



Research completed by Nigel Dennis

THE MOST IMPORTANT STROKE IN SEA KAYAKING “THE FORWARD STROKE.”

This stroke causes more discussion and sometimes arguments than any other stroke. The following information is based on my findings and beliefs gained through many miles of paddling, coaching and analyzing technique and I know everyone will not agree with the following.

Unfortunately to cover this topic well we need a book not just an article, so many areas have been skipped over.

I look at forward paddling as having three main areas of technique:

- The Inuit style that uses custom made timber paddles. These are usually long thin hand made timber paddles. These have evolved from the Inuit who used the paddles for hunting. Just try and get close to a seal and what do we do?

We paddle forwards with a low paddling action keeping the blade as low to the water as possible.

As we approach we try to be as quiet as possible. The Inuit paddle probably glides through the water better than any other.

- Wing paddles. These have evolved through sprint paddling. As a result they have a more efficient blade but tend to be shorter in length to enable a high strike rate, and they are not as user friendly in advanced conditions as the Euro blade. Wing paddles are most efficient when sprinting. When the wing is being used as a sprint paddle it may end up approx 10cm shorter than your touring paddle. (If the chart below is used)
- Finally what is now known as the Euro blade (by some kayakers). A blade that is perhaps not as efficient as the Wing but more user friendly in adverse weather conditions and more powerful than the Inuit blade especially when the wind picks up or you need to tow. I am aware that this statement will be debated and condemned by some.

I do know that when all three techniques are used by kayakers to tow in say a force five head wind, all will end up using an almost identical technique.

There are many arguments for using the Inuit and Wing blades and I fully accept that in some areas they are more efficient than the Euro blade and will also out perform. I however prefer the Euro blade as a better all round paddle and I hope the following will help others who also have the same preference.

We spend a considerable amount of time customizing kayaks so we should also look at paddle sizing in some depth. Larger paddlers in the main need longer paddles, powerful paddlers can use bigger blades, small framed kayakers need shorter paddles with smaller blades and in some cases narrower shafts. With modern technology we are now in a position to fully customize our paddles.

KEY REASONS FOR CORRECT PADDLE SIZING:

1. Minimizing paddling injuries.
2. Gain an efficient stroke.
3. Optimizing paddle choice.
4. Once the correct paddle has been identified an in depth look at paddle technique can then begin.
5. Paddle efficiently in following winds, head and cross winds.

To avoid injury we also need good technique and before we try to coach we must make sure that kayakers use an appropriately sized blade.

We need a paddle that will allow us to maintain good technique at all times even at the end of a long day.

Considerations:

How do we ensure that we use our larger muscle groups?

Maintain good technique?

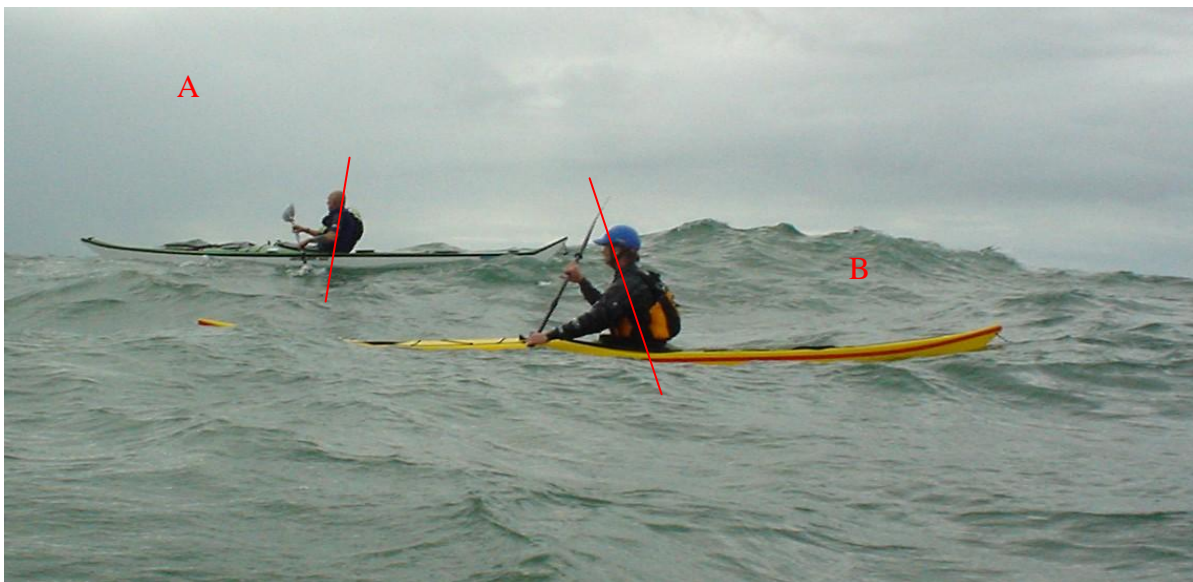
Maximize efficiency?

USING POWER EFFICIENTLY:

We must use our large muscle groups for efficient forward paddling. The smaller we are the more important this is. Not everyone is a Rambo!

The power comes from our feet pushing against the footrests and some kayakers also gain power from their thighs when paddling a kayak that has good thigh contact. As we start to draw the paddle through the water we must power up our legs, engaging our back and stomach by rotating our shoulders and torso. We plant the paddle as far forwards as comfortably possible. We pull with the bottom arm but at the same time we push out with our top arm. The top hand should be approx eye to chin high when pushing out and our arm extends across the deck of the kayak out towards and in some cases past the opposite gunnel of the kayak. We do need to look at what point the blade leaves the water but I will come back to that later. Arms need to be kept reasonably straight.

POSTURE:



Kayaker A's posture may well be caused by a paddle that is too long or maybe blades that are too big.

Kayaker B has a good posture sitting upright and leaning slightly forwards.

Paddler B is also in a good position to maximize efficiency when paddling in rough water as it will be easy for him to lean forwards as the bow of his kayak drops down a wave, this will push the centre of effort forwards and the kayak will accelerate down the wave. Once the wave starts to run on and the bow starts to rise the kayaker slowly comes back up to his/her normal paddling position ready for the next wave.

WEIGHT DISTRIBUTION WHEN PADDLING IN ROUGH SEAS IS VITAL FOR EFFICIENT PADDLING.

THE POSITION OF THE TOP HAND.

The top hand does not want to be above forehead height or below chin height.



It will be impossible to undertake the above with a paddle that is too long.

We must also look at the following three areas before we start looking at technique.

In my opinion for those long day's when on expeditions we are trying to achieve a slower, but powerful stroke and in many cases this will mean a slightly longer stroke.

1. **Footrests:** These need to be set so we can power up by pushing on the balls of our feet when using the footrests. If the footrests are set too close then we will suffer from pins and needles in our feet. Too loose and we won't be able to secure ourselves in the kayak in rough water. An alternative to foot rests is to have a custom bulkhead with a foam pad to allow for winter or summer footwear. A bulkhead footrest over long periods of time will be more comfortable.
2. **The Seat:** This needs to be comfortable but should encourage the kayaker to sit up but at the same time lean slightly forwards. This will allow more power to be delivered to the blade. A higher seat will give you a longer reach allowing a longer stroke and maximizing the power that can be delivered as the blade when pulled through the water. The lower the seat the more stable we will feel, so a compromise is needed. The seat should be designed in such a way that it stops you sliding off the back of the seat as you power up your legs. This is essential as some of the stronger kayakers hardly use or in some cases never use a backrest as the further forwards you lean the less you use the back rest. It would also increase efficiency if the seat was slightly higher than the footrests.
3. **The Backrest:** Backrests are best adapted to suit the individual. Some will want support low down and others higher up. Back rests that wrap around the back in some cases also cause back complaints. Everything from foam blocks, slatted timber back rests to padded bands work. How we roll will also need to be considered. Do we roll leaning forwards or by lying on the back deck? If you lie back then the back rest needs to be at a height that allows you to lie on the back deck. We just need to find out what works for us and choose a back rest accordingly. Also check out the height of the rear deck as it's no good choosing a kayak that won't allow you to lie on the back deck because the rear deck is too high.

Seat position.

The smaller the paddler the further forwards the seat needs to go. This will help stop the kayak bow being blown down wind and improve kayak trim.



Torso height is important as a short torso will add to an inefficient forward paddle stroke. Although a raised seat will help it would also make the kayak less stable.

Smaller lighter paddlers



Paddlers with longer torsos have far better leverage. But their centre of effort is higher.

The rear of the seat can also be raised and angled to help the paddler with posture.

Medium to Large paddlers



Critical points of contact between the paddler & the kayak:

- The foot rest.
- Bracing knees.
- Back rest.
- Hip pads.

It is important to keep our arms as straight as possible, as this will force us to use our more powerful shoulders etc to do this we need a relatively vertical blade. This also helps encourage the blade to run parallel to the kayak. The shaft of the paddle will therefore need to be quite vertical. If you bring your hands closer together when holding the paddle this will create a more vertical blade. (You may need to shorten your paddle)

The table below has been put together by collating information that I have gained over a three year period by recording paddlers heights and noting improved efficiency together with student feed back. This table should be used as a guide, for paddle choice. If you are purchasing a paddle with a variable centre joint then you have a far better chance of finding a suitable paddle without at least a half day session on the water.

Straight shafts are easier as you don't have the additional worry of the position of the crank. I personally prefer the modified crank but it does not suite all and in some cases

even affects wrists. I have known paddlers to have tendon problems with cranks but not straight shafts despite the crank in theory, is meant to be kinder on the wrists.

Although there are a number of excellent paddle manufacturers I chose to help develop a paddle system that I believe is the most versatile that you can buy. I would like to thank Lendal for helping and being willing to work closely on this project.

FINDINGS:-

The table was collated by observing paddle technique, linking it to an increase in performance together with an energy efficient stroke.

All participants were initially videoed paddling forwards using their own paddle. Details of their paddle were recorded in order to make a comparison once the specification of the customized paddle had been finalized. The participants were then videoed paddling with the new recommended blade.

One of the more surprising findings was that forward paddling technique improved considerably without any coaching once an appropriate paddle was used. I would now recommend that an in depth coaching session should not take place until a suitable paddle has been identified.

It should also be recognized that once technique and strength has been improved, sometimes the paddler can increase the blade area without compromising technique.

When deciding on paddle length and blade area, you have two options:-

- A longer paddle with a smaller blade area.
- A shorter paddle with a larger blade area.

If after using the table to determine paddle length, you feel that the blade area is still too large then an alternative to a smaller blade is to reduce the shaft length.

If the paddle you chose for efficient use in calm conditions was shortened by 2/4 cm. It would make a considerable difference in the amount of energy required to maintain an efficient forward paddling technique in windier condition or with a laden kayak. A shorter paddle is also good in rough water. Reducing the paddle length would effectively be changing down a gear. The table shows a suggested length of shaft to blade size. Finally it is much easier to demonstrate strokes with a shorter paddle.

The average advanced paddler has a strike rate of approx 60 per minute when the paddle lengths correspond to the enclosed table.(a strike is every time a blade hits the water)

People with differing frame sizes require different shaft thicknesses. As a way of standardizing I have taken the standard diameter of shaft as being suitable for a medium sized frame. I would recommend that a shaft measuring approx 27mm external diameter for small framed people. (See table) Large framed people sometimes get tendonitis in

their control hand. This is often due to the shaft being too small a diameter. This can easily be rectified by padding out the shaft.

Most small framed paddlers would do well to use a smaller blade area than they would normally use when working on developing an efficient forward paddle technique. Then move up a size when the technique is good.

For large blades use the paddle length in red

HEIGHT OF KAYAKER	PADDLE LENGTH	Blade type	Shaft diameter	Length of paddle with adjustable joint	Frame size
6ft 2in+ 185cm	217-222	Nordkapp/Kinetik T. 750cn ² 700cn ²	Normal/Large	215-220 or 217-222 750cn ² or 700 / 650cn ² blade area.	Large
6ft 0in 180cm	214-219	Nordkapp/Kinetik T.	Normal	212-217 or 215-220	Medium / Large
5ft 10in 175cm	210-216	Kinetik T/ KT small 650cn ²	Normal	210-215 or 212-217	Medium / Large
5ft 8in 170cm	208-215	Kinetik T/ KT small	Normal	208-213 or 210-215	Medium
5ft 6in 165cm	207-214	Kinetik Small	Normal/Small	208-213 or 209-214	Med / Small
5ft 4in 160cm	203-212	Kinetik Small	Small	207-212 or 209-214	Med / Small
5ft 2in 155cm	190-210	Kinetik Small	Small	203-208 or 205-210	Small

ABOUT THE CHART:

Although it would be more accurate to relate paddle length to torso height I have decided to use the height of paddler as the reference point for paddle length.

The chart shows the paddle range ie 215 – 220cm long. This allows 5cm of adjustment so paddles length should be ordered with the joint shut allowing you to open the joint to obtain your normal paddle length this in turn will allow you to reduce the paddle length if needed.

Although I have named blades as the research was undertaken in conjunction with Lendal paddles, I have put the blade areas down so a comparison with other manufacturers can be undertaken.

Shaft Diameter:

Small	27mm external diameter
Medium	29.3/30mm external diameter
Large	32mm external diameter.

(Manufacturers do not need to manufacture a large diameter shaft as it is simple to fit a thin layer of neoprene etc to thicken a normal / medium diameter shaft)

The red figures in the paddle length column give you the paddle length with a larger blade and the white with a smaller blade. This will depend on your personal choice.

Frame size refers to the paddler's skeletal frame.

SOME OF THE INJURIES THAT CAN BE AGGRAVATED OR CAUSED BY INAPROPRIATE PADDLES:-

- Rotational cuff tendonitis.
- Tendinitis of the hand.
- Tendinitis of the forearm – wrist.
- Shoulder Bursitis (calcific Tendinitis)

Incorrectly sized paddles are also a contributing factor to causing partial or dislocated shoulders. Large blade areas or paddles that are too long combined with poor technique are the main cause.

I look at the paddle as being a lever that is used by the kayaker to drive the kayak forwards. The longer and stiffer the lever the greater a force will be placed on joints, muscles and tendons. This together with incorrectly sized paddle blades (area) will increase the chances of developing any of the above conditions.

Rotational cuff tendonitis: can be caused by using a paddle that is either too long or and with blades that are too large in area for the kayaker. For people who suffer from this condition I recommend reducing both the blade area and paddle length. The blade area needs to be considerably smaller than the kayaker would normally paddle with. Only after a period of time, provided the tendonitis improves should you increase the blade size. Rotational cuff tendonitis is caused by damage to three small muscles and their tendons. These three tightly hold the ball and socket joint of the shoulder joint together. These run from the top of the shoulder blade to the top of the arm bone.

Tendonitis of the hand: This is sometimes helped by using a larger or smaller diameter shaft.

Tendonitis of the wrist or forearm: customizing your paddle can help this condition. (as described for rotational cuff tendonitis) or try a modified cranked shaft with a 65 deg feather. With this combination it is possible to paddle without flexing your wrist, but you may have to adapt your forward paddling technique to achieve this. (paddle with straighter arms, more like a stroke used by wing paddlers.)

The hand is controlled by muscles, tendons and nerves. Forearm muscles are connected to the hand by tendons that run across the wrist and into the hand. The tendons that control your thumb unlike others run through sheaths. The tendons are enclosed in these sheaths and when they become irritated extra synovial fluid is produced which lubricates and feeds the tendons. The sheath cannot expand to accept this extra fluid, this results in the fluid pushing hard on the tendon which in turn becomes inflamed. Over time this causes the sheath to thicken resulting in even less room for the tendon the condition now becomes chronic causing further swelling and pain. Immobilization and rest is needed. Again oversized paddles, overuse and in some cases compressed sheaths caused by tight latex rubber cuffs will cause this condition.

Shoulder Bursitis: this is primarily caused by overuse of the shoulder, but also again by oversized paddles. The bursa sac lies between the underside of the shoulder blade and the rotator cuff tendons. The sac comprises of specialized cells that produce joint fluid, called synovial fluid. The fluid also lubricates the sac and tendons. When aggravated it promotes fluid production. This in turn makes the condition worse causing swelling that becomes painful to the touch.

THE CORRECT CHOICE OF PADDLE TOGETHER WITH GOOD TECHNIQUE
WILL GO A LONG WAY TO MINIMISE THE ABOVE CONDITIONS.

RECOMMENDATIONS:-

The sea kayaker adopts either of the following options:-

- Purchase a set of two paddles. Both the same length but one having smaller blades. The paddler can then change down a gear by dropping to a paddle with a smaller blade when tired or in some cases when paddling with a fully laden kayak.
- Purchase a one piece paddle with interchangeable blades and a variable joint.
- Unfortunately a light paddle will mean a one piece and generally this means a stiff paddle and a disadvantage of a stiff paddle is that it may also bring on injuries.

THE ADVANTAGES OF A BLADE THAT CAN BE ADJUSTED IN LENGTH.

For general expedition paddling the paddle that will be most effective especially in strong wind, tidal races and surf will be a blade with the largest blade area that is comfortable for you to manage.

Remember if you shorten your paddle you will be able to paddle with a larger blade. I am 5ft 10 inches tall and will shorten my paddle length to 210cm with a Nordkapp blade in strong wind, tidal races and surf. (When paddling a sea kayak) I will adjust the length of the paddle to either 213 or 215cm depending on who I am paddling with, or the wind direction.

Down wind I use the longer paddle and paddling in strong up wind conditions I would drop the length to 210cm.

When paddling longer distances I will set the shaft so the paddle length is between 213 – 215cm. This makes a difference to the stroke rate and speed. As long as you can still paddle efficiently (ie using your large muscle groups efficiently) the longer blade will be faster but will dictate a longer slower stroke.

If the blade is too long your arms will start to bend at the elbow, this will result in less efficient paddling and you will end up paddling slower. Shorten the blade and you will effectively change down a gear enabling you to increase your efficiency.

Don't forget if your tired, change down a gear by shortening you paddle length.

When towing or paddling into strong winds (F7/8) then I find a more vertical paddle more efficient as this allows you to use your feet and upper torso far more effectively. I

push out with my top arm almost more than I pull with my bottom arm. My top hand is pushed out at about eye / forehead height, and this can only happen with a shorter paddle.

HELPFUL EXERCISES:

1. exercise to help make sure your straighten your top arm, is to open your fingers as you push your top arm out.
2. To help get good trunk rotation, start to paddle with your arms straight holding the paddle just above each blade. This forces your shoulders round, helping to improve trunk rotation. It also helps if you keep looking at whatever blade is in the water right until the end of the stroke. Don't do this for too long as you will get dizzy and fall in! Slowly bring your hands in along the shaft to your preferred hand position on the shaft. Try to keep the same trunk rotation as experienced with your straight arms.
3. Start to paddle and experiment by pulling your hands in along the shaft narrowing your grip. This will allow you to experiment with a more vertical paddle. You may have to shorten your paddle.

Pushing out with your top arm is important as it's easier and more effective to push with your arm than pull. Just try push ups or pull ups!

THE CATCH:

This is the point that the paddle initially enters the water. There are various points that can be addressed to increase the catch but for kayaking in windy conditions the paddler must maintain a firm grip with the hand that is planting the blade but as far forwards as is comfortable. This will be increased by being flexible and by not having tight ham strings that run down the back of your leg. A good exercise to increase your catch can be seen below.

Improving your forward stroke. Extend your catch.



If you mark the deck of the kayak with tape it will encourage you to lean forwards. If a graduated scale is drawn along the tape, you can train yourself to lean still further forwards.

THE BLADE EXIT:

Again this will be controversial but I do believe there are options to consider. We more often than not recommend that the paddler should start to exit the blade from the water when their hand reaches a position approx around their waist. This is to prevent the blade lifting water as it exits and enables the paddler to return the blade to the catch position as quick as possible thus allowing the kayaker to be efficient by pulling the paddle through the water at the most powerful section of the stroke. BUT there are expedition kayakers who develop a far longer stroke allowing the paddle to stay in the water until it cannot be drawn back any further. This is done efficiently by having an aggressive trunk rotation. This results in the paddle blade although exiting the water late being raised and exits the water in a vertical position with the face of the blade facing the side of the kayak. This minimizes the water being lifted and only works when the paddler also maintains relative straight arms but the extra power is gained from the more relaxed longer stroke provided the kayaker keeps the power switched on by continual power being generated through the legs, stomach, back and shoulders.

ONE PIECE PADDLES:

If you want the lightest paddle (straight or a modified crank), then this needs to be a one piece paddle. It is therefore more important when ordering a one piece modified crank paddle that you get the crank in the right place. To do this take a straight shaft the same length as required. Paddle with it until you are happy with your hand position on the shaft and measure between your thumbs. Give this measurement to the manufacturer and the paddle can then be manufactured with the cranks in a position that suits. This only needs to be done if you naturally have a wider or narrower grip than the average kayaker.

With the Lendal range when ordering 1pc or 3pc paddles, you can have the option of a Flexi shaft.

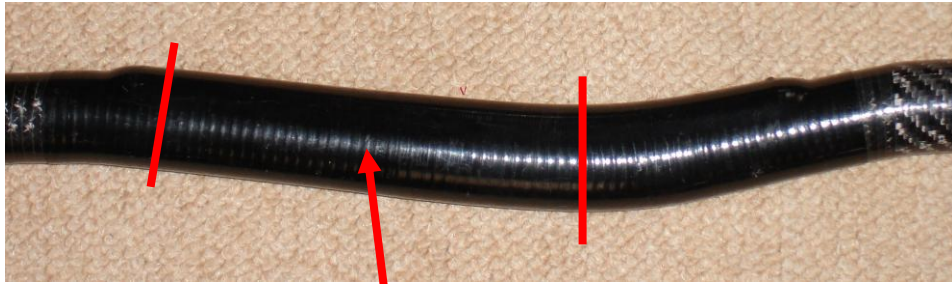
An important consideration especially when ordering a one piece modified crank paddle.



If you have a wider or narrower grip than the average kayaker then this measurement is important as this will determine the correct location of the cranks.

NOTE:

If you move your hands closer together the more vertical the paddle will become, but you may need to shorten the paddle in order to improve technique.



A modified crank should be held with the hand position some wear on the crank between the red lines.

OTHER CONSIDERATIONS:- A shorter paddle will generally mean an increase in stroke rate. A longer paddle will enable the kayaker to have a slower paddle rate. Both will result in a similar kayak speed but the shorter paddle will promote acceleration. The Lendal padlock system provides kayakers and coaches with the opportunity of experimenting with length and has the options of changing blade size.

Don't forget that if you are paddling a double the easiest way of matching stroke rates is to adjust paddle length until both kayakers have the same strike rate.

When paddling down wind the larger the blade the quicker we can catch a wave. For example with a large blade I can put one powerful stroke in and normally provided I am paddling forwards catch the wave immediately. With a medium sized blade it takes say two strokes and with a small blade three or four strokes to catch the same wave.

If you are interested in specific paddle sizing clinics using the Lendal system or need further information on Lendal paddles please check the following web sites.

www.lendal.com

www.seakayakinguk.com

SPENDING TIME ON PADDLE SELECTION WILL IN THE LONG RUN SAVE INJURIES AND YOUR TECHNIQUE AND STAMINA WILL IMPROVE CONSIDERABLY AND QUICKER.

- Short paddles will give you a more dynamic technique and a higher strike rate. Short paddles are better in surf and rough water like tidal races. With the shorter paddles you will be able to use a bigger blade.
- The longer paddle, provided you can still maintain good technique, will result in paddling faster but with a slower strike rate.