



SCOTTISH INSTITUTE OF SPORT

High performance expertise

A guide to recovery from the Scottish Institute of Sport



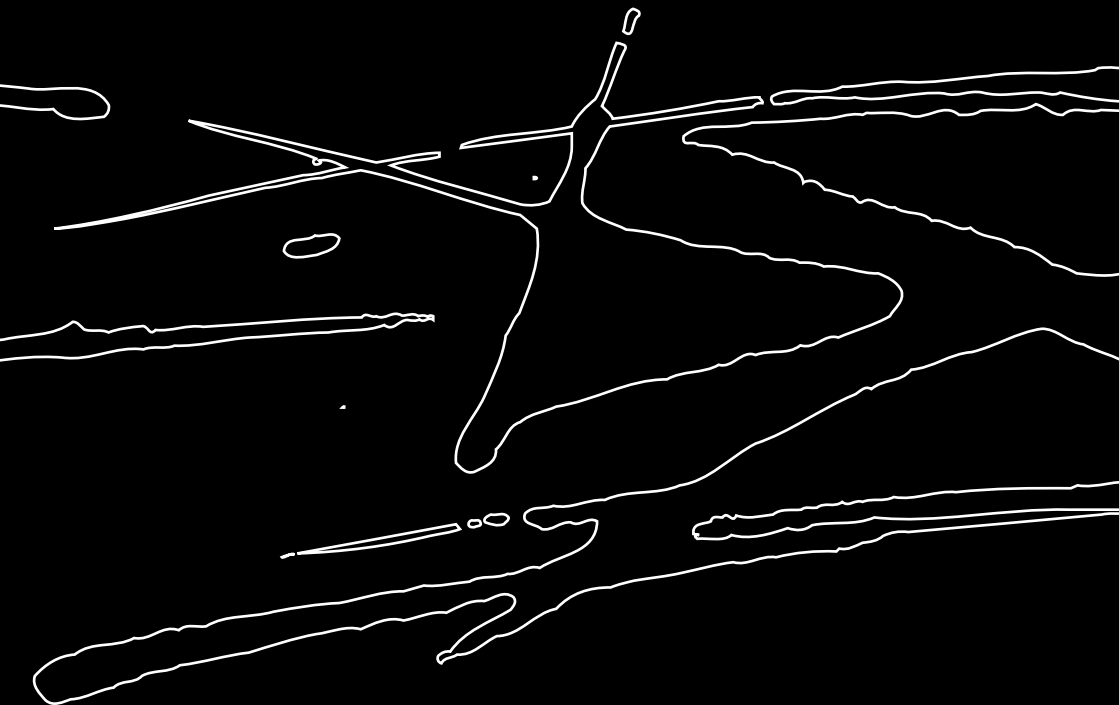
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Introduction

Effective recovery from intense training is the difference between success and failure in sport.

- Recovery can be defined as the re-establishment of the initial state.
- Recovery takes several forms - it could be the immediate compensation, restoring the deficit that the training produces and/or the longer term management of a training programme.
- Recovery does not always need to be relaxation and can occasionally be tension. Sometimes it might just be a change of stress. This recovery takes place through enhancement of activity (e.g. physical exercise), reduction of activity (e.g. sleep) or a change of activity (e.g. swimming for a runner).
- Recovery needs to be individualised and involve more than one strategy. Recovery can be passive, active or pre-active but needs planning and is more than “not training”. It is an integral part of training.
- Intelligent recovery improves performance.

There is very little scientific evidence for specific recovery measures. Where there is science, there is controversy about what is being measured. This document is produced using a mixture of best practice and scientific evidence, if this exists to support this.

All athletes will be at different stages in their sporting journey and this resource should be used as appropriate for the individual and sport.

Some readers may disagree with some of the opinions expressed in areas but there will be few readers who will not learn something useful from this booklet.

A detailed report, with references and further reading, is available on each of the areas covered from the Scottish Institute of Sport on the website.

The Scottish Institute of Sport set up a multi-disciplinary working party to look at individual aspects of recovery for athletes, coaches and support staff. The working party is outlined on the back page.



Periodising your training programme

How does periodisation affect recovery?

When you train you are stressing your body's physiological systems. Training is the systematic and progressive increase in stress that you put your body under for it to adapt and become stronger, faster or fitter. Interestingly, when you are physically training you are damaging your body - it is when you rest that you repair yourself. This process is called General Adaptation Syndrome or (GAS) and was first proposed by Hans Selye (1956).

Periodisation in essence is how we plan your preparation for competition. It is how we, as your coaches, determine the quality and quantity of the training you do to avoid burn out or staleness and optimise your state of readiness for the competitive season.

A periodised plan underpins all of your training which allows you to be physically, technically and mentally at your peak of condition.

Your competitive year is split into different phases. These usually include a pre-season (preparation), in-season (transition), competition (major events) and active recovery (rest) period. Your training cycles are split into macrocycles (1-4 years), mesocycles (months or blocks of months) and microcycles (usually your training week) and are planned in advance to reflect the training year or goal.

Depending on which phase of the year you are in will be reflected in the levels of training you do. The frequency of sessions (number in a week), how much overall work you do (volume) and how hard you work (intensity) are fluctuated across the year to get the best blend of technical and fitness work to minimise the occurrence of overtraining or staleness. This plan is put together by your Technical, Personal, Team and Strength and Conditioning Coach and is built around you being in the best possible shape (peaking) for highest priority events.

Key points:

- Periodisation or fluctuation of volume and intensity is believed to enhance the athletes ability to train hard at the right times.
- Your programme is periodised to optimise performance for key competitions.
- If you were going to "google" periodisation, consider the following words: General Adaptation Syndrome (GAS), Periodisation, Active Recovery, Training Year, Goals, Volume, Intensity, Macrocycle, Mesocycle, Microcycle, Peaking.

Stretching

Does stretching before exercise help your recovery?

Stretching before you exercise, as part of a warm up, does not help you recover or reduce muscle soreness post exercise. There is some evidence to suggest that slower static stretches may decrease your performance in sports which require speed and power. Research into dynamic exercises is still ongoing for recovery although the evidence is there to suggest they do prepare you for the exercise you are about to do as part of a dynamic warm up.

It is worth mentioning briefly the effect of stretching on enhancing performance and so the indirect effects this may have on recovery. This will depend on the sport you are doing and your own physical make up, and will be very specific to your needs. Post injury you may have to add additional stretching to regain muscle length that has undergone adaptive shortening as part of the healing process. You may also have some muscles that tighten up regularly because of the nature of your sport. If you are advised to slow stretch, you should do this separately to training or warm up, but you can include this in your cool down. If you are doing stretches dynamically these

can be part of your training or warm up. You will need to be advised which stretches are best for you by your coach and physiotherapist.

Slow stretching:

takes the muscle to its full length to try and lengthen it even further. It must not be painful, but may feel tense when stretched. There is no consensus on the exact time to hold the stretch but between 15 and 30 seconds are the recommendations from the research. They would also suggest that stretching each muscle three times in succession is sufficient, and there is no gain to be had by stretching more than that.

Dynamic stretching:

uses specific exercises to stretch the muscle fibres within their normal range by a range of short activities targeted at relevant muscle groups. This does not lengthen the muscle itself, but increases the ability of the muscle fibres to be elastic, so they can tension and recoil to release energy without damage but also to use your maximum power, strength and speed.

Key points:

- Do not slow stretch as part of your warm up if your sport relies on speed and power.
- Slow stretching is normally done separately to training or playing or as part of a cool down.
- Dynamic stretches are done as part of a dynamic warm up or a training session.



Ice baths

Can ice baths help in recovery?

The answer would be probably. The studies available do not all use high performance athletes and they do not take account of all the complex factors within your body involved in your recovery. An ice bath definitely makes you feel better afterwards but may be a pain killer effect rather than actually speeding up recovery. It may work better in sports where there is a lot of contact, perhaps because of the bruising involved?

There is more evidence to suggest that alternative hot and cold might be better but this is practically very difficult to do sometimes.

However, one note of caution; there is evidence to suggest that if you ice bath regularly (daily in a short period of time) that you may slow your natural muscle recovery and so impair your performance rather than increase your recovery so you can perform better.

Key points:

- If you are used to having ice baths and you feel they help then it is fine to continue as long as you do not have them daily over periods of time when you need to perform.
- Alternate hot and cold baths might be even better if you have the facilities to do them.

Cool down and active recovery

The return of the muscle/body/mind to its pre-exercise state after exercise.

Cool down

This is a group of exercises you should perform immediately after training to provide a period of adjustment between exercise and rest. It improves muscular relaxation, removes waste products, removes muscular soreness and brings your cardiovascular system back to rest. Stretching is often combined with the cool down, improves the range of movement and reduces risk of injury when body temperature is still elevated.

Compression garments

Compression Garments (e.g. skins and linebreak) are good for recovery after all sports where muscle fatigue, resulting from lactic acid build-up, and/or muscle vibration is an issue for recovery. Although you should follow an adequate and appropriate “cool down regime”, Compression Garments can further assist the removal of waste products (e.g. lactic acid) from the muscles as well as provide the muscles with oxygen/nutrient-rich blood by stimulating circulation. Likewise, as muscles get stressed and tired they become less disciplined and lose their alignment giving rise to an increase risk of injury. The support and gentle compression effect of Compression Garments can help, along with the improved circulatory rate to the used muscles, to enhance recovery. Therefore, Compression Garments assist athletes to recover faster and with less negative effects such as muscle soreness and lethargy.

Active recovery (regeneration)

Active Recovery (regeneration) is a low intensity, non weight bearing aerobic activity taken the day after competition/exercise. This restores energy, muscle tension, balance and range of motion.

Do pool or water based interventions aid recovery?

The research focuses on some deep water running and also underwater jet massage. In addition the temperature of the water is questioned: hot, cold or contrast, and this overlaps with the research into ice baths. The limited research that has been done would suggest the following:

- Cold water immersion might be better than hot, but contrast hot and cold might be even better.
- Underwater massage jets may enhance neuromuscular recovery.
- Deep water running may restore strength and reduce soreness post plyometric session.
- One paper showed that the recovery interventions including pool recovery were equally effective done the next day as done immediately post exercise on the physiological parameters measured at 48 hours.



Nutrition

Nutrition is a key component in enhancing adaptations to training and optimising performance.

It encompasses a range of nutrition-related processes including:

- Refuelling of glycogen stores
- Repair and synthesis of muscle cells from available protein pool
- Rehydration

Refuelling

- Start refuelling within the first 30 minutes after your activity has finished. Recovery begins after your last hard repetition or effort.
- Be organised and have suitable foods and fluids available at your exercise venue.
- Aim for an intake of 50-100g carbohydrate (CHO) (e.g. large bowl of cereal with low fat milk) every 2 hours until your normal meal pattern is resumed.
- When CHO needs are high, or you find it difficult to eat after exercise, go for compact forms of CHO, including low-fibre choices of CHO-rich foods, sugar-rich foods, sports drinks, milk shakes, fruit smoothies and liquid meal replacements.
- Small, frequent meals may assist you to achieve high CHO intakes without the discomfort of overeating.

Repair

- The consumption of protein within recovery snacks and meals helps repair muscle and improve muscle adaptations to training. Carbohydrate combined with protein within 1 hour post exercise is advisable.

Hydration

- Typically, a volume equal to $\sim 1.5 \times$ fluid lost should be consumed over the subsequent 2-4 hours to fully restore fluid balance. Fluid loss is equal to weight pre-exercise (g) minus weight post-exercise (g) plus any fluid consumed during exercise (mL) minus any urine losses (g).
- You should not rely on thirst or opportunity to dictate fluid intake to correct dehydration. A random approach may be acceptable when fluid loss is 1L or less, but when fluid losses are greater, an organised schedule is required.
- Rehydration should be considered an immediate priority, especially where gastrointestinal function is compromised.
- Dehydration will have a negative effect on subsequent exercise sessions if not fully corrected before the next workout.
- Alcohol can increase undesirable swelling to damaged tissues hindering repair processes. The advice is to avoid alcohol for at least 24 hours.

Recovery Strategies are sport specific. For individual advice see a Sports Nutritionist.

Medications

At this moment in time there is no evidence in support of using medication in recovery strategies other than using analgesics e.g. paracetamol for pain relief.

It is important that athletes remember that if they have taken morphine as a pain killer then a therapeutic usage exemption certificate must be completed.

It is also important that all athletes record all medications and supplements taken in the week prior to a dope test on the dope test form when they are completing it.



Massage

There is a long history of using massage to aid recovery in high performance sports.



Its main purpose is to assist in reducing residual training fatigue and stress so that you start a new training or competition session in as fresh a state as possible. It can also be helpful in a preventative way in reducing localised muscle tension that can with time lead to overuse injury. There are times such as following heavy training programmes or long periods of travel when massage can be particularly helpful.

The complex mechanisms by which massage impact on the recovery process have still to be fully researched and understood, particularly the physiological ones. There is evidence of massage leading to improved mood states and feelings of well-being that help physical and psychological relaxation.

Some known specific benefits are:

- Decreased sensations of fatigue
- Calming the nervous system
- Encouraging effective sleep
- Reducing excessive muscle tension and normalising muscle tone
- Revealing soft tissue under stress and potential trouble spots

The type of massage techniques delivered will vary depending on whether the athlete is in training or competition as wrongly applied massage can interfere with performance in competition.

It is important to use approved Institute network practitioners who are experienced in sports massage and are able to apply the appropriate type of massage in different training or competition phases.

Travel and postural stress

Prolonged travel can lead to problems in muscles and joints through encouraging poor seated postures.

These may be unhelpful postures that you already tend to adopt through work and lifestyle patterns. The discomfort that often follows travel to or from training and competition indicates musculoskeletal stress that may impact on performance.

Travel stress will often have the following effects among others:

- Lower back stress affecting discs and ligaments
- Hip flexor tightening
- Hamstring and calf tightening
- Neck and shoulder tightening

It is important to have personal recovery strategies that help deal with such travel associated stress and remove any residual effects of travel before a new training session or competition event.

There are useful self-help techniques that could be helpful to most athletes in a general way. Additional information relating to self-help techniques will be available direct from the Scottish Institute of Sport.

These include:

- Active body movement strategies
- Targeted stretches
- Some self-massage techniques

Some athletes with a history of specific musculoskeletal problems may need more particular guidance from their Medical and Physiotherapy support staff.

An information sheet regarding travel and postural stress is available from Dr Brian Walker at the Scottish Institute of Sport.



Measures to help monitor recovery

Level 1

- One simple way of self-monitoring first thing in the morning is heart rate which is worth recording.
- Orthostatic test (change in position). Use, if possible, a heart rate monitor and record your heart rate in a supine (lying flat position) for 5 minutes followed by standing up and staying upright for 5 minutes. The difference between the pulse rates gives a rough indication of recovery. If there is a large discrepancy advice should be sought from your advisors.
- Using a training diary to mark the quality and quantity (hours of sleep) again changes in this can indicate poor recovery.

Level 2

This is more complex using support staff for further testing.

- There is a system known as Heart Rate Variability Analysis which is available from Institute support staff where appropriate.
- You can use an osmochek or analysis sticks to analyse urine.
- Blood and saliva analysis can take place e.g. CK is a breakdown product of muscle, testosterone/cortisol ratio is a good measure of recovery which has been used by some people and salivary IGA has been used at the Institute.

Other Methods:

- Time taken for the heart rate to return its resting rate after a period of exercise is a useful measure of recovery. The heart rate after exercise should drop to 65-70% of the heart rate at maximum. If it stays around 80% of the heart rate maximum then the recovery period has to be longer.
- An increase in the submaximal heart rate indicates insufficient recovery. This is not perfect and should ideally be combined with blood lactate testing.

In summary there are simple methods available without assistance from support staff. In terms of major competition the support staff can play an important role with more sophisticated measures.

Sleep

How can sleep help recovery?

Good quality and quantity of sleep is thought by many experts of different disciplines as being essential to achieving good recovery. These may vary from individual to individual but athletes should be aiming for close to 8 hours and adolescents even more. Your individual perfect sleep quantity is defined as the amount of sleep produced by waking spontaneously undisturbed when healthy. Sleep disturbance in an athlete who has been previously a good sleeper should be brought to the attention of the Coach, Sports Scientist, Performance Lifestyle Adviser or Doctor.

Sleep loss is accumulative and leads to a tendency to fall asleep during the day or to have reduction in performance. This is recorded by the brain as debt which can only be reduced by more sleep. Studies have shown that extra sleep does not cause

sluggish performance but that immediately after waking there is a period of about 90 minutes when sleep inertia i.e. reduced performance takes place.

This is important in napping in the afternoon and then performing. A clear 90 minutes should be left between sleep and performance or naps should be less than 30 minute (power naps lasting 20 minutes are good). Power naps allow a refreshing sleep but does not allow the brain to have a deep sleep thus leading to inertia. The effect of inertia can be reduced by showering, caffeine, bright lights and light exercise.

A high performance athlete should be assessing their sleep quality and quantity as regularly as possible by using a diary or by a monitoring questionnaire.

Key points:

- Be regular in routine as sleep is a habit which is trainable.
- Try and use the bedroom for sleep only (apart from perhaps sex) and do not watch TV or read. The mind will then associate bed with sleep and retiring to the bed room will send a trigger to the sleep inducing areas of the brain.
- Use night shades and ear plugs when needed.
- While light reading prior to bedtime can be useful it should take place in another room.
- Avoid stimulants in late evening such as caffeine and alcohol. Similarly, while exercise is helpful to aid sleep it should ideally take place in the early evening to allow arousal to settle prior to bedtime.
- Avoid big meals for 3 hours prior to bed but light carbohydrate and a warm drink may help e.g. milk.
- A warm bath may help but a bath that is too hot close to bedtime is counter productive.
- Have subdued lighting in the bedroom and a comfortable temperature, not too hot or too cold, and making sure the extremities are warm.



Psychology

The key to psychological recovery is developing a high level of self awareness.



Only when you have developed a level of awareness that allows you to recognise when and where particular emotional states and feelings trigger symptoms of tiredness, lethargy, a lack of motivation and apathy, will you be more likely to adopt appropriate strategies which will enable you to switch to more functional emotional states and thus facilitate the recovery process.

How and why it is important to recognise your emotions

The most effective way athletes can assess emotions is via regular use of a written, video or audio diary. By recording emotions over a period of time, you can recognise what “pushes your emotional buttons” or sends you into “emotional meltdown”. By reflecting on how you react to specific emotionally inducing events whilst at competitive events or training camps, you can learn to become aware of whether your subsequent reaction/behaviour to emotionally inducing events are positive or negative.

Over time, you will learn to establish the most effective coping strategies to adopt when experiencing any similar dysfunctional thoughts/emotions and subsequent behaviours. Not effectively monitoring your own emotions, within the performance environment, can lead to an increased risk of you developing ruminating (repeating) worries over again and again, such thoughts can lead to uncontrollable debilitating anxiety or a negative bias. This type of thinking combined with other physical indicators of fatigue can subsequently lead to mental and emotional exhaustion.

In team or squad based sports it is important that you develop the ability to not only assess your own emotions but also those of your team-mates. A better understanding of the best way to interact with other individuals when they are displaying destructive behaviours that could be linked to dysfunctional emotional states, can facilitate a supportive environment in times of adversity.

Post training/competition strategy

<i>Within the first hour</i>	<i>Post first hour</i>	<i>Prior to bed sleep optimization</i>
<ul style="list-style-type: none">• Carry out your individual performance review/debrief, if possible.• Start to individually unwind, use music if appropriate (particularly important if training or competing at night, as you need to cool down mentally as well as physically).	<ul style="list-style-type: none">• Relax as appropriate (e.g., read, take in a movie, socialise).• Continue to hydrate and refuel as appropriate.• Have a specific set time to access social support groups.	<ul style="list-style-type: none">• Use relaxation skills to switch off.• Follow personalised sleep guidelines.

Key points:

- **Listen to music.** Use music to elicit changes in mood states eg: if over anxious use relaxing music.
- **Debrief performances.** Ensures that there is closure and disengagement from performance.
- **Emotional recovery.** Use of simple distracters that are non-sport related.
- **Contingency planning.** Developing solutions to “what if?” post performance scenarios.
- **Access to social support.** Know who and when to access significant supportive others.
- **Relaxation techniques.** Exercises designed to energise and regulate levels of anxiety/arousal.

Performance lifestyle management

How does lifestyle management affect recovery?



Strategies for recovery include different scientific approaches – lifestyle management has an impact on recovery by pulling together this advice and developing a lifestyle that is conducive to performance. We know that when you learn to manage the distractions that get in the way of your performance – your motivation, attitude and performance improves.

If you are training, competing and managing a performance based lifestyle then you will have to contend with a variety of distractions. Similarly, as you develop and progress, more and more demands are placed on your time by a number of people – including coaches, a variety of support staff, employers/educators, family and friends. In the middle of all of this – we need to ensure that you can prioritise recovery from training and competition, in both passive and active ways.

Distractions can have both a positive effect and a negative effect – depending on the individual; their circumstances and their stage of development.

Research into Training Motivation in Elite Rugby Players (McCarroll and Hodge 2004) revealed that players who had good time management; organisational skills and had an integrated lifestyle (i.e. they had some other interest outside rugby), were those players who adhered to their programmes; had high levels of training motivation; were able to manage the distractions around them and, as a result, were able to successfully perform at the highest level and sustain their performance over time.

Key points: work with your performance lifestyle manager!

- **Use a diary.** To prepare, plan, prioritise your time; monitor your training, performance and recovery and to control your time. Plan for recovery! Recovery is as important as training and needs to be built into the periodised plan.
- **Distractions.** Need to be identified and relevant to you as an individual. Distractions can be positive or negative – depending on the individual and circumstances. When you find the solutions to help you manage distractions – this makes a significant difference in your ability to be independent, plan, rest and recover. All of these factors can assist your performance and supports the longevity of performance.

Negative examples	Exams, finance, travel, relationships, time, boredom, injury
Positive examples	Doing something away from sport, mental stimulation, active recovery, passive recovery, new challenges, personal development, time management

- **Transition tolerance.** identify your key athlete development stages in your sport and plan for the transition phases i.e. when you move from junior to senior level of competition.
- **Plan.** A lifestyle that is conducive to performance by using a Periodised Plan and Diary; Eat to Fuel and Refuel; Drink Fluids to Hydrate and Rehydrate; Quality Sleep; Adopt Psychological Strategies that Facilitate Recovery and Discuss Individualised Recovery Strategies with your Support Team.

Working party

Marek Aneštk
Exercise Physiologist

Bob Easson
High Performance Rugby Coach

Susie Elms
Head of Performance Lifestyle

Alan Hay
Lead Massage Therapist

Keith Joss
Women's High Performance/
National Team Hockey Coach

Ryan King
Strength and Conditioning Coach

Ruth McKean
Area Nutrition Coordinator

John Marchant
Sports Psychologist

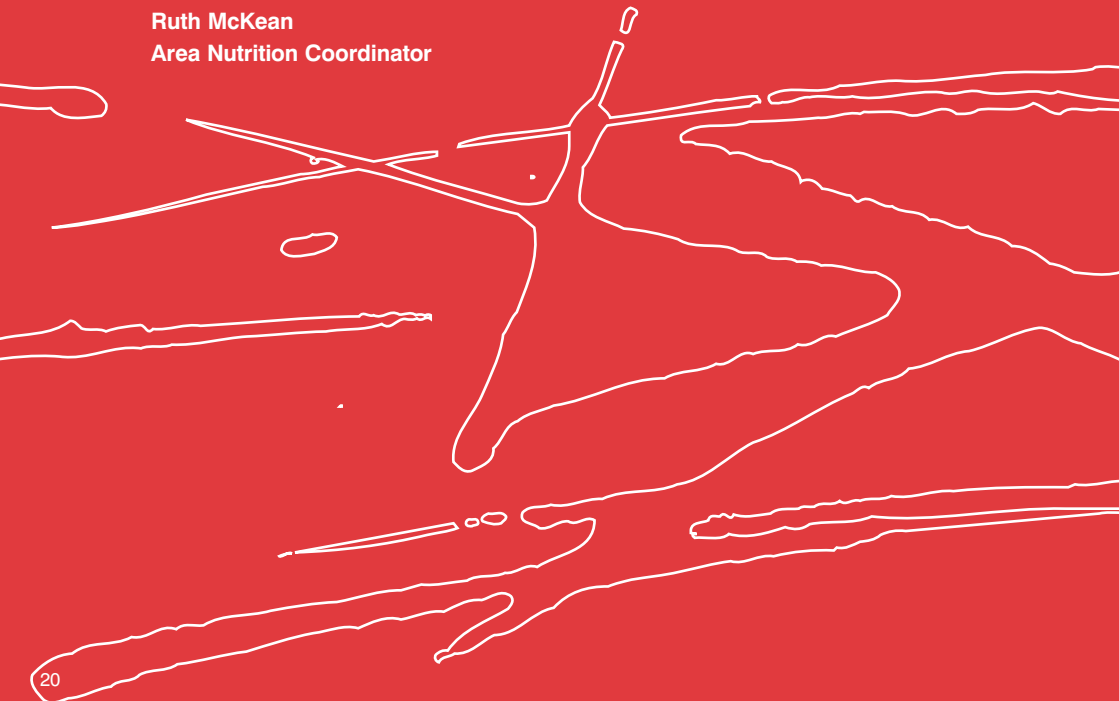
Adelle Purbrick
Performance Nutritionist

Irene Riach
Performance Nutritionist
- People Development

Lindsay Thomson
Lead Physiotherapist

Brian Walker
Head of Sports Medicine

Karina Buchanan
Senior Administrator





SCOTTISH INSTITUTE OF SPORT

High performance expertise

Scottish Institute of Sport
Airthrey Road Stirling FK9 5PH
Tel: 01786 460 100
Fax: 01786 460 101
Email: firstname.surname@sisport.com
info@sisport.com

www.sisport.com



sportscotland