

## WOMEN'S DISTANCE SWIMMING

*By Dr. Ralph Richards  
Presented at 1999 ASCTA Convention*

To assess the long-term **health** of our distance program at senior level we must first take a look at what's happening among our Age-Group girls.

- How many 14 year-old girls are training 10x2-hour pool sessions **every week**?
- How many 14 year-old girls train consistently, completing about 8km in a 2-hour session?
- How many 13-14 year-old girls will complete 2000km of training (each year) over a 44-46 week season?
- How many 13-14 year-old girls will train 300-400 sessions each year (approximately 900 hours/yr of training)?
- How many 13-14 year-old girls will compete within 3% of their best times on 12 or more occasions each year?

WHAT CAN WE DO TO IMPROVE  
PERFORMANCE AND STIMULATE GREATER  
INTEREST AMONG OUR POTENTIAL DISTANCE  
SWIMMING STARS OF THE FUTURE?

### WOMEN'S DISTANCE TRAINING SQUADS PHASE 1

Pilot Project to stimulate the development of  
400-800-1500m swimmers

#### BACKGROUND

In mid-1998 the National Youth Coach, Bill Sweetenham, put forward a proposal to all State Swimming Associations regarding the establishment of State (or Regional) training squads for female Age Group distance swimmers. The initiative is intended as one response to the decline in the number and quality of Australian female 400/800m Freestyle specialists performing at high National/International standards.

#### STRUCTURE OF THE PROGRAM

Each State operated within general guidelines to structure a suitable program. With guidance from Bill, and support from key State Swimming Association personnel (or in some cases State Institute/Academy of Sport personnel) each State trialled a program. The general guidelines included...

- Establishment of one or several small training squad(s), possibly 4-6 swimmers, to minimise pool space requirements. Each State nominated a coach to coordinate the program, although the primary supervision of training sessions may rotate among several coaches.
- Selection of female swimmers in the 12-15 year age range who demonstrate potential in the 400/800m Freestyle or 400m IM

events. Swimmer selection targeted those girls having the potential to achieve National Age qualifying results (i.e. as a minimum standard) within the next year.

- In all programs swimmers and coaches were involved on a voluntary basis (i.e. selection is actually an **invitation** to participate). State Associations or Institutes/Academies of Sport were encouraged to **sponsor** the program (or find a suitable external funding source, such as the **Women in Sport** program within the State Department of Sport and Recreation) so that additional training costs were not passed on to the swimmers.
- Swimmers participating in the program should undergo a musculo-skeletal assessment some time before/during the program.
- Three specific training sessions per week were recommended as the baseline-training program for the distance squad. This would allow swimmers from different programs (having similar goals) to train together, thus stimulating a positive environment to encourage excellence in the distance events. Each training session should be 2-2½ hours in duration.
- Sessions were intended to complement the work being done during the remainder of the week, but offer stimulating and challenging training sets. Cooperation from the home program was essential to the success of this project.
- Home coaches were encouraged to attend squad training sessions and coordinate their weekly program to work toward performance objectives in the distance events. Swimmers in the program would target 55+km per week of training throughout the duration of program. This training volume is consistent with the recommendations of the National Youth Coach (i.e. "An Endurance Training Progression for Maturation – Elite Level Age Groupers" by Bill Sweetenham).
- If possible, one training session per week would rotate through the home programs of the squad members. However, if a home coach was not able to host a training session his/her swimmers would not be excluded from the program.
- Performance outcomes were monitored using suitable testing methods (i.e. step test or blood lactate analysis, heart rates, stroke parameters, and records of training times, etc.) over the duration of the program. Testing was not be the primary

focus of the program (this is not a research project), but would serve to document the overall training outcomes. Home coaches would receive regular evaluations of the group training sessions from the coordinating coach.

- Participation in the pilot program would be tied into the National Youth program (i.e. a training camp would be included for female distance swimmers in December 1998).
- Initially, the program would run for about three months. Evaluation of the program outcomes would determine if the program should continue.

**INTENDED OUTCOMES**

- **Performance improvements** (i.e. competition times) among the swimmers involved in the program.
- Improvements in **individual physiological capacities** of the swimmers involved in the program.
- Increased **emphasis on women’s distance Freestyle** events and the 400m IM endurance events. The intent of the program is to make it desirable for other young female swimmers to aspire to belong to the squad and/or achieve in endurance events.
- **Specialist work** on pace, technique, and goal sets (guidelines provided by the National Youth Coach) specific to endurance events.

**CURRENT STATUS OF WOMEN’S DISTANCE EVENTS**

On the national scene the decline in performance can be seen in the results of the Australian Age Championships (see 1996-98) comparison. This trend has also been identified over a longer period (see article by Richards, Pyne, Sweetenham, and Goldsmith) and has been highlighted in publications and at coaching conferences over the past three years. Now is the time to take action and attempt to reverse this trend.

Internationally, women’s distance events have also stagnated. This fact has been recognised by US Swimming and recent publications have highlighted the need for a return to sufficient quantities of aerobic workload, particularly among young girls. The article “Age Group Training” by Rick Stacy, coach of the Lake Erie Silver Dolphins Club, proposes a simple solution (see attached article, along with Rick’s results from the 1998 US Long-Course Nationals). If we leave our woman’s distance program to chance, then the medals at the Sydney Olympics will most certainly go elsewhere. However, it’s not too

late, as our current 13-15 year-old girls (provided they have the talent) can progress to Olympic standards within the next two years.

**SAMPLE WEEKLY TRAINING PLAN [10 SESSIONS]**

(Squad Sessions in **bold** type)

MON	TUE	WED
Aerobic Threshold HR≈ 50-40 Below Max Main Set of 3km – 4km plus kick set w/out board	Coach to select from Aerobic (Pull & Kick) Skills, HVO and IM sets	Morning Rest
Coach to select from Anaerobic Threshold or Aerobic Endurance, Plus Skills & HVO’s	High Performance or Quality Main Set of 3000m	Anaerobic Threshold Main Set of 4km + and will include IM work

THU	FRI	SAT	SUN
Aerobic Endurance set of pull (2km-3km) Skills, HVO And IM sets	<b>Anaerobic Threshold HR≈40-30 Below Max Main Set</b> <b>7-8km session</b>	<b>High Performance Endurance HR≈20-10 Below Max Main Set</b> <b>8+km session</b>	Rest Day
(similar to Monday morning)	<b>Aerobic Threshold HR≈50-40 Below Max Main Set</b> <b>7-8km session</b>		

RECOMMENDED MINIMUM WEEKLY TRAINING VOLUME OF 55+ KM

Note: A progressive build-up of training volume may be necessary over the first four weeks of the program; if so, the weekly training volume will start at 40km over 7-8 sessions and progress to 10 sessions per week at the recommended training load.

**EVALUATION OF PHASE 1 OUTCOMES**

Comprehensive written reports were received from Western Australia, South Australia and New South Wales with verbal feedback from Victoria and Queensland. There was general agreement that the initial program had been very successful in meeting the intended objectives. The program proved to be a **cost effective** way of addressing an event weakness and taking positive steps to improve the number and quality of performance in specific events. In addition to the intended outcomes, these additional benefits of the Program were identified by the State Coordinators...

- Evaluation questionnaires completed by participants (and their parents) in New South Wales indicated great value was placed upon the **motivational** aspects of the program. Improved self-esteem, confidence, and dedication to training were reported.
- A large percentage of girls in the program gained selection to State Teams for the 1999 Australian Age Championships (in the case of New South Wales, many of the girls were selected to compete in their annual overseas trip to Germany).
- Performance improvements were universal among the girls completing the Program; in some cases there were dramatic. More importantly, the girls were encouraged to accept (even welcome) distance training as the **norm** rather than the exception. Some of the girls improved their overall training load significantly during the three month program and were able to sustain or increase this training load following the completion of the program.
- Home Coaches were encouraged to interact with the coordinating or Program Coaches; thus receiving valuable information and practical experience relevant to the planning and implementation of an endurance-based training program.

### PHASE 2

#### CONTINUATION OF THE WOMEN'S DISTANCE TRAINING PROGRAM RECOMMENDED CHANGES OR ADDITIONS TO THE PROGRAM

- The original guidelines for the program will remain for Phase 2 ... States will have the flexibility to alter some of the provisions to suit their individual needs.
- The 12-week duration of the program (this may be flexible, depending upon individual State requirements) appeared to be sufficient. The 1999 program should commence during May to allow for a full preparation cycle prior to each State's winter (usually held short-course) Championships. A second 12-week program could then be scheduled following the Australian Short Course Championships in September.
- One or more competitions should be included within the program. States may organise separate distance competitions or include the Squad swimmers in existing competitions (July ASI Grand Prix, or State Winter Competitions). States might trial a 'fax meet' where all Programs

across Australia hold time trials on the same date.

- The National Youth Coach has suggested that one standard training session (of his design) be completed each week by all girls in the program. This **common** training session (or at least the main training set in that session) could be completed within the home program (near the start of the week) or as part of a Squad session. Home Coaches should be encouraged to take a more active role in the planning of Squad sessions. All Squad sessions will work to a major physiological and technical objective as outlined by the NYC.
- The age of selected swimmers should be 12-14 years, with girls from Phase 1 allowed to continue past the age limit. Selection will be left to the individual States, although attention should be given to girls competing in the 400-800-1500m Freestyle and 400m IM events. Girls selected into the program should use the specialised training sessions to improve their racing potential in the targeted events, not to simply improve their fitness for 100-200m events.
- Log Books should be kept and a summary of the overall information provided to Home Coaches and forwarded to the NYC on a regular basis.
- A National Youth **Distance Camp** should be planned for the end of the year. This Camp would be open to all swimmers based upon merit, with consideration given to those girls participating in the Distance Program. The camp is intended to **top-up** work done in the home program or Distance Squad and should be limited to girls capable of training 80km per week leading up to the camp. The training load during the camp should represent a step-up in quality, not a significant increase in training volume.
- Greater commitment must be exercised by the **Home Coaches** of girls in the program. Specifically, attendance at 20% or more of the Squad training sessions.
- Each State should try to provide recognition to the girls participating in the Distance Program. This may be done in several ways; for example, distinctive T-shirts, profiles in the media, recognition of personal achievements (i.e. making a top-10 all-time list of age-group performances for that State), etc.

### APPENDIX

*“Aerobic Base and Endurance Swimming for Age Group Swimmers” (Bill Sweetenham)*

*“High Performance Workouts for Women’s Endurance Athletes at Maturation Age” (Bill Sweetenham)*

*“Training for Aerobic Improvements – training at maxVO<sub>2</sub> may, or may not, be the best methodology” (Ralph Richards)*

**AEROBIC BASE & ENDURANCE SWIMMING FOR AGE GROUP SWIMMERS**

*Bill Sweetenham*

It must be said that recovery skills and adaptation abilities of Age Group swimmers compared to mature full developed Open senior swimmers are very different. Males will be different from the less muscled females and specific events will require different levels of aerobic base training. Each athlete will be slightly different in some way.

The successful coach must evaluate the requirements of each individual and provide the correct coaching mix in order to achieve maximum aerobic and endurance fitness for an athlete.

This aerobic and endurance training and preparation begins prior to maturation on a very simple and general application and will stay with the athlete through their post maturation senior involvement in swimming. For females it will quite often have a great influence on their ability to improve in the 200-100m Freestyle combination and 200 IM/Formstroke events as well as the traditional 400-800-1500m Freestyle and 400 IM endurance events after maturation.

Whilst this is also true for males, the effect is not so significant. A senior athlete will require less exposure to any given stimulus for the same amount of improvement as an age-group athlete will require, if an adequate aerobic background has been achieved through maturation.

**Aerobic training** is defined as “doing the greatest amount of work in the shortest possible time, with the least amount of rest, without the heart-rate exceeding 40 beats below maximum.” This workload should also allow full (i.e. in this context **full** is not the same as **complete**) recovery for the next training session (usually 8-12 hours later). **Endurance training** is doing exactly the same as the description of aerobic training, but with a little more demand; perhaps 30-40 beats below maximum heart-rate.

This will mean the parameters that a coach works with in designing workouts are to either control the intensity to a higher level whilst holding the other variables (i.e. rest, volume, etc.) steady; or maintaining the intensity whilst decreasing the rest. However, only one of the

above designs should be implemented at any one time; although one design can be done once the other has been achieved.

It is far more beneficial and interesting to do this in a **team** environment while accepting and understanding the significance of the athlete’s ability to do this during the pre-maturation and maturation phases of development. However, the coach must not ignore or neglect an **integrated training approach** which balances the amount of other types of work, specifically quality speed training, required in the program on a regular basis along with aerobic-endurance training.

A gradual build-up of aerobic work will be required, avoiding sudden increases and only increasing one training demand at a time. I have found it beneficial to increase kilometres (volume) one week and quality (intensity) the next, with a holding or adaptation week about every 4 or 5 weeks for age-group swimmers.

An example would be (note: reference to **pull** are band only)...

Wk1	5 training sessions / 4km each hold 38sec per 50m pace on pull and swim, regardless of repeat distance / hold 50sec per 50m kicking speed pull or swim on a 50sec cycle and kick on a 60sec cycle
Wk2	As above, but reduce to 37sec per 50m pace on swim or pull and 48sec pace for kick
Wk3	Six workouts per week, but as per week 2
Wk4	As above, but reduce swim and pull by 1sec and kick speed by 2sec per 50m
Wk5	Hold maximum values of volume, intensity and rest achieved during the past 4 weeks
Wk6	As per week 5 with intensity and volume, but swim and pull on 45sec cycle and kick on 55sec cycle
Wk7	Hold all variables steady at previous weeks’ values, but increase to 7 training sessions per week at 5km per session
Wk8	Hold all variables as per week 7, but increase to 8 training sessions per week at 5km per session

The other option would be to...

Wk1	11 training sessions at 4km per session, pull and swim on 50sec cycle per 50m (holding 38sec pace) and kick on 60sec cycle per 50m (holding 50sec pace)
Wk2	11 training sessions at 5km per session, but reduce pull and swim to 37sec per 50m
Wk3	11 training sessions at 5km per session, but reduce pull and swim pace to 37sec per 50m and kick to 48sec per 50m
Wk4	Hold maximum values achieved in previous 3 weeks (in rest, intensity and volume)

This progression would then proceed through four more weeks, but decreasing cycles on Weeks 5 & 7, while holding all other variables constant and increasing intensity on Weeks 6 & 8 while holding volume constant; Week 9 would be an adaptation week. The example above illustrates how volume and intensity are manipulated in the training program.

## SWIMMING IN AUSTRALIA – January-February 2005

As stated many times, the key to optimal adaptation involves even or negative split swimming on every repeat distance of 100m or more. Along with this, a coach should be aware that another way of increasing intensity is to hold the repeat swim time and cycle time from a previous week's freestyle work, but program a percentage of the training volume as formstroke work. Also, not every training session will focus on aerobic-endurance base as a primary training objective (but at least three out of every five sessions should focus on this for age-group swimmers), particularly during the first 8-10 weeks of a season. Then progressively aerobic sessions can be replaced by more **quality** type sessions or training sets.

It is wise to increase intensity after maximum volumes of training have been achieved. Training volume can then be decreased as intensity is increased after week 9 or when optimal aerobic values have been developed. This is a very basic and simple goal that minimises the potential exposure to too much work at any given stimulus.

Each coach must ask: is my program developing aerobic-endurance base adequately and systematically whilst being both **goal oriented** and **team motivating**???

### HIGH PERFORMANCE WORKOUTS

For Women's Endurance Athletes at Maturation Age  
(provided by Bill Sweetenham)

#### SESSION PLAN #1

3x

8x50m Freestyle @ 60sec odd numbers moderate, even numbers explode 15m

200 Freestyle @ 2.50

100 Freestyle @ 1.40 broken at 50m at 200→100m pace (descend 100's 1→3)

300-200-100m at Checking Speed on 2.00 per 100m cycle 12x

(150-100-50) on 45sec cycle per 50m for the first 8 sets and then 50sec cycle per 50m of the last 4 sets ... hold heart-rate at 15 beats per minute below maximum for 150's and 100's and hold exact 400m goal pace on 50's ... ALL SWIMS ARE EVEN SPLIT

8x50m drill Freestyle (odd number repeats) and swim

Backstroke (even number repeats) @ 50sec

800m band only pull, controlled frequency breathing (every 6 strokes) @ 11.00

20x50m either Butterfly or Freestyle on short rest interval (i.e. 45sec for Freestyle)

2x100m @ 1.40 easy

8.7km

#### SESSION PLAN #2

20x100m Freestyle, first 5 @ 1.30, next 15 @ 1.20

4x

400m ⇒ at 800m pace

200m ⇒ at 400m pace

100m ⇒ at 200m pace ... start next repeat when HR is at 50 beats per minute below maximum (record swim time & HR, and interval time)

20x100m Freestyle pull, band only (as per intervals used during warm-up)

24x50m @ 50sec (explode odd number repeats, 1500m pace on even numbers)

200m easy

8.0km

#### SESSION PLAN #3

3 x (8x50m @ 50sec)

1<sup>st</sup> set ⇒ build

2<sup>nd</sup> set ⇒ explode

3<sup>rd</sup> set ⇒ 400m pace

200m dive start, swim 800m pace (even split), check HR and stroke rate

5 x 800m Freestyle @ 10.30 (all 800's are negative split)

Target times for first 400m split ⇒ 1<sup>st</sup> 4.50, 2<sup>nd</sup> 4.45, 3<sup>rd</sup> 4.40,

4<sup>th</sup> 4.35 and 5<sup>th</sup> even split faster than any of the above

(Add 15sec rest each time the standard is achieved)

16x100m kick, starting @ 2.00 interval and reducing by 5sec on each subset of 4

32x50m Freestyle at 800m race pace @ 50sec (only count those swims 'on pace' against the total of 32)

8.6km

#### SESSION PLAN #4

12x50m Freestyle @ 45sec, count strokes

12x100m Freestyle @ 1.30, last 4 at 800m pace

12x200m Freestyle @ 3.00, slightly faster than 800m pace

12x100m Freestyle @ 1.40, last 4 at 400m pace

12x50m Freestyle @ 50sec, odd numbers at 200m pace, evens at 400m pace

Hop out if you successfully complete the above, if not →

40x50m @ 45sec at 1500m pace

6.0km

#### SESSION PLAN #5

40x200m →

5 @ 3.15 choice (kick, pull, swim), at least 50m kick

5 @ 3.00 choice, at least 50m Butterfly

10 @ 2.40

10 @ 2.30

10 @ fastest possible interval, or 10sec rest, or 2.50 interval holding 400m pace

200m easy

8.2km

#### SESSION PLAN #6

20 minutes of 30m sprint (swim 20m easy) on long rest

20 x 100m → first 10 @ 1.45, last 10 @ 1.30 (odd's

kick/swim and evens swim/kick)

500 (1500m pace) ... first two sets @ 1.30 cycle per 100m

400 (800m pace) ... third set @ 1.40 cycle per 100m

3x

300 (checking speed)

200 (400m pace)

100 (200m pace)

1600m ... kick for time

200m easy

8.3+km

#### SESSION PLAN #7

8x150m (100m easy, last 50 at 400m pace) @ 2.45

4x150m (dive 50m max, 100m easy) @ 2.45

5x

400m at 800m pace ... OR ... 6x200m max effort

200m at ICS ... 400m at ICS

(2.00 per 100m cycle or start next repeat effort when

HR is 60 beats below max, start ICS swims when HR is 40 beats below max)

1200m continuous swim; descend each 200m or 400m

6.0km

#### SESSION PLAN #8

1500m swim on 18.00  
20x150m Freestyle @ 2.15 at 800m pace, record heart rates  
20x50m Freestyle @ 1.00 (or 50sec) at 400m pace  
1500m band only pull @ 18.00  
200m easy  
7.2km

**TRAINING FOR AEROBIC IMPROVEMENTS – TRAINING AT MaxVO<sub>2</sub> MAY, OR MAY NOT, BE THE BEST METHODOLOGY**

*Ralph Richards*

In Australian Swimming's recently-published Coaching Manual<sup>1</sup>, the application of various types of training are discussed within the context of an integrated training model for swimmer development. The way in which training methodology is described is based upon a straightforward supply-and-demand analogy of the energy systems as they apply to swimming. However, factors such as age, maturity (and associated differences by sex), genetic potential, training environment, and lifestyle all have a profound influence on the end result of a training program. That's why any two swimmers in the same program will most likely react differently (sometimes the differences are slight, sometimes profound) to the group training stimulus.

**AEROBIC CAPACITY**

Aerobic Capacity is one physiological measure that seems (and with good reason) to attract our attention. We define aerobic capacity as the amount of oxygen delivered to the working muscles per unit of time (i.e. litres of O<sub>2</sub> per minute). However, it's obvious that factors such as growth (larger body, larger lung capacity) and maturity (larger muscle mass) have a strong influence on aerobic capacity. Simply, aerobic capacity can change as the result of physical factors without a proportional improvement in the amount of oxygen available per unit of muscle mass. Scientists generally qualify the measurement to reflect these differences; one's aerobic capacity is generally interpreted in terms of millilitres of oxygen per minute per kilogram of body weight (i.e. ml/kg/min). Further, body weight may not be a specific enough to tell us what we want to know, because it's muscle mass in relation to oxygen consumption that's important to us (i.e. fat cells don't help us to move the arms and legs in swimming). Body mass is therefore expressed in terms of lean tissue. Even this delimiting measurement may not be good enough, because the propulsion/resistance characteristics of

swimmers are determined by body shape and not mass alone. Therefore, body volume (as an important hydrodynamic variable, influencing swimming efficiency), in combination with muscle mass, may be more important factors in determining one's capacity (Zwiren, 1989; and Grana, et. al. 1989); particularly during childhood/adolescent growth periods. Studies of children participating in sports training programs have reported varying results regarding the relative contributions of **growth** and **maturiation** and **training** to improvements in aerobic capacity (Mercier, et. al. 1987). After recognising the differences in experimental protocols, the bulk of scientific evidence indicates that children and adolescents who regularly train using aerobic activities will increase their maxVO<sub>2</sub> significantly more than would be possible by growth and maturation factors alone.

Now assume that an Age Group swimmer's maximum capacity to consume oxygen increases, what are the likely outcomes in terms of performance? First, let's look at the nature of energy supply in prepubertal swimmers. There are two considerations ...

1. What are the effects of energy supply at submaximal swimming velocities?
2. What are the effects during high velocity (i.e. high intensity) swimming?

At any given submaximal swimming velocity if the percentage of aerobic energy demand (i.e. in relation to the maximum available) is reduced, the metabolic efficiency will increase. In other words, if the swimmer places less physiological demand upon the body to sustain a submaximal swimming speed, overall swimming efficiency is improved. If other factors such as glycogen availability, swimming mechanics, etc. remain favourable, the net result is the swimmer's increased ability to sustain the workload. This is generally called 'fitness'. It's also the case that a swimmer's ability to perform greater volumes of work, at both low and high workloads, will improve (Yaacov et al 1991). There are good reasons why swimmers should not concentrate exclusively upon training a single energy supply mechanism (Pyne 1995) and Richards<sup>2</sup>. During high intensity race swims, or repeat swims as used in a training set, it has been demonstrated that both anaerobic and aerobic energy contributions are important to children. Although prepubertal swimmers use proportionally more aerobic energy (this is due to a number of biological factors) to meet their race/training demands.

<sup>1</sup> Coaching Swimming: An Introductory Manual. Ralph Richards. Australian Swimming Inc., 1996.

<sup>2</sup> Ibid. Chapters 6 and 11

### AEROBIC POWER OR AEROBIC CAPACITY – WHAT'S THE DIFFERENCE?

Increasing one's aerobic capacity can easily be seen as an advantage in swimming because of the increased potential for energy supply. However, statistical analysis of the characteristics of elite swimmers shows only a **moderate** association between having the highest maxVO<sub>2</sub> and being the most successful in endurance events (Troup and Daniels, 1986). The relationship varies because many physiological factors work together...

1. All three energy supply pathways must function simultaneously
2. There are genetic and adaptive influences related to muscle fibre composition
3. Lifestyle variations, psychological factors, etc. are different from one swimmer to the next

However, a strong association does exist between swimming economy at race speed and success in endurance events (i.e. races of 400-1500m). For this reason, sport scientists have concentrated their efforts over recent years on identifying specific points where energy supply is critical in relation to swimming velocity. How this relationship changes over the course of a training program helps to explain fitness adaptations. Each swimmer's individual anaerobic threshold is associated with a swimming speed, oxygen consumption, blood lactate concentration, and heart rate. If this point is reached at a very high percentage of one's maximum oxygen capacity, then a swimmer has better **aerobic power**. Thus, aerobic power becomes a more practical measure, but aerobic capacity **AND** aerobic power will together influence one's endurance potential.

### TRAINING TO IMPROVE AEROBIC CAPACITY & POWER

Three questions come to mind when planning a training program...

1. **Are there critical periods of development when aerobic training can be used to best affect?**

This question actually has a number of implications. First, when considering a swimmer's career, it's suggested that the bulk of training activities for prepubertal swimmers should be aerobic in nature (Obert, et al 1996; Richards, 1996). Naturally, swimming skill and the development of speed must not be overlooked as part of the integrated training model. Second, when considering a seasonal training plan, improvements in aerobic capacity and aerobic power (together) provide the basis for specific race adaptations later in the season

(Pyne, 1995). It's important that sufficient aerobic work follows any period of detraining.

2. **What volume of training should be devoted to aerobic work?**

Again, this will have implications based upon the age, maturity, and background of swimmers. There is also a consideration of how training volume triggers adaptation. Training prescription based purely upon volume will be inherently flawed because the effects of volume and intensity **interact** to stimulate adaptation. The volume-intensity relationship must also take into account the need for suitable recovery (the third factor in the adaptation equation). Therefore, very large volumes of daily work are possible at relatively low percentages (i.e. 50-60%) of one's aerobic capacity. Smaller volumes of work are possible at higher percentages (i.e. 85-95% of maxVO<sub>2</sub>) until the body has adapted to higher levels of stress, then greater volume of training may take place at these intensities. The volume of work that can be absorbed will depend upon the rate at which a swimmer is able to recover. Among young swimmers the volume of aerobic training usually remain relatively constant during a season; for older swimmers the volume may reduce (although it should never be eliminated) as training adaptations progress. Coaches are often frustrated when they're not provided with clear-cut prescriptions (i.e. 80% of training volume done aerobically at the start of a program and work down to 50% during specific race preparation, for **example**). However, you can see that the question, "how much volume is enough?" is too complex, and the variation between swimmers in any training group may be too diverse, to warrant a simple formula. What is simple, and practical, is regular assessment on the part of the coach. By using simple swimming performance tests the relative improvements or declines in aerobic measures (i.e. capacity or power, or both) can be determined and training volumes and intensities adjusted.

3. **The third question is one of "what training intensity is best employed to improve aerobic potential"?**

Again, the consideration of individual variation within a population of swimmers poses a problem to a quick and easy answer. For example, consider that in addition to one's individual genotype there may be variations in one's sensitivity to training stimuli (Bouchard & Lortie 1984). Some individuals show immediate response to either high or low levels of stimulation while others continue to absorb training volume (at either high or low levels of stimulation) and then respond all at once. The

way to understand this phenomenon is to keep extensive records of each swimmer's training history and then adapt the program to reflect the way an individual best reacts to training stress. Here are some general guidelines the coach can use to help determine training intensity. **First**, swimmers who are **less fit** (i.e. have a relatively low aerobic capacity because of limited training history, or recent detraining effects, etc.) require lower levels of stimulation to improve. Because the majority of coaches don't have the resources to measure aerobic capacity directly, they must rely on perceived exertion or heart rate to estimate the percentage of aerobic capacity used.<sup>3</sup> Light-to-moderate intensity (i.e. heart rates of 40-50 beats/min below maximum) is usually sufficient to elicit a fitness response. **Second**, swimmers who have an accumulated training history (i.e. several years of training background) or a favourable genotype will adapt faster to training loads and will quickly require greater stimulation. Increased training volume at higher intensity (i.e. about 75% of maxVO<sub>2</sub>) will be required to improve aerobic fitness. Generally, this is **moderately hard** endurance work performed at 30-40 beats/min below maximum heart rate. **Third**, well-conditioned swimmers will require aerobic loads of 75-85% of maxVO<sub>2</sub> to elicit the required training response. This work is perceived as **hard** and is performed at approximately 20-30 beats/min below maximum heart rate. Once this level is reached, the coach must test regularly to determine if aerobic capacities are still improving or if they have plateaued. High levels of fitness can be maintained using reduced volumes of aerobic work, but this level of conditioning can not be maintained indefinitely. Eventually, even superbly conditioned swimmers will exhibit reductions of aerobic capacity if both volume and intensity requirements go unfulfilled.

Even young swimmers will respond to these training principles. Evidence from research, as well as practical experience by coaches, supports this. A recently reported study involved prepubertal girl swimmers (average age 9.3 years at the start of the study), training over a twelve-month period. They demonstrated a 38% increase in maxVO<sub>2</sub>, while a matched control group showed only a 13% increase on the basis of growth and maturity alone (Obert et al 1996). It's interesting to note the training protocol for the study involved progressive loading of both training volume and intensity. The subjects began with three months of training with an emphasis on swimming skill.

---

<sup>3</sup> Ibid. pp.55-57

Training volume and intensity were initially relatively low. This was followed by eight months of training where volume progressively increased to 10-15km/wk and finally peaked at 20km/wk at the conclusion of the study (i.e. this training load is **not considered** to be excessive for this age group). Although the study was labelled as **intense swimming training** an analysis of the methods indicated that workloads never exceed 90% of maxVO<sub>2</sub> and progressively built-up from low levels to about 75-85% of maximum capacity during the later months of the study. The training load is similar many programs in Australia for 9-10 year-olds, and is consistent with guidelines suggested in ASI's Coaching Manual.<sup>4</sup>

It's clear that young swimmers do not need high volumes of training at a very high percentage of their aerobic capacity to improve. This is not to be confused with using appropriate amounts of **high velocity** training to improve anaerobic capacities (both lactic acid producing and alactic) of young swimmers. The overall limitations imposed by maturation factors will reduce the need for large volumes of work requiring a high anaerobic energy component. Yet many coaches still advocate training for junior swimmers that includes a substantial volume of high intensity training (i.e. well above 90% of maxVO<sub>2</sub>) for the purpose of developing aerobic capacity. In his book, Maglischo<sup>5</sup> states, "What proponents of VO<sub>2</sub>max training failed to take into account was that athletes cannot maintain VO<sub>2</sub>max speeds for very long without becoming fatigued. Consequently, the volume of training that could be performed at these speeds is not sufficient to produce maximum adaptations in aerobic metabolism". In his book, Richards<sup>6</sup> states that, "Prior to and during the childhood growth spurt it may not be advisable or necessary to program maximum aerobic training. Sub-maximal aerobic training loads are more than sufficient to stimulate continued improvements among young swimmers."

In reality, the coaching literature is full of training prescriptions that use high-volume/high-intensity training sets. These **may** have a valid place within the program of senior age-group or elite senior swimmers if properly applied. The concerns of Maglischo that "training volume may not be sufficient" can be

---

<sup>4</sup> Ibid. pp.90-91

<sup>5</sup> Swimming Even Faster. Ernest Maglischo. Mayfield Publishing Company, 1993. p.77.

<sup>6</sup> Coaching Swimming: An Introductory Manual. Ralph Richards. Australian Swimming Inc., 1996. p.69.

overcome to some extent if interval loads are applied using very short rest between swims. However, achieving and sustaining swimming intensity that stimulates maximum oxygen consumption is not easy. First, maximum oxygen consumption is not immediately reached; it usually takes 1-2 minutes to achieve, even when the effort is 'exhausting' almost from the start. Second, swimming velocity at maximum O<sub>2</sub> consumption will only be sustained for about 3-5 minutes before neuromuscular fatigue and increasing lactate accumulation have a significant affect. Therefore, the swimmer must sequence the effort (for example 4x100m at a very high level of effort, with short rest, 5-10 sec., followed by a recovery swim and a repeat of the sequence). It's unrealistic to expect young swimmers to achieve sufficient volume of training, at this exhaustive intensity, on a frequent basis. Older swimmers will be able to absorb this type of training, provided suitable recovery training is also integrated into the overall training program.

### SUMMARY

Improvement in aerobic capacity is a desirable training goal for the development of swimming endurance and overall ability to absorb a variety of training stimuli. The concomitant goal of improving aerobic power may also be achieved through the prescription of training loads that represent as little as 60% (for unfit or novice swimmers) to 85-90% (fit swimmers) of maximum capacity. The resulting adaptations that occur produce a shift in the swimming velocity required at one's **individual anaerobic threshold** (i.e. threshold speed becomes progressively faster). A greater percentage of aerobic capacity becomes available for sub-maximal performance, thereby improving energy efficiency through a range of swimming speeds. Programs that regularly require maximum aerobic capacity training loads do not seem to be warranted for prepubertal swimmers. Progressive loading of both training volume and submaximal intensities will produce the desired aerobic improvements. However, senior age-group and/or elite swimmers may effectively use training sets designed to elicit a maximum aerobic load. Whenever maximum aerobic training loads are used, there must be sufficient recovery (i.e. adjusting the intensity of other training stimuli to act as active recovery) between applications in the training cycle.

### References

- Bouchard C., & Lortie G. "Hereditry and Endurance Performance". Sports Medicine, Vol.1, 1984.
- Grana W., et al (editors) "Swimming Economy: A Physiologic Perspective". In Advances in Sports Medicine and Fitness (Vol.2). Year Book Medical Publishers, Inc., Chicago, 1989.
- Maglischo E. "Swimming Even Faster". Mayfield Publishing Company, Mountain View, California, 1993.
- Mercier J. et al "Effect of Aerobic Training Quantity on the VO<sub>2</sub>max of Circumpubertal Swimmers". International Journal of Sports Medicine, Vol.8, 1987.
- Obert P. et al "Effect of long-term intense swimming training on the upper body peak oxygen uptake of prepubertal girls". European Journal of Applied Physiology, Vol.73, 1996.
- Pyne D. "The Specificity of Training - A Fresh Look at an Old Principle: Using Aerobic Training to Improve both Aerobic and Anaerobic Fitness". Australian Swim Coach (Journal of the Australian Swimming Coaches Association), Vol.11, No.7, (Jan/Feb) 1995.
- Richards R. "Coaching Swimming: An Introductory Manual". Australian Swimming Inc., Canberra, 1996.
- Troup J., & Daniels J. "Swimming Economy: An Introductory Review" Journal of Swimming Research, Vol.2, No.1, 1986.
- Yaacov A. et al "Oxygen uptake dynamics during high-intensity exercise in children and adults". Journal of Applied Physiology, Vol.70, No.2, 1991.
- Zwiren L. "Anaerobic and Aerobic Capacities of Children". Paediatric Exercise Science, Vol.1, 1989.