

Chapter 7: Mussel Farm Equipment

The typical equipment employed by the surveyed growers consisted of a small open boat with a motor, a barge with hydraulic hauler, and a socking table with a water pump. The barges often had outboard motors. Some growers also incorporated cranes and/or winches into the equipment mix. New equipment like hydraulic seed graders and socking machines are also becoming more common in the Newfoundland mussel aquaculture industry.

Barges

Most of the surveyed growers used barges to work their mussel farms (Figure 7.1). Those that did not used small open boats. The barges were much more efficient, safer and comfortable to work on than the small boats. One grower did purchase a large aluminum flat bottomed boat from PEI that had most of the characteristics of a barge (Figure 7.2). There were four types of barges that were utilized by the surveyed growers. These were: the aluminum pontoon, the wooden frame pontoon filled with styrofoam, the fiberglass pontoon and barrel floatation barge. The aluminum pontoon had to be purchased at considerable expense to the grower resulting in barge costs of approximately \$ 25,000 to \$30,000 for a 10 to 15 m (30-45 ft) long barge. Although expensive, the life expectancy is much longer for the aluminum barge.

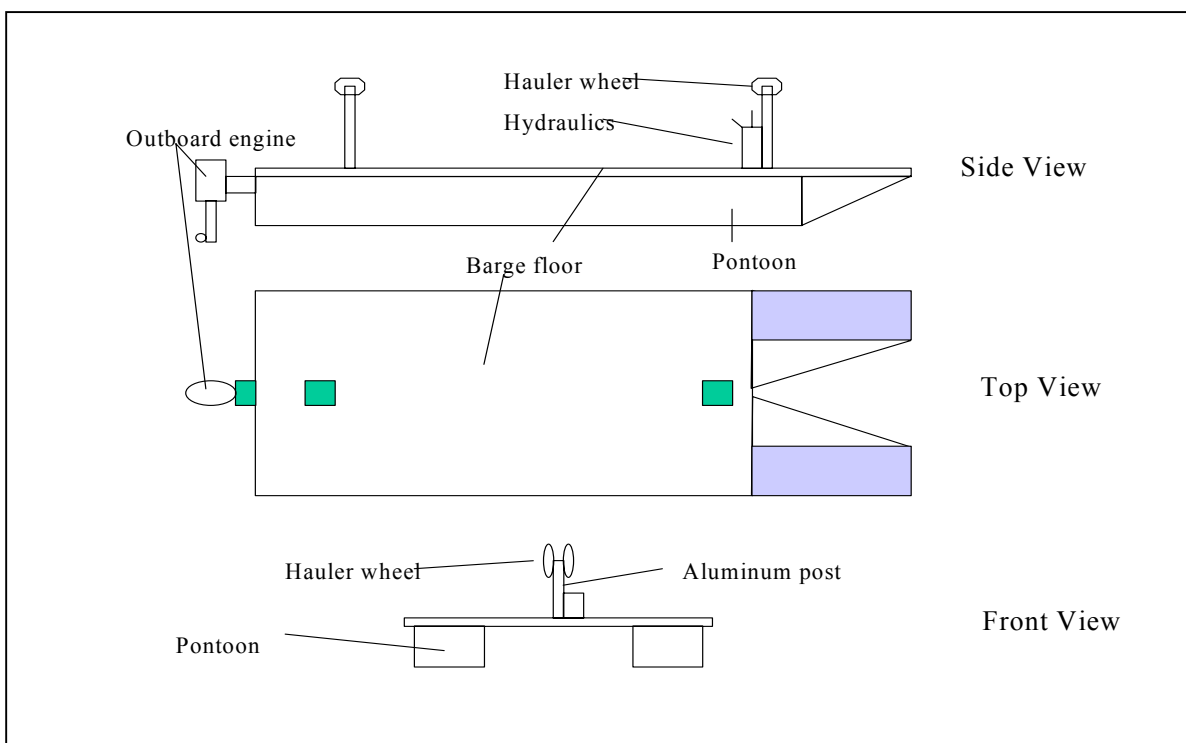


Figure 7.1: A diagrammatic representation of the typical Newfoundland barge. Most barges are 10-12 m in length and 4-5 m in width.

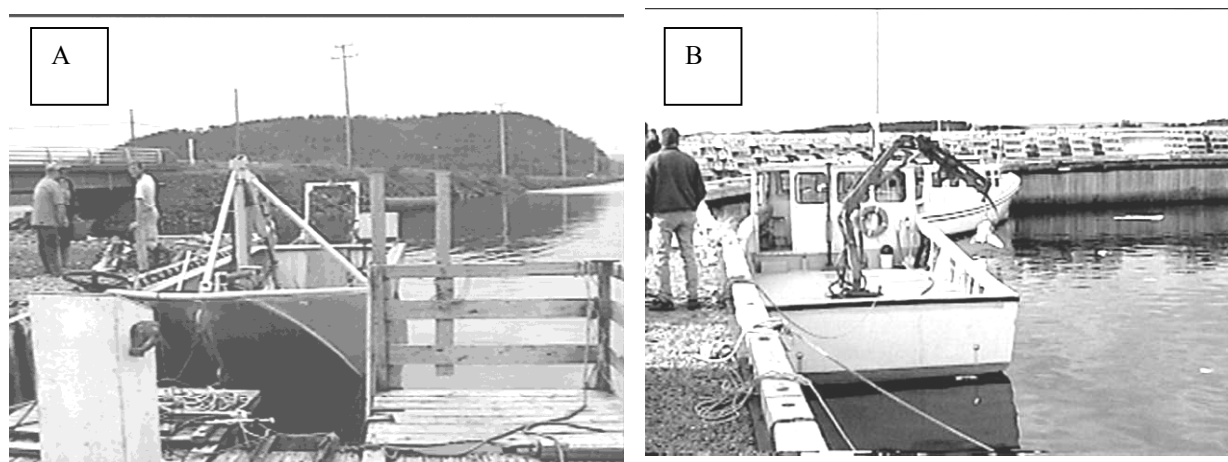


Figure 7.2: (A) Flat bottomed aluminum work boat with hydraulic crane and hauler, (B) boat with center mounted boom commonly used in PEI mussel culture.

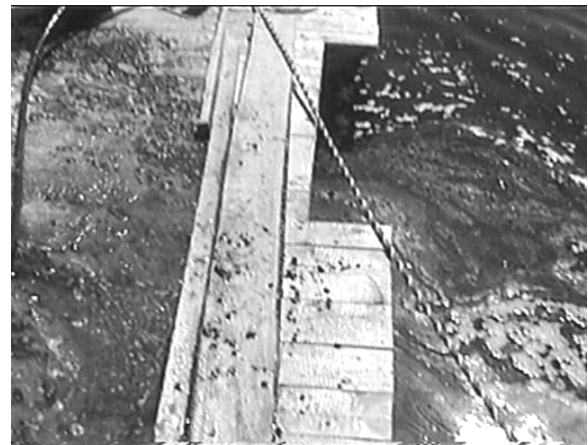
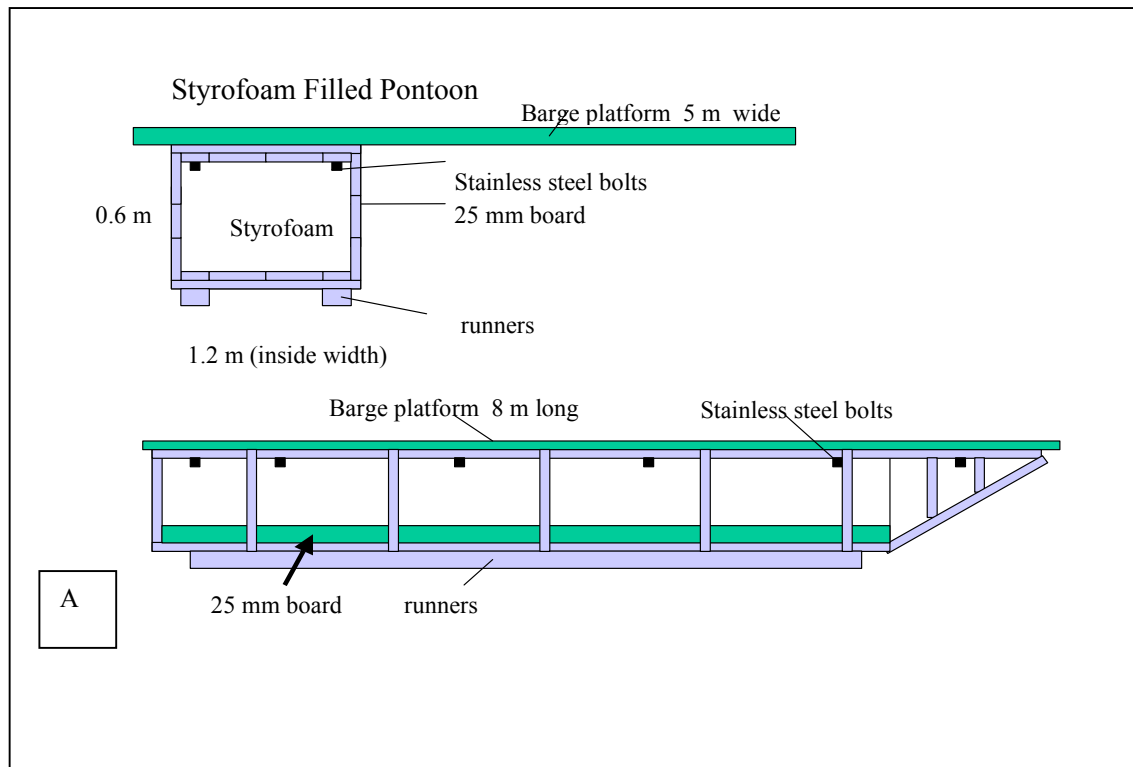
Considering the high start up costs in mussel farming, for the first two to three years a mussel farmer may want to build his/her own barge. This can be accomplished relatively cheaply since most growers already own or have access to the tools required to build a barge. Two barge designs, the styrofoam filled pontoon and the fiberglass over wood pontoon barges, appear to be the most economical barges for the developmental mussel farmer

The Styrofoam Filled Pontoon Barge

The Styrofoam Filled Pontoon Barge is constructed using 2.5 cm (1") board that is nailed or screwed to a two by four or board frame (Figure 7.3). The completed frame is then filled tightly with sheets of styrofoam insulation. If the frame is placed on the outside, then the inside area can exactly match the area of a styrofoam sheet. The sheet can then simply be slid snugly into the frame. The styrofoam provides the floatation and thus sealing the pontoon is not necessary. The pontoon size can vary but one grower that used this design suggested a width of 1.2 m (4 ft) and a depth of 0.6 m to 0.9 m. Pontoon length depends on the desired space on the barge but a length of 8 m (24 ft) is considered small.

The pontoons should be constructed such that the barge platform can be connected to the pontoons by stainless steel bolts. This allows for the removal of a pontoon should repairs be necessary. A runner can be screwed or bolted on the bottom of the pontoon to allow the barge to be hauled up on a slipway for over wintering. One grower that used this barge design suggested

that he could build it for less than \$2000 (material costs). This does not include labour costs and



hydraulics.

Figure 7.3: (A) The styrofoam filled pontoon design, (B) small styrofoam filled pontoon barge, (C) styrofoam filled pontoons protruding from the front of the barge.

The Fiberglass Over Wood Frame Pontoon Barge

Solid fiberglass pontoons can be constructed by many of the fiberglass boat companies but these tend to be more costly. A less costly alternative is to construct a wooden pontoon and then coat it in fiberglass (Figure 7.4). The pontoon frame is constructed from two by four and then coated in 6-13 mm ($\frac{1}{4}$ to $\frac{1}{2}$ ") plywood. This shell is then coated in five layers of fiberglass (Fiberglass thickness recommended by L. Squires, Sea Serpent Boats 1998, pers. comm.).

The pontoon is constructed such that the barge platform can be attached via stainless steel bolts. Runners may also be added to the bottom of the pontoon to allow the barge to be hauled up for the winter. The grower that used this type of barge estimated material costs at less than \$2,000 for materials. This does not include labour and hydraulics.

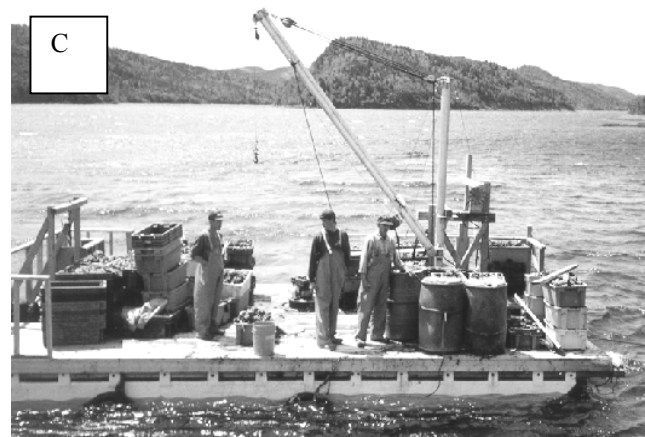
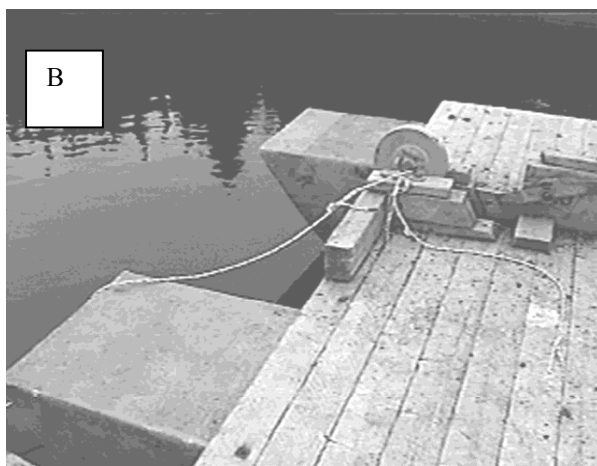
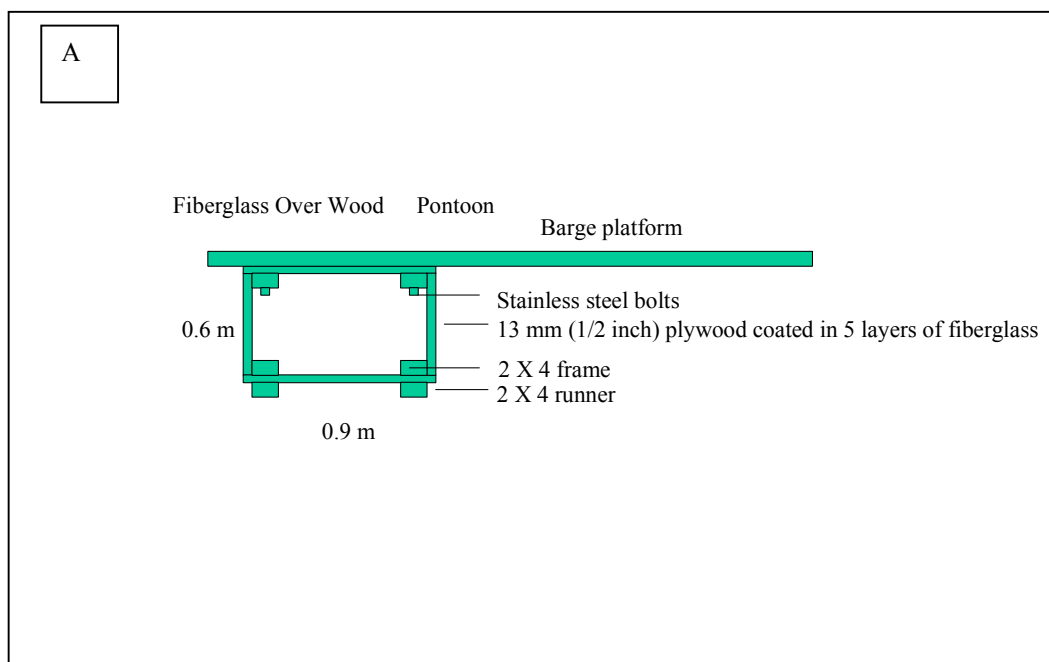


Figure 7.4: Fiberglass over wood-frame pontoon design (A), picture (B), commercially made fiberglass pontoon (C) (photo by Sean Macneill).

The Barrel Floatation Barge

Barges that utilized 200 l plastic barrels for floatation were the most common type used by the surveyed growers. In all cases a wooden framework was constructed beneath the barge platform to hold the barrels in place (Figure 7.5). The number of barrels employed depended on the size of the barge and often barrels would cover most of the bottom surface of the barge rather than just the sides like a pontoon. An 8 m long barge would require at least 22 barrels, 11 on each side.

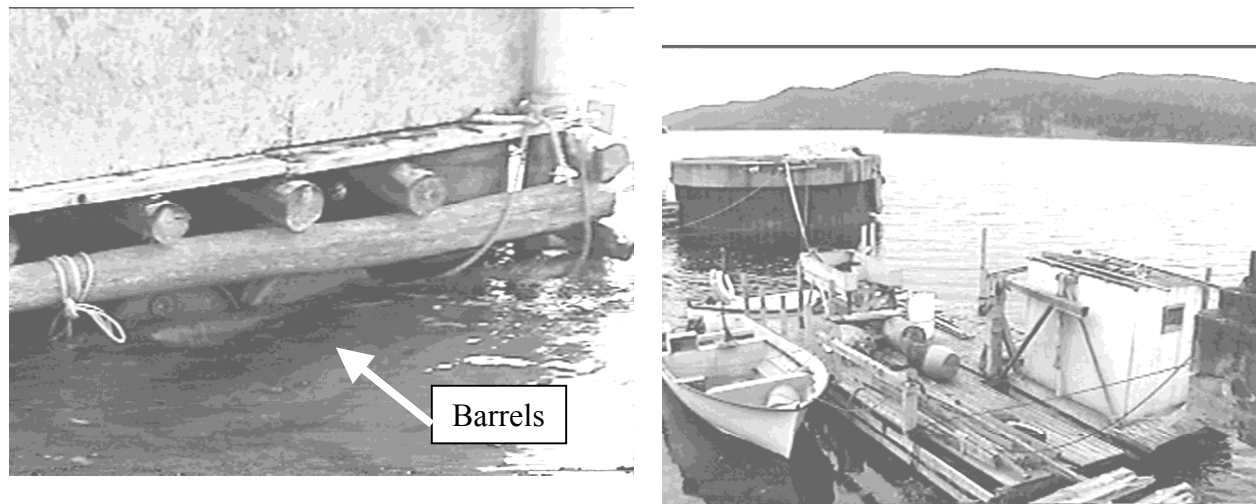


Figure 7.5: Barges that use barrel floatation.

These barges tend to be very slow based on the poor ability of the barrels to break the water. By inserting a plywood plane at the front of the first barrel barge speed may be increased. Another disadvantage is that barrels often leak and need to be replaced. A 8 m long barge would have a barrel cost of at least \$1,000 at \$40 a barrel.

Commercially Designed Pontoon Barge

There are commercially designed and manufactured pontoons available to the mussel grower. These tend to be primarily aluminum although some plastic, steel and fiberglass pontoons have been developed. There are several aluminum pontoon barges in use in the Newfoundland mussel industry (Figure 7.6). The grower may wish to build the platform for the barge to reduce costs rather than purchase it with the pontoons. These systems tend to be very costly resulting in total barge costs exceeding \$20,000. However, they offer large work areas (at least 50 % more

surface area) and have a much greater life expectancy. Costs also include custom hydraulic systems.

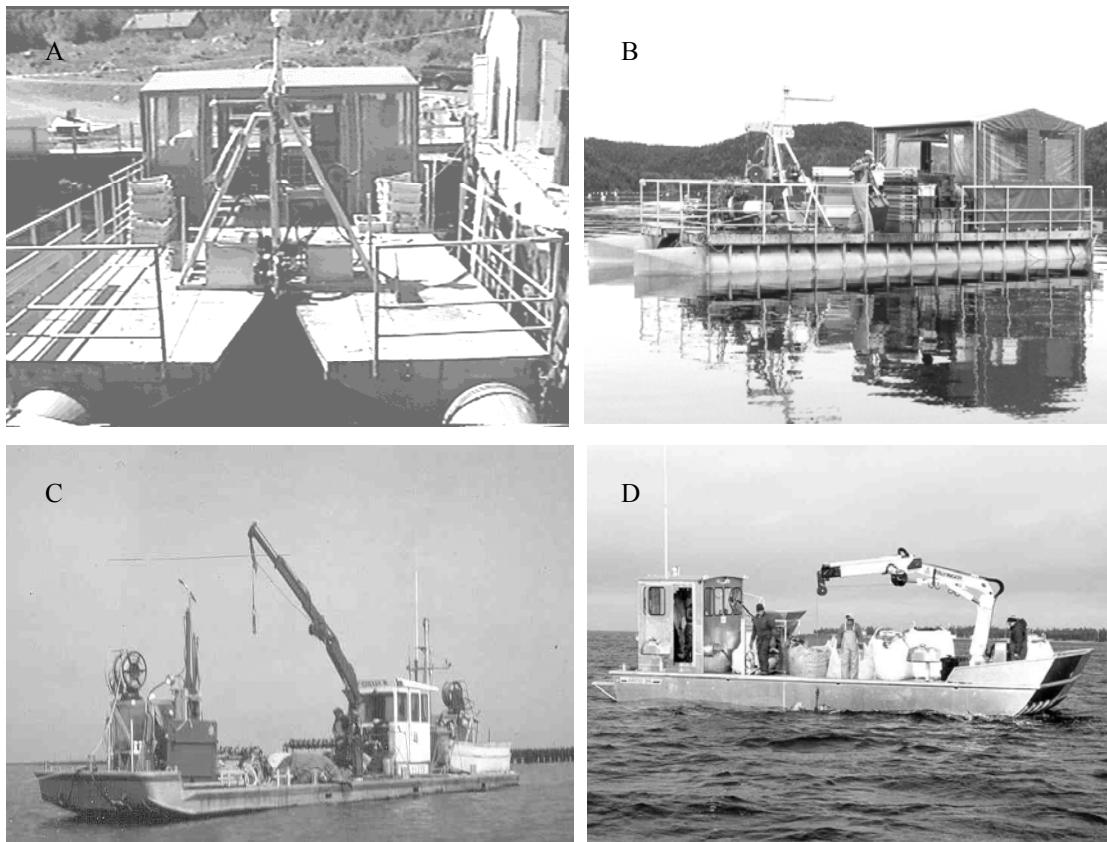


Figure 7.6: (A and B) Newfoundland aluminum pontoon barges, photos courtesy of Sean Macneill, (C) barge from France and (D) barge for Ireland (photos courtesy of Cyr Couturier).

Although large aluminum barges require larger initial costs compared to the smaller wooden types they will likely be required for long term commercial production. Increased efficiencies in labour, harvest volumes and durability from the aluminum barges will make them more and more attractive to developing mussels businesses.

Barge Platforms

Once the pontoons or barrel frames are constructed the barge platform must be built and attached. The platform frame may be built out of wood or metal (steel or aluminum) depending on availability and cost (Figure 7.7). Extra framework is used near the front of the barge to provide more strength to the base of the hydraulic hauler.

Once the frame is completed, plywood, one 25 mm board, 5 cm X 15 cm (2" X 6") boards may be used to create the barge floor. The 8 m long barge of previous examples would require 12 sheets of plywood. This area may then be coated in fiberglass if the grower desires. Typically a notch is created at the front of the barge to allow a work area that allows socks and collectors to remain hanging in the water. After completion the barge platform is mounted on the pontoons using the stainless steel bolts jutting from the pontoons.

Haulers and Winches

The heavy sock lines require winch or hauler systems to allow the grower access for maintenance and harvesting. These may be simple hand winches to very expensive hydraulic winch/hauler systems.

Many new growers that have not invested heavily into equipment often use a simple hand or trailer winch to haul up heavy lines (Figure 7.8). These are inexpensive at approximately \$50 and very powerful. Hand winches although useful have several drawbacks. They are slow and require manual labour and there is a limit on the load they can handle (two tonnes). Thus hauling up several lines may be both physically draining and very time consuming.

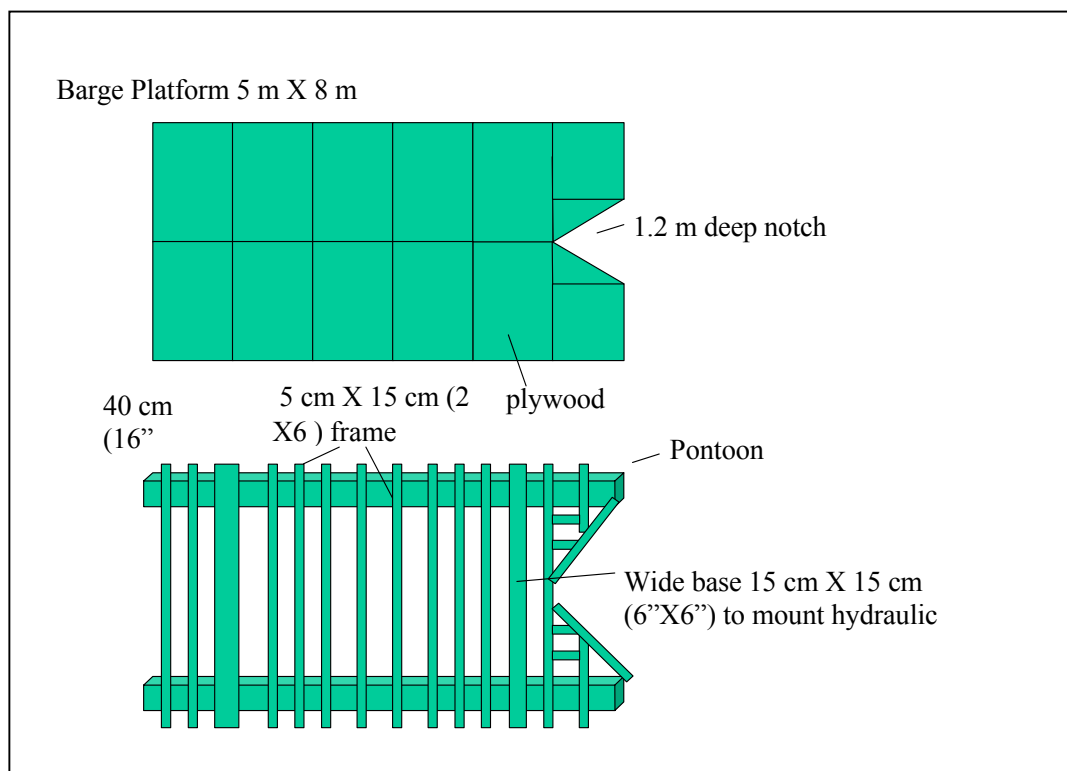


Figure 7.7: Typical barge platform design and flooring.



Figure 7.8: Simple hand or trailer winch used to haul mainlines to the surface. This system may be suitable for line maintenance or inspection but is not advised for commercial scale harvests.

As financing becomes available the mussel grower usually purchases a hauler wheel or builds one. The hauler wheel is normally powered by hydraulics but an electric motor can be used and hand powered models have been used in Newfoundland (Figure 7.9). Wheels typically have notches or teeth that grab the line. A simple wheel will haul the mainline but will not allow the passage of socks, collectors or floats. The socks or collectors must be cut off before they reach the wheel or manually lifted around the wheel. Consequently using this type of wheel limits the work area to the front of the barge. It also causes the grower to drop the mainline each time a different section of the line must be reached which is time consuming increases labour costs and may result in some loss in product.

A more versatile type of hauler wheel is the sta wheel. This wheel has raised extensions that cause the wheel to resemble a multi-pointed star (Figures 7.10 and 7.11). As a sock or collector approaches the wheel it is deflected to the side by a metal bar (sock deflector). The sock lies between two points of the star and is rotated with the wheel until it clears the hauler. This system allows the grower to move along a line of socks without having to detach and then reattach to the mainline. This results in the best mussels on the line being harvested because the difficulty in bypassing

smaller mussels is virtually nonexistent. An additional benefit to the starwheel system is that the grower can now use the entire length of the barge as a work area.

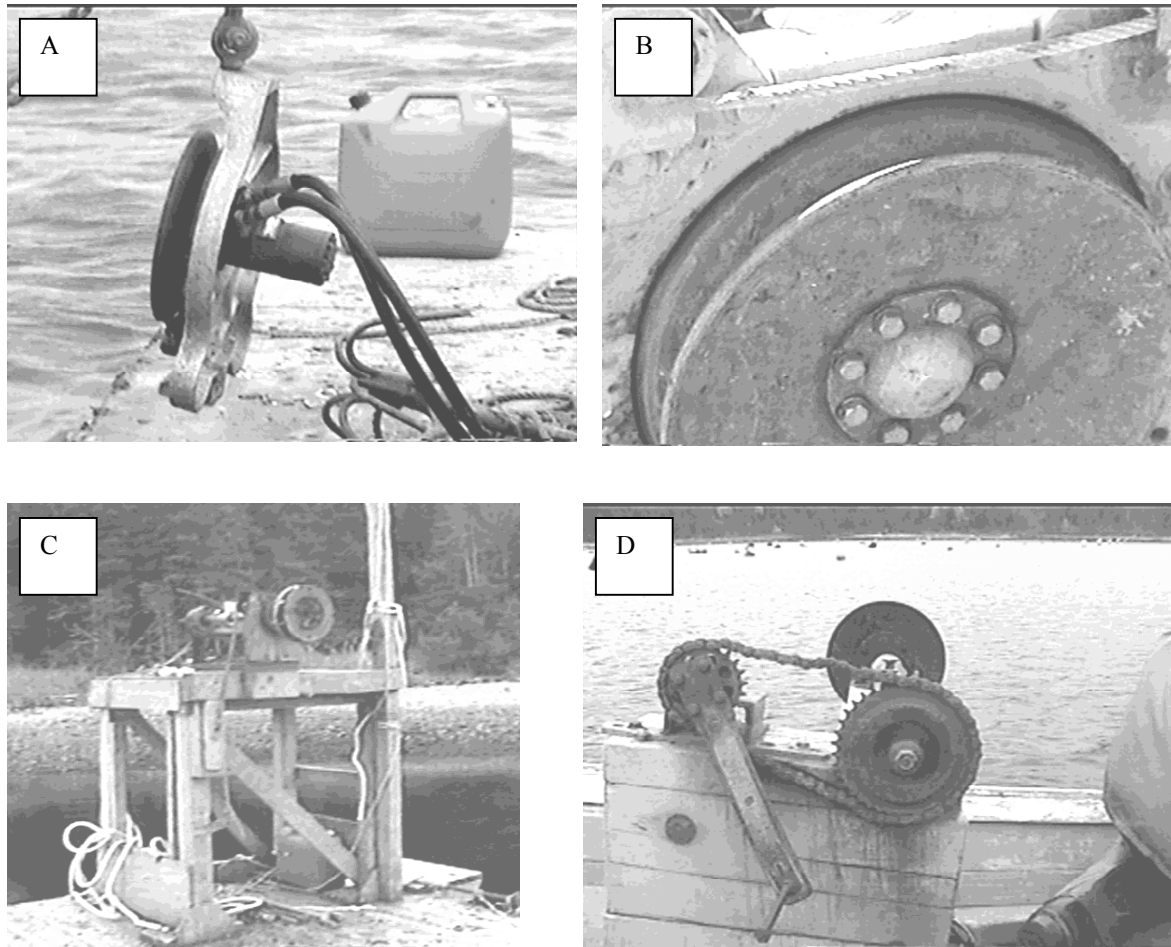


Figure 7.9: Simple hauler wheels. (A & B) Hydraulic, (C) electric, (D) hand powered.

Some growers add a crane and/or winch to lift the mainline up until it can be placed on the hauler wheel (Figure 7.12). These crane systems may be simple aluminum shafts or large booms that have been removed from boom trucks, or specialty booms designed for marine use

Barge layout

Once the barge has been assembled and the hauling system purchased the layout of the barge must be decided upon.. Most growers with barges used aluminum or steel posts to mount the hauler wheel. Some growers made these posts telescopic to lift socks or collectors high into

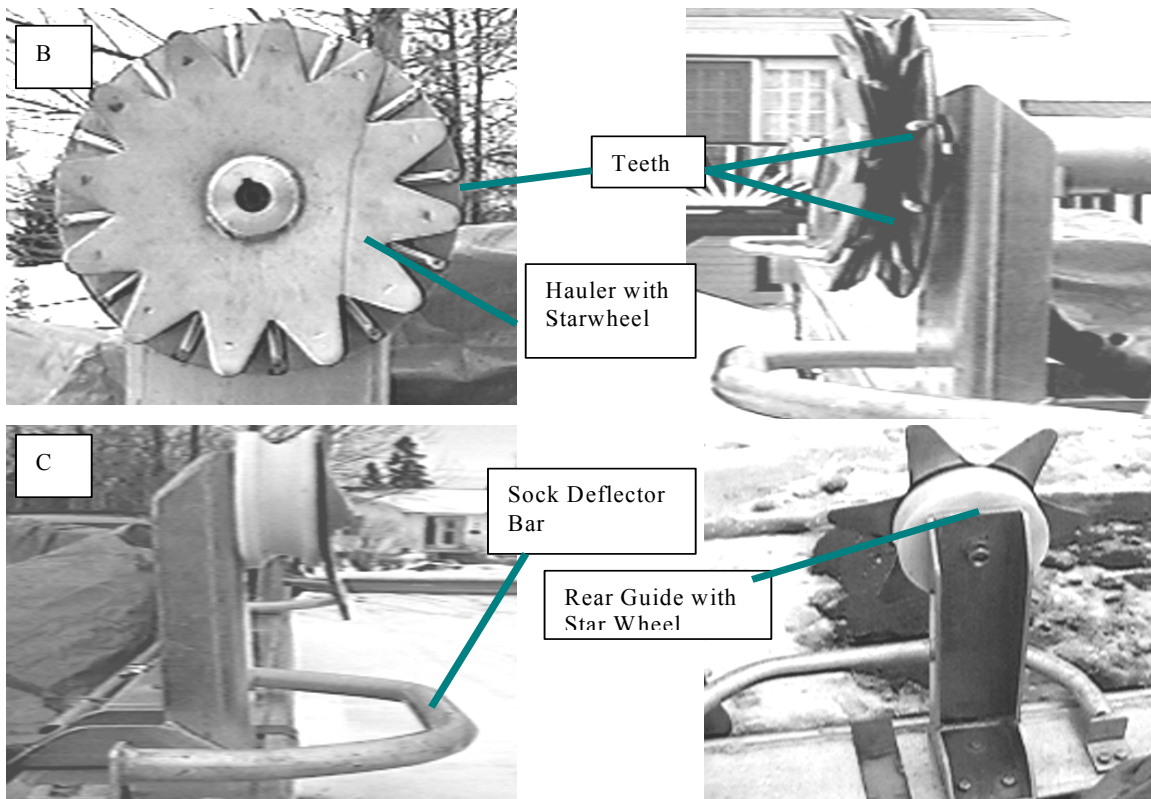
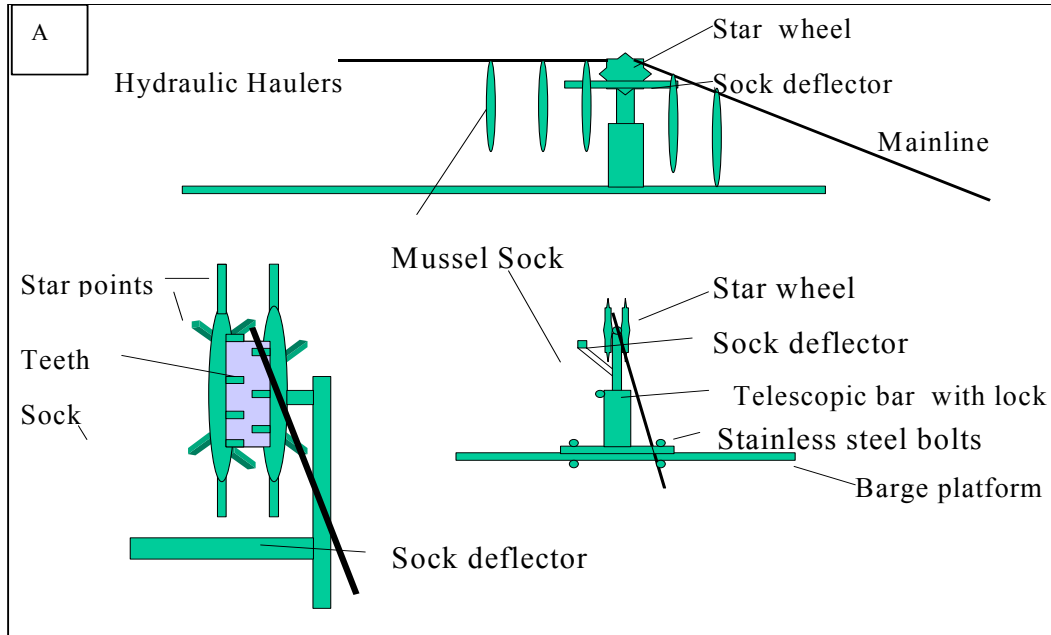


Figure 7.10: Star-wheel diagrams and photos. (A) Diagram of a starwheel in operation, (B) hauler wheel with star wheel and sock deflector, (C) rear guide wheel with star wheel

wheel and sock deflector.

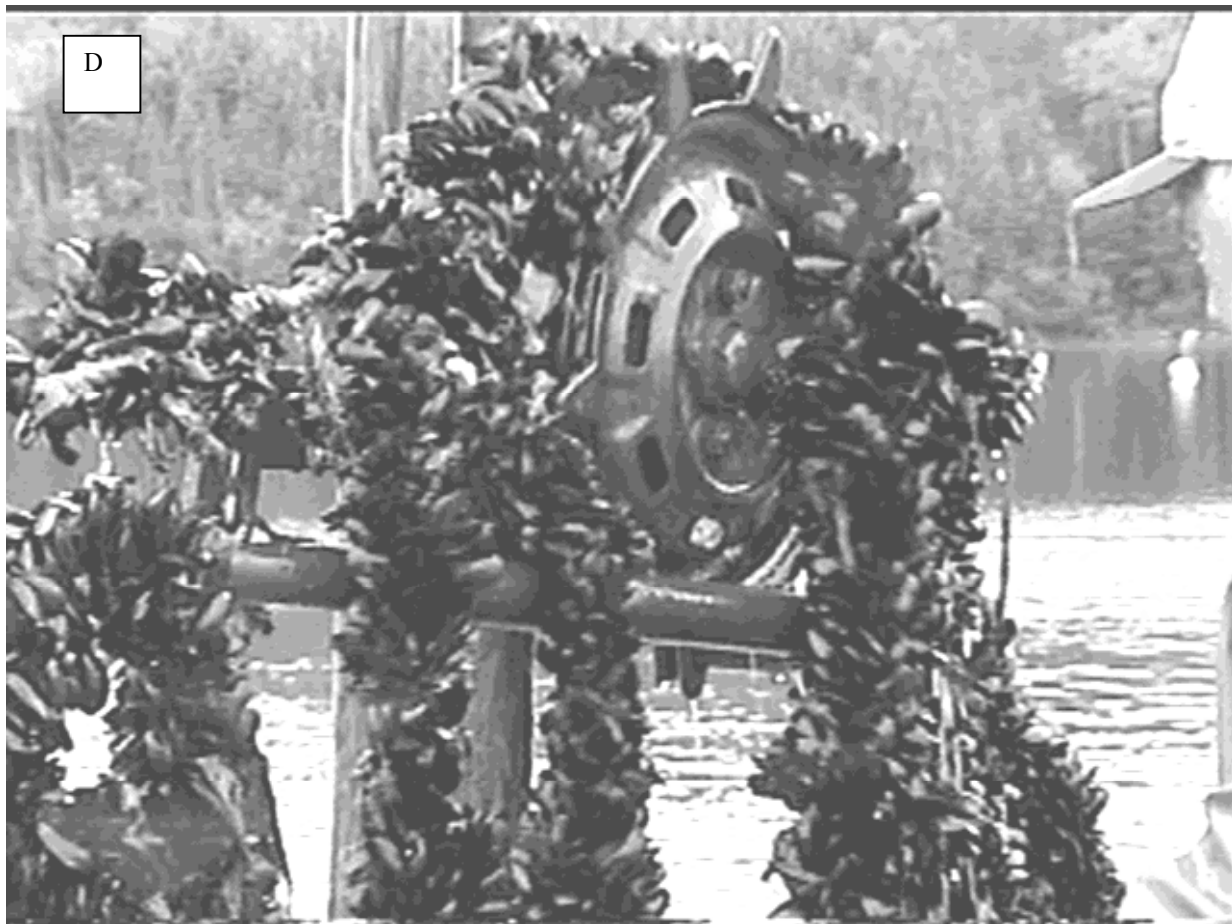


Figure 7.11: A homemade starwheel and deflector bar used to harvest collectors. Star wheel was made from an old tire rim.

air. Typically a post is placed in the center of the barge at both the front and rear of the barge to allow the mainline to pass completely over the barge (Figure 7.13). The hauler may be placed at either the front or the rear of the barge. This system allows the grower to haul seed or market sized product directly over the barge where it can be stripped into tote pans. The total area of the barge may be utilized with this system assuming a star wheel is used. If a simple hauler wheel is used the work area may be limited to just the front area of the barge. A disadvantage is that the mainline is at chest height or higher across the middle of the barge. This may restrict movement and equipment placement on the barge.

Another alternative is to mount the hauler wheels along the side of the barge. This also allows a large area of the barge to be utilized (Figure 7.14). The grower though must physically lift the socks or collectors in over the side of the barge to strip them. Consequently workers can only

work on one side of the line compared to either side if system were through the center of the barge.

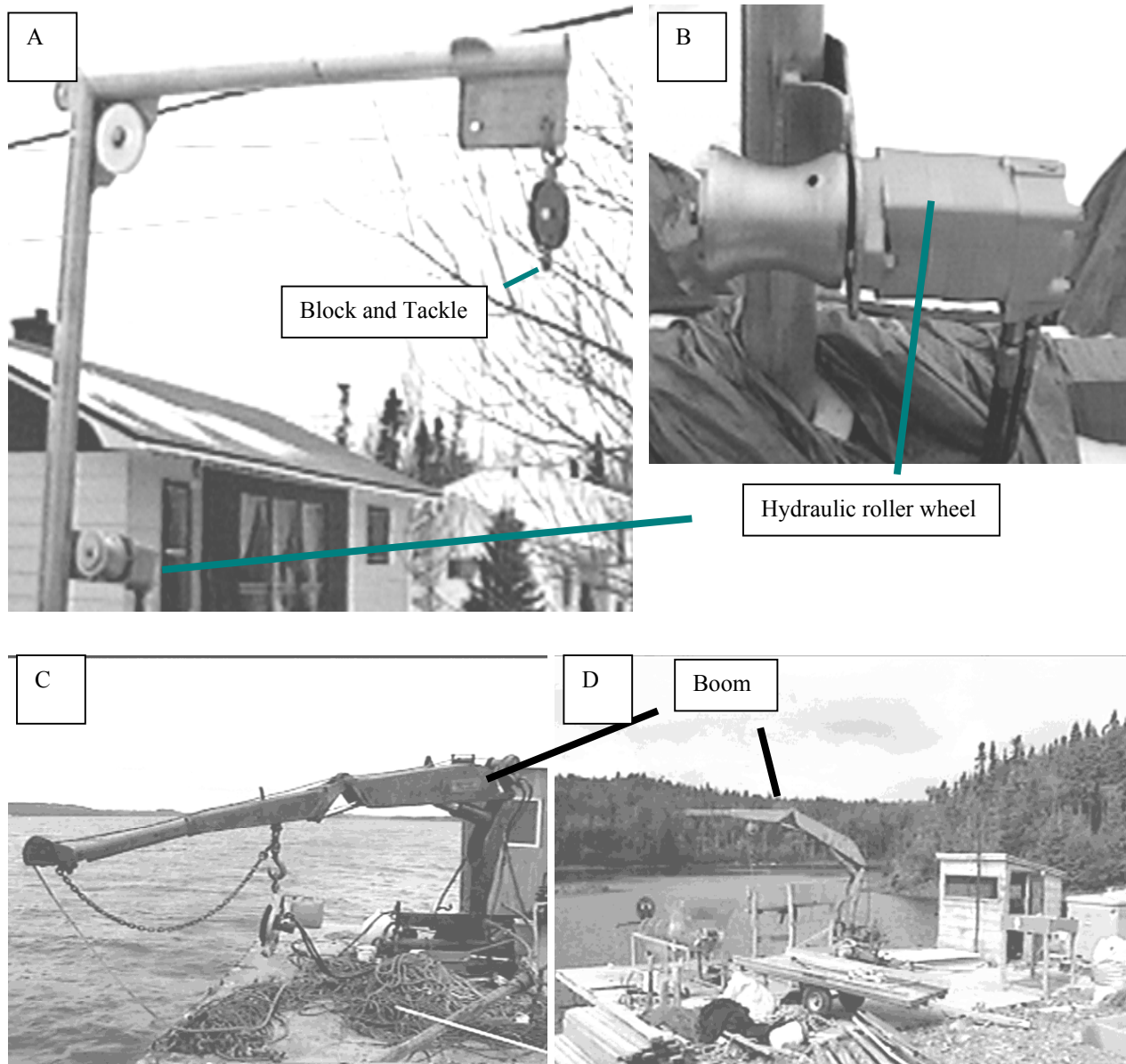


Figure 7.12: Crane Systems. (A) Crane with roller wheel, (B) hydraulic roller wheel, (C) boom with pot hauler, (D) boom mounted on a barge.

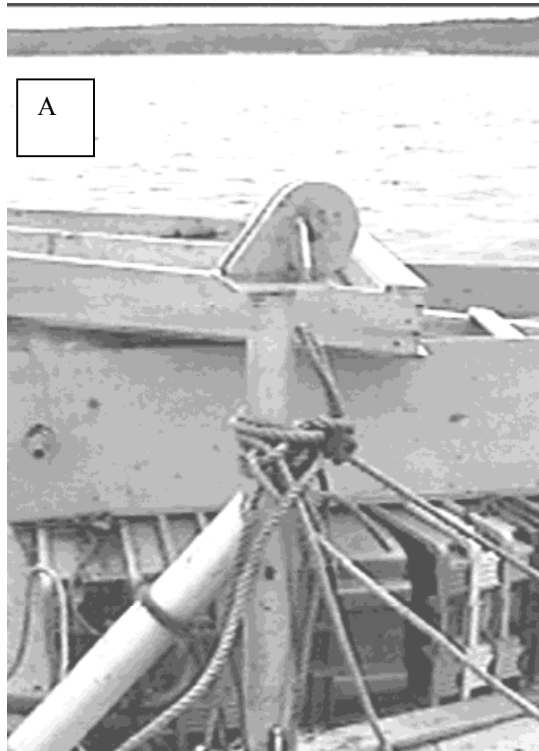


Figure 7.13: Hauler systems mounted in the center of the barge. (A) Simple aluminum post, (B) hauler mounted on the front restricting work area to the front of the barge, (C) hauler mounted at the back with star wheel at the front, work area is extended to the total area of the barge.

One system lifted the mainline only at the front of the barge and passed the mainline underneath the barge (Figure 7.15). This system prevents the barge platform from being cluttered with lines allowing deck space for stacking product and equipment but reduces the work area primarily to the front of the barge.

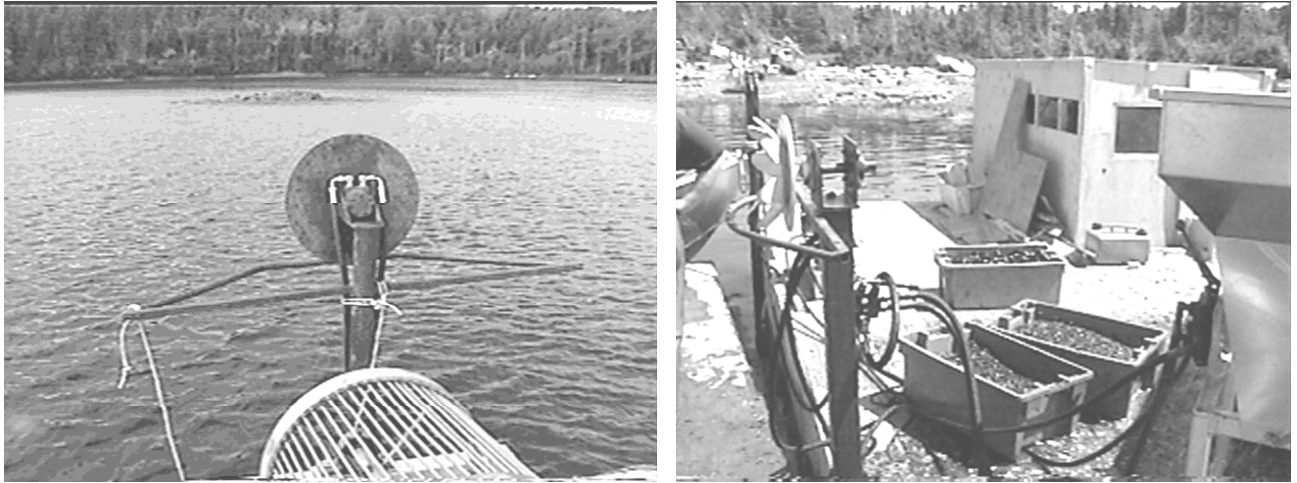


Figure 7.14: Barges with side mounted hauler wheels.

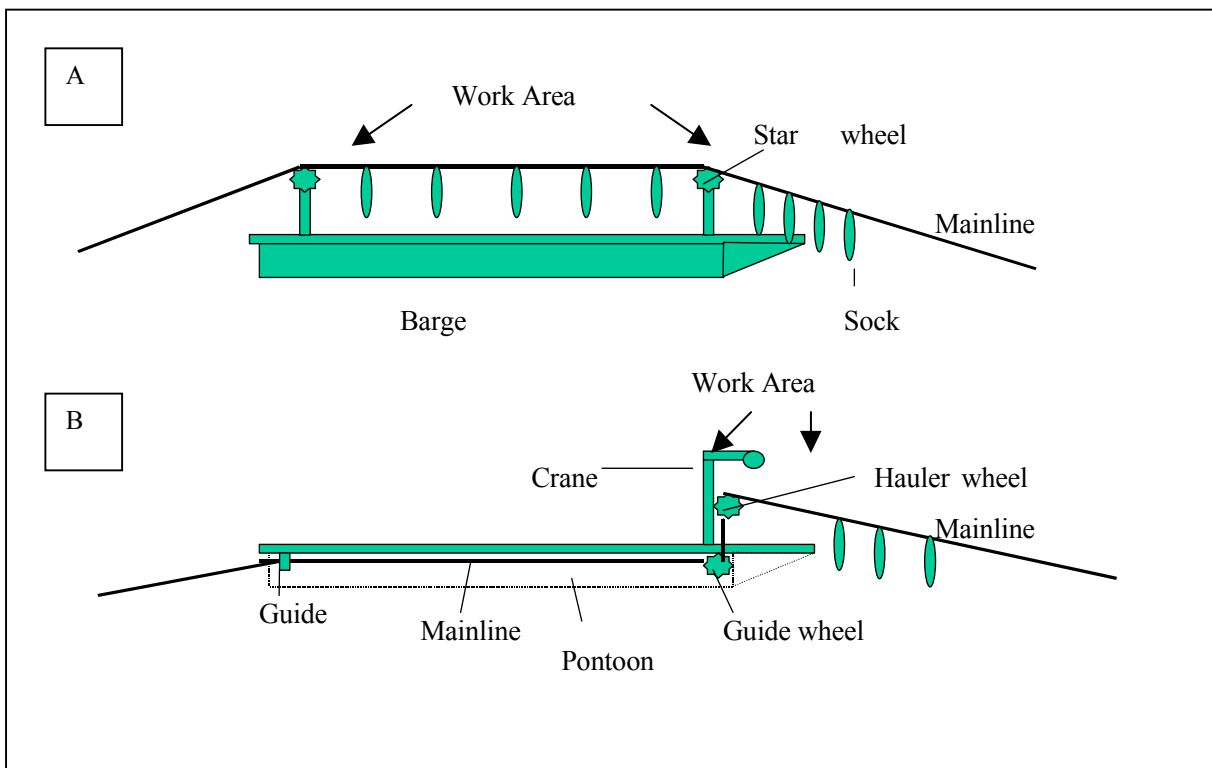


Figure 7.15: A comparison of the (A) above and (B) below barge mainline hauler designs.

Many growers do not have a work barge but simply use a variety of boats which have been modified with hauler systems for use in the mussel industry (Figure 7.16). In most cases these boats simply do not have the room or load carrying capacity to be truly effective, especially for large farms. They may be useful for line maintenance or inspection however. Large longliner type vessels are suitable but are often more costly than a barge.

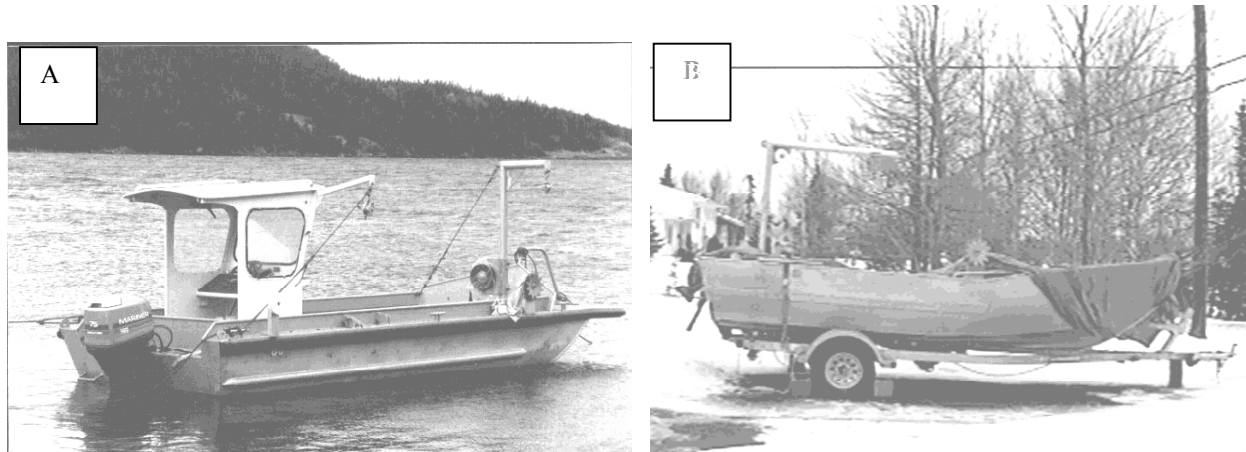


Figure 7.16: Aluminum work boats. (A) Modified boarding vessel with simple crane and side mounted star wheel, (B) 6.5 m workboat with crane and side mounted star wheel.

Socking Tables

The typical Newfoundland socking table was composed of a plywood box that was mounted on a (5 cm X 10 cm (2 X 4) frame such that the box tilted at an angle. At the lowest end of the box a PVC pipe was inserted as a sock tube. Usually these tubes were mounted on a separate board so that different sized tubes could be easily interchanged. Typical tube sizes include (2.5, 3.75, 5, 6.75 and 7.5 cm (1", 1.5", 2", 2.5" and 3") diameter tubes which will cover the range of sock diameters which may be needed depending on sock time. Most socking tables had tubes that jutted out from the end of the box (Figure 7.17). The tubes usually had a gate across the hole to stop the flow of water and mussels thus giving control to the socking process.

Another table design placed the sock tube on the bottom of the table (Figure 7.18). This would take greater advantage of gravity flow and potentially reduce clogging. If the tube did get clogged a simple up and down motion with a pipe could free the clog. The standard end tube requires a side to side motion with the arm on an angle under water inside the sock table to free a clog.

Many tables used two tubes with two people socking and two people feeding the tubes. By cutting a notch in the side or front of the table, a simple modification, the two sock tubes could

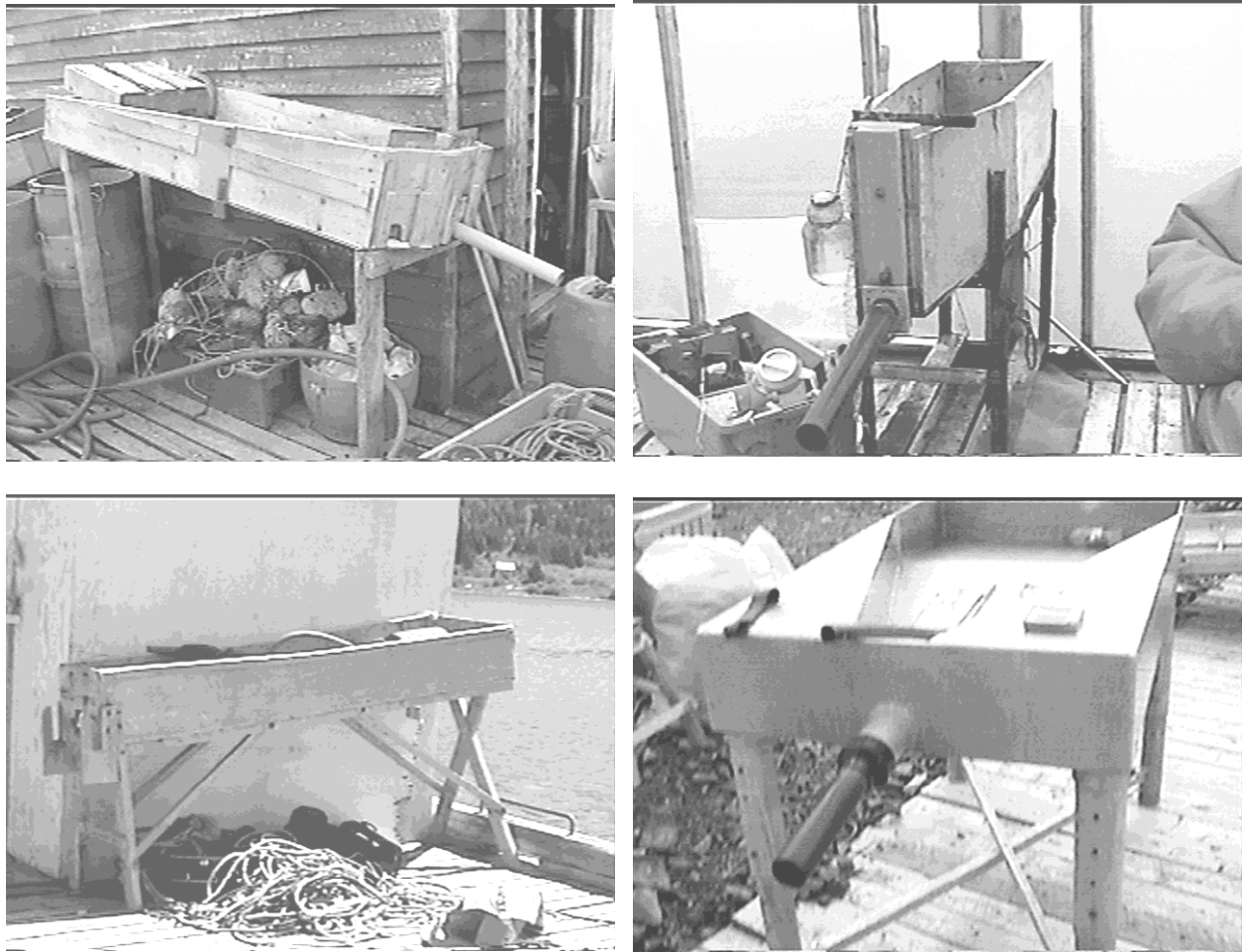


Figure 7.17: Common one tube socking tables with end tubes.

be supplied by just one feeder. This would lower the socking labour requirements and cost by up to 25%.

The table should also be elevated to try and increase gravity flow. This can be accomplished by increasing the height of the table frame and increasing the slope of the box. This usually requires a box for the feeder to stand on. With this extra height the end of the sock tube can be located at the most comfortable height for the socker. If the socker does not have to bend over to sock, socking performance should improve. The height of the sides of the table may also be increased so that more water can be held back, increasing pressure and socking speed.

Commercially manufactured tables can also be purchased (Figure 7.19). These are made of aluminum and are considerably more expensive (\$2,000-\$3,000) than the home made variety. Manufactured tables are very large and are usually used on land (depends on barge size). This

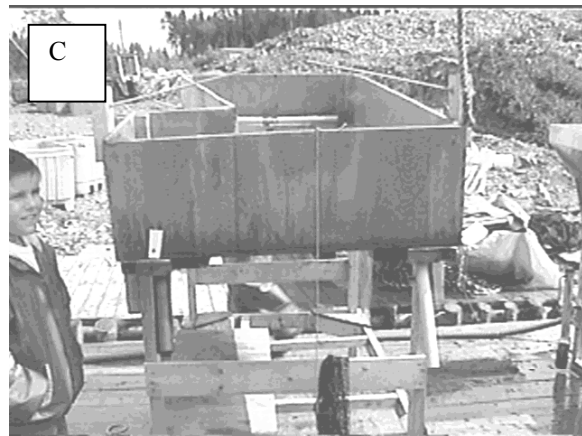
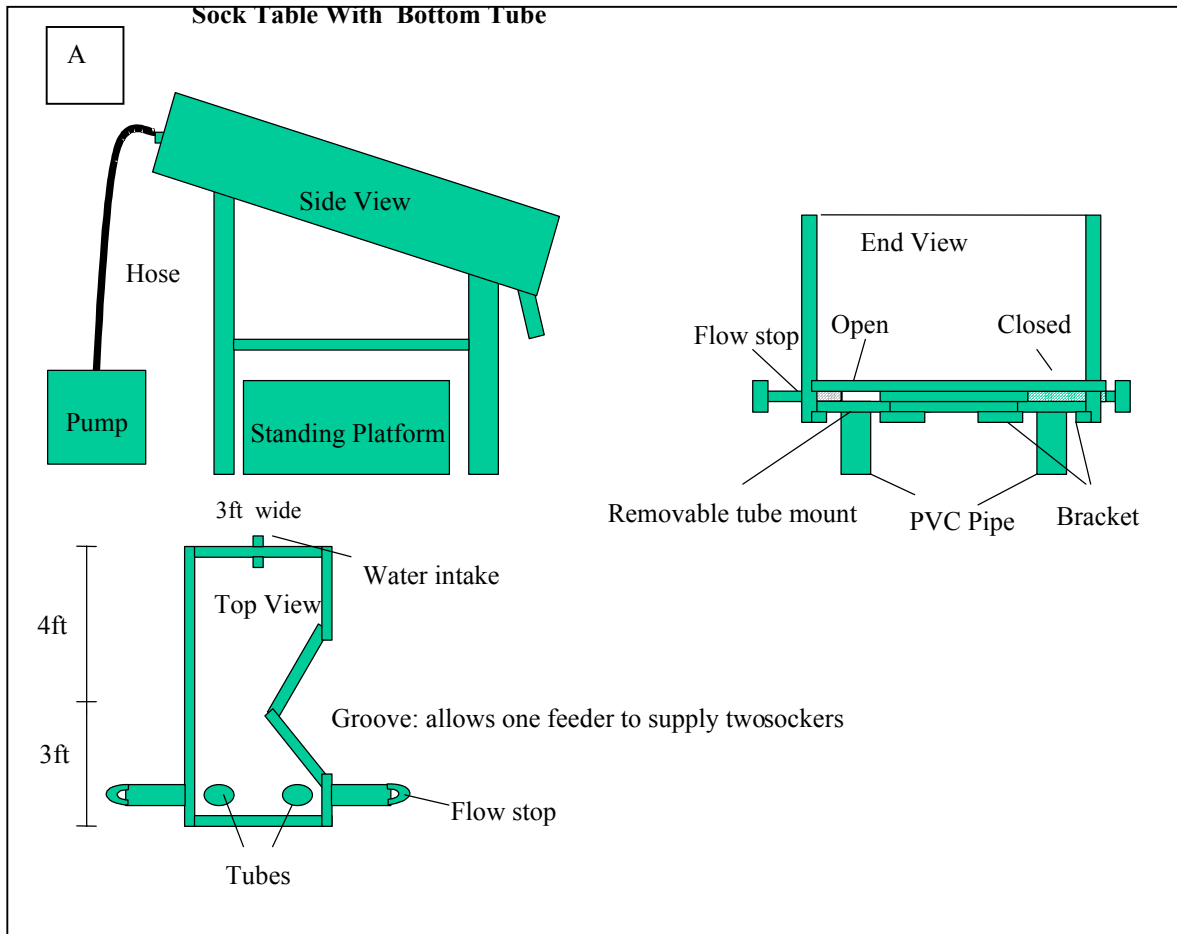


Figure 7.18: Wooden socking tables with bottom tubes that have been modified with a groove that allows one feeder to supply two sockers. (A) Diagrammatic representation, (B) front groove, and (C) side groove.



Figure 7.19: Commercially manufactured aluminum socking table.

will place a restriction on their use as many growers prefer to sock on the barge while connected to the mainline for direct deployment of socks as they are filled. The large tables will require land socking followed by the transportation of socks to mainlines for deployment. The extra sock handling may result in seed loss during deployment with some socking materials.

Water Pump

The gas powered water pump was the most popular method to supply water to socking tables in the survey. On grower used an electric water pump and socked on land and another dry socked. The gas-powered pump seemed to be more versatile and powerful than other options. The growers could take the pump on the barge and sock on site with the gas pump. Honda was the most common brand (Figure 7.20) name and purchase price was approximately \$600

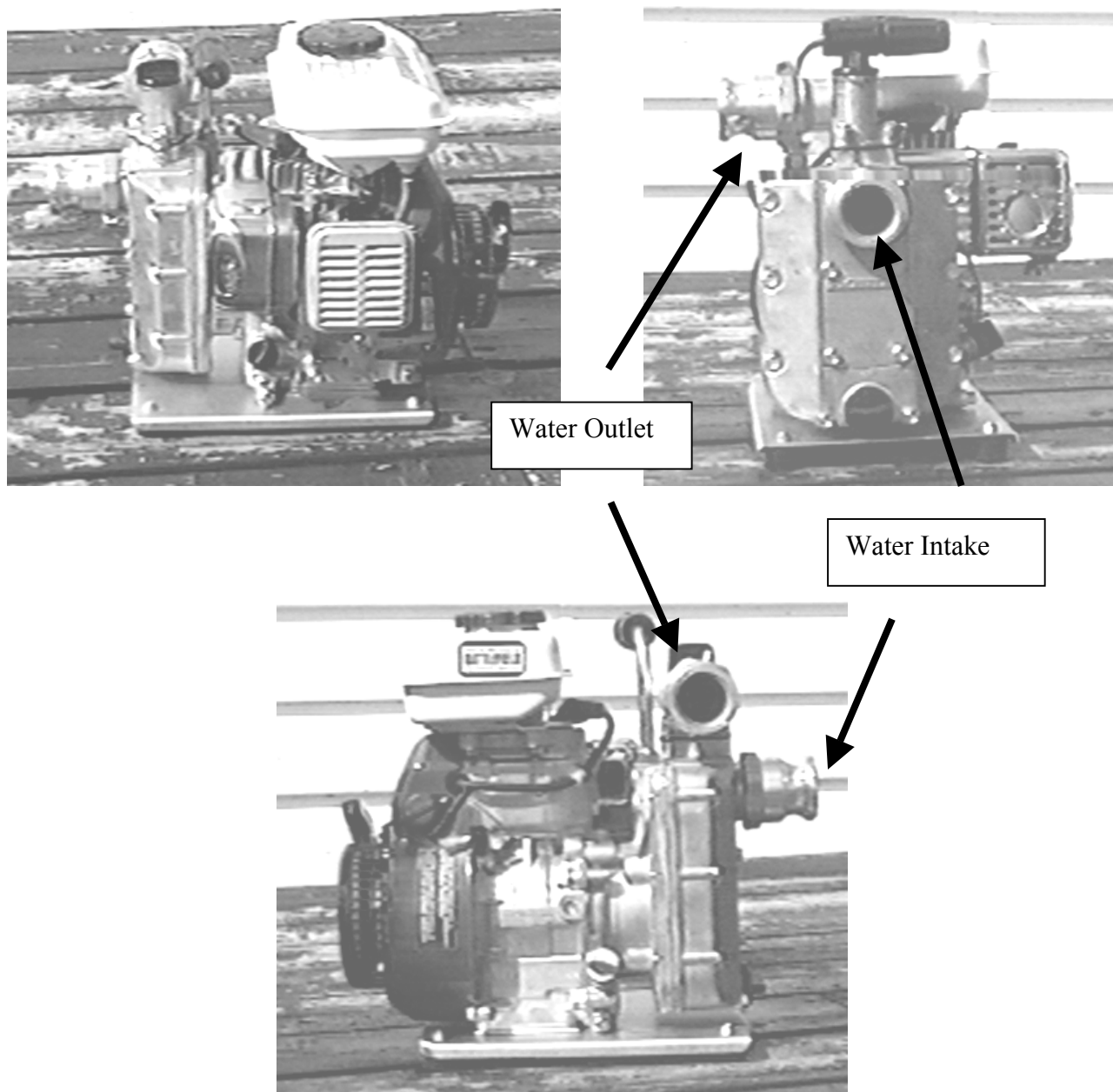


Figure 7.20: Gas powered Honda water pump.

Seed Graders

Mussel seed graders are a relatively new technology for the Newfoundland mussel industry. The number of graders in use in Newfoundland increased dramatically in 1997. The most common type was a PEI model (Figure 7.21) which is a 3.3 m long, 180 kg aluminum and stainless steel device, which is designed to separate mussel seed into four sizes; 5 mm, 9 mm, 13 mm and greater than 13 mm shell height (3/16", 3/8", 1/2" and larger than 1/2"). It contains an aluminum hopper and drum, stainless steel shaft and declumper auger, stainless steel seed sizing bars, and hydraulic motor. A hydraulic power pack is required to power the grader. The total purchase price for the grader is approximately \$5500-\$6000 delivered.

Operation of the grader is relatively simple (Figure 7.22). Mussels are dumped into the hopper and the byssal threads are torn apart by the rotating declumper bars. The separated mussels then slide over the sizing bars. The smallest mussels fall through the first set of bars and are collected in a tote pan that is placed under the grader. The second and third size groups are collected in the same manner. The seed greater than 1/2" will fall out of the end of the grader. These different size seed can then be placed into the appropriate size socking.

The declumped seed should also speed up the socking process. Individual mussels pass very quickly through socking tubes and rarely get clogged.

Other grader models are also in use in Newfoundland. A new model recently developed by a Newfoundland company, Fab Tech Industries, is very similar to the PEI model described previously (Figure 7.23). This model has the same size grades and is approximately the same size. It does have some improvements such as a larger grading drum and tighter joints. This increases the grading speed while at the same time reduces breakage. It is slightly more expensive, starting at approximately \$6,000.

One other seed grader type was utilized in Newfoundland. This was a large grader that had only three grades and had the grading bars arranged in a circular pattern around the drum rather than straight and perpendicular to the drum as in the other models. This grader is likely too large to use on a barge (depending on barge size) and must remain on land. This makes it unsuitable for many Newfoundland sites that are remote. The grader was also considerably more expensive than the previously discussed models.

When purchasing or using a seed grader certain general practices are recommended. First seed graders should be set up at a low angle to achieve good seed separation. Secondly, graders should have high volumes of water going through them. This helps declump the mussels and reduces shell damage. Grader speed should be kept low enough to achieve a high quality grade, otherwise the grower will just declump the mussels and lose the growth benefits from size grading. If purchasing a grader, a better and faster grade can be achieved using a longer and wider grader barrel.

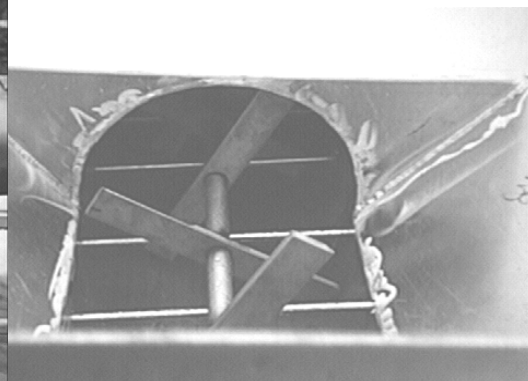
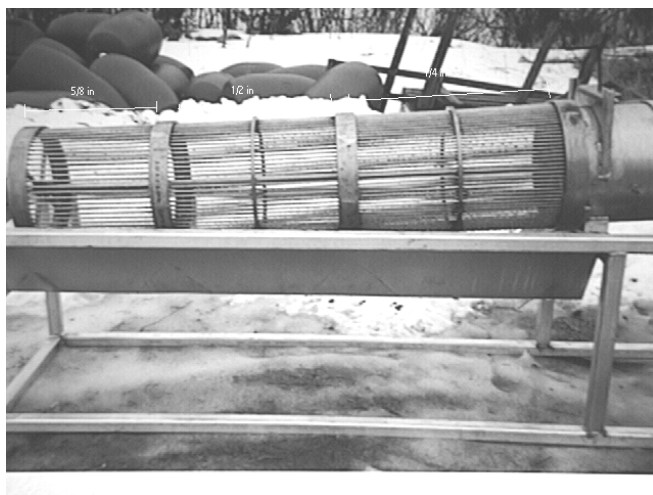
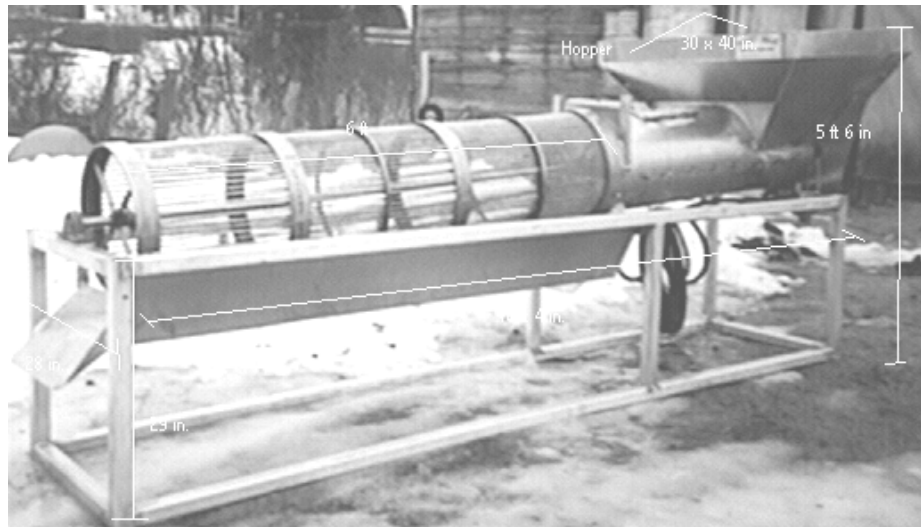


Figure 7.21: PEI model stainless steel and aluminum declumper grader purchased by the Marine Institute for the ACERA Mussel Aquaculture Project.

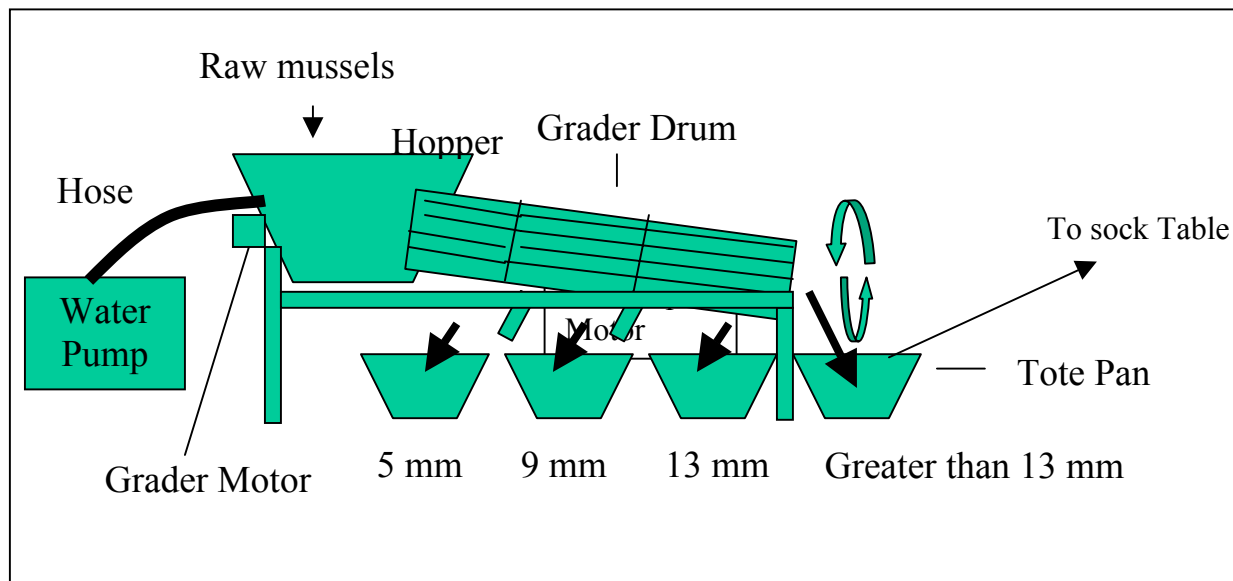


Figure 7.22: Diagrammatic view of declumper-grader operation. Sizes indicated are mussel shell height.

Sock Reel

Most of the growers surveyed stated that they measured socking material by wrapping it around two chairs or two poles that were the appropriate distance apart. This is a time consuming process which may require two people, one to hold the sock roll and one to measure it out. A sock reel can be constructed easily and inexpensively to greatly speed up the process (Figure 7.24). The sock roll is hooked on a roller and the socks simply spun on a wheel. The length of the arms of the wheel determines the length of the sock. A single person can reel off a

quantity of socking material and then cut them all off at the same place creating a large number of socks all the same length. A grower that used this system stated he could cut up a roll of socking in only five minutes. The reels can also be used to cut float ropes of the same length. When cutting ropes a heated blade was used to cut and seal the ropes at the same time (must be conducted in a ventilated area to avoid toxic fumes).

Automatic Socking Equipment

Automatic socking machines have been used around the world for many years but only two Newfoundland growers utilize this technology to date. All automatic socking machines use a biodegradable mesh that holds mussels around a rope core. Over a brief time the mussels attach to the rope core and the mesh dissolves leaving only mussels and rope. The system uses a

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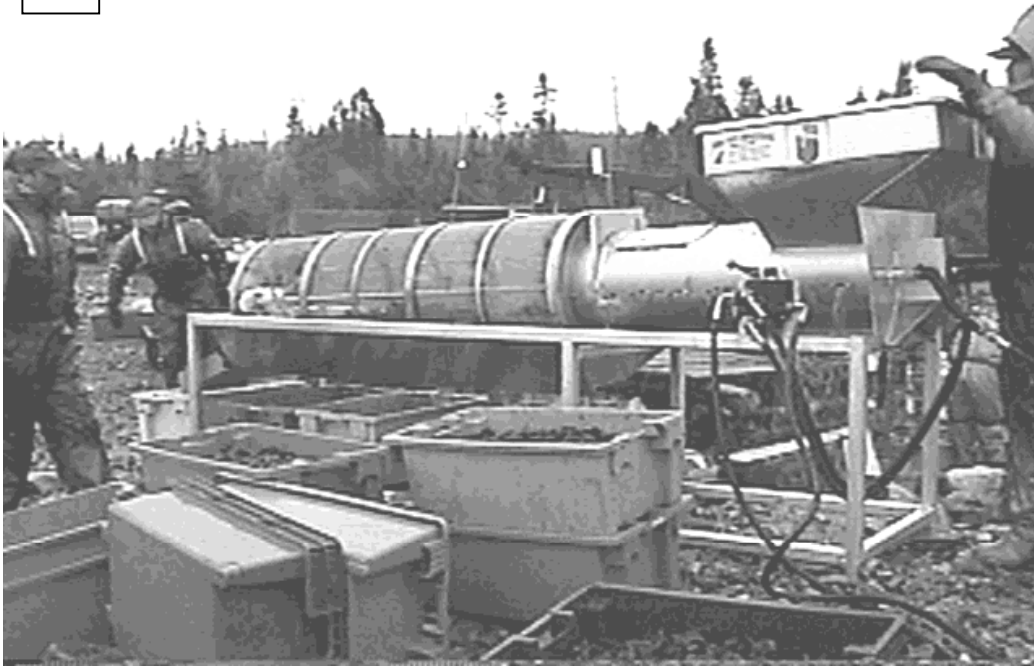


Figure 7.23: Graders; (A) Fab Tech Industries built grader with larger grading drum, and (B) large grader with circular grading bars.

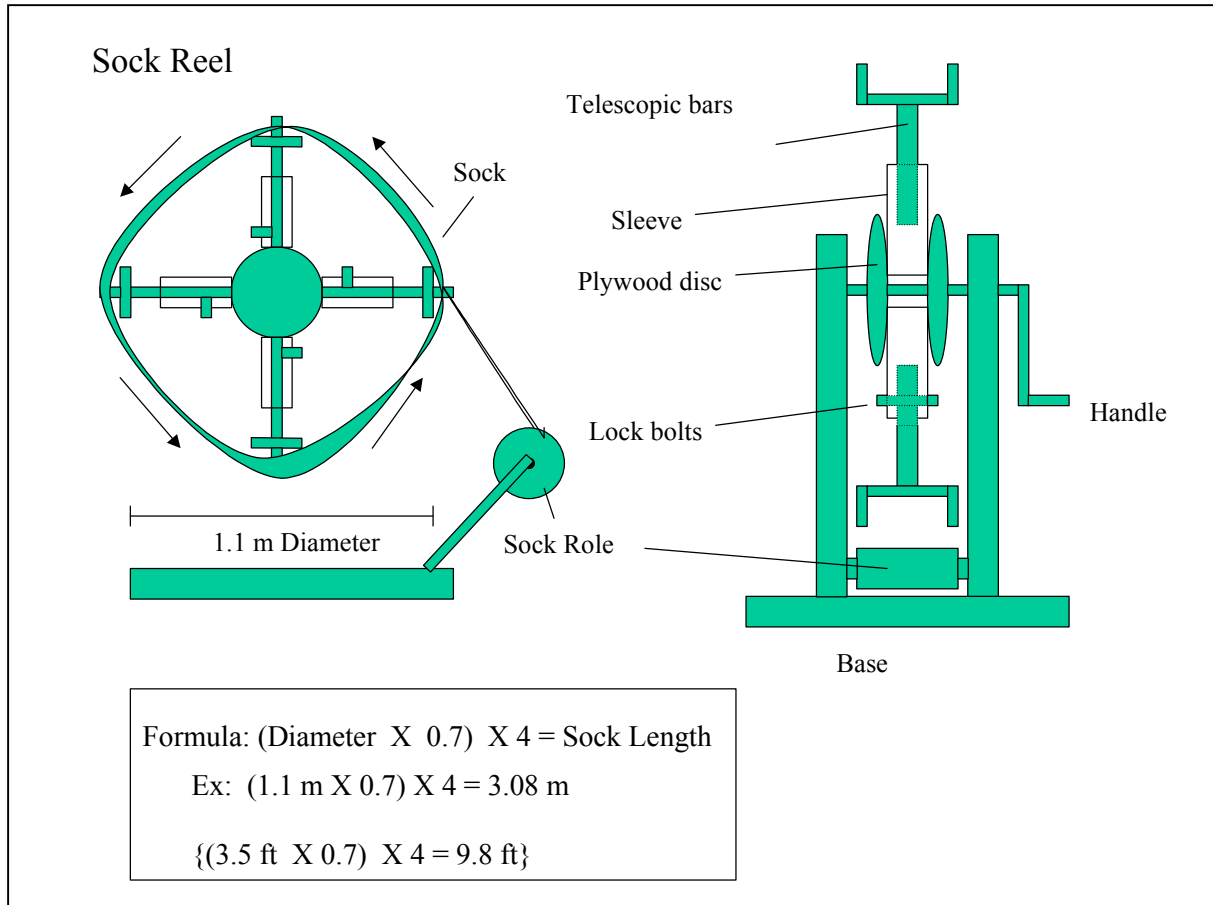


Figure 7.24: A simple sock reel with sock length formula. Based on pictures from Scarratt (1993).

continuous socking principle. This means a long section of rope, hundreds of meters in length is socked through the machine and then tied to the mainline in loops.

There are two basic types of these continuous machines, the Spanish Wrap and the New Zealand style socker. The Spanish Wrap simply wraps a biodegradable mesh around a rope with pegs and mussels (Figure 7.25). This wrapping procedure may allow gaps where mussel seed may fall out if the operator is careless or inexperienced. The rope core usually contains pegs that help prevent the mussels from sliding off.

The New Zealand style socking machine uses a biodegradable mesh tube that is hauled over the rope core and mussels. This system eliminates the gap problem of the Spanish wrap machine.

The core is made of fuzzy rope and does not use the peg technique. This machine has a built in computer, which will tell the grower when a specific length of rope has been soaked. This allows the grower to control the length of the loops.

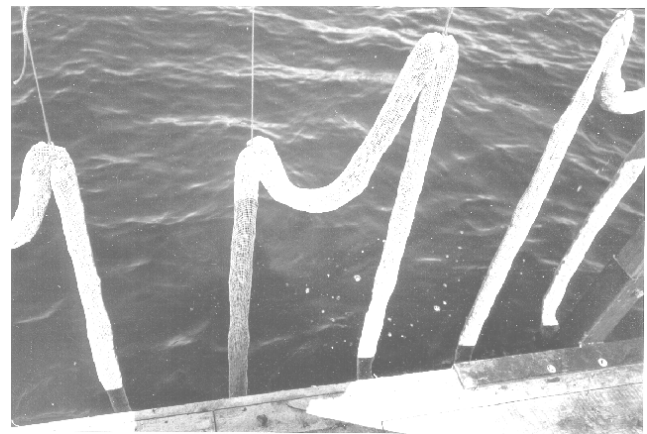
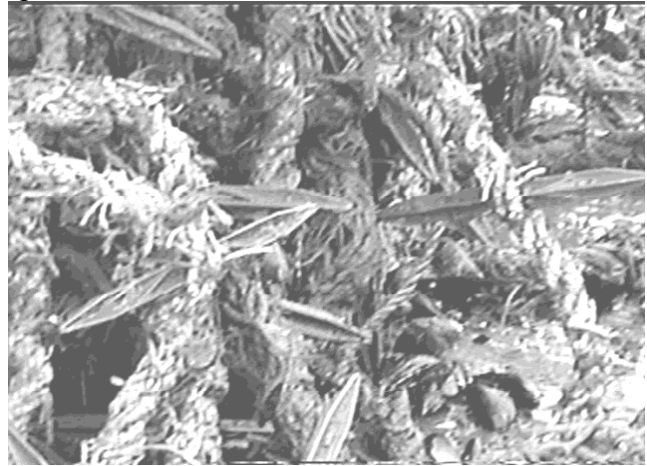


Figure 7.25: Socking Machines. (A) Spanish Style socker, (B) Rope core with pegs, (C) New Zealand style continuous socking and (D) New Zealand style continuous socking machine.

Socking speeds of these systems are suggested to be much faster than standard socking table type practices. One Newfoundland grower stated that he could sock 1500 m (5000 ft) of rope in 2 hours, the equivalent of 250 3m socks per hour. A technical mission to the Maritimes to examine this technology indicated socking rates of 17,000 m per 8 hour day with three workers. This is the equivalent of 5,000 standard socks per day (House 2000). Supplying seed to keep the systems running at capacity will likely be a problem.

