An Updated Assessment of Reef Tank Parameter Testing Kits

Abstract

Water testing is an important aspect of the reef keeping hobby. As part of a regular maintenance regime, testing provides insight into the effectiveness of other tasks such as supplement dosing, water changes, and feeding. As a tank changes over time, demands for various chemical compounds change as well, and various deleterious substances can build up. Testing provides a road map for dealing with these changes.

Some years ago, a group of hobbyists spent an afternoon testing samples of marine tank water with all the hobby grade test kits they had. They found that there was a lot of variation from kit to kit, and from person to person using the same brand kit.

There are new test kits on the market, including the Red Sea Master kit and the Hanna line of electronic colorimeters. We wondered if test kits have gotten any more accurate or reliable. To that end, Frank Garner of Frank's Tanks offered to host another water testing session.

Introduction

When it comes time to buy a test kit for our tanks, we often use price, complexity, and/or resolution as a stand-in for accuracy. "Surely a $50 test is better than a $10 test, right?" "This test that measures down to tenths of a dKh must be more accurate than one that measures in whole units, don't you think?"

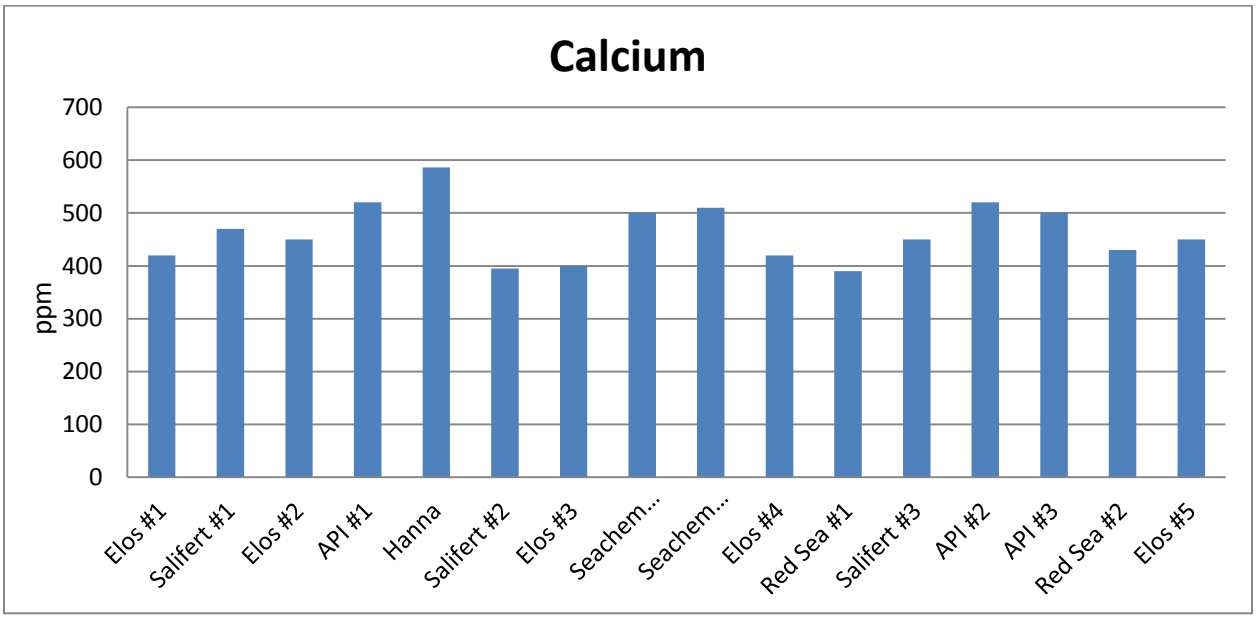
Previous test comparison experience shows that this isn't necessarily true.

Methodology

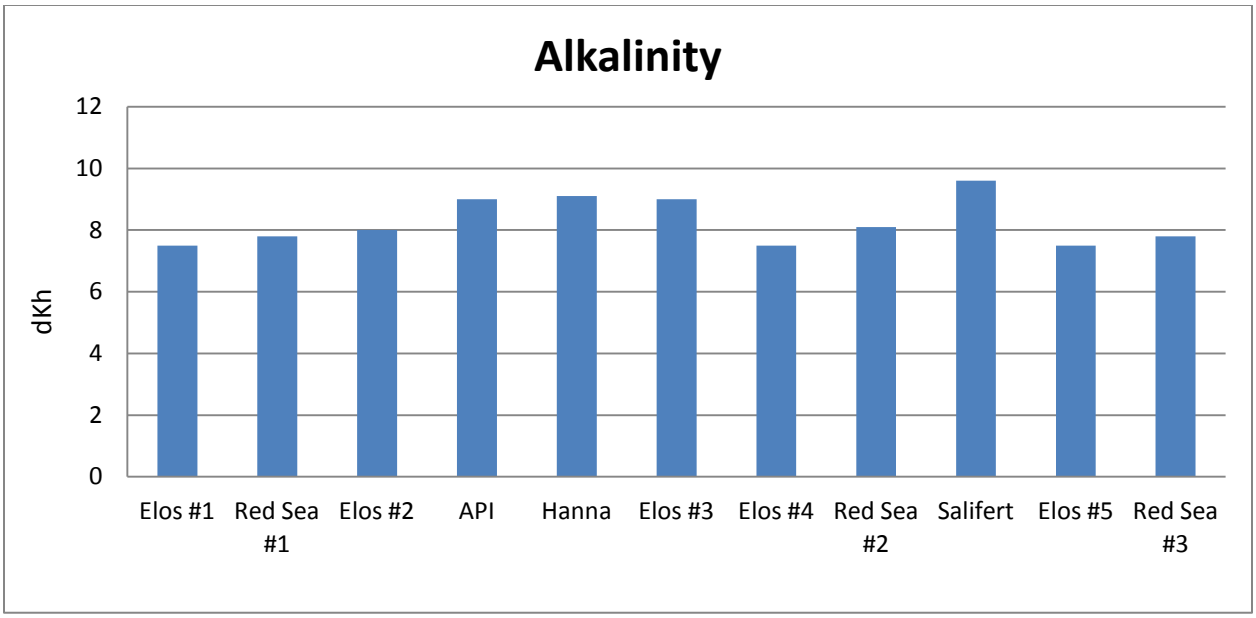
Six testers were provided with one sample of water from the same tank. Each tester completed all their tests on hand, and recorded the results. Testers brought different brands and kinds of test kits. (See Table 1.) Testers followed the directions given with each kit, and were provided with RO/DI water to clean their equipment between tests. In titration tests, testers made sure to record the drop of reagent where the color changed and stayed changed for thirty seconds. Tests requiring manual color comparison were done under fluorescent lighting.

Results

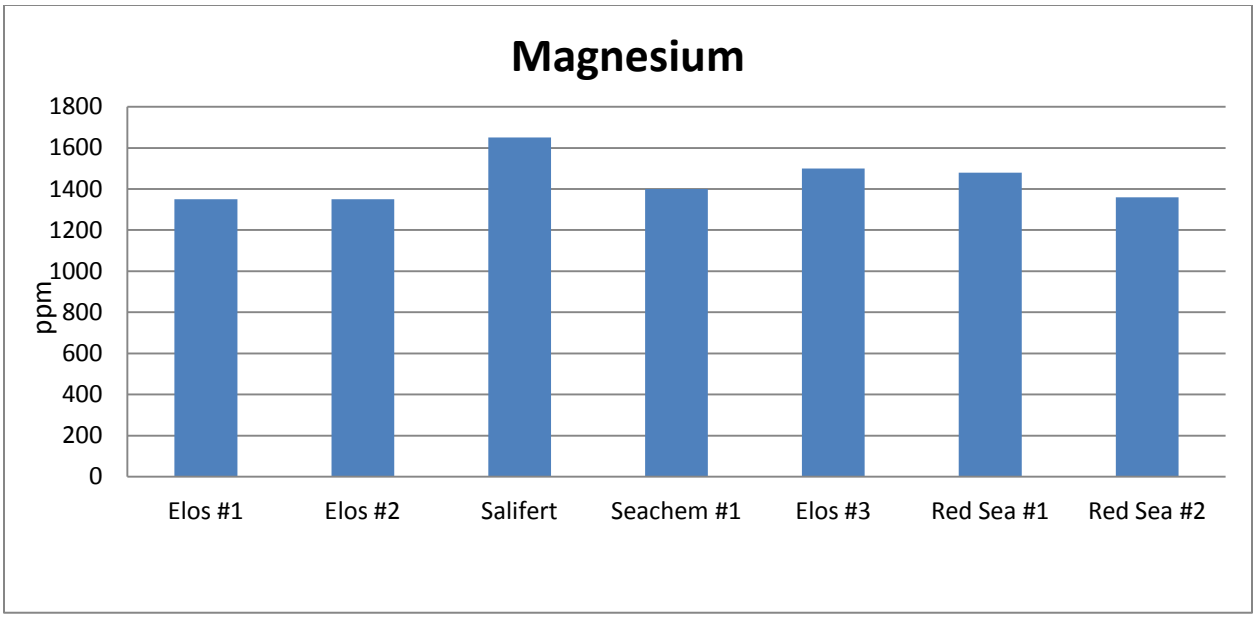
Here are the raw results of the various tests. See the analysis and conclusion section for more details.



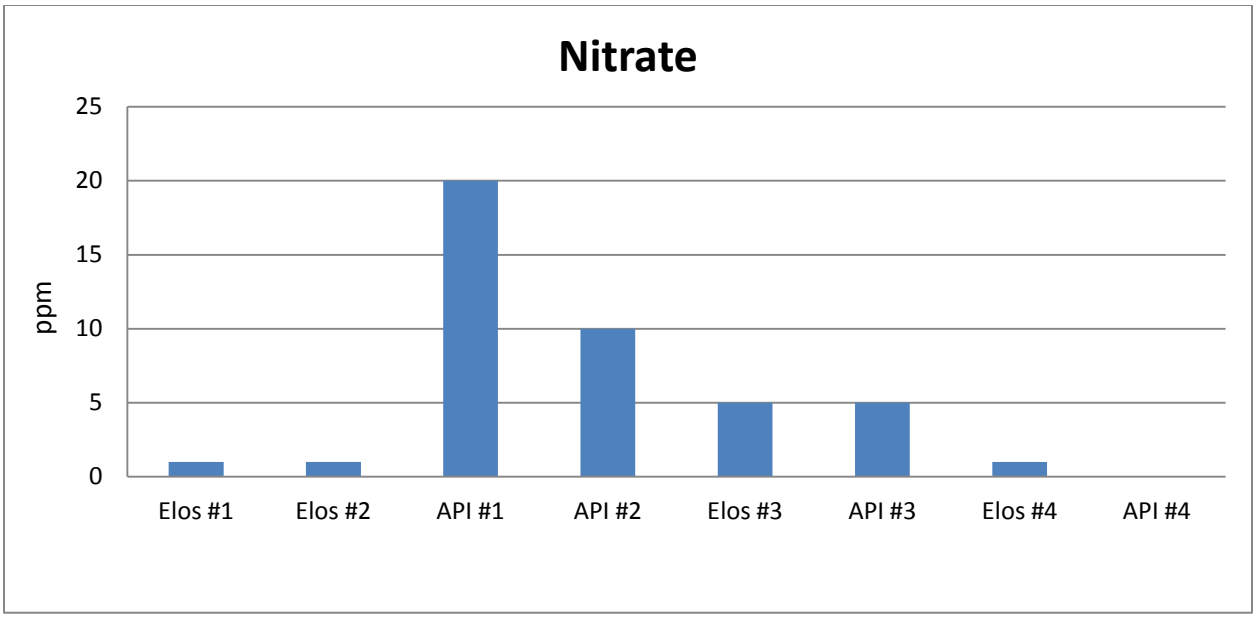
Calcium	
Elos #1	420
Salifert #1	470
Elos #2	450
API #1	520
Hanna	586
Salifert #2	395
Elos #3	400
Seachem #1	500
Seachem #2	510
Elos #4	420
Red Sea #1	390
Salifert #3	450
API #2	520
API #3	500
Red Sea #2	430
Elos #5	450
Mean	463
Standard Dev	55
Margin Error	14



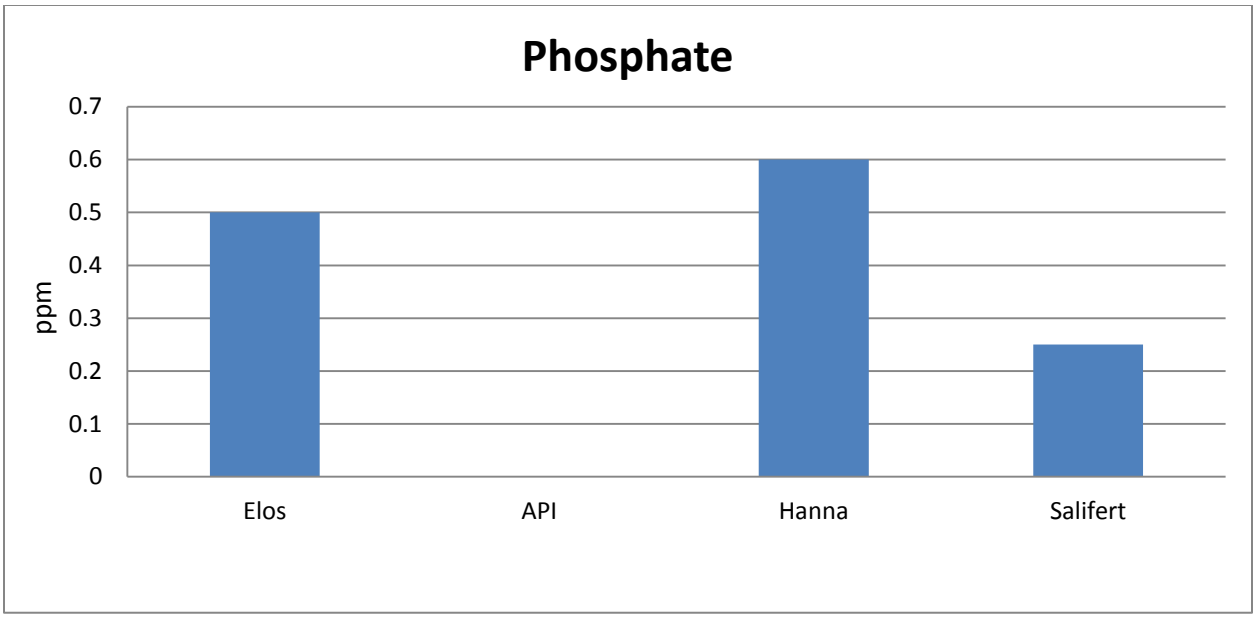
Alk	
Elos #1	7.5
Red Sea #1	7.8
Elos #2	8
API	9
Hanna	9.1
Elos #3	9
Elos #4	7.5
Red Sea #2	8.1
Salifert	9.6
Elos #5	7.5
Red Sea #3	7.8
Mean	8.3
Standard Dev	0.8
Margin Error	0.2



Mg	
Elos #1	1350
Elos #2	1350
Salifert	1650
Seachem #1	1400
Elos #3	1500
Red Sea #1	1480
Red Sea #2	1360
Mean	1441
Standard Dev	111
Margin Error	42



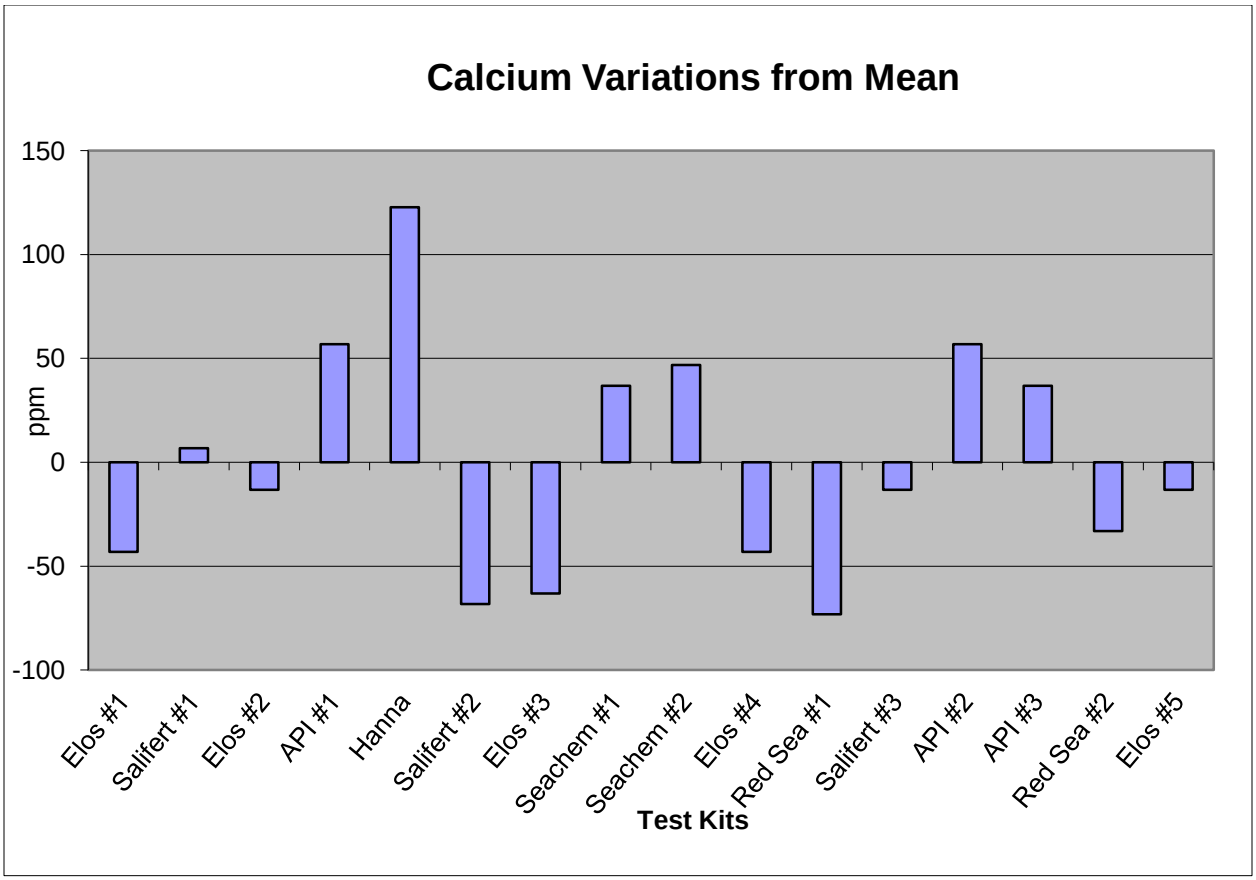
Nitrate	
Elos #1	1
Elos #2	1
API #1	20
API #2	10
Elos #3	5
API #3	5
Elos #4	1
API #4	0
Mean	5
Starndard Dev	7
Margin Error	2



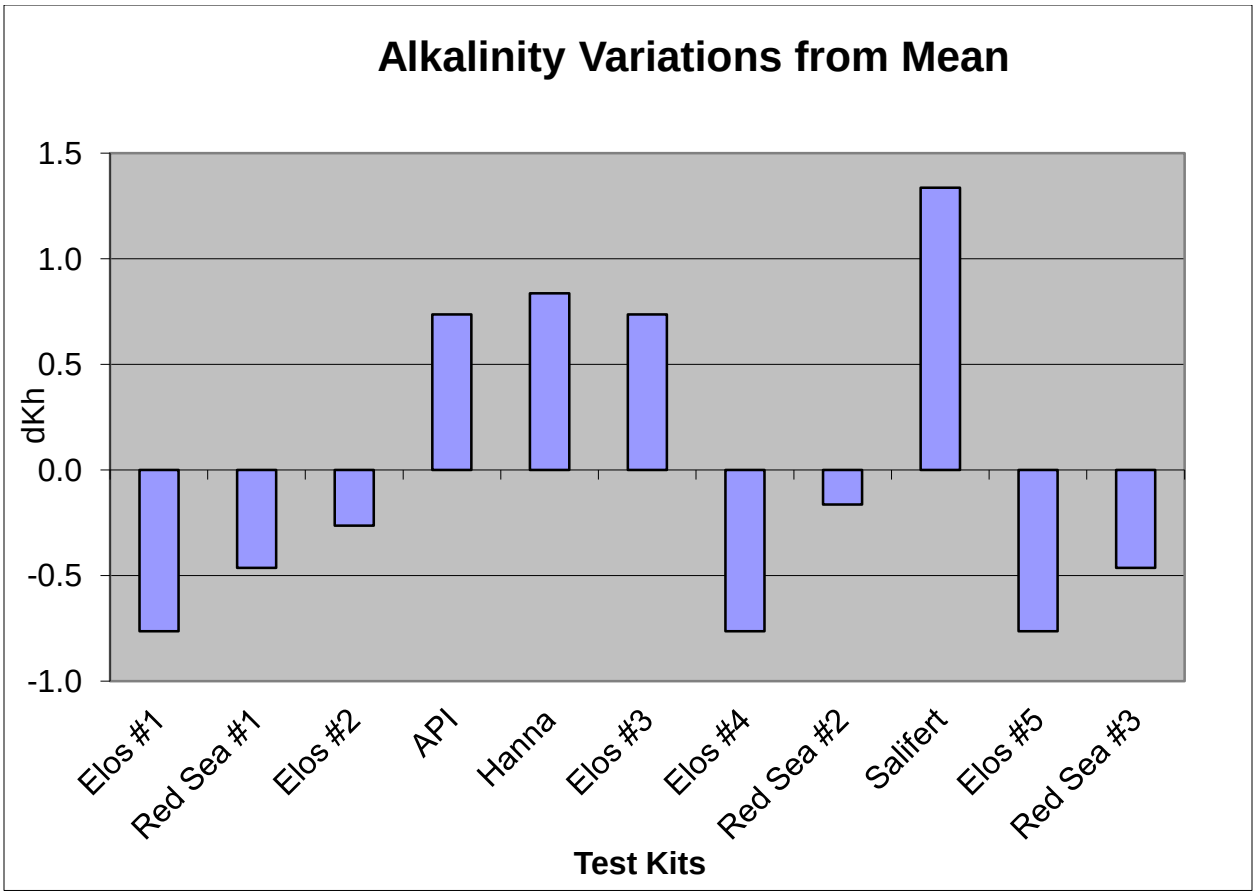
Phosphate	Elos	API	Hanna	Salifert	Mean	Standard Dev	Margin Error
	0.5	0	0.6	0.25	0.3	0.3	0.1

Analysis

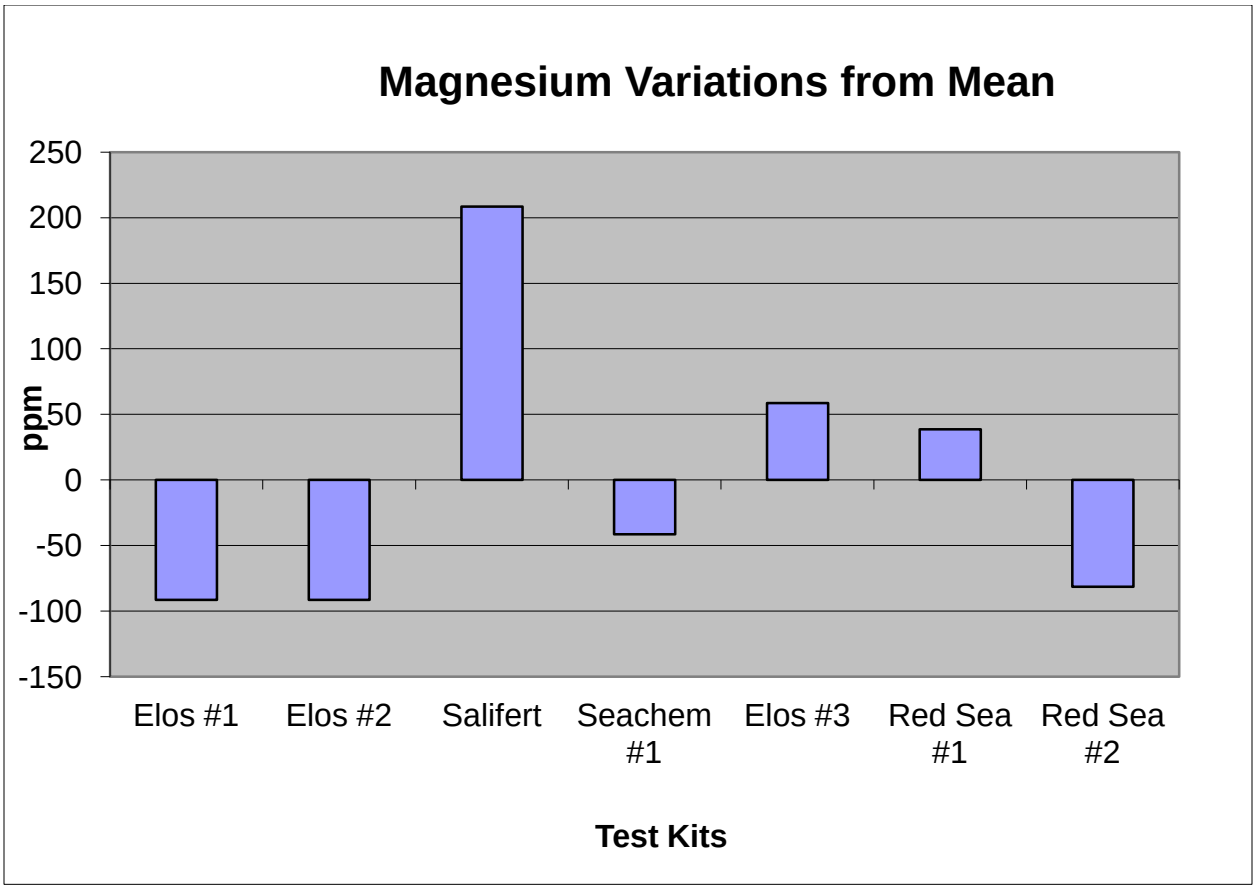
In order to compare tests to each other, we calculated the variation from the mean (average) for each set of tests. Of a given set of results, the mean is assumed to be closest to the true value. Therefore, a test whose result is closer to the mean is more likely to be accurate.



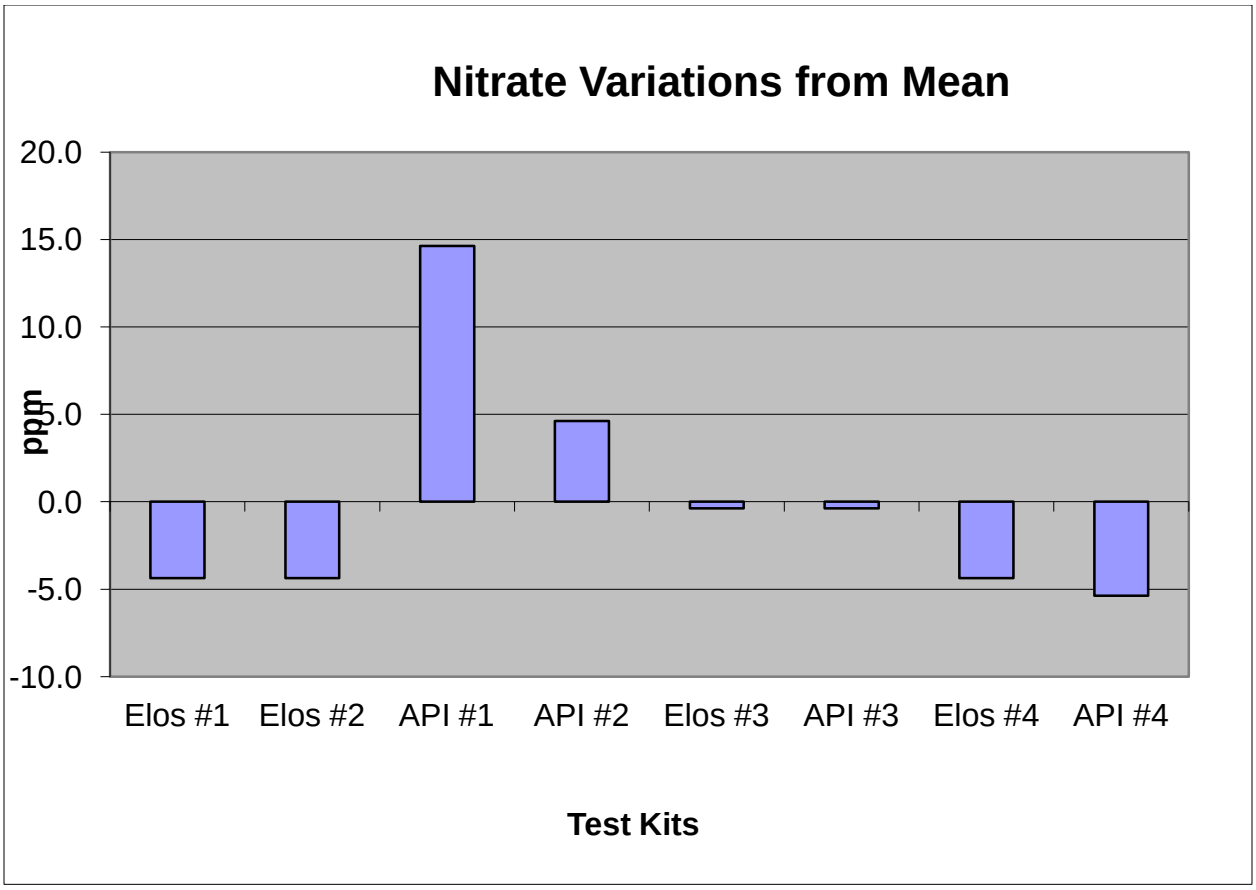
Calcium		Variation
Elos #1	420	-43
Salifert #1	470	7
Elos #2	450	-13
API #1	520	57
Hanna	586	123
Salifert #2	395	-68
Elos #3	400	-63
Seachem #1	500	37
Seachem #2	510	47
Elos #4	420	-43
Red Sea #1	390	-73
Salifert #3	450	-13
API #2	520	57
API #3	500	37
Red Sea #2	430	-33
Elos #5	450	-13



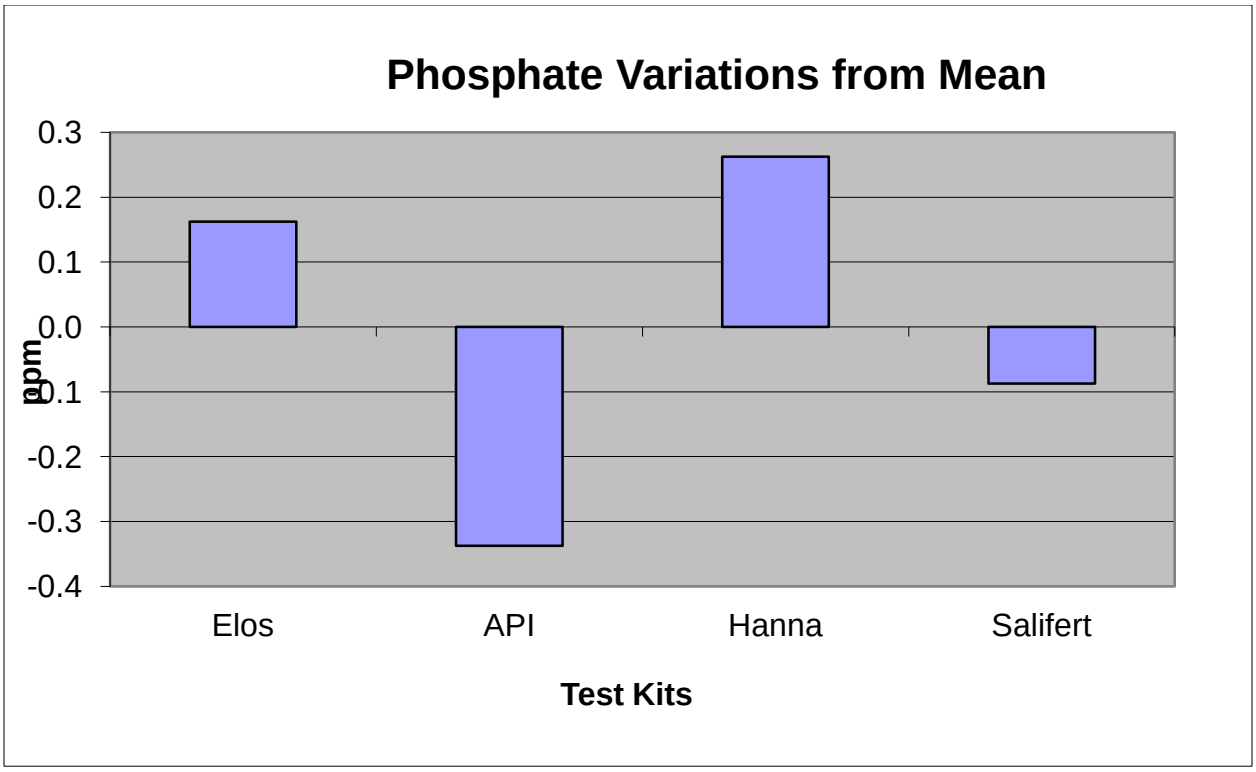
Alk		Variation
Elos #1	7.5	-0.8
Red Sea #1	7.8	-0.5
Elos #2	8	-0.3
API	9	0.7
Hanna	9.1	0.8
Elos #3	9	0.7
Elos #4	7.5	-0.8
Red Sea #2	8.1	-0.2
Salifert	9.6	1.3
Elos #5	7.5	-0.8
Red Sea #3	7.8	-0.5



Mg		Variation
Elos #1	1350	-91
Elos #2	1350	-91
Salifert	1650	209
Seachem #1	1400	-41
Elos #3	1500	59
Red Sea #1	1480	39
Red Sea #2	1360	-81



Nitrate		Variation
Elos #1	1	-4
Elos #2	1	-4
API #1	20	15
API #2	10	5
Elos #3	5	0
API #3	5	0
Elos #4	1	-4
API #4	0	-5



Phosphate		Variation
Elos	0.5	0.2
API	0	-0.3
Hanna	0.6	0.3
Salifert	0.25	-0.1

Conclusion

Generally, there seems to be a lot of variation in the results, even within the same brand of test kit. Salifert seems to be quite accurate in one test, but not as much in another. The same is true with Elos, Red Sea, and API. However, all results were within a pretty safe margin for the things we test frequently, like alkalinity and calcium, except for the hanna calcium checker (which is a known issue.)

The results highlight a line of thought to which many subscribe: given a sufficiently accurate test kit, any one result isn't as important as a series of tests over time showing a trend. While there is a definite "recommended" range for a given parameter, corals can adapt to quite a range of conditions.

Rather than focusing on absolute numbers, a better strategy is to monitor changes over time, looking for trends that indicate action might be prudent. For example, as a tank filled with stony coral frags matures, the demand for calcium, alkalinity, and magnesium will likely increase. This increased demand is indicated by a trend line of lower test results. Adjusting the dosing regime would be a corrective action, monitored by the same test kits that brought the problem to the aquarist's attention in the first place.

Hobbyist test kits seem to range from "simple to use, but might require subjective interpretation" (color-based ones like API) to "harder to use, but more objective results" like the Red Sea kits. It seems the best (read: more accurate) results were obtained by testers using the kits that they are most familiar with. That hints that one strategy for maximizing reliable, accurate testing is to stick with a chosen test kit and make sure the procedure used is consistent from session to session.

Future phases of inquiry may focus on "repeatability" – how accurate is a given test kit when the same test is performed multiple times in succession on the same sample of water.

Table 1. Test Kits Used

Manufacturer	Test Kit (*)
Elos	Calcium (5), Alkalinity (5), Magnesium (3), Nitrate (4), Phosphate
Salifert	Calcium (3), Alkalinity, Magnesium, Phosphate
Hanna	Calcium, Alkalinity, Phosphate
API	Calcium (3), Alkalinity, Nitrate (4), Phosphate
Red Sea	Calcium (2), Alkalinity (3), Magnesium (2)
Seachem	Calcium, Magnesium

* -- The number in parentheses denotes the number of a particular kind/brand of test kit.