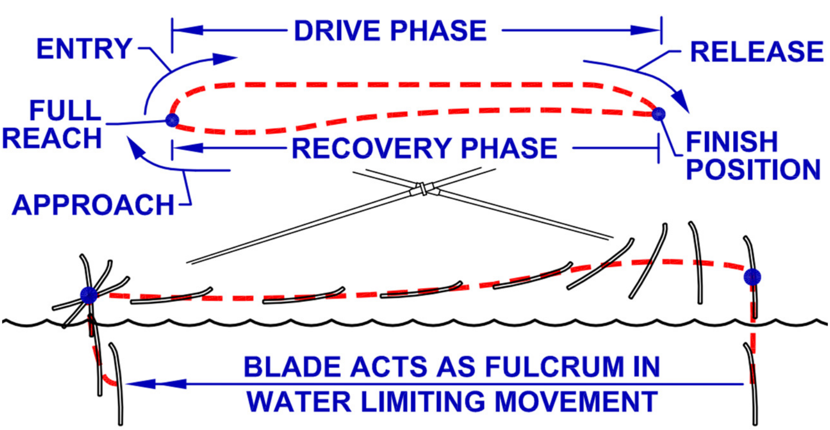
2.3 BLADEWORK by Mike Purcer

The movements of the oar blade are essential for the boat's propulsive efficiency and the effective use of muscle power during the rowing stroke. The blade provides the resistance against the water needed for the athlete to exert force on the oarlock through the oar. Proper bladework also helps minimize inefficient movements during the entry, drive, release, and recovery phases of the stroke. Bladework is a technique in itself, and poor bladework can significantly limit boat speed. This section will focus on bladework and the movements of the blade throughout the rowing stroke.

Some coaches consider bladework the most critical aspect of rowing technique. Figure 2.3a, Oar Handle and Blade Paths, highlights the related oar handle and blade movements through the stroke cycle.

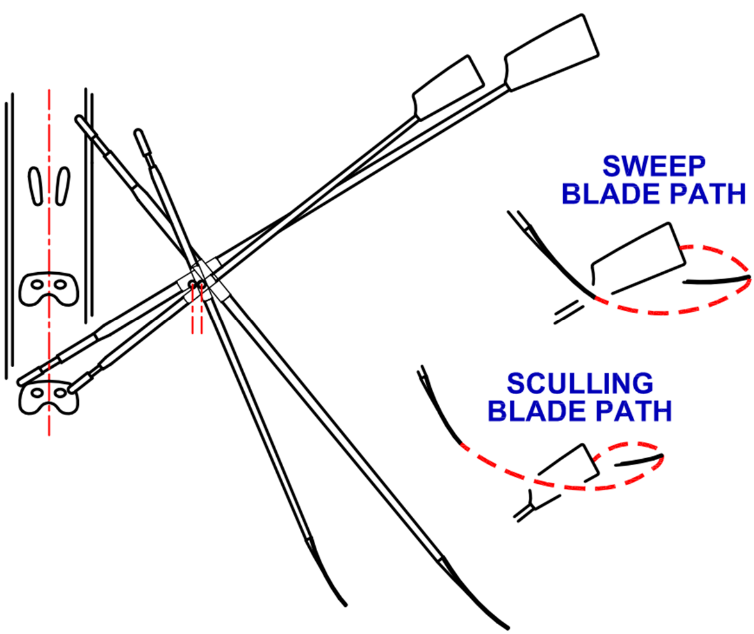
Figure 2.3a *Oar Handle and Blade Paths*



There are variations in the oar handle and blade path, as coaches may have their own style. The depth of the blade during the drive can range from just below the water's surface to considerably deeper. During recovery, the blade height above the water will also vary among coaches. Some coaches prefer the blades to remain well above the water throughout the recovery. Others keep the blade closer to the water's surface during the first part of the recovery and lower the oar handles as they cross over the knees, creating space to square the blade as it approaches the catch.

The blade path for sculling closely resembles that of sweep rowing, with some differences due to the outboard and inboard lengths of the sculls. Sculling oars move through a larger stroke arc angle because the inboards are shorter than in sweep rowing, and the oarlock pin is positioned closer to the boat. Figure 3.2b, Horizontal Oar Movement Geometry, shows the catch position and the differences in the horizontal arc between sculling and sweep rowing. The graphic also illustrates the movements of the sculling and sweep blades in the water.

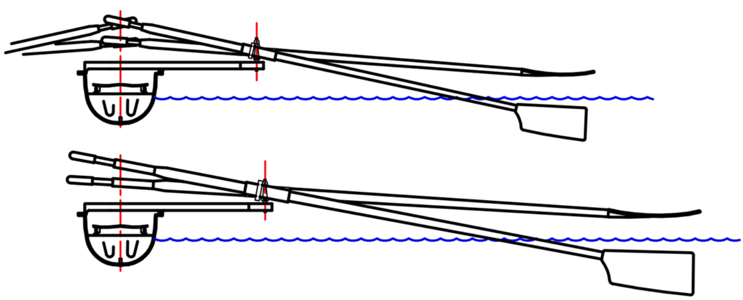
Figure 2.3b *Horizontal Oar Movement Geometry*



Although the sculling oar outboard lengths are shorter than in sweep rowing, the effective boat movement during the drive remains similar because the sculling stroke arc angle is larger.

The vertical oar angles for sculling and sweep are similar, with sculling oars at a slightly steeper downward angle due to shorter outboards. Although the sculling oars are at a different downward angle, the oar handles are at a similar height because the inboards are shorter. Figure 2.3c, Vertical Oar Movement Angles, shows the sculling and sweep oars during recovery and drive.

Figure 2.3c *Vertical Oar Movement Angles*



Another distinction between sweep and sculling is the movement of the oar handles: in sculling, the oar handles must cross over or be at slightly different heights, as one handle follows the other through the middle of the recovery and drive phases.

The oar handle grip was discussed in Section 2.0.9, The Grip, and is vital for proper control of the oar and blade. This section will reference the oar handle as a key element in controlling the blade. Remember, a proper grip can maximize control of the oar and blade and enable optimal power transfer from the body to the oar handle. The grip is highlighted here to emphasize its importance, but no further discussion of it will be included in this section.

Finally, the ability of athletes in a crew to synchronize blade movements during the stroke is essential to performance and will be further examined in Section 2.3.6 Blade Timing.

2.3.1 Entry

The entry or catch is one of the most technically challenging parts of the stroke to master, as it involves moving the oar handle horizontally and vertically while rotating it, all while the athlete simultaneously changes direction in the boat. The entry is the moment when the oar blade submerges into the water between full reach and when it is fully buried. The entry or catch can be divided into three parts: the approach, the entry, and the connection. These parts are described separately and can and should be coached individually.

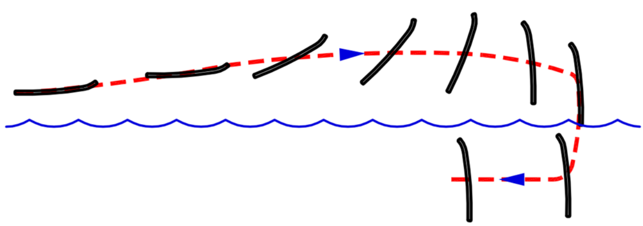
The approach to the entry is part of the recovery phase, and the effectiveness of the entry depends entirely on the blade's movements as the athlete approaches the full reach position. During the approach, the athlete must control the oar handle and rotate the blade to fully square it before reaching the full reach position. The leading edge of the blade should remain at about the same level as it squares, while the trailing edge is lowered toward the water. In the final part of the recovery, the squared blade arcs downward as it moves toward the bow, touching the water's surface when the athlete achieves the full reach position. During the recovery, the oar develops momentum as it rotates around the oarlock pin due to its mass and speed. This momentum can aid an effective entry if it is brought down toward the water during the approach to the catch.

The entry stage begins when the blade touches the water's surface, and the athlete quickly places the blade in the water by lifting the oar handle. As they lift the handle, they must simultaneously pull on it to allow the blade to match the speed of the water passing the moving shell. A quick vertical lift enables the athlete to stay as close as possible to the full reach position. This near-full reach position extends the effective stroke length (boat movement) and allows the boat to accelerate more quickly.

The connection part of the entry occurs when a positive lock forms between the water and the face of the blade. Pressure on the blade, caused by the athlete's legs beginning to extend and pull the oar handle, transfers a force to the boat (oarlock pin) through the oar. The oar acts as a lever around the fulcrum of the blade.

The combination of the athlete's movement, the momentum within the blade, and gravity during the approach creates the most effective blade entry. Figure 2.3.1a, Blade Entry Profile, illustrates the path of the blade at the catch. The path shown can utilize the three forces: athlete lift, momentum, and gravity, making an effective entry.

Figure 2.3.1a *Blade Entry Profile*



One of the most important aspects of the entry is crew timing: the blades submerge together and connect to apply power simultaneously. The importance of timing cannot be overstated, as it affects boat acceleration, balance, and steering. The entry is a great opportunity to improve boat speed by increasing the stroke length and increasing the opportunity for acceleration in the power application stage.

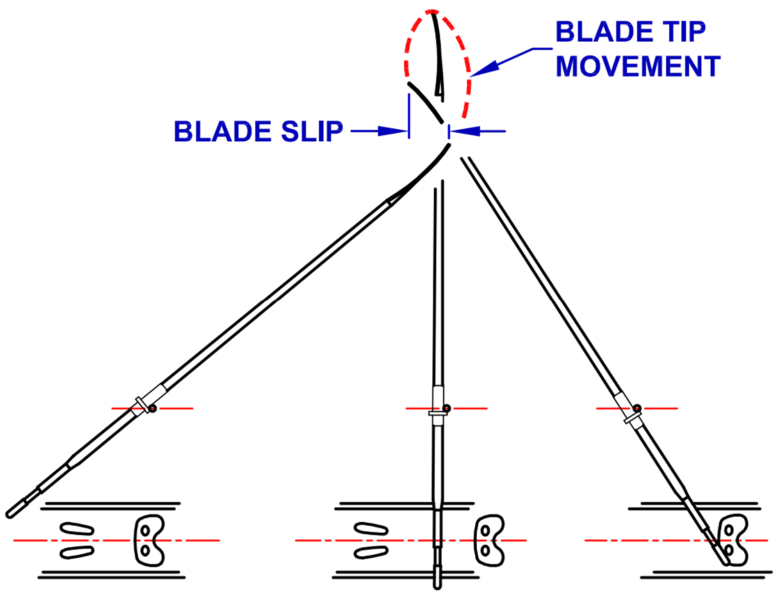
The entry continues until the force is taken up on the blade face, at which point the power application stage of the drive phase of the stroke begins. Section 2.10.3 Entry

Time outlines the objective measurements of the catch and its importance to boat speed.

2.3.2 Drive (Power Application Stage)

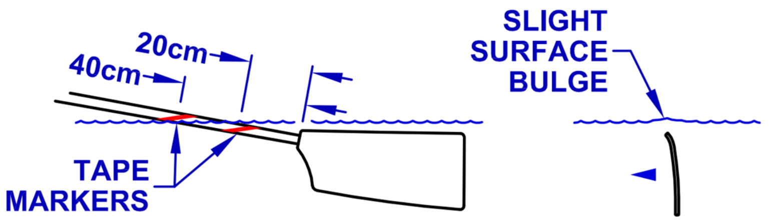
The power application stage occurs after entry, when the blade is fully submerged and engages the water to produce propulsive force. During this stage, the blade acts as a fulcrum in the water, allowing the oar lever to pry the oarlock pin around the blade puddle. Although it functions as a fulcrum, the blade itself moves in the water due to the rotation of the oar around the oarlock pin, as shown in Figure 2.3.2a Blade Movement - Drive. The stage continues until the blade begins the release phase of the stroke and is lifted out of the water.

Figure 2.3.2a *Blade Movement - Drive*



The blade's movement through the water causes blade slip and affects the distance the boat travels during the power application stage (Purcer, 2024). Blade slip is the distance the tip of the blade moves in the water parallel to the boat. This distance varies and depends on many factors, including bladework. Consistent blade depth is critical throughout the power application stage to maximize blade-water interaction and efficiency. Vertical movements of the blade allow water to flow over the top or bottom edges, as shown in Figure 2.3.2b Blade Depth.

Figure 2.3.2b *Blade Depth*



The depth of the blade in the water may vary as individual coaches' bladework style. Some coaches prefer the blade just below the surface, creating a mound of water over it. Other coaches prefer the blade much deeper, burying the oar's shaft 45 cm beyond the blade. Many coaches use tape on the shaft to gauge the depth of the blade. Although there is a significant difference between the depth of the blade related to the style, all styles promote the constant blade depth through the power application stage.

The late drive is especially susceptible to shallow blade depth, which promotes negative blade slip and a loss of connection with the water. Blade depth must be maintained for as long as possible during the late drive part of the power application stage.

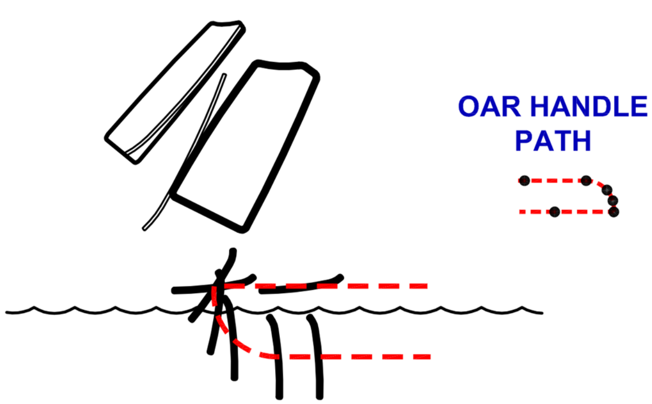
The power application stage is the only opportunity the athlete has to accelerate the boat and the athlete as a system. Bladework on the drive is key to maximizing the oar blade's efficiency.

2.3.3 Release

The release phase of the stroke involves quickly extracting the blade from the water, including rotation to the feather position. The release begins after the power application stage has been extended as long as possible, keeping the blade fully buried, as discussed in the previous section. The blade begins its extraction with vertical movement, then rotates to the feather position above the water's surface, usually when it is half to three-quarters out of the water. The height of the feathered blade above the water and the point at which rotation to feather begins depend on the coach's style.

The release begins with the blade lifting out of the water, corresponding to the removal of force on the blade's face. The release is complete when the oar handle begins to move away from the body, and the feathered blade starts the recovery. Efficiency depends on extending the power application phase as long as possible, and minimizing the time the blade is lifted out of the water and rotated into the feathered position without adding resistance that would slow the boat's progress. This movement is highlighted by a clean removal with minimal water disturbance. Figure 2.3.3a Blade Release shows the blade and handle movements during the release.

Figure 2.3.3a *Blade Release*

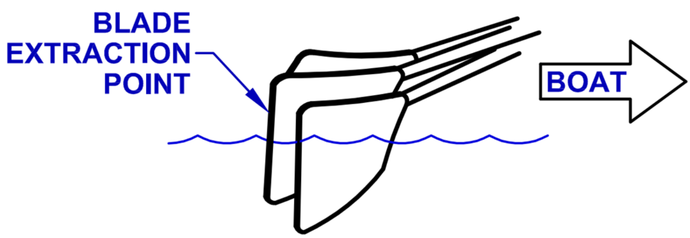


The oar handle(s) should be as close to the body as possible before the release begins to allow for an extended power application stage of the stroke.

Style variations of the release include not beginning to rotate the blade to the feather until it is lifted vertically and fully out of the water. This style contrasts with the blade rowing shallow, creating a cavity behind the blade, allowing it to be feathered as it is extracted with minimal splash. The author’s preference is to begin to feather when the blade is three-quarters out of the water and rotate the blade at a speed that matches the boat's movement to minimize water disruption.

The release movements will be adjusted as water conditions change. In rough water, the athlete will need to release and feather the blade higher above the water’s surface to avoid splashing against the wave crests.

Figure 2.3.3b *Blade Extraction Point*



Release Time is a technique factor outlined in Section 2.9.4 and measures the time between blade extraction and feather. The measured time data may suggest that lower times correlate with better performance.

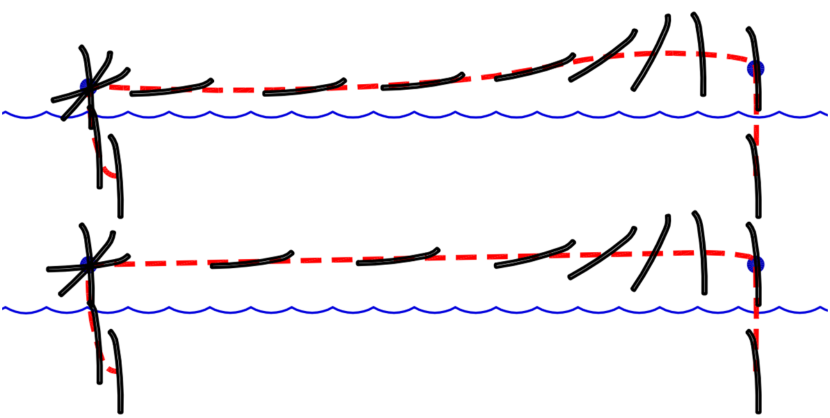
The blade extraction point marks the change in the blade's direction of movement and is typically identified when the blade is half out of the water and begins moving in the same direction as the boat.

2.3.4 Recovery

During the recovery, the blade moves from the finish position (finish angle) to the full-reach position at the catch angle. The blade must remain above the water throughout the recovery, as contact with the surface increases resistance and reduces the boat's speed. The height of the blade above the water is a style variation between coaches and ranges from closer to the water in the first half of the recovery to full height above the water's surface throughout the recovery. Figure 2.3.4 Recovery Blade Height shows two versions of blade height above the water.

The blade's height above the water's surface varies as it moves from the finish position: some coaches prefer it well above the surface, while others allow it to be just above the surface. The difference in blade height above the water is a style variation and will not affect boat speed. Figure 2.3.4a Recovery Blade Height shows the two extremes of blade height above the water.

Figure 2.3.4a *<u>Recovery Blade Height</u>*



As the oar approaches the perpendicular, the handle moves over the athlete's lower legs (shins), and the blade must then rise above the water to allow it to square.

Typically, when the handle crosses over the knees, it is lowered during its forward movement. When the handle crosses over the toes, the blade should be at a height above the water that enables it to be squared without lowering the handle during the reach forward.

The blade's height above the water during the last half of the recovery is important to ensure it is squared for entry. This part of the recovery is known as the approach and was briefly discussed in Section 3.2.1, Entry. The importance of this part of the recovery cannot be overstated, as it helps perform an efficient catch.

The height of the blades above the water is important. The approach of the blade towards the catch must maintain the kinetic energy of the movement of the oar and blade to set up for the catch.

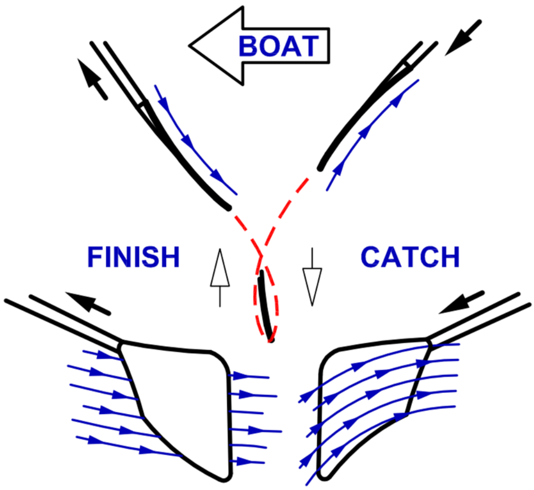
Bladewok, during the recovery, controls the balance

2.3.5 Blade Movements

The movement of the blade during the stroke can be viewed from two perspectives: relative to the boat and relative to an external stationary object. Figure 2.3xx shows both the top view and side view, illustrating the blade movement and water flow across the face of the blade.

During the drive, the blade moves away from the hull as the oar rotates around the oarlock pin, with the blade acting as a fulcrum for the oar and moving within a small section of water. In the first half of the drive, the blade moves away from the hull, and water is forced along the face from the tip (the leading edge) to the inside (trailing edge). This flow allows the blade face to behave like a propeller, reducing negative slip and increasing the effective stroke length. As water flows over the trailing edge, pressure drops quickly, causing cavitation that creates a vortex. Figure 2.3.5a, Blade Movements, shows the path of the blade in the water (from entry to extraction) and the flow of water along the blade face in the first and second halves of the power application phase.

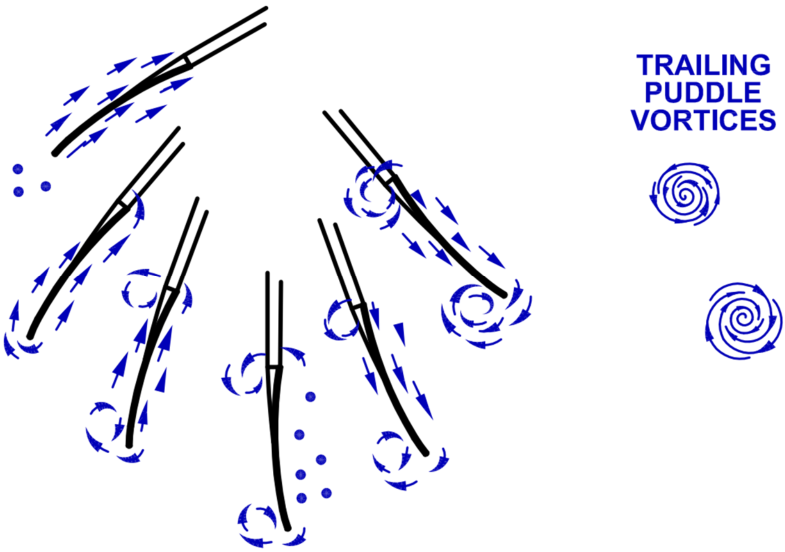
Figure 2.3.5a *Blade Movements*



As the oar reaches the perpendicular to the hull, the blade is in its most effective position, with the force applied directly to the blade face. This is also typically the point of maximum boat acceleration, due to the oar's angle and the athlete's biomechanically effective body position.

During the last half of the drive between the oar perpendicular and the extraction, the blade moves back toward the hull as it rotates around the oarlock pin. The water flow across the blade shifts from the inside edge to the tip, which becomes the trailing edge. Water flowing over the tip creates a low-pressure area, and cavitation forms a vortex, as shown in Figure 2.3.5b, Water Flow on Blade. As the oar rotates toward the finish angle, its effectiveness diminishes. Figure 2.3.5b, Water Flow on Blade, illustrates the water flow around the blade during the drive phase of the stroke, but it must be emphasized that the blade positions in the graphic do not represent the actual positions during the stroke.

Figure 2.3.5b *Water Flow on Blade*



The flow of water along the blade face during the stroke is crucial for the effectiveness of the blade-water connection. Maintaining consistent blade depth is vital to maximizing blade contact with the water.

2.3.6 Blade Timing

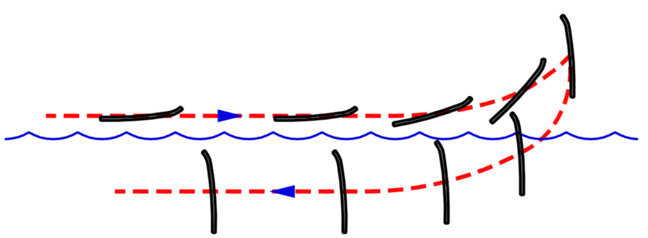
Blade timing is highlighted here to emphasize its importance. Timing at the catch, when the blade enters the water, is critical and improves efficiency. Releasing the blade together at the finish is vital for power application and boat balance, and allows the crew to begin the recovery simultaneously. The placement of the stroke arc and the consistency of the oars moving together (parallel) through the stroke are important. Oars moving through the perpendicular of the stroke at the same time are essential to maximize the boat's peak acceleration.

2.3.7 Common Errors

Bladework errors can lead to an ineffective connection and reduce the boat's potential for maximum acceleration. Moreover, these errors can increase drag and greatly slow the boat's movement. They may significantly contribute to a loss of boat speed and should be corrected to prevent a notable decrease in speed.

Ineffective blade entry is common and usually results from poor preparation during the approach, leading to longer entry times and a lack of proper connection when not locking in at full reach. Keeping the blade close to the water during the approach requires the athlete to drop their oar handles near full reach, creating space to square the blade. Lowering the hands just before the catch will slow the speed at which the blade enters the water. Figure 2.3.7a shows the Inefficient Blade Entry Profile as the blade lifts away from the surface at full reach to square.

Figure 2.3.7a *Ineffective Blade Entry Profile*

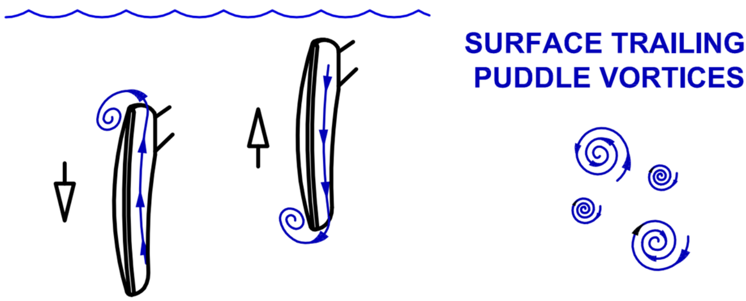


Athletes who drop their hands during the final part of the recovery lose the blade's momentum and move away from the water's surface, decreasing the effectiveness of the catch.

The power application stage of the drive requires the blade to stay connected to the water at a consistent depth throughout. Vertical movement of the blade in the water will reduce its connection, so coaches should make sure the blade stays at a constant depth.

Inconsistent blade depth during the power application stage will be less effective, as water flows over the top and bottom edges of the blade. This creates low-pressure zones along these edges, leading to cavitation. Figure 2.3.7b Blade Vertical Movements shows water flow directions up or down, opposite to vertical blade movements, and the resulting puddles with additional vortices.

Figure 2.3.7b *Blade Vertical Movements*



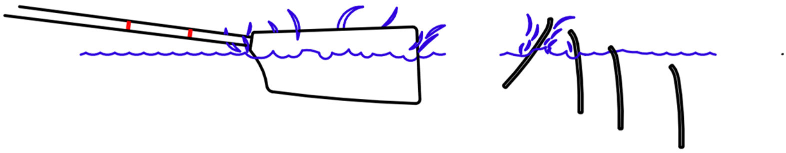
Cavities forming along the top and bottom edges will develop into vertical vortexes and become visible at the water's surface in the puddles after blade extraction.

Cavitation occurs when there is a reduction in pressure, causing vaporization and the formation of vapour bubbles. Along the edge of the oar blade, where water experiences pressure on the face of the blade during power application and slips over the edge, this pressure drops, leading to the formation of cavities along the edge of the blade.

In the late drive stage, the blade must maintain depth as long as possible.

The release stage usually involves two common errors. The first is that the blade is brought to the surface too early, causing reduced connection with the water and reduced force on the blade. This, and the hands are close to the body. This loss of connection can be measured with the NK EmPower Oarlock, known as Finish Wash, and is expressed in degrees.

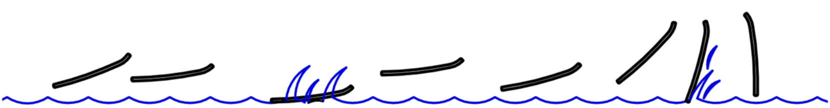
Figure 2.3.7c *<u>Release Errors</u>*



Pick catch drill. Also known in Canada as the rush-in catch drill

Recovery blade-work errors can slow the boat's speed and affect its balance. Figure 2.3.7d Recovery Errors, shows the blade contacting the water and splashing during mid-recovery. The graphic also shows inconsistent blade height above the water, usually caused by hand-level inconsistencies during recovery. This contact reduces the speed of the shell. The figure also shows inconsistent blade height above the water, which will affect the shell's balance. The figure also shows squaring, with the blade touching the water before full reach, which also reduces speed.

Figure 2.3.7d *<u>Recovery Errors</u>*



Recovery bladework, specifically blade height above water, must be consistent for the entire crew and will be affected by the water conditions, as rough water will require a different blade height and blade squaring timing.

Finally, bladework is a critical part of rowing technique and crucial to the shell's speed.