common one cent pieces required to deflect a horizontally fixed rod downward a distance equal to one third of its length. The AA is a measure of the angle the tip top forms when the rod is so deflected. These two values provide unique coordinates for that rod on a chart plotting the DBI as ERN vs AA. This is extremely useful for comparing completed rods, i.e., the final destination of the rod maker's odyssey (See Common Cents Figure 5 in RodMaker 6 #2.)

While knowing where a rod ends up is important to the consumer, the keen rod maker is more concerned with where the journey began and the route followed to the final destination. In other words, one would like to see the BIG Picture.

Since bending for a fully loaded rod is defined as equal to one third of the rod's length, a DBI can be determined over any length of a rod blank, tip, mid-section, or butt one might choose. By combining such measurements, one can create that BIG Picture. Let me show you how.

If one treats an entire rod as a single blank, one can determine the DBI of any shorter rod which could be constructed from it. To do this, I constructed the fixture shown in Figure 1 to hold the rod. It serves as the handle and prevents undue flexing in that region. Then, starting with one foot of exposed tip, I determined that DBI. Subsequently, I increased the length of the tip one foot at a time and determined each new DBI up to a distance of seven feet of free rod.

This was done on three rods, described later, and the data was plotted to create the BIG (Bending Index Graph) Picture shown in Figure 2. For each rod, the data points are numbered corresponding to the length of free flexing rod. The final 0 value represents the DBI of the complete rod.

A Tale of Three Rods - A, B and C

Living on the Olympic Peninsula, only eight miles from the Sage factory, most of my fishing friends swear by their products. Consequently, it was easy to obtain a selection of rods to examine.

My goal is to evaluate the relative roles of intrinsic rod strength and rod action in determining the distance one can cast - excluding the vastly more significant factors of hauls, double hauls, and advanced casting skills. It also requires several rods of approximately the same ERN but differing AA values.

One fishing buddy provided me with two "7-weight" rods (i.e., designated for use with an AFTMA No. 7 line.) Rod A (a 10 ft. Prototype) had a moderate/slow action with a DBI = 7.8 : 60. Rod B (796 RPL) had a moderate/fast action with a DBI = 7.7 : 65. Another friend provided rod C (796-4 XP) which had a fast action with a DBI = 7.4 : 70. (796 indicates a 9′6″ rod for an AFTMA No. 7 line.)

Interpreting the Data

In general shape, curves A, B, and C in Figure 2 appear both typical and similar - like a U lying on its side.

Point 1 reflects the strength of the first 12 inches of the tip. Generally this is relatively strong to force the bending down from the tip, i.e., preventing the action from being too fast. It is subsequently modified by the next two feet of the tip.

The first two feet of tip (points 1-2) still indicate extremely slow actions. Rods B and C do indicate a greater speeding up of action, however, rod A is stronger and never manages to completely overcome its original slowness.

The first three feet (points 1-3) essentially define the minimum intrinsic power of any rod which might be constructed from that tip. The tip for rod A could produce a 5-weight rod if the mid section and butt were so constructed to retain that intrinsic strength. The tip of rod B could produce a 4-weight rod, and the tip of rod C could produce a 3-weight rod. Unfortunately, such rods would have to be inordinately long to produce anything but extremely slow action rods. (This appears to be relevant to Spey rods.)

All of this makes sense. We intuitively recognize that since the intrinsic strength (ERN) of these three rods are essentially the same, the weaker the tip the faster the action will be. So it is, and the BIG Picture provides the objective measurements proving it.

The effect of the butt section of the rod is described by the last two points (7 and the 0 final point). The addition of a stiff butt section always increases both the ERN (intrinsic power) and AA (action). Also, the relative changes in AA relative to

Figure 1

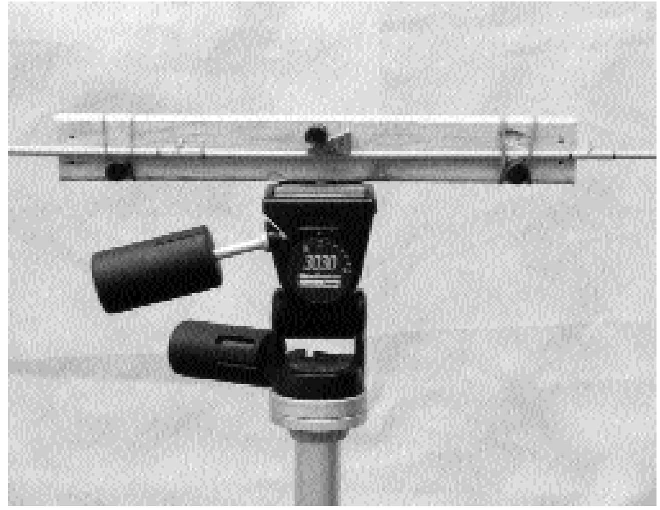


Figure 2

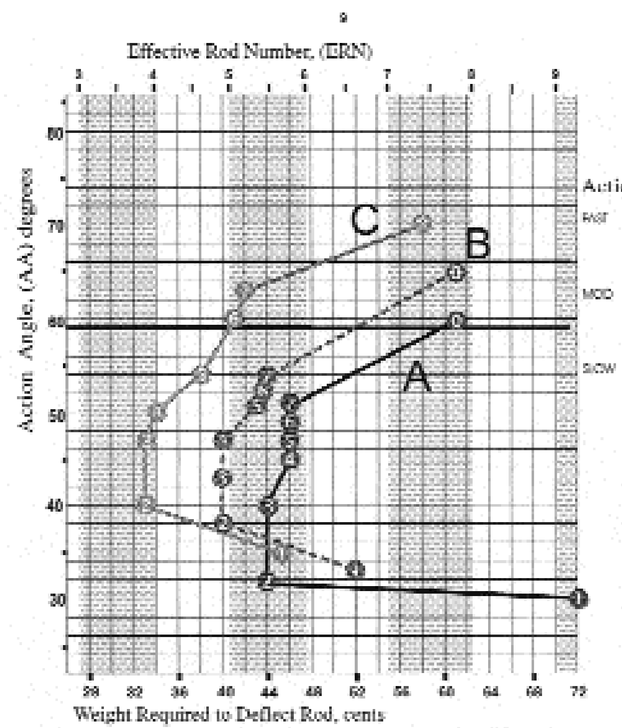
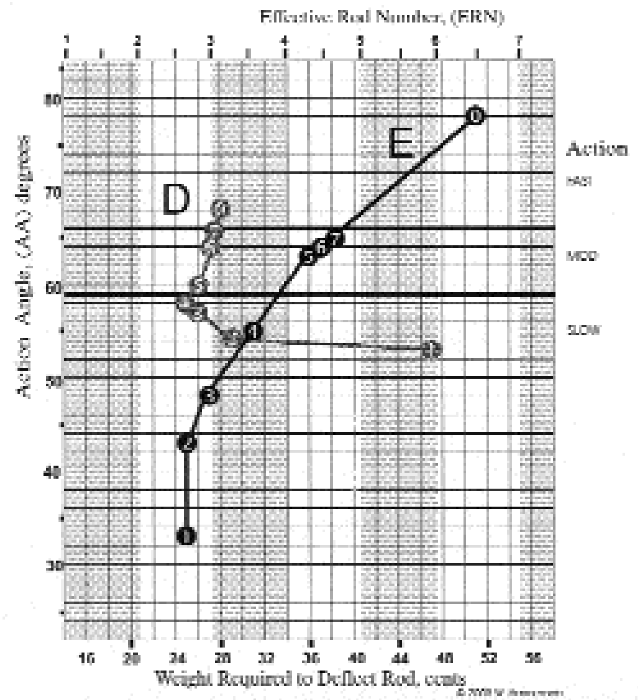


Figure 3



changes in ERN due to increasing the lengths (i.e., the slopes of the lines) of these three butts are very similar. Consequently, for instance, if you know your destination, i.e., the specified DBI, you might be able to work backwards to determine just what you must demand of the mid section - providing, of course, the tip you started with was appropriate.

The mid-regions of these rods (points 4 through 7) serve to blend their weak tips to their strong butts - hopefully, in a smooth gradation. This is where the rod maker's skill is tested.

If one considers just where the rod sections are joined, it is often possible to correlate joints with discontinuities in the curves. For instance, rod A, a two piece rod joined at point 5, produces a very smooth transition. Rod B is also a two piece rod joined between points 4 and 5 and exhibits a discontinuity. Finally, rod C is a four piece rod and the discontinuities are more evident.

While these discontinuities can indeed be detected, they do not materially affect the rods' performances in the hands of the average angler. However, expert casters may not feel the same. Nevertheless, multi-piece travel rods are popular and you should master the technique of making that transition smooth.

Using any number of sections you might wish, you should be able to construct any type of action you might desire. In any event, being able to make DBI measurements and with the information derived from the BIG Picture, you can accurately predict your results and/or indicate any problems which might later become serious.

Table A

Cents*	Nominal Rod No.	IP Range, grains IP_{low}	IP_{high}
<14	0	130	550
15-20	1	550	790
21-26	2	790	1050
27-33	3	1050	1310
34-40	4	1310	1570
41-47	5	1570	1830
48-54	6	1830	2115

*One cent = 38.61 grains

Rod D - An Old Favorite - The Sage 389 LL

While we "old timers" can enjoy our old 389 LL rods (389 signified a rod designed for use with an AFTMA No. 3 fly line and having a length of eight feet nine inches. The LL signified "Light Line." Here, the term "Line" appears to have referred more to a product line than to a fly line.), there appears hope for you newcomers. Recently, I received several catalogs describing Sage's 2003 new products. In one was the statement, "The VPS Light is actually a resurrection of the LL (Light Line) rod that was a casualty in the race for high performance rods." That could be good news.

Unfortunately, words are cheap, and subjective descriptions are essentially meaningless. These rods were said to be "slightly softer action," "still relatively fast action rods," and "feature a medium action." However, obvious questions arise: Softer than what? Relatively faster that what? and since action is defined in terms of fast, moderate, and slow, what is the definition of medium action?

Explaining my quest, I asked Sage if I could examine one of these rods. My letter was never acknowledged. Consequently, I can only report on my old rod.

Experimental Results

For this study, my two piece rod (Rod D) was examined as previously described. The result, DBI = 3.1 : 68, indicates a "very weak" 3-weight rod with what could be called a fast action (This designation will be discussed later.). The results are plotted in Figure 3.

With this rod, the tip (point 1) gives the maximum ERN value and the minimum AA value. As the tip is lengthened (points 1 and 2), the ERN decreases very rapidly and the AA rises slowly. At point 2, the ERN decreases more slowly while the AA increases rapidly. Points 1 to 3 represent the intrinsic properties of the tip section. Then, at point 4, the effect of the butt section comes into play. The effect of this stronger butt section causes the ERN to increase again. Also, the AA continues increasing, i.e. the action gets faster and the rod stronger - but at a very slow rate. The results on the tip section (points 1, 2, and 3) indicate this tip is suitable for constructing a slow action 2-weight rod - providing a suitable butt is used. The addition of a stiffer butt always increases both the ERN and the action (AA) of the rod. The butt provided (points 4-8) did just that. The net result was a 3-weight rod - but barely.

While the first five feet of Rod D has characteristics similar to Rods A, B, and C, the butt sections are entirely different. Instead of a U shaped curve, it produces more of a J. Whereas the previous rods showed a rapid increase in ERN (strength) with increased length, Rod D showed very little change. This is the result of having to use a relatively weak butt in order to produce a 3-weight rod from that tip.

This illustrates the need for seeing the BIG Picture and recognizing the path taken to the final result.

The characteristics of the first three feet of tip indicate a relatively strong slow action - pushing the minimum ERN to the 4 foot point. Characteristics of the last three feet of butt indicate a weak butt incapable of producing a classic fast action rod.

One of the results of this configuration is that the AA no longer primarily reflects the tip, but also the effects of the very weak butt - producing abnormally high AA values. This indicates the heavy dividing lines for action in Figure 3 are not valid for very low ERN creations. This, in turn, raises the question whether or not one can actually construct a classic fast action ultra light fly rod. We'll leave that to the tip designers and/or the next generation of graphite.

Rod E - The Ultimate?

Another friend loaned me his Sage New Ultra High-Performance 590-4 TCR which I dubbed rod E. (The designation TCR stands for Technical Casting Rod and this model is said by Sage to be the result of "a design exercise to find out just how far we could push the boundaries of fast action taper.")

We know that the weaker the tip and the stronger the butt, the faster the action will be. The BIG Picture for this rod is plotted as rod E in Figure 3. These data indicate they have taken a very weak tip suitable for a short 2-weight rod and wedded it to a stiff butt to produce a 6-weight rod with a very fast action. The DBI = 6.5 / 78.

The BIG Picture does indeed demonstrate that they have succeeded in pushing the boundaries of fast action taper. You will note no initial strong tip, the vertical line between points 1 and 2, as well as the smooth gentle curve between point 2 and the end of the rod. This is markedly different from the discontinuous U shaped curves of Rods A, B, and C or the J shaped curve of Rod D.

Leveling the Playing Field

Found within the catalog of an agent for Rod E was the statement "(not designed just for tournament casting)." Although not being familiar with this sport, this statement gave me pause.

Since it is generally understood a 12-weight rod will cast a line farther than will a 6-weight rod, I assume there must be weight classifications in order to give the little man a chance - like boxing. If that is so, in what classification would rod E qualify?

The ERN of this rod is 6.5 (mid-range 6-weight), however, the rod is labeled "No. 5 Line." To compound the matter, a specially designed line has been produced for this rod, however, that line does not meet the manufacturing specifications for an AFTMA No. 5 line. The Effective Line Number (ERN) of this line is 6.0. (Matching rod to line and how to measure ELN will be covered in the next issue)

I would think that, at the boxing weigh-in where officials do not take the word of the contestants, the intrinsic properties of the rods and lines are objectively measured.

I recognize that heretofore there has been no means of easily doing this. However, with the introduction of the simple Common Cents Approach and Dr. Bill's Fly Line Analyzer (see next issue) there is no reason why future contests could not be held on a level field.

AFTMA has already set standards for fly line weight. If a rod is not designed to function as expected (i.e. fully load the rod using 30 feet of line under normal casting conditions) with any specified AFTMA line number, it should not be labeled as for that Line Number.

Likewise, if a rod does not meet the intrinsic power specifications for a given weight (corresponding to the AFTMA standard line number) it should not be called by that number.

These precepts should apply equally to tournament competition and the retail marketplace.

However, a 5-weight rod or any other x-weight rod has never been defined in terms of its intrinsic strength. Table A will rectify that issue for common trout fly rods. As for more powerful rods designed specifically to cast more than 30 feet of line, a different approach is required to match rods with lines. That too will be treated in the next issue. ✍