

## Statistical Analysis Flyfishing Success Rates

By Sudesh Pursad



It all started way back in 2002... I was frustrated with hearing that in saltwater flyfishing, a flyfisher has to make a thousand casts before catching a fish. I believed that this was an inaccurate way of measuring the effort required before success is realised. Furthermore, what constitutes a cast?? From my own experience, there are times when I have to cast a full line to catch a fish. Sometimes I merely roll cast a few metres, and sometimes I simply use a rod length of line. All of these techniques yield success when used at the appropriate time. So what constitutes a cast then?? In addition, fishing ability differs greatly between anglers. One angler may cast a full line all the time and make three casts per minute, while another angler may cast ten meters and make six casts per minute (assuming similar stripping speeds). Both anglers caught the same number of fish at the end of the session, but one made more casts than the other. Hence the general statement of a thousand casts per fish did not work for me.

I wanted to find another way to determine the amount of angler effort required to yield success, so I decided to record my fishing effort in hours per session, and then over a long period of time, average out the number of fish per hour. I recorded only my fishing effort for the sake of consistency, as anglers' ability varied greatly. I tried my best to record as much info as possible. Full details of the Catch Per Unit Effort (CPuE) data can be found in Table 1 below.

I also made a distinction between effort required for success in targeting large fish and smaller fun fish. This distinction was made by the techniques, tackle and flies that I used. Generally, any fish

caught when using large deceivers and poppers were recorded as a “big” fish, even if it was a small fish. All fish caught using small flies, including big ones were categorised and recorded as “small” fish. The data below is for “small” fish caught in 2002.

The results were quite fascinating. The Small fish data showed that in 58.75hrs of fishing, I landed a total of 286 fish. Simple maths gives an average of 4.9 fish per hour over a period of ten months. (Incidentally, the Large fish results were a total of 33 fish in 54.25 hrs of fishing also over the same period, giving an average of 0.6 fish per hour). So all of this sounds cool. I now had a benchmark to work with for my “small” and “large” fish.

In 2007, during my studies I was introduced to statistical regression analysis. This basically is a tool used to analyse and predict trends in data so I decided to try this on my CPuE data to establish what are the factors that drive flyfishing success. I was quite astounded, as you will see. (I am at the level of pre-amateur, so please feel free to correct any mistakes).

Taking into account all the factors recorded in the data, and using dummy variables for categorical variables, I constructed a correlation matrix (as per table 2 below). “Correlations are numerical summary measures that indicate the strength of linear relationships between pairs of variables”<sup>1</sup> (Albright, et al, 2006). This is summarized in table 2 as a relationship between each of the variables in the data set.

By using the Multiple Linear Regression tool from Stat Tools, we get the summary of the data as indicated in table 3. While my success rate is dependent on all of the categories listed in the data set (Effort per Activity (hrs), # of Fish Landed, # of Fish Lost, # of Strikes/ Chases/ Follows, High, Incoming, Outgoing, Durban Harbour, Middle South Coast, Offshore, Other, Upper South Coast), the summary indicates that the data with the highest correlation explains 79.07% (from the R2 value) of my success rate. In short, it is basically saying that 79% of my catches were dependent on the number of Fish Lost and number of Strikes/ Chases/ Follows.

The analysis also revealed some other interesting facts. As a fly fishermen, it is interesting to observe that even though some relationships are small (20%-40%), a positive relationship does exist. For example, the fact that a 42.3% relationship exists between the Upper South Coast and the Incoming tide indicates a worthwhile option if I am searching for a location. Similarly, a relationship between the offshore habitat and the amount of effort. From practice, the statistics prove the real life situation.

Through statistical analysis, the outcome of the regression analysis was considerably surprising. General belief in the fishing industry is that the more time you spend on the water, the greater your chances of success will be. With the number of landed fish being a direct function of the number of fish lost and the number of strikes, presents a surprising predictive equation {No. Fish Landed = -0.515 + 0.674(fish lost) + 0.428(strikes)}. As surprising as it may be, it is highly valid to base success rate on these factors alone, especially since 79% of the data can be explained using this.

This analysis also provides a clear indication that success rate is not significantly dependent on location (although being in the right place at the right time helps). The correlation matrix in Table 2

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<sup>1</sup> Albright, et Al, (2006), Data Analysis and Decision Making with Microsoft Excel, Thompson South-Western

also indicates that while relationships between variables may not be significant, that relationships do exist. Identification of the positive relationships provides greater options when those conditions prevail. Previously, choice of venue and target specie was purely done through “gut feel”. The statistical approach confirms much of what was selected through experience.

On a numeric level, the regression equation can be used as a rough benchmark for the expected success rate. To test the equation, suppose that there were no chases and no fish lost. The number of fish landed will therefore be -0.515, which is impossible and is better represented by a zero catch (or a blank).

Further point estimates can be made for all combinations of fish lost and strikes. This prediction of success can also be associated with hypothesis testing the calculation probabilities of success rates based on one or two standard deviations yielding a 68% and 95% confidence interval.

Lastly, with fishing being a natural phenomenon that cannot be controlled, while the predictive regression equation may hold true for most fishing sessions, this may still “fail” under extreme environmental conditions.



Table 1 - Catch Per Unit Effort (CPUE)

Date	Effort per Activity (hrs)	# of Fish Landed	# of Fish Lost	# of Strikes/ Chases/ Follows	Catch per Unit Effort (this activity) in fish/hr	Activity per Effort	Barometric Pressure (hPa)	Total Fish Caught	Total Fishing Hours	Catch per Unit Effort (overall) in fish/hr
111202	1hr00m	2	0	0	2/hr	Moderate South Easterly wind. Incoming tide. No fish activity. Landed 2 Torpedo Scads. Durban Harbour. 17H30-19h00		286	58hr45m	4.9/hr
091202	3hr00m	0	0	0	0/hr	Moderate north easterly winds. Incoming tide. ONLY a few takes from Garfish - none landed. Upper South Coast. 09H30-14H00.		284	57hr45m	4.9/hr
121102	0hr45m	1	0	0	1.3/hr	Calm early morning condition. Incoming tide. Landed one Shad of over 1kg. Upper South Coast. 04H30-05H45.		284	54hr45m	5.2/hr
031002	0hr30m	2	0	2	4/hr	Fresh South Westerly wind. Not much fish moving. Landed one Walla Walla and one Razor Belly. Durban Harbour. 18H15-18H45.		283	54hr00m	5.2/hr
021002	1hr30m	0	1	10	0/hr	Fresh North Easterly wind gusting up to Gale force. Plenty takes from probably Tarpon. None landed. Christy landed one. Upper south coast. 16H00-18H00.		281	53hr30m	5.3/hr
190602	1hr00m	6	0	3	6/hr	Outgoing to low tide. Fresh South Westerly wind. Sea very rough and unsettled. 3 Shad, 3 Moonies. Upper south coast. 16H00-17H15.		281	52hr00m	5.4/hr
180602	1hr00m	13	plenty	plenty	13/hr	Very light North easterly wind. Sea very calm. 13 Shad. Upper south coast. 16H00-17H15.		275	51hr00m	5.4/hr
60602	5hr00m	15	plenty	plenty	3/hr	Moderate to fresh South Westerly wind. Sea calm becoming unsettled. Shad, Yellowtail Kingies, Maasbunker, Sugar Mackerel. Offshore. 07H00-16H00.		262	50hr00m	5.2/hr
140602	2hr30m	5	3	few	2/hr	Outgoing, high and incoming tide. Moderate South Westerly wind. Sea unsettled and very rough. 3 Shad, 1 Moonie, 1 Striped Mullet. Upper south coast. 07H00-15H30.		247	45hr00m	5.5/hr

130602	0hr15m	2	3	3	8/hr	Outgoing tide. Very fresh north easterly wind. Sea unsettled and very rough. 2 Shad. Upper south coast. 10H00-10H30.		242	42hr00m	5.8/hr
120602	3hr30m	30	plenty	plenty	8.6/hr	Outgoing tide. Very fresh north easterly wind. Sea unsettled and very rough. 28 Shad, 1 Yellowtail Kingie, 1 Moonie. Upper south coast. 07H00-10H30.		240	41hr45m	5.7/hr
110602	1hr30m	25	plenty	plenty	16.7/hr	Outgoing tide. Fresh north easterly wind gusting to very strong at times. Sea unsettled. 25 Shad (very conservative estimate. Upper south coast. 07H00-10H30.		210	38hr15m	5.5/hr
060602	2hr00m	16	plenty	few	8/hr	Incoming tide. Light to moderate north easterly wind. Sea unsettled but fishable. 9 Shad, 5 Yellowtail Kingies, 2 Moonies. Upper south coast. 07H00-12H00.		185	36hr45m	5.0/hr
020602	1hr00m	7	4-6	±10	7/hr	Incoming tide. Moderated South Westerly Wind gusting to fresh. Sea rough and very bumpy. 7 Shad, 1 Yellowtail Kingie. Upper south coast. 06H45-08H30.		169	34hr45m	4.9/hr
010602	0hr30m	6	0	3	12/hr	Incoming tide. No Wind. Sea very calm. 4 Shad, 1 Moonie, 1 Yellowtail Kingie. Upper south coast. 06H30-07H00.	1008-	162	33hr45m	4.8/hr
310502	1hr30m	18	8	plenty	12/hr	Incoming tide. Light to Moderate South easterly Wind. Sea moderate. 15 Shad, 1 Yellowtail Kingie, 1 Puffer Fish (Toby), 1 Mullet. Upper south coast. 15H30-17H00.		156	33hr15m	4.7/hr
300502	1hr00m	16	plenty	plenty	16/hr	Incoming tide. Fresh to Moderate South Westerly Wind. Sea rough to moderate. 16 Shad. A fish or chase on every cast except 3. Upper south coast. 16H15-17H00.	991	138	31hr45m	4.3/hr
290502	1hr00m	2	2	9	2/hr	Incoming tide. Moderate North Easterly Wind. Sea moderate. 1 small Yellowtail Kingie, 1 small Ignobilis. Upper south coast. 15H30-17H00.	1012	122	31hr00m	3.9/hr
190502	1hr00m	1	0	7	1/hr	Incoming tide. Moderate North Easterly Wind. Sea moderate. 1 small Yellowtail Kingie. Upper south coast. 15H30-17H00.		120	30hr00m	4.0/hr

170502	1hr30m	12	plenty	plenty	8/hr	High tide later running out. No Wind. Sea vey calm. 12 Shad. Upper south coast. 07H00-9H30	1013+	119	29hr00m	4.1/hr
160502	1hr00m	3	0	3	3/hr	High tide running out. Wind very light north easterly with Berg wind conditions. Sea calm. 1 Moonie, 1 Yellowtail Kingie and 1 Shad. Upper south coast. 07H30-8H30	1014-	111	27hr30m	4.0/hr
150502	00hr20m	1	0	0	3/hr	High tide running out. Wind light south easterly. Sea calm. 1 Moonie. Uper south coast. 07H30-10H30	-	108	26hr30m	4.1/hr
120502	1hr00m	3	0	3	3/hr	High tide running out. Spring Tides. Wind light to moderate north easterly. Sea moderate. 2 Small kingies and 1 small shad. Upper south coast. 16H00-17H30		107	26hr10m	4.1/hr
120502	2hr00m	3	plenty	plenty	1.5/hr	Outgoing tide. Tides turning to springs. Wind light north easterly. Sea very calm. 2 Small shad and 1 small kingie. Uper south coast. 08H00-10H30		104	25hr10m	4.1/hr
110502	2hr00m	5	plenty	plenty	2.5/hr	Outgoing tide. Tides turning to springs. Virtually no wind. Sea very calm. Small shad. Uper south coast. 08H00-10H30		101	23hr10m	4.4/hr
100502	1hr30m	0	0	0	0	Outgoing tide. Tides turning to Spring. Moderate North Easterly winds. Sea conditions settled. 16H00-17H30		96	21hr10m	4.5/hr
030402	0hr30m	0	0	2	0	Incoming tides. Tides full neaps. Fresh North Easterly winds. Sea conditions rough and unsettled. 16H00-17H30		96	19hr40m	4.9/hr
020402	1hr30m	4	0	plenty	2.7/hr	Incoming Tide. Fresh North Easterly. Sea conditions rough. 16H00-17H30	1011-	96	19hr20m	5.0/hr
220302	1hr30m	1	0	2	0.7/hr	Outgoing tide. Hot and humid. Moderate North Easterly. Sea conditions unsettled and dirty. 10H00-11H30.	1015-	92	17hr50m	5.2/hr
210302	9hr00m	50	plenty	plenty	5.6/hr	Whole Day fishing. Hot and sunny with moderate South Westerly wind. Cape Vidal. 7H00-18H00		91	16hr20m	5.6/hr
260202	0hr20m	0	1	plenty	0	Incoming tide. Cool and overcast. Light south easterly swinging to easterly. Upper South Coast Beach. 11H10-11H30		41	7hr20m	5.6/hr

240202	1hr00m	1	0	2	1/hr	Outgoing tide. Warm day. Moderate North Easterly. Upper South Coast Beach. 17H20-18H20		41	6hr50m	6/hr
230202	1hr30m	4	2		2.6/hr	Outgoing tide. Warm day. Light to moderate North Easterly. Upper South Coast Beach. 17H00-18H30		40	5hr50m	6.9/hr
220202	1hr30m	19	4		12.6/hr	Outgoing tide. Warm day. Light North Easterly. Upper South Coast Beach. 17H00-18H30		36	3hr20m	10.9/hr

Table 2 - Correlation Matrix

	Effort per Activity (hrs)	# of Fish Landed	# of Fish Lost	# of Strikes/ Chases/ Follows	High	Incoming	Outgoing	Durban Harbour	Middle South Coast	Offshore	Other	Upper South Coast
Effort per Activity (hrs)	1.000											
# of Fish Landed	0.302	1.000										
# of Fish Lost	0.298	0.852	1.000									
# of Strikes/ Chases/ Follows	0.240	0.796	0.738	1.000								
High	-0.011	-0.176	-0.173	-0.222	1.000							
Incoming	-0.034	0.010	0.074	-0.064	-0.459	1.000						
Outgoing	0.043	0.161	0.097	0.277	-0.530	-0.510	1.000					
Durban Harbour	-0.169	-0.264	-0.286	-0.208	0.215	-0.366	0.141	1.000				
Middle South Coast	0.046	-0.031	-0.081	0.011	0.069	-0.121	0.049	-0.121	1.000			
Offshore	0.498	0.214	0.213	0.151	0.186	-0.085	-0.098	-0.085	-0.023	1.000		
Other	0.242	-0.156	-0.117	-0.205	0.100	-0.032	-0.066	-0.175	-0.048	-0.034	1.000	
Upper South Coast	-0.106	0.280	0.299	0.254	-0.323	0.423	-0.092	-0.782	-0.215	-0.151	-0.309	1.000

Table 3 - Linear Regression Summary Table

	Multiple	R-Square	Adjusted	StErr of	Durbin	
<i>Summary</i>	R		R-Square	Estimate	Watson	
	0.8892	0.7907	0.7545	3.2588	2.0312	
<i>ANOVA Table</i>	Degrees of Freedom	Sum of Squares	Mean of Squares	F-Ratio	p-Value	
Explained	9	2085.982	231.776	21.8250	< 0.0001	
Unexplained	52	552.227	10.620			
<i>Regression Table</i>	Coefficient	Standard Error	t-Value	p-Value	Lower Limit	Upper Limit
Constant	-0.515	1.091	-0.472	0.639	-2.704	1.674
Effort per Activity (hrs)	7.903	13.689	0.577	0.566	-19.566	35.371
# of Fish Lost	0.674	0.119	5.640	0.000	0.434	0.914
# of Strikes/ Chases/ Follows	0.428	0.123	3.477	0.001	0.181	0.676
Tide = Incoming	-0.285	1.177	-0.242	0.810	-2.647	2.077
Tide = Outgoing	0.000	1.074	0.000	1.000	-2.156	2.155
Location = Middle South Coast	0.501	2.448	0.205	0.839	-4.411	5.414
Location = Offshore	1.070	4.070	0.263	0.794	-7.097	9.237
Location = Other	-0.456	1.935	-0.235	0.815	-4.339	3.428
Location = Upper South Coast	0.485	1.074	0.451	0.654	-1.671	2.640