ARCHIPELICAN
A Modern Fishing Boat for the Modern Angler

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Abstract

Consisting of more than 24,000 islands and inlets, the Stockholm Archipelago stretches nearly 60 kilometers. The rich water of the Baltic is home to an array of fish that are highly sought after within the sport fishing community. The brackish water makes fishing in the archipelago unique. It is home to freshwater fish such as perch and pike, as well as marine species like herring and cod. It is free to fish in the archipelago and permits are not necessary when using handheld rods. These features make the Stockholm Archipelago a prime destination for enthusiastic anglers.

In order to find the best catch, Swedish anglers need the top-of-the-line gear. This includes their boat. Speed and agility are matched with tranquility and comfort when anglers climb aboard the Archipelican. With its carbon fiber hull and it’s 5.2 meters in length, this boat is easy to launch and transport anywhere around the archipelago. The extension and retraction of the boat’s hydrofoil allows anglers to reach the best shallow water fishing spots faster and more comfortably. Anglers feel safe and close to nature while fishing. The boat’s unique design lets the angler stand close to the water surface while still remaining stable. An electric engine powers the boat silently throughout the archipelago and the pollution reduction keeps Stockholm’s waters pristine for future anglers to enjoy.
Mission Statement

Explore, design, and evaluate a new innovative concept for a sports fishing boat for the Stockholm Archipelago which has a significantly improved environmental profile compared to existing boats. The boat should also include improved fishing functions, features, and ergonomics.

Stakeholder Analysis

Recommendations and desires from the fishing community were recorded in order to design a boat sufficient for operation in Stockholm's archipelago. The information was gathered from studying articles in fishing magazines, reading blogs from Swedish anglers, interviewing anglers from Stockholm, as well as analysing questionnaires answered by anglers. Stakeholder focus was aimed towards avid anglers within the Stockholm region. These anglers tend to be competitive, tech-savvy, dedicated, and interested in new fishing trends. At the same time, these anglers like the serenity of nature and the chance to relax. There is an understanding of sustainability, and they realize the importance of keeping the archipelago clean.

Requirements

Key stakeholder expectations for the boat consists of:

- Operated by one person
- Capacity of 3 anglers (including the operator)
- Good fishing functionality, features, and ergonomics
- Transportable on Swedish roads by someone with a Swedish B-class driver's license
- Possible to launch from and recover to road transport by 2 people
- Driven by renewable energy
- Appropriate operating speed and range
- Innovative

Concept of Operations

The Archipelican has been designed for use within the Stockholm Archipelago. The archipelago consists of more than 24,000 inlets and islands that stretch 60 km. The
archipelago follows the coastlines of Södermanland and Uppland. It begins with the island of Öja in the south and reaches all the way to Väddö in the north.

![Map showing the distance of the Stockholm archipelago](image)

*Figure 2: A map taken from Google Maps showing the distance of the Stockholm archipelago*

As seen in the map above, fishing hotspots can be several kilometers apart. In order to spend more time fishing, anglers need a boat that can get them to their favorite spots as fast as possible. The archipelago is a challenge because it varies greatly and quickly in depth. With desired fishing spots in shallow waters, the Archipelican is designed to clear areas where many other fishing vessels may run aground. The hull of the Archipelican is strong enough to withstand bumps and scrapes from other boats or unforeseen objects under the surface.

These natural settings of the archipelago allow the Archipelican to operate at two different modes. There is a high speed mode, and a tranquil mode. A built in hydrofoil is extended during the high-speed mode to create a flying sensation. Here anglers can travel throughout the archipelago smoothly by “flying” above the water surface. The boat has a higher efficiency because there is little resistance when flying compared to having the hull in the water. In the tranquil mode, the foil is retracted and the shallow body of the hull can easily maneuver within shallow areas.
Anglers use the waters of the Stockholm Archipelago all year round. The natural position of the archipelago leaves it susceptible to all types of seasons the Baltic can produce. From snowy winters to scorching summers, the Archipelican can accommodate any conditions. The peak season for fishing in the archipelago is in the fall. Crisp mornings and evenings of the later months are primetime for anglers in Stockholm. The Archipelican contains features throughout the boat to keep anglers warm and content while fighting the elements.

To reduce emissions that are harmful to the fish and natural beauty of the archipelago, the Archipelican operates using a clean renewable energy and an electric motor. Using a clean propulsion system reduces carbon emissions and oil leaks into the area. Anglers can be comfortable knowing that they leave the archipelago in a clean and sustainable condition that allows future generations to enjoy.

**Design Process**

**Data Collection and Interviews**

The early design process consisted of four stages that helped the group decide on a concept that would fulfill the stakeholder requirements. These four stages looked as followed:

1. Brainstorming
2. Questions
   
   *Example questions:*
   
   - What type of fish do they fish in the archipelago?
   - What seasons do they fish?
   - How long are their fishing trips?
   - How many times do they stop to fish?
   - Do they fish privately or with a guide?
4. How do they fish?
What equipment do they take with them when fishing?
What is the weight of their equipment?
Are there any desired colors and/or materials commonly associated with fishing?

3. Data Collection and Interviews

4. Conclusion

This early design process was iterative and not necessarily in a 1-4 order. The iterative design process was done consulting the whole group, studying fishing publications, as well as was based on receiving feedback from an array of anglers.

After extensive research, a focus group was decided and a boat concept began to take shape. There was a sense among the designers that there was room for improvement amongst the avid anglers that are passionate about fishing. Through interviews and research, there was a noticeable void to be filled where there was nothing suitable that could combine comfort, speed, as well as a feeling of being close to nature.

Interviews were held with professionals as well as amateur anglers from around Stockholm. Some of the key features, according to these anglers, that concern fishing within the Stockholm archipelago are listed below:

- In the Stockholm archipelago the most popular fish to hunt are pike, seabass, and trout. These fish are considered year-round, and can be caught in any season.
- Using a boat for fishing is done during all seasons and in any weather condition (except for when there is ice). A classic quote that was recorded was: “Every season has its charm.”
- When it comes to boats and climate, the current sportfishing boats on the market are not compatible for the harsh weather climate in Sweden. There is typically limited wind and/or rain protection. In the few cases there is a rain protection, there is often a gap between the front window and ceiling. This leaves little protection from water while driving.
- A fishing trip is often an entire day. Anglers will fish until it gets too dark to continue. It is not common to sleep on the boat. It is more common to bring a tent for camping.
- When sportfishing, anglers may change their fishing spots up to 30 times/day and drive a total of 70 nautical miles. The distance between fishing spots is often large.
- When finding a good spot, anglers use a front engine to slowly change position in order to adjust for wind and currents. The engines are usually controlled by a remote control or a foot pedal so that anglers can fish and control the boat simultaneously.
- The sound of the engine was brought up several times. The sound from petroleum engines disturb the wildlife and scare away fish.
- The majority fish with family and/or friends. Fishing is considered a social sport. Anglers with children bring them along to fish as well.
- Fishing for certain species may depend on the season and location. Fishing is done in bays with shallow water as well as in areas with deep water. It is imperative for sportfishing that a boat that can go anywhere.
- When fishing, anglers stand close to the edge. This means the stability of the boat is very important. Another very important aspect is the height/freeboard of the boat. Reaching the water shouldn't be too difficult.
- Equipment and storage is important for sportfishing. Anglers bring several rods for different fishing conditions as well as an array of baits. The gear can vary between 5-10kg per person. The rods are often stored in vertical tubes or in stands. The baits are most popularly stored in Plano 37-00 boxes (a box made for fishing baits).
- The preferred materials and colors has a lot to do with a simplicity and stiffness of the boat. For example: light colors show the dirt on the boat, or that plastic may crack when it's frosty. A material that was often mentioned was aluminium. An aluminium hull was considered amongst anglers to be sturdy and easy to maintain. A rubber railing was another option to protect the boat's edges.

Three key characteristics of the boat were defined after analyzing the results from the interviews:

**Protection from weather**- a boat that is adapted for the swedish climate.

**Made for families/friends**- space to fish on different locations of the boat.

**Transportation**- different boat modes to simplify transportation.

**Scenario**

![Figure 4: An example of a typical fishing scenario for the Archipeligan](image)
Inspiration

The three inspirational core values that were taken from the interviews with the anglers were:

*Thrill, Wildlife,* and *Calm*

These values were guidelines that inspired the shape of the boat. Nature and sea wildlife were the focus for the continued ship design. Organic shapes were created to make the fishers feel closer to nature.

A mood board was created to portray the sense of inspiration the design team wanted to use:

![Moodboard](image)

*Figure 5: Moodboard*

Form and function

After further research, the hull needed to be designed. There were two main alternatives when deciding on a hull concept, the foil and a catamaran. The criteria for the project was weighted from 1-5 (1 is least, 5 is most). Next, the expectations for each hull fulfilling the criteria was ranked (1 is lowest, 5 is highest). The table below shows the results for the grading:
Table 1: The grading of the two hulls

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Foil</th>
<th>Catamaran</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low boat</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Protection from weather</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Light boat</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stability</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Storage</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pace</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Renewal energy</td>
<td>5</td>
<td>4.5</td>
</tr>
<tr>
<td>Transportable</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Form/colour</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Indifferent - Result: Foil:72 Catamaran:67

The foil alternative was expected to be better at fulfilling the main criterias.

When designing the foil, it is important to have a steady construction. It has to be able to withstand the boat and crew when foiling, yet the construction may not take too much space when the boat is not flying. Alterations to the hull measurements had to be made in order to fit the foils inside without having the legs sticking out of the deck.

Focus was aimed at getting the shape of the foil and the hull to work together. The challenge was to make the angle for the foil right without making the entire hull to narrow and unstable. The foil must also fit the general shape of the pulpit. The hull, foil and pulpit were ultimately combined together using organic shapes with similar trajectory curves.
The aim was to portray a feeling for the hull that makes it feel light when foiling yet robust in water. The boat's wave-like shape cuts through the profile of the hull which also acts as a protective barrier that blocks any water spraying from the foils when moving at higher speeds.

**Storage and Shelter**

Aside from interviews with the avid anglers, a better understanding of what is on the market for functions on fishing boats was necessary. Comparisons and conclusions could be made after research was done on five popular models. The most important functions and solutions were recorded.

- Lockable storage
- Space for camping gear and life vests
- Storage for 15 fishing rods
- Fire extinguisher
- Space for at least 10 Plano 37-00
- Sea water hose
- Foldable seat backs (usable to stand on)
- Anchor
- Fridge
- Foot pedal for front engine steering
- Remote control for shelter
- LED-lighting in hatches, pulpit, and around the railing
- Heatable handles on pulpit

A life-size 2D model was done to get a sense for the boat’s layout. Important factors such as the possibility of easily following a catch around the boat could be tested. Geometric representations were made in CAD to make room for the necessary gear. The representations could then be placed around the boat in the early 3D-sketches.
To make the boat fit better with the Swedish climate, a shelter function was added to the boat. The shelter was made retractable to avoid interference when fishing.

**Boat Specifics**

**General Dimensions**

The Archipelican is designed to be easily transported by trailer around the archipelago and can be launched by two people. The boat is also large enough for three anglers to fish comfortably and safely. The main dimensions for the boat can be seen in the table below. The hydrostatic values are given while fishing.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length over all</td>
<td>m</td>
<td>5.20</td>
</tr>
<tr>
<td>Width</td>
<td>m</td>
<td>2.40</td>
</tr>
<tr>
<td>Height</td>
<td>m</td>
<td>0.82</td>
</tr>
<tr>
<td>Waterline length</td>
<td>m</td>
<td>4.97</td>
</tr>
<tr>
<td>Waterline width</td>
<td>m</td>
<td>1.41</td>
</tr>
<tr>
<td>Draft</td>
<td>m</td>
<td>0.32</td>
</tr>
<tr>
<td>Freeboard</td>
<td>m</td>
<td>0.5</td>
</tr>
<tr>
<td>Lightweight</td>
<td>kg</td>
<td>530</td>
</tr>
</tbody>
</table>

*Table 2: General dimensions*
Material

The hull of the Archipelican is for the most part constructed using a sandwich-structured composite consisting of carbon fiber and cork. The decision to use the sandwich structure was intentional. The use of a sandwich-structure composite reduces the total weight of the boat while remaining stiff enough to withstand the elements that the Swedish archipelago is known for. There is an added bonus where the sandwich design has shown to have better insulation capabilities, this should help keep the anglers warm when inside the deck pulpit. Other materials such as steel, fiberglass, and aluminum were considered, but were ultimately passed upon due to their lack of stiffness compared to density. There are parts of the hull that use an aluminum plating in specific areas along the structure as an extra protection against grounding or excessive contact from harder elements such as rocks or other boats. These reinforced areas can be found along the keel and around the bow of the hull.

Stability

There is a self filling ballast tank along the bottom of the hull that fills when the boat is at rest. This is done for the comfort of the anglers. When the boat is at rest, the holes on the bottom of the hull let in water. Once the boat begins to accelerate the holes in the front lift above the waterline, and the ballast water exits the wide hole in the aft of the hull.

Figure 10: Rear ballast tank exits
By filling a ballast tank, the vertical center of gravity for the boat is lowered. The draft and waterline are increased, resulting in a decrease of the boat's heeling accelerations. If an average angler weighs 85 kg, the heel angles when fishing from the edge of the boat look as followed when the ballast tank is full:

<table>
<thead>
<tr>
<th>Number of anglers</th>
<th>Heel angle (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.4</td>
</tr>
<tr>
<td>2</td>
<td>6.8</td>
</tr>
<tr>
<td>3</td>
<td>10.1</td>
</tr>
</tbody>
</table>

Table 3: Heeling angles for different loads

With three anglers on one side of the boat, there is still a freeboard of 36 cm. The equations used for the stability calculations can be found in the appendix.

**Foil Implementation**

A retractable foil can be found flush along the hull. When the skipper wants to transport themselves at a higher speed, the foil is deployed so that the hull is lifted above the waterline. Without the hull touching the water, there is minimal resistance from a wetted surface area. There is less fuel consumption with the reduced resistance. Flying above the water also allows for a smoother ride in rougher waters. The foil consists of an aluminum profile to increase its density. The dimensions and properties of the foil must be considered so that it naturally sinks when the locks for the extension legs are released. In order to have a stable “flight”, a V-shaped foil was chosen, which corresponds easily to the shape of the hull.

![Figure 11: The V-shape foil](image)

The foil is easily deployed using a pin set-up and gravity. When the boat is at standstill, the skipper can deploy the foil by disengaging the foil lock. The locking mechanism consists of a
pin that locks the foil in place. Once the pin is pulled, the weight of the foil will cause the wing to sink. Once the wing is at its desired extension length, the same pin is used to lock the structure in place.

To retract the foil, the skipper can decide to do so at speed or at standstill. If the locking pins are removed, the foil retracts when the boat is moving. The force upon the wing naturally lifts the foil into the hull. The foil can retract at while the boat is at rest with the help of a small electric motor acting as a winch. The motor retracts the foil into the hull where it can be locked using the same pin system as mentioned. The figure 12 below illustrates the concept for how the foil is positioned (the units are measured in meters).

![Figure 12: The foil deployment/locking system](image)

**Foil Dimensions and Specifics**

The foils are working in two different modes: the “take-off” phase, where the hull is still in the water, and the “flying” phase where only the foils are still in the water. Take-off is the phase where the resistance is the highest, and this determines the maximum needed power. The foiling phase, even if faster should consume less energy by reducing a lot the total drag by removing the hull from water. In order to evaluate the needed power, a velocity was chosen for the ship to take-off, *i.e.* at this speed, the force on the foils has to be just equal to the weight of the boat, any increase in lift after this point will pull the hull above water. The determination of foils characteristics is based on this speed. This speed value should not be too low, either the foils have to be too big, but not too high not to have a too high hull resistance. The speed was arbitrarily fixed at 10 knots.
A rather common profile was used for the main foil, a NACA 63412, which is asymmetric, therefore it doesn’t need a high angle of attack to create lift. The foil length is determined by the width of the ship and its deadrise angle. The required area is computed using basic fluid mechanics theory of lifting surface, which enables to compute the chord length of the foil. To calculate the last value, an area ratio of 6 is assumed by considering usual values of aeronautics. The V-shape of the foils was chosen because it assures self lateral stability during flight, and was also easy to be flushed to the hull. The average deadrise angle of the hull on the section where the foils are is taken into account to compute the total lift. This assumption is on the “safe side” for the dimensions calculation, since when looking at the whole shape, the foil is flatter than that, leading to higher lift than predicted. No precise stability calculations have been performed during the flight because that went out of scope of the project but they should be done for the final ship. More precise dimensions of the stabilisator should be calculated also. They have been designed as a “reasonable” guess from our experiences.

Once the dimensions of the foil were set, the resistance of the foil and hull are evaluated in order to chose an appropriate propulsion system. Only the profile and induced drag are taken into account for the foil, while the hull resistance is estimated by considering friction and pressure resistance, as they are computed in Savitsky method [1], which is common and well defined for this kind of high speed craft. These resistance components are known to be the most important ones. The hull resistance calculated at a relatively low speed during take-off have to be considered carefully because it is know that the Savitsky method is not completely relevant at low speeds. It should still be more relevant than using other methods such as Holtrop & Mennen which is made for bigger and slower displacement ships. The hull resistance is only considered during the take-off phase, and in the flying phase, only the foils drag is considered. To compute the power in the different phases, the resistance is increased by 15% in order to account for the ignored resistance components (air, wave making, ...) and sea state.

The Table 4 summarizes the foils dimensions needed for take-off.
because

Savitsky

ballast

for

In

efficiency 0.7)

Needed Power (with margin)

Induced drag

Foil profile drag

Pressure resistance

Speed

Friction resistance

Pressure resistance

Foil profile drag

Induced drag

Total resistance (with 15% margin)

Table 4: Characteristics of the main foil dimensioned to enable take off at 10kn.

In order to evaluate the required fuel quantity and autonomy, the resistance was evaluated for three different cases: take-off, flight, and “slow” displacement. In the first two cases, the ballast is considered empty, while in the latter case, the ballast is taken into account because it should empty only at higher speed. The resistance of the hull is evaluated with Savitsky method even at the lowest speed, but the values have to be considered carefully because of the known incertitude at low speed. The Table 5 summarizes the different resistance components in the three cases.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Unit</th>
<th>Take-off</th>
<th>Flight</th>
<th>Slow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profile</td>
<td>-</td>
<td></td>
<td>NACA 63412</td>
<td></td>
</tr>
<tr>
<td>Angle of attack</td>
<td>°</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>m</td>
<td></td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Chord length</td>
<td>m</td>
<td></td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>Area ratio, A</td>
<td>-</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Mean deadrise angle</td>
<td>°</td>
<td></td>
<td>27.6</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: Resistance and power for the three different studied cases

As the rest of the hull shape, the foils are inspired by nature. This explains the bumps on the leading edge, which are inspired by whale fins. Even though this has not been studied for
this project, this particular shape of whale fins is known to have good fluid mechanical properties, mainly to decrease the risk of cavitation. Fast sailing boats such as the IMOCA 60’ PRB, or the fast cruiser Rambler 88, use that kind of profile on the rudder blades for example.

Propulsion

The Archipelican’s design is founded on a design for the future as well as a desire to preserve and decrease the impact on the unique ecosystem that is the swedish archipelago. This of course has a large impact on the choice of propulsion system.

Thanks to interviews with anglers working in the swedish archipelago a list of specific requirements was stated.

Requirements

- Environmentally friendly
- Range of at least 70 nautical miles
- Light, boat can’t weigh more than 550 kg
- Able to reach shallow coves
- Operating speed of at least 30 knots

Engine

The foil design used for this boat reduces the resistance on the hull at high speeds but sets some unique requirements on the propulsion system. While the hull is lifted out of the water the propeller still needs to be in the water to have optimal efficiency. This traditionally means using a elongated shaft to reach far enough down in the water which, when not foiling, causes drag and drastically impairs the ability to reach shallow water. The solution is simple, since the foils are retractable and therefore always in the right position the propeller is mounted on the rear foil.
Using a combustion engine to power the propeller is therefore not ideal since this requires shafts and gears to retract and extend with the foil and will reduce the efficiency of the engine. An electrical engine is therefore the ideal choice since it can be mounted in the foil itself and the only thing it needs to work is powerlines which can be put inside the support for the foil. An electrical engine is also a better choice from an environmental point of view which supports the goal of having a boat with a low environmental impact.

Energy

The drawbacks of electrical engines are well known, the batteries required to power them for a reasonably long time are at the moment too heavy, take too long to recharge and has to be exchanged within a few years since the number of recharges are limited. In a couple of years this problem will likely not exist as batteries are getting better and more efficient by the day, but right now there simply is not a good battery type light enough to fulfill our requirements.

To calculate the needed batteries for a 70nm trip a suitable electric engine capable of producing the power required for take-off, 9kW, was used weighing in at 60 kg and needing a 20kWh battery. With this battery the boat would be able to travel the allotted range and take off 4 times. A battery of this size weighs around 300kg which is too high considering the total weight of the propulsion system including the engine of 60kg needs to be below 285 kg.

Figure 14: The propeller mounted on retractable foil
Instead of the heavy batteries an existing form of engine setup could be used called a "series hybrid" or "range-extended electric propulsion". This is often used on large trains and ships and could save a lot of weight.

The idea is to have a small efficient combustion engine mounted to an electric generator continuously generating power, making the amount of batteries needed for propulsion reduced to the amount needed to start the engine. This also means that the only thing limiting the range of the ship is the amount of fuel for the generator, making the range limitless as long as you have access to a gas station. This setup together with the generators combustion engine running on biodiesel, the range would be longer than batteries and also environmentally friendly.

Using the same electrical engine for propulsion as for the battery calculation the boat requires a generator setup capable of delivering the same amount of power, 9 kW continuously during takeoff. A generator making 10,6 kW at peak efficiency was found. This generator weighs about 178 kg and needs about 3,6 liters of fuel per hour to run at peak efficiency. In Table 6 the fuel consumption for different running-modes is shown.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Take-off</th>
<th>Flight</th>
<th>Low speed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speed</strong></td>
<td>kn</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>min</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td><strong>Needed power</strong></td>
<td>W</td>
<td>8678</td>
<td>7589</td>
</tr>
<tr>
<td><strong>Consumption</strong></td>
<td>l</td>
<td>0.26</td>
<td>1.37</td>
</tr>
</tbody>
</table>

*Table 6: Fuel consumption*

With the 60kg engine added there is still room for 30kg of fuel and still be below the 285kg limit. This means a range of 260 nm and 16 takeoffs on just 30 liters of fuel according to the above table making the series-hybrid the ideal choice for this application.

**Shallow waters and coves**

During the interviews a wish for a smaller and completely silent engine was expressed by many of the fisherman. The engine would mainly be used to move around where you're fishing, often in shallow water and near the fish, it needs to be silent and very shallow. The problem with electrical engines is that the engine often is put in the water directly behind the propeller which makes a lot of noise in the water that can scare away the fish.

A new and interesting idea from a small swedish company may have a solution to this. An accessory can be added to the ship, a small outboard using a Dolprop © [2] fin instead of a
propeller. This new and futuristic mode of propulsion is still in its cradle but has had some promising test. Here the electrical engine sits out of the water and two rods moving in a lateral motion moves a dolphin like fin mounted on the bottom. This means a silent and harmless propulsion system that can "slap" the bottom without being destroyed. This propulsion system could even be run by hand power.

**Solar cells**

On top of the shelter there is a solar cell system mounted. This is not meant to power the main engine but to power the auxiliary batteries used for things as radio, heating, gps, sonar, Dolprop engine or any other auxiliary features that may be installed. This is to minimize the need for the main engine and thus also the generator being used when stationary.

**Discussion**

The Archipelican is a modern fishing vessel for the modern angler. The features of the boat keeps avid anglers excited while simultaneously brings them closer to the natural beauty of the Stockholm archipelago. The advanced foils give an adrenaline filled experience, while the shallow hull results in a tranquil escape from everyday stress.

The creation of the Archipelican is a result from the collaboration between Konstfack and KTH. Students were able to work together from the early design phases all the way through to the final product. Communication has been vital throughout the process. Feedback was discussed frequently between the two schools. The Konstfack students were responsible for a concept design as well as stakeholder requirements. The KTH students focused on calculations and implementation of the design. The division of labour was not exclusive, and both groups helped discuss within each respective field.

The end result is a boat that both parties are content with. It is an innovative craft that has the opportunity to be a trend-setter. The project has been educational as well as enjoyable for all parties involved.
References


[2] Dolprop.se, Thomas Jemt [visited last 2016-12-14]

Appendix

To understand the boat’s stability, Chapter 2 of Anders Rosén’s: *Introduction to Seakeeping* [3] was used. The metacentric height was calculated using the equation:

\[ GM_0 = KB + B M_0 - KG \]

Where \( B M_0 \) can be found using:

\[ B M_0 = \frac{I_{WAX}}{V} \]

\( I_{WAX} = 1.662 \text{ m}^4 \) and the displacement volume, \( V = 1.29 \text{ m}^3 \). The KB is the distance from the keel to the center of buoyancy. For our hull, this was determined using the MATLAB code for hydrostatic stability. KB = 0.21 m. The KG is the distance from the keel to the center of gravity, which was estimated to be 0.2 meters.

To find the heel angle of the boat with a varying amount of anglers on the edge, the following equation was used:

\[ GM_0 = \frac{\mu y_\mu}{m \tan \eta} \]

Where the equation was solved for \( \eta \).