

A Tripartisan Look at the State of Rebreathers

ANDI, IANTD, TDI Collective rebreather certification numbers and market analysis

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Abstract

ANDI, IANTD and TDI have combined their 65+ years of collective rebreather training experience and will brief the state and future of rebreathers with detailed certification numbers. We will trend this data and provide insight into market direction. Attendance at this lecture provides you with the opportunity to speak with the leaders in rebreather training. (Ed Betts, Brian Carney and Joseph Dituri.)

Keywords: ANDI, IANTD, TDI, rebreather, training, diver training, rebreather market, experience, expertise, certification, Betts, Carney, Dituri

Introduction

The three largest rebreather certification agencies came together to understand the opportunities with respect to rebreathers and foster openness as well as discuss their individual responsibilities as industry leaders in the diving community. The need for knowledge of precise rebreather certifications numbers is overdue. This paper will summarize rebreather certification numbers and analyze their trend as well as mathematically predict the future of rebreather certifications.

Methods

Primary in our minds was the validity of the data. As seems evident, there may be cross certifications between agencies. That is to say, some divers may seek certifications in two or more certification agencies which would effect the resulting certification agency's numbers. To alleviate this, our respective agencies opened our certification files to one another. We traded all unit specific

certification data on rebreather training. We combined our numbers and confirmed the accuracy of the data for a statistically relevant number of years and cross checked each person by name that was certified in a geographical area, by year, unit and level of training. This process allowed each agency to personally verify numbers of certifications. From that we determined a 1% duplication effort. We then applied that duplication decrement number (γ) across all the 22 years of numerical data. All data presented represented the γ reduced data which indicates zero duplication in data. The training agencies know the units on which the training is being completed for each year. Due to potential financial implications we are not sharing unit specific information.

The resultant data was analyzed for the mean by summing the total number of certifications and dividing by the number of years, yielding the mean over the spread of years. Since the early years of rebreather certifications were very low and manufacturers were not regularly producing rebreather, the mean did not contain 1990-1995. The mean was calculated using the following equation:

$$\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^n x_i$$

Standard deviation shows how much variation or "dispersion" exists from the mean value. A high standard deviation indicates that the data points are spread out over a large range of values. Standard Deviation was calculated using the following equation:

$$\sigma = \sqrt{\frac{\sum_{i=1}^n a_i^2}{n} - \left(\frac{\sum_{i=1}^n a_i}{n}\right)^2}$$

Our three companies have slightly different methods for classifying rebreather certifications. Basic includes any entry level program to CCR's and SCR's as well as no stop diving and depths not greater than 30 meters. Intermediate qualifications comprises any training with minimal decompression. Advanced qualifications include dives that generate both hard and soft ceilings that are significant in nature such as trimix, cave and exploratory qualifications.

Since forecasting the market data was an important consideration, we turned to the Holt analysis. Holt's linear exponential smoothing captures information about recent trend and time series data that is non-seasonal. For any statistical test, the probability of making a Type I error is denoted by the Greek letter alpha (α), and the probability of making a Type II error is denoted by Greek letter beta (β). Type I errors, also known as false positives, occur when you see things that are not there. Type II errors, or false negatives, occur when you don't see things that are there (see Figure below). Alpha (α) was chosen to be 0.3 and beta (β) which was chosen to be .03. The equations are:

$$L_t = \alpha Y_t + (1 - \alpha)(L_{t-1} + b_{t-1})$$

$$B_t = \beta(L_t - L_{t-1}) + (1 - \beta)b_{t-1}$$

$$F_{t+m} = L_t + b_t$$

L_t and b_t are respectively (exponentially smoothed) estimates of the level and linear trend of the series at time t , while F_{t+m} is the linear forecast from t forward. The group understands the Holt analysis continues to have less validity each year after projections are incorporated to determine another year of trend data. That is why the forecast was stopped after four years.



Results

This data that reflects over 30,000 divers have been certified on 27 different types of rebreathers at varying levels from 1990-present. The mean certified per year is 1852 divers (number based only on developmental years 1996-present). The Standard Deviation is 707. Further study of the data reveals that greater than 66% of the years studied reflected a number at or greater than the mean which indicates the market is continually growing and has significant recent growth. A comparison of the SCR to CCR certifications, as shown in Figure 1, indicates a growing trend of CCR certifications although a minor resurgence is noted in SCR certifications toward the end of the data recording period.

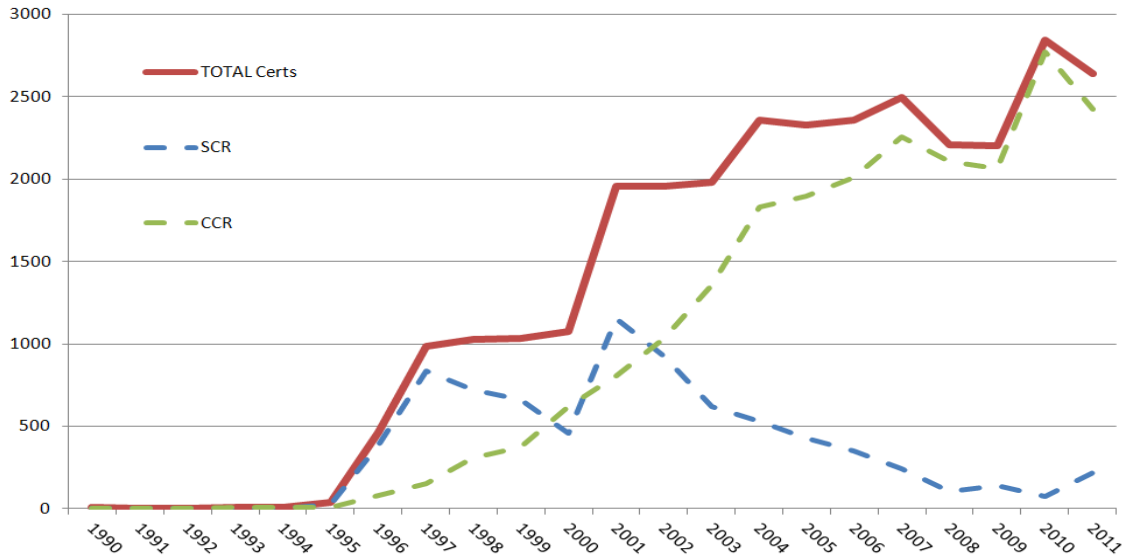


Figure 1. Overall rebreather certification numbers along with SCR to CCR comparison

As demonstrated in Figure 2, basic rebreather certifications (new rebreather divers) total more almost 18,000 divers. Over 12,000 divers carried on to continuing education classes on rebreathers. (50% at the intermediate level and 50% at the advanced level.) New rebreather divers are at almost an all time high in the market save a single year in 2001.

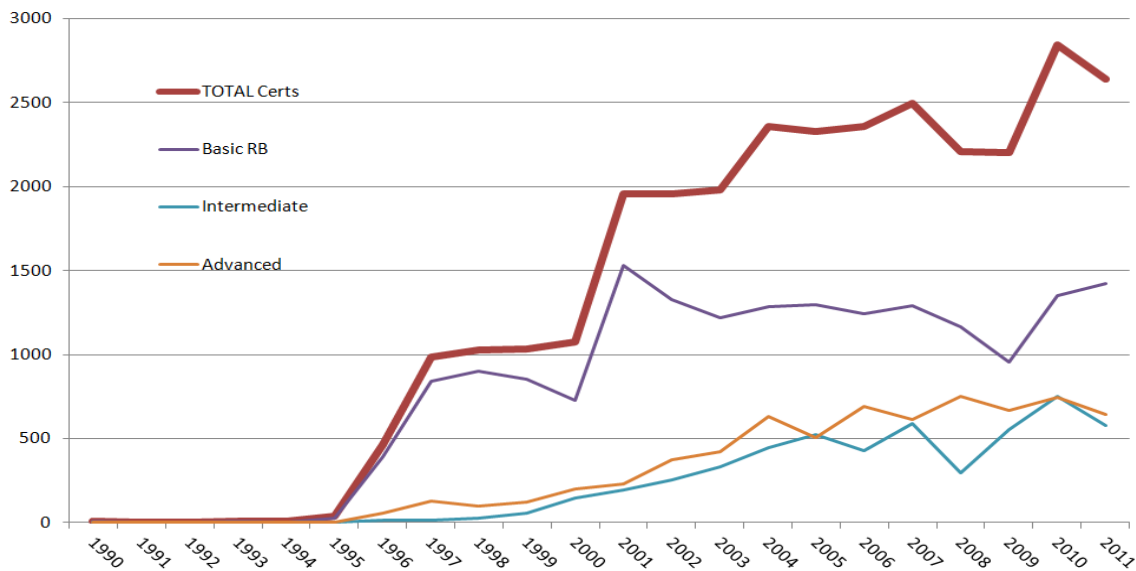


Figure 2. Analysis of skill levels of rebreather divers



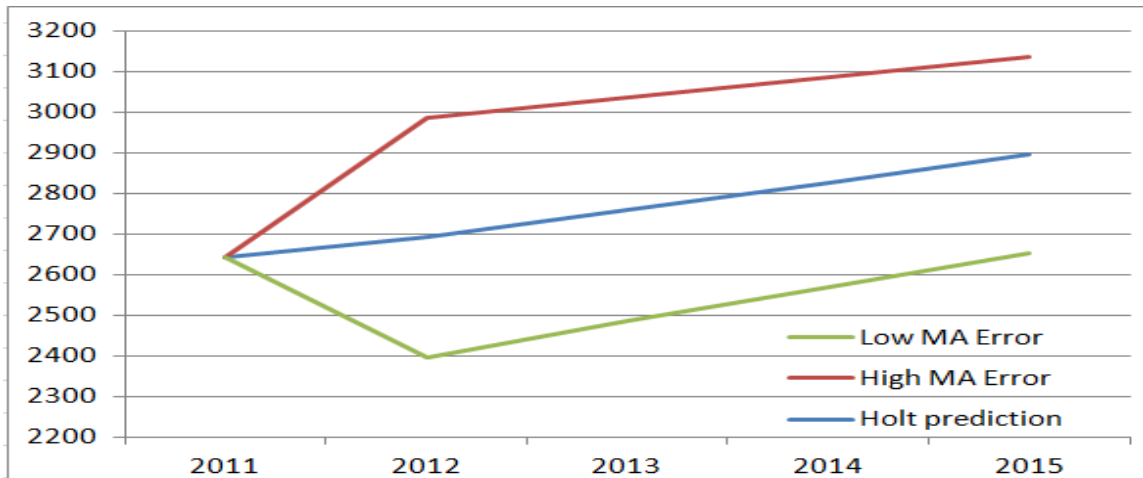


Figure 3. Holt Analysis projections with Alpha = 0.3 and Beta = 0.03.

The Holt analysis projections depicted in Figure 3 indicate the market will generate between 2400 and 3100 rebreather diver certifications each year. This trend continues upward and as expected, the calculation error boundaries converge on a Holt analysis because the result calculated from one prediction is fed into the next year's prediction. The raw data used for all calculations depicts the duplicate certifications removed and is contained in Table 1 below.

Conclusions

Rebreathers are a growth market. The basic rebreather divers are at a high and climbing. CCR certifications continue to grow, but we have noticed a minor resurgence of SCR in the last two years.

ANDI, IANTD and TDI are three different training agencies. We have similarities and differences in the conduct of our individual businesses. Together we have a successful training methodology with 65+ years of experience. We thoroughly enjoyed working together and we will continue to work together in the future to foster openness as well as discuss our individual responsibilities as industry leaders in the diving community. While we may have minor differences as competitors, we agree on a few training items. The most important of which is that the rebreather instructor's experience matters when choosing an instructor.

Year	total	SCR #	CCR #	Bas	Int	Adv	Year	total	SCR #	CCR #	Bas	Int	Adv
1990	10	5	5	8	2	0	2001	1935	1140	795	1516	193	227
1991	2	1	1	1	1	0	2002	1939	917	1023	1312	254	373
1992	5	2	3	2	0	3	2003	1959	613	1346	1210	329	421
1993	10	0	10	6	4	0	2004	2335	523	1813	1271	442	623
1994	6	0	6	2	3	1	2005	2303	426	1877	1287	518	501
1995	36	27	9	29	4	3	2006	2336	347	1990	1233	422	682
1996	460	381	79	386	16	58	2007	2470	239	2231	1278	586	606
1997	978	827	151	835	17	127	2008	2189	106	2083	1152	294	743
1998	1020	717	303	895	27	98	2009	2181	140	2041	944	549	662
1999	1024	653	370	844	53	123	2010	2818	72	2745	1338	742	738
2000	1066	454	612	722	147	198	2011	2616	214	2402	1408	573	635

Table 1. Total rebreather numbers from 1990-2011 for all three organizations with duplications removed.

