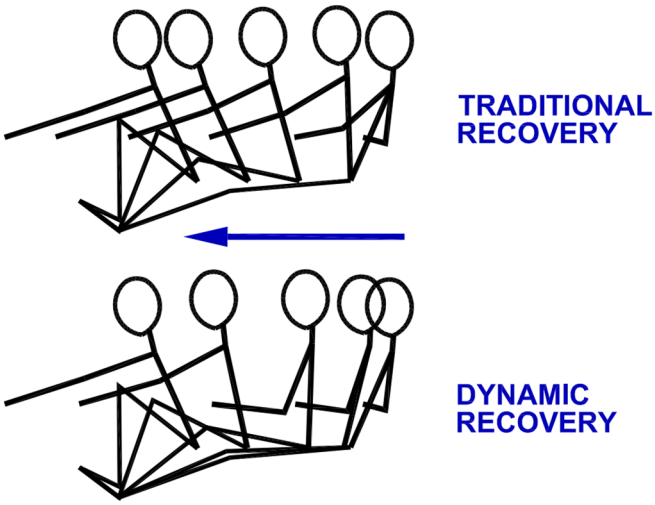
2.2 RECOVERY *by: Mike Purcer*

The recovery phase of the stroke begins when the athlete leaves the finish position with the body furthest to the bow of the boat and ends when the athlete achieves the full reach position closest to the stern. During this phase, the athlete utilizes their legs to pull their feet (footstops) toward their seat while simultaneously pivoting the torso forward and extending their arms to maximize their reach sternward in the full reach position.

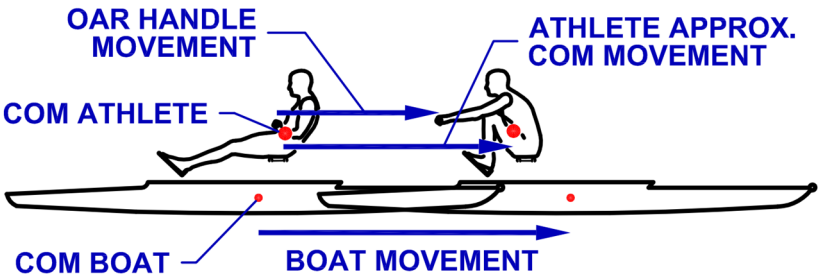
For most of the history of our sport, the recovery movements were taught in sequence, with the hands and arms moving first, away from the body. The arm movement was followed by a forward torso swing, pivoting at the hips, and, lastly, by knee flexion to pull the athlete up the slide. Although these recovery movements were practised in sequence, during racing the legs, torso, and arms move almost simultaneously as the athlete pulls the footstops toward their body, accelerating the boat. Figure 2.2a Recovery Styles shows the difference in body movements between traditional practice recovery and the racing 'dynamic' movements that occur simultaneously.

Figure 2.2a *Recovery Styles*



It is important to recognize that although the graphic in Figure 2.2a shows the rower moving toward their footstops in the rowing shell, it is the footstops that move toward the rower. During the recovery, the rower's centre of mass (COM) continues to move in the same direction as the boat, toward the finish line. Figure 2.2b, Recovery Movements, shows a single sculler moving from the finish to the full-reach position, with examples of the boat, body, and oar-handle movement vectors.

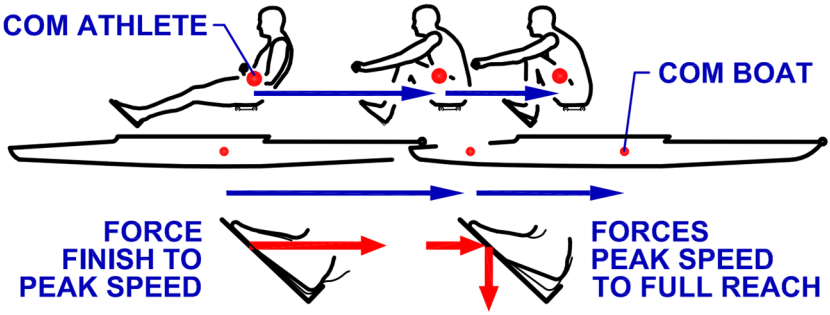
Figure 2.2b *Recovery Movements*



A strong understanding of athletes' movements and the boat's motion challenges traditional views by recognizing that the athlete does not move toward the boat's stern; rather, the stern moves toward the athlete during the recovery. This means the crew has no momentum in the sternward direction because their mass is continuously moving in the same direction as the boat. Additionally, as their mass moves in the same direction as the boat and their knee joints contract to pull their footstops toward their seats, they apply no sternward force on the footstops during the recovery. However, in the final part of the recovery, when the athletes slow their approach to achieve full reach at the catch, the boat is moving faster and transfers momentum as a force pushing on the footstops. The athletes resisting the force of the push on the footstops allows a transfer of momentum to the athletes, increasing their speed. At the full reach position, the athlete, and the boat travel at the same speed.

Figure 2.2c, Forces on Footstops, shows the athlete at the finish, peak speed, and full reach positions as the boat and athlete move in the same direction. The lower part of the illustration shows the vector forces on the footstops. The force from finish to peak speed occurs as the athlete pulls on and accelerates their footstops toward their seat. This acceleration transfers momentum from the athlete to the boat, increasing the boat's speed and decreasing the athlete's body speed, as shown on the graph. The boat accelerates as long as the athlete's force pulling on the footstops is greater than the drag resistance on the boat. The forces from peak speed to full reach occur as the athlete stops accelerating their footstops, and the boat's momentum pushes on the footstops. In the final move to full reach, a downward vertical force is generated as the athlete's knees rise and the torso moves over their legs.

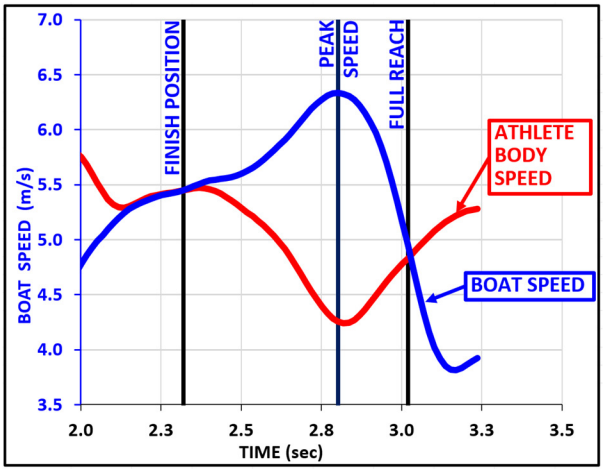
Figure 2.2c *Forces on Footstops*



During the recovery, the athletes must pull on their footstops to move along the slide toward the next catch, because approximately 85-88% of the resistance slowing the boat is due to water drag (Killing, S., 2026). As the athletes move within the shell, they transfer momentum to the boat, increasing the boat's speed while decreasing their own speed. At racing rates, this movement accelerates the hull, and the boat reaches maximum speed during recovery (Sanderson & Martindale, 1986).

Figure 2.2d Recovery Speeds shows boat and athlete speeds independently during the recovery at a racing rate. As the athlete leaves the finish position, they accelerate their footstops towards the seat. This increases the boat's speed while the athlete's speed slows. At peak speed, the boat is travelling much faster than the athlete, as shown in Figure 2.2d Recovery Speeds, and the athlete slows their approach towards the full reach position. The steep deceleration of the boat following peak speed results from the boat transferring momentum back to the athlete and corresponds to the increase in the athlete's speed. Although the boat has a much lower mass, its higher speed allows momentum to be transferred through the footstops, increasing the athlete's body speed, as shown on the graph.

Figure 2.2d *Recovery Speeds*



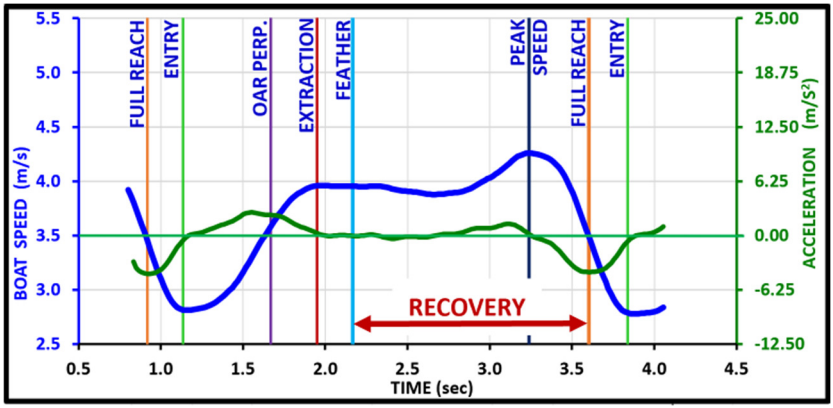
Recovery techniques at lower practice rates must be discussed, as movements during practice should not differ from those during racing. Traditionally, at lower rates, the recovery joint sequence has been separated into arms out straight, followed by torso swing, and finally legs moving the seat on the slide at a constant speed. These traditional

recovery movements are far from the coordinated recovery technique athletes use when racing.

This text highlights the biomechanics of racing movements and the synchronized, multi-joint engagement of muscle groups during the recovery phase at lower-rate practices. The specificity of training principles, including the firing-order sequencing of joint movements, suggests that recovery in practice should mirror racing. This principle guides the biomechanical coordination of muscle-group engagement by sequencing the arms, torso, and legs simultaneously during low-rate practices.

Figure 2.2e, Practice Boat Speed, illustrates the boat speed and acceleration curves at lower stroke rates.

Figure 2.2e *Practice Boat Speed*



This curve represents a slower, controlled movement of the athlete on the recovery between the finish (FEATHER) and the full reach positions. The recovery phase of the stroke at lower rates lasts two to three times longer than during racing. The boat speed line from the finish position shows that the athlete is pulling on their footstops with a force almost equal to the resistance (drag) force on the hull, resulting in near-constant acceleration through most of the recovery. Adjusting the speed of muscle contractions during low-rate practice is necessary to maintain the simultaneous joint movements similar to racing technique.

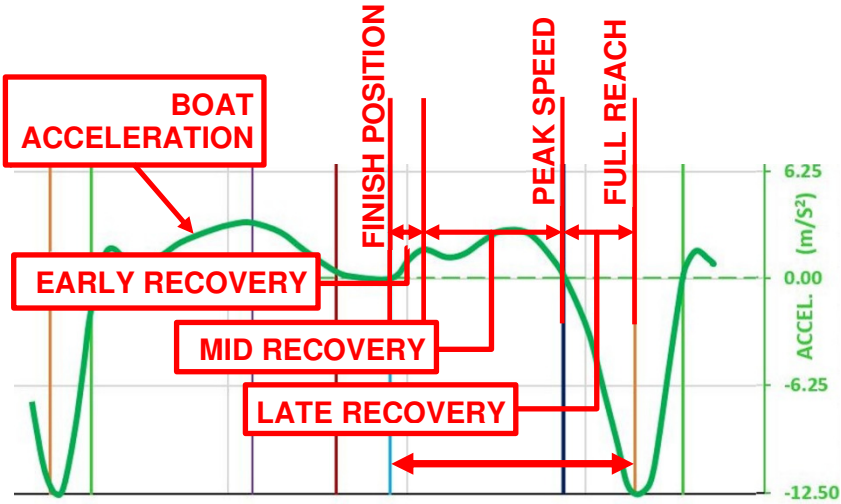
At racing speeds, the athlete accelerates their footstops toward their seat from the finish position, then slows their approach to stop to reverse direction at the full reach. Practice speeds must also provide for acceleration of the footstops but at a much slower rate. Practice movements must start slowly from the finish position to allow acceleration throughout most of the recovery, given the longer time available. A slow start from the finish position helps athletes develop their timing and rhythm by moving with control. During practices with the longer recovery times, athletes often accelerate their footstops in the mid/late recovery to practice extending their pull on the footstops toward full reach. The late-recovery acceleration, as shown in Figure 2.2e, provides a movement more similar to racing and helps athletes develop their entry (catch) skills.

Some coaches have their crews pause at the finish position for varying periods to reduce recovery movement time and bring the movements closer to racing speed. An extreme example of this was the Australian four that paused for about a full second, allowing their recovery movements to match racing speeds. Pausing or starting slowly at lower rates is required to allow the crew to accelerate during recovery and match racing movements.

The recovery phase of a stroke can be divided into three stages, as shown in Figure 2.2f Recovery Stages. Stage one is early recovery, when the legs, torso, and arms connect to initiate movement. In this stage, the hands and shoulders often move visibly out of the finish position. The second stage, mid-recovery, is when the legs, torso, and arms move together to pull on and accelerate the footstops toward the athlete. Although these joints move simultaneously, they do so at different speeds to support the constant pull on the footstops and the repositioning of the body during recovery. Mid-recovery acceleration is maintained as long as possible toward the next catch. Finally, in the late recovery stage, the athlete slows their movements as they approach the full reach position and prepare to change direction. In this stage, the arms become

straight, and the torso achieves the catch angle forward before full reach is achieved on the slide.

Figure 2.2f *Recovery Stages*



The specificity of training principles indicates that the sequence and timing of muscle engagement are critical for technique development. Video analysis of crews racing shows that the arms, torso, and legs move simultaneously during the recovery phase. The athlete needs minimal force during recovery, as hull drag is low and the athlete and boat trade momentum. However, the sequencing of movements is critical for momentum transfer and boat speed. The technique described here is the one most crews use in racing. This text aims to promote the use of the neuromuscular sequence of racing movements during practices at all stroke rates.

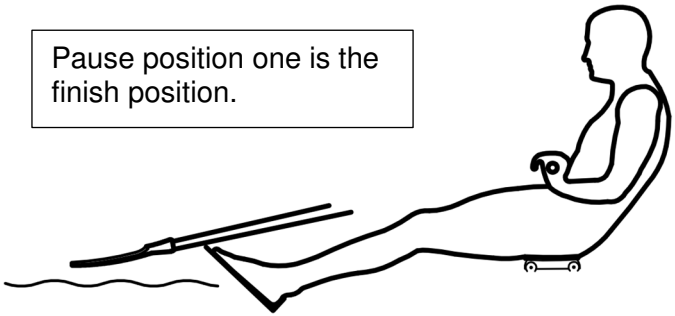
2.2.1 Finish Position

The finish position is both the end of the drive and the beginning of the recovery, where the athlete changes direction. The recovery begins when the athlete starts their movement toward the stern of the boat. It is worth reviewing the finish position to ensure the athlete is in the correct position to begin their recovery. Figure 2.2.1a Finish Position shows the athlete ready to start the recovery. A description of the body positions is detailed below, Figure 2.2.1a Finish Position.

The finish position is often used in a pause drill to allow coaches to observe and analyze the placement of the athlete's arms, shoulders, head, and torso. The Pause One (finish) position can be held for up to two or three seconds. The pause can also be very short, such as a tenth of a second, which is referred to as a micro-pause. The micro-pause gives athletes a physical break between the drive and recovery and may improve the crew's timing at low rates. Along with the athlete's physical position, pause exercises allow the coach to compare the finish positions of all athletes in the crew to ensure they are similar.

Some athletes combine the release with the recovery by moving the torso forward (sternward) as the blade is extracted and feathered. This forward torso movement allows athletes to pull on the footstops and initiate hull acceleration during the blade extraction. This combined release-recovery movement is not currently popular, but it is used by a number of athletes, and the author feels it is worth noting as a variation from the start of the recovery.

Figure 2.2.1a *Finish Position*



Legs

- legs are straight, fully extended
- legs are relaxed
- There is no pushing on the footstops as the feet have transitioned from pushing to pulling in the shoes

Torso

- the lower back is straight
- torso in the layback position
- core muscles engaged, supporting the torso
- shoulders are down and back, having just completed the release
- head up, eyesight forward and level on the horizon

Arms

- arms are relaxed
- forearms are level with water
- upper arms back with elbows at or behind the torso
- hands holding the oar handle at the body
- sculling wrists are down as they have just rotated oar handle to feather the blade
- In sweep rowing, the inside wrist is down having feathered the oar, but the outside wrist is flat as the oar handle rotated under the athlete's palm

Oar

- the blade is above (off) the water and on the feather

2.2.2 Early Recovery

The recovery begins when the athlete leaves the finish position and moves toward the full reach position.

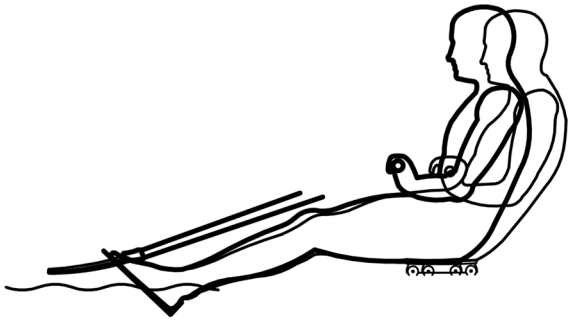
The early recovery stage is the initial movement when the legs connect, and the torso and arms begin to move. Although the arms, torso, and legs move together, the arms (hands) and torso (shoulders) must move a greater distance and appear to start first from the finish position. It is important that athletes engage their legs, pulling on the footstops, to connect with the boat and support upper-body movements. The initial leg contraction (movement) is almost unnoticeable but critical to transferring body momentum to the boat.

The early recovery stage is very short, typically between one and two-tenths of a second. At racing rates, the shell's speed increases immediately after the athlete engages their legs on the footstops. The movement from the finish position must allow for constant acceleration towards the next catch. At practice (low) rates, the movements start slowly to allow the footstops to accelerate towards the seat throughout the longer recovery time.

Figure 2.2.2a Early Recovery shows the athlete's movement during the initial recovery stage of the stroke. The ‘Pause Two Position’ is the darker body position in Figure 2.2.2a, occurring just after the initial movement out of the finish. This position allows coaches to see the simultaneous connection of the legs, torso and arms. The hands are about 20 cm from the body, the torso has begun to pivot forward, and the leg muscles are contracted, pulling on the footstops.

The crew's timing, including starting the early drive together and moving at the same speed, is essential for crew rhythm and for the effective transfer of crew momentum into boat speed.

Figure 2.2.2a *Early Recovery* (0 - 15%)



Legs

- the feet are connected, pulling on the shoes to initiate the recovery
- hamstring muscles engage, contracting to flex the knee joint and pull footstops towards the seat

Torso

- torso starts pivoting forward simultaneously as the legs engage
- lower back remains straight with a neutral spine as the torso begins to pivot forward from the hips
- shoulders move forward with the upper arms
- head remains level as eyes track the horizon

Arms

- arms move the hands toward the stern, simultaneously with torso and leg movements
- wrists (sculling) flexed down from the release, behind to relax, maintaining the blade on the feather
- in sweep rowing only the inside wrist is flexed, holding the blade on the feather, and the outside wrist is flat

Oar

- the blade is in the feather position above the water

2.2.3 Mid Recovery

In the mid recovery stage, the athlete accelerates their footstops towards their seat and body's centre of mass (COM). The legs, torso, and arms move simultaneously but at different speeds, as they travel different distances from finish to full reach positions. The mid recovery stage extends as long as possible to prolong the boat's acceleration and increase its average speed.

The athletes' acceleration of the footstops toward the seat provides a positive (forward) force on the hull. Acceleration of the footstops toward the seat is key, as constant speed on the slide causes the boat to slow due to hull drag. Athlete acceleration on the slide should be uniform to minimize hull disruption. Excess or uneven acceleration of the body on the slide will result in a sudden surge of the boat, increasing hull drag due to turbulence and wave resistance (Scott, 1964). Maintaining constant acceleration of the footstop toward the seat will prolong the boat's acceleration, increase the stroke rate, and maximize the boat's speed.

Practising at lower rates helps the crew learn to move together, accelerating toward the full reach position. The crew's movements during practices should mirror their racing movements, but at slower speeds. Starting slowly from the finish position allows the crew to extend their acceleration during the recovery.

Drills such as 'Pause Three', Figure 2.2.3a allow the coach to evaluate the body positions of the crew at a point in the mid recovery.

Figure 2.2.3a *Pause Three Position*

Rower is at quarter slide, torso almost perpendicular, with arms bent, elbows at ninety degrees

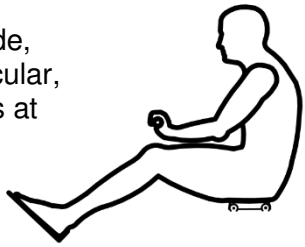
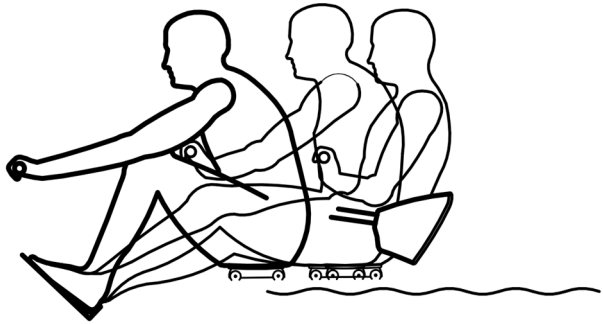


Figure 2.2.3b *Mid Recovery* (15%-65%)



Legs

- feet pulling on footstops
- legs flexing at the knee, continue to accelerate footstops toward the seat

Torso

- the torso continues to pivot from the hips
- the lower back remains straight with good posture, and a neutral spine is maintained
- shoulders down and shifting forward with upper arms
- head level with eyes on the horizon

Arms

- arms continue to extend and move the oar handle away from the body
- arms and wrists are as relaxed as possible
- hands holding the oar handle under the fingers

Oar

- once the oar handle crosses over the knees, the blade on the feather is high enough above the water to allow feathering without lowering the oar handle
- the blade begins to rotate to the square near the end of the mid recovery as the hands cross over the footstops

2.2.4 Late Recovery

The late recovery starts after peak boat speed, when the athlete rapidly slows their movement toward full reach, causing the boat to decelerate quickly. During racing, this stage is the last third of the recovery, typically thirty to forty percent of the recovery time. Minimizing the time the boat decelerates is essential for maintaining the highest average boat speed.

As the athletes approach full reach, their arms rise and the wrists rotate to square the blade. In the final few inches of the slide, only the legs move as the arms are fully extended and the torso has reached the forward catch angle. The oar handle rises, bringing the squared blade down to touch the water as the athlete achieves the full reach position. In sweep rowing, the athlete's shoulders and upper torso twist toward their rigger as they follow the rotation of their oar handle around the pin.

The late recovery is a critical part of the stroke in preparation for the catch. Typically, coaches discuss the catch in three parts: the approach, the entry, and the connection. The entry (blade into the water) and the connection take place during the drive phase, but are noted here for reference to the approach. The approach to the catch is part of the late recovery stage and involves preparing the blade for entry into the water.

During the late drive, at race rate, the boat's hull moves faster than the athlete on their approach to the catch. The boat's momentum is transferred to the athlete, slowing the boat and increasing the athlete's body (COM) speed. The force on the footstops pushes the athlete into the catch position.

Figure 2.2.4a
Force on Footstops

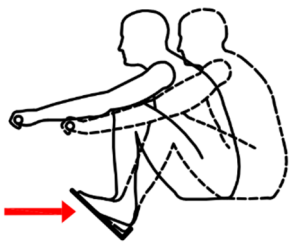
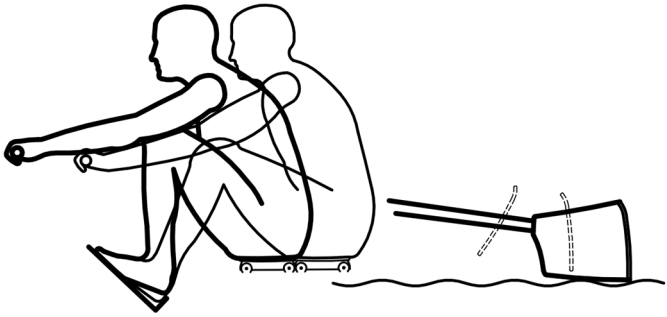


Figure 2.2.4b Late Recovery shows the athlete in the final stage of the recovery.

Figure 2.2.4b *Late Recovery* (65%-100%)



Legs

- the athlete's heels lift as their shins approach the perpendicular
- legs slow as the athlete approaches full compression
- sweep rowing knees separate to allow torso compression and the outside arm between the knees

Torso

- the torso achieves the full catch angle before the seat reaches frontstops
- the torso compresses on the thighs when sculling, or inside thigh in sweep rowinglower back is straight
- shoulders are reaching forward
- sweep rowing shoulders are level, but twist towards the oar handle

Arms

- oar handle is being held firmly in the fingers
- hands lifting the oar handle as the wrists rotate up, squaring the blade
- arms are straight

Oar

- blade squares and is brought down to the water's surface
- the square blade touches the surface of the water when the athlete achieves the full reach position

2.2.5 Full Reach Position

The full-reach position is the ending point of the recovery phase and the beginning of the drive phase. A clear description of the position allows coaches to observe the athlete at full reach. Full reach is not a pause position, as it can be a very unstable position for the crew. However, a video of the athlete from the side and stern will allow a stop-action view of the full reach position. When viewing from the stern, holding the camera at an elevated height will allow viewing of athletes behind the rower in the stroke seat.

The full reach position in sculling is reviewed in relation to the athlete's hand spacing, Figure 2.2.5a Oar Handle Gap Catch.

Figure 2.2.5a *Oar Handle Gap Catch*

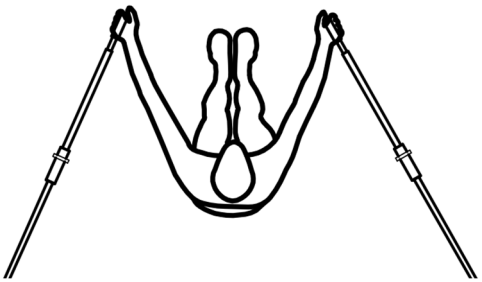
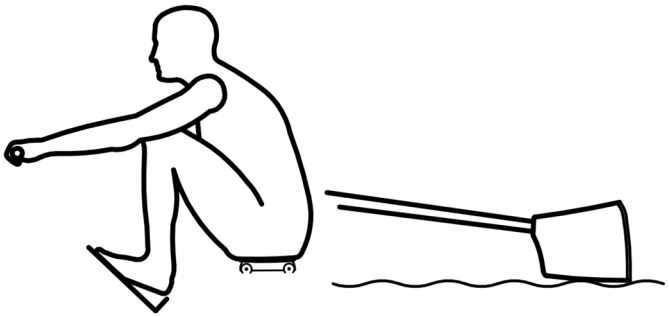


Figure 2.2.5b Oar Handle Gap Catch shows the athlete in the full reach position. Below the figure is a description of the body positions.

Figure 2.2.5b *Full Reach Position* (100%)



Legs

- athlete on the balls of their feet
- shins are perpendicular
- knee joint compressed

Torso

- lower back (spine not collapsed)
- torso pivoted forward, reaching the stern
- shoulders (sweep) rotated toward the oar handle

Arms

- arms straight and fully extended
- wrists flat
- oar handle is held in fingers under the first knuckle
- hands (sculling) spread wide

Oar

- the oar is at the catch angle
- the blade is touching the water

2.2.6 Recovery Speed

The boat acceleration during recovery is critical for maximizing speed and stroke rhythm. Although the speed of the movements has been emphasized throughout this section, it is referenced again here to highlight its importance.

The average boat speed during the recovery varies with the recovery time and technique. The timing of the crew's movements is critical, as all athletes must move together on the slides. Although the recovery phase durations (speeds) differ substantially between racing and low-rate practices, the synchronization and simultaneous movements of the legs, torso, and arms remain the same. Only the duration and speed of the muscle contractions change.

2.2.7 Recovery Balance

Balance is critical to an effective recovery, keeping the blades off the water and allowing the athlete to minimize unnecessary physical movements at racing pace. During low-rate, low-intensity practices, a balanced boat promotes better muscle relaxation. Balance during recovery results from precise blade-release timing, clean blade extractions, consistent blade height above the water, and controlled body movements.

The recovery is an opportunity to increase the boat's average speed. Maintaining a constant boat acceleration during the recovery at a given stroke rate minimizes sudden speed increases, as abrupt changes in hull acceleration increase drag. Continuing acceleration for as long as possible during the recovery reduces the time the boat spends decelerating between peak speed and blade entry. It is important to remember that the principle of specificity of training holds that athletes should practise the technique used in competition.