Chapter 2 - Predicted Log Contest

Overview of Predicted Log Contests

A predicted log contest (PLC) may be sponsored as an event in itself with accompanying rendezvous, party, award ceremony, and other related activities. It may be staged as one activity in a rendezvous weekend or other event. United States Power Squadrons Districts often sponsor a PLC in connection with a boating rendezvous or conference. In any case, the sponsoring organization defines and publishes a description of the contest course. The course description establishes the starting point, the specific route to be followed, control points along the way, the finish point, starting or finish time requirements, and such other information as may be needed. Standing and special rules, as formal or informal as required to conduct the contest, are made available to potential contestants ahead of time. Participants take this and other information on currents, tides, boat performance, etc., and use those data to prepare their logs, predictions of the exact time (to the nearest second of time) they will be at each control point.

Shortly before the contest, each contestant will enter all the pertinent information on a form provided by the committee and present the form to the committee. Each contestant will be assigned an observer, who represents the committee, to accompany each boat. Each boat will then proceed to the starting point. At a specified time each boat will cross the starting line and proceed to each control point (checkpoint) along the described course. The observer keeps a record of the *exact* times at each control point and enters the times to the *exact* second into the contest log. This log becomes the official record of what each contestant did and is the basis for scoring the contest.

At the conclusion of the contest, the contestant and the observer turn the contest log in to the committee who then compare all logs and determine the winner. The winner is the contestant who actually ran the course with the smallest total error from the predicted time.

PLC Equipment

Charts

The first piece of equipment to be used in preparation for a predicted log contest is the paper chart. Electronic charts based on GPS equipment are specifically prohibited in sanctioned predicted log contests because speed, time and distances are integral elements of GPS equipment. Charts to be used are those specified by the committee of the sponsoring organization. They should be the latest edition; older charts may not show changes to aids to navigation. Another reason for using the latest edition is that NOAA is in the process of changing to the 1987 North American Datum for latitude and longitude and converting to metric charts. Courses must be accurately drawn on charts and distances carefully measured. Plots should be checked by a competent crew member because even expert predicted loggers have been known to make "novice" errors. The same individual frequently repeats the same error on a recheck.

Compass and Pelorus

Since many course descriptions include requirements to steer a prescribed course, an accurately compensated compass should be installed on the boat and a deviation table prepared and used.

It is occasionally helpful to be able to take relative bearings on various objects during a contest. A well-mounted pelorus can be invaluable for this purpose. Practice in using a pelorus is necessary for successful use of this technique under contest conditions.

Engines

Engines should be in reliable condition. In order to minimize errors, the boat should carry approximately the same amount of fuel, water, and personnel weight during the contest as was carried on the speed trial runs. Or, to emphasize the obvious, all preliminary calibration trials should be run with a "standard" amount of fuel and other supplies on the boat. Sufficient fuel for the contest and emergencies should be in the tanks. Fuel filters should be checked. Closed cooling systems should be checked for water leaks, and engines and transmissions checked for oil leaks and fluid levels.

Tachometers

A tachometer is the only piece of equipment normally allowed to be used to measure the boat's speed during a predicted log contest. Either digital or analog tachometers can be used. Digital instruments tend to be more precise, but good analog tachometers can provide adequate accuracy. The goal is to be able to repeat the tachometer setting later and be traveling at the same speed as before on a consistent basis. As will be seen, a speed curve, showing boat speed in knots at various engine rpm, must be developed before the contest. This speed should be well below the maximum operating speed of the engine. There should be sufficient range of engine speeds available on each side of the selected speed to permit the application of any mid-course variation allowed by the contest rules and to be available in emergencies.

Engine Synchronization

On boats with twin engines, use one tachometer (always use the same one -- port or starboard) as the primary control for rpm and synchronize the other engine with it. Unless you have an automatic synchronizer or digital tachometers, the best method is "sound", as two tachometers will rarely agree precisely when the engines are synchronized. Often there may be 100 rpm or more variation between the two instruments. The same may be true if you have two tachometers on one engine. When increasing speed, move throttles up to desired point rather than passing your predetermined speed and then backing the throttle down. This avoids cable slippage. Set throttles as accurately as possible. Do not make the mistake of moving the throttle to a "set" position. Instead, set the throttle at a fixed engine speed as shown on the tachometer.

Watches and Timing Devices

Ship's clocks, engine-hour meters, any device that can indicate time or elapsed time, and all watches except the skipper's and the "official" watch provided for the observer are covered over or stored before the contest. The skipper's watch may be used to determine the start time and then immediately given over to the observer for the duration of the contest. The observer's "official" watch, which may be the watch handed to him by the skipper, should be easily readable to the nearest second. It may also be synchronized with the contest committee's "official" time, which is in turn normally synchronized with Universal Time. A digital timepiece is usually preferred.

The following may be perceived as being "picky-picky", but it is important that ALL time-keeping devices aboard the boat be out of sight *except* for the observer's official watch. This ensures that no guest will be tempted to "assist" the skipper.

Safety Equipment

All equipment required by the United States Coast Guard and any special equipment required by the contest committee must be aboard and in good working condition. A Vessel Safety Check (VSC) courtesy motorboat examination by the Coast Guard Auxiliary or United States Power Squadrons is required or recommended by most contest committees. The VSC decal should be affixed or suitable evidence furnished that an equivalent exam has been made and passed. The crew should be familiar with all safety equipment and location of life jackets, dinghies, life rafts, and flares.

Other Equipment

Speed or distance measuring devices such as radar, loran, radio direction finders are not generally used except under conditions of reduced visibility or when needed for safety purposes. Autopilots and depth sounders are normally permitted. Autopilots help eliminate "fiddling" with throttle settings, but can introduce other errors. Depth sounders are an aid when running narrow channels in tidal bays and rivers.

General Preparations for Predicted Log Contests

Steering Practice

Without practice, it is very difficult to form the habit of steering the straight line courses prescribed by predicted log course descriptions. Any wavering back and forth along the way merely increases the distance traveled and introduces unnecessary errors into the running of the contest. In any case, some compromise is necessary, because attempts to be too rigid about steering can be very tiring on a long run. The important thing is to steer the same way during the contest as on the measured distances used to develop speed curves.

In the course of normal cruising, boaters should form a practice of steering a straight or mid-channel course. There are at least three ways to determine a straight course. First, turn the boat onto a given compass course and steer so as to maintain that course on the compass by making small adjustments as needed. As skills improve, adjustments become smaller and less frequent. Second, get onto a course and notice a fixed point or object and steer toward it. Notice the compass heading occasionally. If this compass indicates heading changes while still heading toward the point, current or wind is affecting the boat. Practice in overcoming these effects will improve performance as a predicted logger. Third, and the best method, is to set a course to stay on a range of two objects. Find a point on the shore and another further away and stay on the line they form. These points are usually ahead. You may be able to use a back range (two objects in line behind the boat). A back range is more difficult to use, but is just as accurate as a normal range ahead of the boat.

Speed Curve

All cruising boatmen should have a complete speed curve pertaining to their boat. They should know how many knots their boat moves through the water for at least three engine speeds:

1. No wake speed;
2. Comfortable economy cruise;
3. Maximum sustainable speed.

It is absolutely necessary in a predicted log contest to know the speed curve at least over the fairly narrow range of throttle settings that will be expected during the contest. In order to obtain such a curve, select any measured mile course or any equivalent course whose distance is known accurately. Avoid distances between floating aids to navigation. These floating aids are rarely sufficiently accurate and can vary over a period of just a few hours.

If a measured mile course is not available, use any accurately determined distance. Almost any kind of feature forming a line of position or a point of position may be used for the end points: the face of a bridge, a range formed by two stacks, the end of a dock, a dolphin. However, distances between features on any but the largest scale charts are generally not accurate enough. Accurate distances usually require surveys or surveying instruments for their determination. A measured mile (statute or nautical) is much preferable.

Determine speeds by using the Speed-Time-Distance equation. This is good old "Sixty-Dee-Street." For most purposes, this can be expressed as 60 D = S T, where D is the distance traveled in nautical miles, S is the boat's speed through water in knots, and T is the time in minutes required to travel the distance. In creating a speed curve we'll be dealing with a relatively short straight line distance of about a mile. This means we should time our passages in <u>seconds</u> rather than hours or minutes to arrive at time. To put it simply, "Sixty-Dee=Street" is not good enough. You'll be dealing with seconds. Use this formula:

3600 D = ST

If any two of these quantities are known, the missing quantity can be calculated. A 3600 D = S T calculation with a boat moving at an S of 10 knots for a T of 60 seconds will travel a D of 1/6 of a nautical mile, or somewhat more than 1,000 feet. Just as distance needs to be measured more accurately for contest purposes than is the norm, so does time need to be determined more precisely. Boat performance is *much* more precise than this example suggests, a fact that is taken into account in computing predicted logs. When moving at a speed of 10 knots over ground, a boat will move about 17-feet in 1 second. In ten seconds the distance becomes 170 feet (and so forth).

In virtually all waters, there exists some current. This must be taken into account in preparing a speed curve for the boat. If this current is in the same direction as a run, the boat will go faster and measure a time that is less than the "flat water" time of the boat over the distance. When the current is against progress, the boat goes more slowly and it takes more time. In order to measure an accurate time, run the boat at the same constant engine speed in both directions over this measured course. When establishing a speed in a varying tidal current, it is preferable, as shown below, to make a triple run (down, back, down). Then average the speeds, NOT the times.

To determine the effect of any current present, run the course both ways and calculate the overall speed in each direction. Then averaging the speeds will cancel out any current that might be present. Thus, (S1 + S2) / 2 = boat speed through the water, where S1 is the speed of the first run over the course and S2 is the speed of the return run. Don't calculate an average time, "T" this way. This kind of speed determination should be repeated at several boat speeds, ranging from the three recommendations mentioned earlier. They are:
1. No wake speed;
2. Comfortable economy cruise;
3. Maximum sustainable speed.

<u>Triple Runs Determine Accurate Speeds</u>

A triple run over the course: down, back, and down again; produces the most accurate speed value. Let's decide here that a tachometer setting of 2500 rpm delivers a comfortable cruising speed. We'll be using a digital stop watch for timing. We've topped of the fuel tank, having two passengers aboard, and a modest supply of water, food, and other goodies aboard. We're set up in a fashion very close to what we plan to use in PLCs of the future. We arrive at our test site and make sure there are no likely problems. We notice there is hardly any wind at all, but we notice some current running along the course. Then we start our runs. Here are the results:

1. Run #1 upstream = 268 seconds.
2. Run #2 downstream = 246 seconds.
3. Run #3 upstream = 259 seconds

Comparing Run #1 to Run #3, we can see that the current is slowing which is typical for operating in tidal waters. This is especially true in areas where river waters flow into wide open coastal areas such as Winyah

Bay in South Carolina. What we need now is a way to accurately record our speed at 2500 rpm. We do that by averaging *speeds* NOT *times*.

The speed for Run #1 works out to 3600 x 1 (nautical mile) = S x 268 seconds, or
S = 3600/268 = 13.432835 knots. Then we get the speed for Run #2 as 3600/246 which works out to 14.634146 knots. We'll do the math for run #3 now which is 3600/259 = 13.899613 knots. Our next act is to use the speed for Run #2 *twice*. Why? Because we want the average speeds up and downstream at two separate times and then again at a slightly later time. Here's how that works out:

1. Run #1 upstream = 13.432835 knots.
2. Run #2 downstream = 14.634146 knots.
3. Sum of #1 & #2 = 28.066981
4. Divide by 2 = 14.033490 knots.

Now we need the average speed a few minutes later and we begin with Run #2:

1. Run #2 downstream = 14.634146 knots.
2. Run #3 upstream = 13.899613 knots.
3. Sum of #2 & #3 = 28.533759
4. Divide by 2 = 14.266879 knots.

The slightly later time in running the course shows the impact of the decreasing current flow, but we aren't finished. We now go back through the mathematics using Run #2 twice and see this:

1. Run #1 upstream = 13.432835 knots.
2. Run #2 downstream = 14.634146 knots.
3. Run #2 again = 14.634146 knots.
4. Run #3 upstream = 13.899613 knots.
5. Sum of above = 56.600740
6. Divide by 4 = 14.150185 knots.

We can now be quite confident that under realistic conditions our boat will travel at 14.15 knots at a steady 2500 rpm. If we want to get "picky-picky" we also know that, as the fuel load decreases, the boat will increase in speed ever so slightly. There are so many other factors acting on the boat that this is normally insignificant.

The ideal speed curve for any boat is one that includes the full usable range of engine speeds from idle to full sustained maximum. This can be very difficult and time-consuming to determine because conditions will change during the development of the curve. For example, fuel loads will decrease, currents will change, wind will have an effect, and crew aboard the boat will move or change. When applied to a predicted log contest, remember it is the *predicted* times compared to the *observed* times that count. Any variation (plus or minus) affects the scoring. A practical speed curve can be developed for most boats by simply deciding on the most useful throttle settings beginning with idle speed and on open still water. With the propeller engaged and turning, boats usually move at a "dead slow" speed and that is the beginning of the speed curve chart. At the opposite end is the highest possible speed that can be maintained under normal conditions. Be careful here that the engine is in excellent condition and that the maximum allowable engine speed is not exceeded.

WARNING! If it is decided to document the maximum sustainable boat speed, make absolutely certain the engine is equipped with an electronic "rev-limiter". This device cuts off the ignition in a gasoline-powered engine when the set number of revolutions per minute is reached. In a diesel engine the fuel is shut off at a set engine speed. Never exceed the "red line" recommended by the engine manufacturer. Running at maximum speeds in any boat requires extra close attention to safety factors.

When developing a useful speed curve the most practical method is to find the idle speed and record that. Then advance to a no-wake speed that is safe wherever required. Next (for planing boats) find the slowest sustainable planing speed. Next move on to a realistic and comfortable cruising speed and then onward and upward by 500 rpm increments.

For the purposes of this Predicted Log Contest Learning Guide, a hypothetical speed curve is presented based on practical observations. The boat is a small *Bayliner* model with an "L-drive" engine, with a full fuel load, all normal safety, docking, and anchoring gear aboard. There are three adults aboard and the canvas is erected for shade. Here are the figures:

Throttle Setting	RPM	knots
Idle	625	4.00
No wake	1000	4.50
Slow	1500	6.90
Plane*	2000	10.20
Cruise	2500	14.15
Fast	3000	25.00
Faster	3500	34.00
Faster	4000	40.00
Maximum	4200	40.20

*Not sustainable

The figures shown above are used in this Learning Guide.

Distance

While it is important to know a boat's speed at throttle settings, it is equally important to know how far the boat moves at each speed. It's a simple mathematical problem and easily solved. Consider, for example, how *far* a boat moves at a steady 2500 rpm. Here we'll consider only distance over ground and a nautical mile as being 6,076.12 feet. When we multiply 14.150185 (nautical miles per hour or *knots*) by 3600 (seconds per hour) we find that our boat travels 85,978.222 feet per hour or 23.882839 feet per second at 2500 rpm. That translates to 23 feet 10.6 inches per second which is fast enough to require careful attention to details. Being able to judge distances accurately helps when making turns and when shouting "Mark" to inform observers as checkpoints are reached. Being off just a few degrees of angle can make a difference of several seconds. Remember that in a PLC being off just a few seconds can mean the difference between winning and losing.

Currents

Very often, predicted log contests are set up so that much of the course runs through channels or straits or along shores where currents are either in the same or opposite direction to the boat travel. Here we will cover currents that are either directly with or against your boat. Allowing for currents flowing at an angle to the course is covered in detail as an advanced topic in Chapter 4. Suppose we are running at a boat speed of 14.15 knots and the current is flowing in the same direction as the boat at a speed of 3 knots. The speed over the ground (SOG) in this case is 14.15 + 3 or 17.15 knots. We'll apply this to an example which we might encounter in a real PLC.

Traveling WITH the current

One leg of the course is from Checkpoint A to Checkpoint B and is 12.7 nautical miles. We're confident we'll be running this leg with the 3.0 knot current at 2500 rpm. With our speed over the ground (SOG) at 17.15 knots, we'll calculate our predicted time for this leg of the Course.

1. Distance A to B = 12.70 nm
2. With the current = 3.00 knots
3. Boat speed = 14.15 knots
4. SOG = 17.15 knots
5. 3600 D = ST
6. 3600 x 12.70 = 45,720
7. T = 3600 D / 17.15 = 2665.8892 seconds
8. T / 60 = 44.431486 minutes
9. Time = 44 min 25.88916 seconds (44 min 26 seconds)

When we get to Point B, what if we must make a 180° turn and head back toward Checkpoint A to continue the PLC. Now we will be running *against* the current of 3 knots. (Be careful with this assumption because as we've seen running the speed curves the current in tidal waters can change.) We'll go ahead here and remain confident the current will be 3 knots. Our speed over the ground will now be 14.15 knots *minus* 3.0 knots or 11.15 knots. This means our calculation will look like this:

1. 3600 x 12.70 = 45,720
2. T = 3600 D / 11.15 = 4100.4484 seconds or 1 hr 8 min 20 seconds.

Note here that a 180° turn was required. How much time in seconds will be required to make that turn. These seconds are added to the *next* leg of the course. The subject of determining time to make turns follows.

Traveling AGAINST the Current

Travelling *against* the current can have a dramatic impact on a very small or limited-power boat. For example, a small sailboat which when operating under power can just barely make 4 knots. This boat going from Checkpoint A to Checkpoint B with the current, would cover the distance in about an hour and 49 minutes. Coming back the other way would be an ordeal requiring about 12 hours and 42 minutes. This one reason small sailboat skippers rarely (if ever) compete in a PLC.

In the real world, where water flows, currents vary depending on many factors including volume of water, channel width, and channel depth. A casual glance at a river's rapids reveals this rather quickly. Out in the narrow and rocky middle of the stream, the water seems to be almost boiling as it rushes along. Yet, near the shore, there may be nothing but benign eddy currents. In a PLC this can be important. Take, for example, the Atlantic Intracoastal Waterway (AICW). This waterway for most of its length meanders along natural channels and often uses rivers leading to the ocean. Rain and drainage from upstream flows into the rivers and then into the AICW. This flow eventually reaches the ocean where it is opposed by tidal effects. Multiple inlets occur along the entire length of the AICW and affect any current flow in the AICW. During a 24-hour period, the current may flow rapidly in one direction, slow to slack water, and then reverse the current. That's why a realistic forecast of anticipated current can be valuable to contestants in a PLC in these waters.

An example of this condition occurs when the current is known to vary from one point to the next. When this is known, it may become necessary to break a distance into elements with known current velocities. Let's say that in the 12.7 nm leg used above, the current varies as the river narrows and widens. Starting at Checkpoint A for a distance of 3 nm the current runs at 5 knots. Then the river widens and the current slows to 2.5 knots for the next 4.1 nm. Next, the current increases to 3.5 knots for 3 miles. Finally the current slows to only one knot for the remaining 2.6 nm to Checkpoint B. The overall current in this river is rated at 3 knots, but the individual segments vary. We can calculate this by averaging the speeds. Here's how to do that and is based again on the average speeds of the currents:

	Leg	Dist.	Current	
1.	A to #1	3.0 nm @	5.0 knots	= 15.00
2.	#1 to #2	4.1 nm @	2.5 knots	= 10.25
3.	#2 to #3	3.0 nm @	3.5 knots	= 10.50
4.	#3 to B	2.6 nm @	1.0 knots	= 2.60
5.	Sum of above	12.7		= 37.85
6.	37.85 / 12.7 = Aver. weighted current = 2.98			

While the overall current for the 12.7 nm is reported as 3.0 knots, the weighted average using multiple observations is very close at 2.98 knots. Note that this probably varies considerably from one day to the next.

There are several methods available to get predicted times involving currents. The next page describes an alternative to using weighted averages.

Let us now examine the situation with the tachometer at 2500 rpm and the intended slack water speed is 14.15 knots. Here we'll average speeds over the ground and find:

1. A to #1 (14.15 + 5) = 19.15 knots
2. #1 to #2 (14.15 + 2.5)= 16.65 knots
3. #2 to #3 (14.15 + 3.5)= 17.65 knots
4. #3 to B (14.15 + 1.0) = 15.15 knots
5. Sum of speeds over ground = 68.60
6. Sum of SOGs / 4 = 17.15 knots
7. 17.15 - 14.15 = 3.00 knots

Note here that we are subtracting the anticipated 2500 rpm speed of 14.15 from the average SOG and get the result as 3.00 knots for the current. This alternate method shows that there are a number of methods available to check our work and predictions. This helps build confidence.

Determining Time Required for Turns

During a typical PLC some turns are usually required. It is very important to include the time required for any turn to be included in the total predicted time. Turns are usually performed at no-wake or normal cruising speeds. Here is how to determine the time required. If possible, find a quiet location on the water with little or no wind or current and enough space to allow normal turns with the boat. Set the throttle at a steady no-wake speed and make several complete 360° turns timing each turn. Do whatever is required to maintain a steady circle radius. One method is to use a temporary buoy or float and make consistent circles around this object. Find a fixed object that will aid in determining when you have completed each circle and make at least three timed circles. Divide the total time in seconds by the total number of degrees to determine the time required for each degree of turn. If you made three circles and each required 60 seconds, you would multiply 3 x 360 = 1080 degrees. You needed 180 seconds to do that so you simply divide 180 by 1080 to see that a turn at no-wake speed requires 0.1666 seconds. Therefore a 180° turn will require 30 seconds. Next repeat the exercise at your normal cruising speed and hold a comfortable turning radius to develop the time required for turns at this speed. If each complete circle required 45 seconds and you made three circles, the time per degree would be 0.125 seconds. This means a 90° turn would require 11.25 seconds.

On the matter of timing events for predicted log contests, do not neglect the time required to go from a dead stop to no-wake or cruising speeds.

Safety Considerations

Equipment

The safety equipment the U. S. Coast Guard requires being aboard and checked during an ordinary Vessel Safety Check (VSC) will normally be adequate for predicted log contests. Regular maintenance of the boat, engine, and associated gear is probably the best safety procedure available.

Rules of the Road

During any regular Predicted Logging Contest, the rules of the road must be followed. Being in a contest gives no special privileges. The Rules of the Road do not permit violation of the rules because of competitive conditions. In addition to the normally prescribed "Rules of the Road", there is one other that should be followed in predicted log contests. When two boats are approaching a buoy where they are to turn, the outer boat, i.e., the one further from the buoy, is required to give the inner boat room to go around the buoy. Observing the rules may sometimes mean that the planned course cannot be followed exactly. A contestant must speed up, slow down, or change course whenever the Rules of the Road require. Once the situation has returned to safe conditions, the contestant decides what, if any, further corrections to his planned course are needed to compensate for the maneuvers.

Visibility

In situations of partially limited visibility, particularly in restricted channels, it may be desirable or even required by authorities, to have radar in operation to provide warning of potentially dangerous situations. If visibility is so severely limited as to present a potential danger, the contest should be delayed or canceled. Radar must not be used as a time or location indicator by the contestant. The specific rules of the contest should indicate any radar requirements or restart times. The competition probably seems important to sponsors and contestants, but safety is paramount. Common sense must come into play. Remember: *Safe Boating is More Fun!*

Time Out

Situations may arise during a PLC that interrupts normal progress. It may be an emergency or mechanical failure. Law enforcement authorities may stop the boat for whatever reason. Observers are allowed to take this into consideration and record the precise times when the time out began and ended. The committee will decode whether or not this time out is allowed and not impose any time error.