**Introduction**

Hey everyone! We are Megha, Amlan, Tawhid, Susmi, and Stefano, and our group chose to focus on SDG goal 14 - life below water. Much like other SDGs, this topic is incredibly broad and there are tons of issues affecting life under water, both in saltwater and freshwater environments. Once we had settled on this SDG, our group started looking at clarifying the problem, which is the first stage of the Creative Problem Solving (CPS) problem.

**Clarification**

During our first workshop, our team conducted a discussion session where we divided members into different roles: the client (Megha), the facilitator (Tawhid), and the resource group (Stefano, Susmi, and Amlan). This framework helped us start navigating the problem space and bringing up things we were aware of that negatively impacted life under water.

At this first discussion we diverged about several different things that were impeding progress on this SDG: pollution, global warming, tourism in protected areas, and several other subproblems in this space. This gave us a great starting point to start looking at additional resources on each of these problems. When we tried to converge from this discussion, our team identified that fishing was a common theme to many problems we identified, and we all watched the “Seaspiracy” documentary to understand more about this specific problem.  
  
After watching the documentary and searching for resources, it became clear that focusing on a subproblem related to fishing was the best way to positively impact our SDG. We then contributed different tentative problem statements to a shared document over the course of a few days as a way to document our diversion under this more specific problem scope, and had a meeting prior to our next workshop session to converge on our problem statements. We decided to use the 3 I’s (influence, impact, imagination) as our criteria for conversion, and also looked at combining similar and complementary problem statements. After doing this, we reached our first attempt at a refined problem statement:

* How might we help consumers make an informed decision about the marine products they purchase, and create awareness about the impacts of illegal fishing?

**Ideation**

With our refined problem statement identified, our group then moved to the ideation stage. We had a divergent discussion at one of our workshops where we tried to look at multiple different ways we might go about addressing our problem. We identified several ideas, generally falling within three main areas: laws and regulations, marketing and public engagement, and technology and information. Some of our ideas included pushing for the creation of additional laws and regulations, others looked at ways to make the public aware of the extensive environmental damage caused by fishing, and others aimed to use technology to allow for ways to monitor the supply chain of marine products from the ocean to a shelf on a store.

At this workshop we also connected with Bruce to take a look at our problem statement and progress, and he made it clear that our problem statement was still too broad at that time. This initially felt like we were set back since we would have to circle back to the clarification stage, but this iterative process is very common in CPS where we have to continuously iterate through different stages to make progress toward finding a solution. This was the point where the messy, iterative nature of creative problem solving became apparent to us. Our next goal was to continue to refine our problem statement, but this happened through a cycle of ideation, development, clarification, then ideation again, then more clarification, and so on.

**Narrowing down our problem statement**

We decided to continue to explore our broad problem statement through ideation and development stages (circling back to clarification at times). In this stage, we were able to diverge to prototype our problem and sketch out how we might go about solving it - even if it was still too broad. We would then converge to identify an acceptably narrow and specific problem space to address. Our divergent sketch included a 6-step process to monitoring the complete supply chain of marine products, as well as a diverse set of resources on addressing each step that we might use, combine, or improve in our solution:

1. Determine when and where each fishing vessel is fishing (done, AIS system)
2. Determine whether each vessel was fishing legally or illegally based on behaviour (done, [source using passive acoustic telemetry](https://link.springer.com/article/10.1186/s40317-019-0163-9), [source using vessel trajectory](https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9006545&casa_token=fuMnkqC5rlQAAAAA:Z_uajAVJY6jc225eJacVdMeSMluIuiZYHvZQpofJBr9KsT8wsIJ0T0j3SYy11GbfcU5310hCOA), [source looking at elasmobranchs in the Greek market](https://www.sciencedirect.com/science/article/pii/S0308597X19302027?casa_token=uZWXUZ40encAAAAA:oK47K9zUKkpWbJCp6rMOPaij3pl1asVUsM4s6tS0QhHXmG3hR9Npuk6W7nJIbsIDCuh5REcHtw)
3. Determine likely target species based on geographic location (done, [source](https://www.sciencedirect.com/science/article/pii/S0165783610001554?casa_token=UqAaTaVvhjQAAAAA:RUj6-raZZJlaiuXGWzz24O47LDRkdhDjRbsvTbM3FUOEvwpttkasQJ05WrDXGPZmCRO5-5Xrhg) on matching vessel location to declared catch, [source on how fishermen select target species and location](https://cdnsciencepub.com/doi/pdf/10.1139/f04-007)
4. Determine change in reefer (transport vessel) mass after transshipment event (done, [source](https://cdnsciencepub.com/doi/pdf/10.1139/f04-007) on historical approaches to modelling vessel wake based on a series of parameters. Can apply the same process with a known wake and regress the vessel mass using any of the listed models)
5. Determine who purchases catch from each transshipment vessel (work in progress, nothing solid yet. [Block chain approach](http://www.fao.org/3/ca8751en/ca8751en.pdf), [open government site search results](https://search.open.canada.ca/en/od/?mlt_id=fa1cd4cf-c8fe-4102-b3cd-19e2dde9f703), [dataset on these from quebec (ftp link)](ftp://ftp.mapaq.gouv.qc.ca/gouvernement_ouvert/Ventes_Produits_Valeurs_Transf_reg_maritimes.csv))
6. Tie purchased marine products to the produced lots of seafood (nothing yet)

**Convergence from narrowing down problem statement**

Narrowing down the problem statement cycled frequently through ideation and development, so our convergence happened by selecting relevant, workable, and innovative ideas as well as determining which were the most important parts of this process so that we could contribute to larger solutions in the future. We eventually converged by choosing to focus on the supply chain until the fish gets to port, and not going beyond that. Our narrowed down problem statement now was:

* How might we integrate existing open-source technology tools used to monitor illegal fishing behaviour at sea in a way that could empower stakeholders to verify the supply chain (and legality thereof) of the marine products arriving at ports within the Greater Vancouver Fishing Industry?

This problem statement addressed steps 1,2,3, and 4 of our larger solution.

**Development and Implementation**

Our group spent a lot of time clarifying the problem statement, and that included a ton of jumping around between clarification, ideation, and development. In this process, we identified existing solutions to each of the steps, and our role as a group would be then to integrate these solutions in a novel manner so that the groundwork is laid out for a wider supply chain monitoring strategy in the future. Our idea is to create a system that allows port workers to input a vessel identifier number and receive a report that shows:

* When, where, what species, and whether the vessel was fishing legally or illegally(if it is a fishing vessel)
* When, where, what species, and how much mass of products was transferred from a fishing boat to a transport vessel (if the vessel identifier number is of a transport vessel)
* The estimated mass of illegal vs. illegal cargo in a transport vessel

Our intention would be to then use this information as a way to empower stakeholders to prevent illegal marine products from being sold on land, thereby making it financially not viable to fish illegally. Alternatively, we could pressure stakeholders to tie the vessel from which a fish was purchased to its production lot at a food processing plant. This would allow consumers to scan a barcode and determine how that marine product got to port and what is the likelihood that particular fish was harvested legally or illegally - which allows the public to make an informed decision about what they purchase.

**Resisters and Assisters**

Diverging to identify assisters and resisters of our solution, we believe that NGOs (such as the BC Seafood Alliance, Living Oceans Society, and many others located in our target test area of Vancouver) would be potential assisters. Generally, the Ministry of Agriculture, Food, and Fisheries in Canada seems interested in preventing illegal fishing nationally, so these could also be assisters. In general, resisters would include people and organizations that profit from illegal fishing activities - which includes large international seafood producers (Mitsubishi controls a large distributor in Japan, and Thailand has an extensive seafood industry that is known to incentivize illegal fishing).  
  
Based on our research, it seems that a progressive first-world western nation such as Canada would be an excellent testing ground for this system. We foresee some resistance from communities concerned with privacy, but it historically seems that Canada is able to mediate conflicts when the goal is related to sustainability - particularly when wildlife is involved.  
  
Looking at the bigger picture, the timing of greatest resistance would likely be when taking this strategy to different countries where illegal fishing is a bigger issue (such as Thailand and Japan). At this future stage we also foresee difficulty in managing this resistance given the extensive resources these countries and large organizations have at their disposal.

**The plan**

1. Use the Automated Identification System to determine when and where each fishing vessel is fishing
2. Use available resources on migratory and spatiotemporal patterns of marine species to infer likely target species of any given vessel
3. Use satellite imagery (Copernicus is open to the research community) and the AIS system to determine whether vessels were fishing legally or illegally
4. Use satellite imagery to estimate the mass of products transferred from fishing to transport vessel based on changes in the transport vessel’s wake (process exists to simulate the wake characteristics based on factors including vessel mass, this regression line would have to be adjusted so that the vessel mass is the target variable and the wake characteristics are used as predictors instead of targets).
5. Create an app to visualize this information based on an inputted MMSI value
6. Create awareness within stakeholder communities (port authorities to gain acceptance, public to build enthusiasm) about this newly available information

**The Actions**

The items in our plan are not in a specific order, and we would likely continue to apply the CPS framework to tackle each of these problem areas over time. We would likely start by continuing to converse with port authorities to further validate our solution and build acceptance, and starting to establish a public presence through social media and a website discussing our solution.

Our short term goals would be to validate and adjust the solution, build a website and social media profiles, and start developing our app.

Our mid-term goals would be to integrate the necessary technologies into a cohesive system, including the reverse-engineering process of detecting changes in vessel mass based on changes in wake patterns.

Our long-term goals would be to iteratively validate and adjust our solution with the help of the Greater Vancouver Fishing Industry and the relevant ministries within the Canadian government. Eventually, our focus would shift to monitoring the supply chain after the port.

In the next 24 hours:

* Build and launch the “**save the fish**” website and social media profiles
* Continue to connect with port authorities and NGOs for continuous validation