



## HRVathlete Understanding the Data

### Getting Started

In order to get an effective measure of an athlete's fatigue, it is important to capture a minimum of 2-3 weeks of data from an athlete. Large differences exist between the baseline HRV measures of each individual, therefore you cannot compare values between athletes. This also means that it is important to establish the baseline profile of an athlete before determining their fatigue. We recommend a minimum of 2-3 weeks, however the more data you have on an individual the more meaningful the data will be. The reason for this is that you may have 2 weeks of data from an athlete but this may have been captured during their offseason when they were fresh and as soon as the athlete shows even the slightest fatigue they will look heavily fatigued compared to this fresh baseline.

It is also important to capture regular HRV samples. HRV measures are very sensitive to stress in the last 24-48 hours, and therefore if you capture irregular data, you may miss key periods. It is recommended that you capture a minimum of 4 days of data per week in order to maximise the effectiveness of HRVathlete.

### Understanding the Data

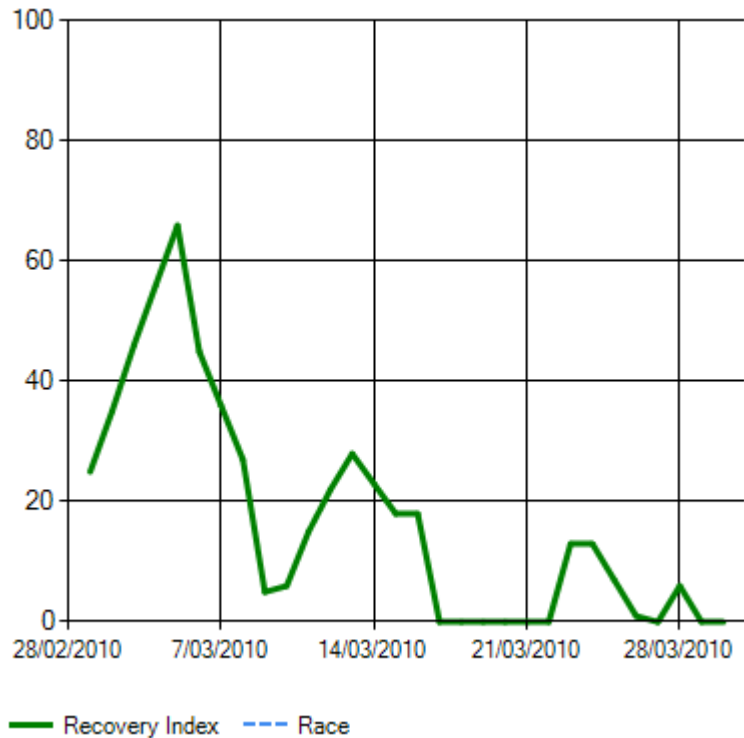
HRVathlete offers two key feedback options, a basic view and an advanced alternative. The default view is advanced; you can change to the basic view by clicking the box above the graph. These options have been developed to allow you to maximise the feedback you get from HRVathlete, regardless of the depth you want to go into.

#### Basic View

Recovery Index (green line): The recovery index is a score between 0 and 100 which rates your level of fatigue. A score of 100 indicates maximum freshness while 0 indicates maximum fatigue. This score is a simplified version of the *Individualised Accumulated Fatigue* measure detailed below in the Advanced View descriptions. A score of 100 indicates that the athlete is 2.5 standard deviations fresher than their average, while a score of 0 is 2.5 more fatigued than the average.

Performance Index (not graphed): Most athletes will perform best when they are neither too fatigued nor too fresh. Optimum results generally occur mid way between recovered and fatigued, or at close to the athlete's mean. The Performance Index assesses this and provides a score of 100 when the athlete is at this mean, right down to a score of 0 when the athlete is 2.5 standard deviations either side of their mean. It is important to note that the Performance Index is not a measure of fitness, only of the athlete's ability perform well given their current level of fitness.

Race/Competition (dotted light blue line): HRVathlete allows you to enter a competition which will then be displayed on the graph as a vertical dotted line. This allows you to better understand fatigue state leading into and out of competition.



### Automated feedback in the basic view

To assist your interpretation of the data, the Basic View offers automated written feedback which is based on your *Hardness*, *Individualised Acute Fatigue* and *Individualised Accumulated Fatigue* (see the full descriptions in the Advanced View section). If you have entered a competition date, this feedback will also provide an indication of your response to recent competition. If the competition is in the coming 10 days, it will provide you with training recommendations aimed at getting you to your optimal performance point on competition day.

### **Advanced View**

The advanced view displays the data in two ways: a graph and a table.

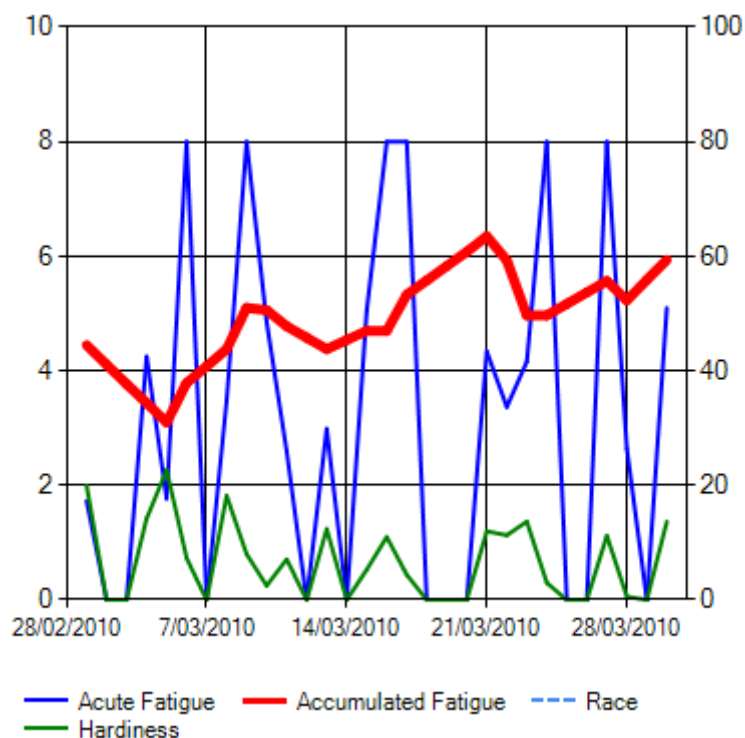
#### Graph

Acute Fatigue (blue line): Acute fatigue is the low frequency to high frequency ratio (LF/HF) determined from a Fast Fourier transform. This is a commonly accepted measure of sympathetic (LF) and parasympathetic (HF) tone. The higher the value, the greater the short term fatigue. This value is largely impacted by the stress the athlete has undertaken in the 24-48 hours prior to the test. For this reason, there can be quite a lot in the movement of acute fatigue.

Accumulated Fatigue (red line): Given that the acute fatigue is so dependant on responses to short term stress, it does not accurately measure the overall fatigue levels of an athlete. In order to assess overall, or accumulated, fatigue we need to look beyond this short term response. Therefore the accumulated fatigue is used as the key measure of assessing an athlete's fatigue. The accumulated fatigue is a rolling average of the past seven days of acute fatigue. The higher the value, the more fatigued.

Hardiness (green line): Heart rate variability provides a measure of parasympathetic tone which is closely related to aerobic endurance. In order to get a measure of this endurance, a heart rate variability measure known as pNN50 is used. In HRVathlete, this is called Hardiness as it provides an indication of an athlete's aerobic endurance, or their ability to handle training load. This value is shown on the secondary axis. This value should be relatively stable, although it may drop during periods of high fatigue. A decline in this value is also often seen towards the end of a long competition period.

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Table

The table shows the date and four columns of data. Column one displays the short term, or Acute Fatigue measure as per the graph, while column three displays the Accumulated Fatigue measure.

The other two columns (two and four) provide the individualised fatigue measurements. Given the large variation in an individual's HRV measures, it can be easier to interpret the data by determining a Z-score for each measure. The Z-score looks at the athlete's data over the last 12 month to determine their mean and standard deviation. The resulting individualised data then shows the number of standard deviations that athlete is above or below their mean for the day. A result of 0 means the data is the same as the average; a positive number indicates freshness and a negative number indicates fatigue.

This process is then applied to the acute/short term and the accumulated fatigue measures. These values are called 'individualised' as they are based on the individual's own history of data. The Individualised Accumulated Fatigue (column four) then becomes one of the key measures for determining an athlete's level of fatigue. This data is also what the indexes in the Basic View are based on.

The individualised measures are then colour coded as green or red in the following situations:

- Individualised Acute Fatigue
  - Red – value is less than -1 (ie. fatigue is greater than one standard deviation)
  - Green - value is greater than 1
- Individualised Accumulated Fatigue
  - Red – value is less than -0.5
  - Green – value is greater than 0.5

Data					
Date	Short Term	Individualised	Accumulated	Ind. Accumulated	
30/03/2010	5.1	-0.62	5.94	-1.95	
28/03/2010	2.64	0.49	5.23	-1.34	
27/03/2010	8	-1.92	5.57	-1.66	
24/03/2010	8	-1.95	4.97	-1.13	
23/03/2010	4.16	-0.22	4.97	-1.13	
22/03/2010	3.37	0.14	5.93	-2.02	
21/03/2010	4.34	-0.3	6.35	-2.44	
17/03/2010	8	-1.97	5.33	-1.54	
16/03/2010	8	-2	4.7	-0.96	
15/03/2010	5.05	-0.66	4.7	-0.97	
13/03/2010	2.99	0.28	4.38	-0.67	

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### Additional information

While we use HRV as a measure of fatigue, it is actually a measure of stress on the body, of which training load is only one factor. Other factors effecting HRV include:

- Altitude
- Travel
- Lack of sleep
- Heat
- Mental stress

For this reason we prefer to say that HRVathlete is a measure of 'training readiness'.