Searching Fishing Grounds

Introduction

Fish resources are one of the most important food sources for the world's population. Fish has high quality proteins, such as vitamins (D, A and B), and minerals (including calcium, iodine, zinc, iron and selenium), essential fats (e.g. longchain omega-3 fatty acids) and all essential amino acids. Fish also usually has high unsaturated fats, so fish has benefits in protection our body against cardiovascular diseases. Fish also aids fetal and infant development of the brain and nervous system. With its valuable nutritional properties, fish also play a major role in correcting unbalanced diets and, through substitution, in countering obesity. In addition to high protein, fish is relatively easy to get. Fishing activities can be done from the smallest scale, simply use the fishing line and done by the beach, to use a giant ship that has a variety of advanced equipment for navigation and fishing. The importance of fish as food source can be seen from annual per capita consumption of fish has grown steadily in developing regions (from 5.2 kg in 1961 to 18.8 kg in 2013) and in low income food-deficit countries (LIFDCs) (from 3.5 to 7.6 kg). Fishery take almost 20 percent of their average per capita intake of animal protein (FAO, 2016).

Because of its importance, fishery has been growing for decades. Fish production continues to increase. This can be happened because of the support of technological developments such as shipping, navigation, freezing, to satellite technology. However, fishing is not as sharp as it once was. The catch is more stagnant nowadays. This is allegedly due to the limited resources of fish and the amount of fishing effort made by human. Fishing takes place in almost all waters and all year long.

To overcome the fish crisis, one of the efforts that need to be done is good fisheries management. Good fishery management means keeping the fish resource sustainable, taking into account the growth rate and fishing rate in balanced condition. Fish are caught to meet food needs with regard to their ability to regenerate.

As one of the efforts to implement good fishery management, we need to know the characteristics of fish and its environment. What kind of environment is suitable for fish and how the fish migrate. It is important to be a policy input in fisheries management. Information about waters and fish populations can be used, for example, for closing fishing season policy. This is done to keep the fish spawn to stay sustainable.

Geographic Information System (GIS) and Remote Sensing (RS) can really help us for this. In general, we can do it in two ways, ie from the sky (ex situ) and the sea (in situ). From the sky, we use satellites that capture electromagnetic radiation waves emitted by the sun and are reflected off by the ocean until they are bounced and captured by satellite sensors. From the sea, we use a ship carrying sonar technology to detect hordes of underwater fish. Both mechanism principals are a matter of Remote Sensing. How to process all information we collect, including non-remote sensing data, is how GIS works.

Fish and Fish Ecology

Fish should be in water where the temperature is tolerable. Fish cannot adjust his body temperature to water temperature (Coutant, 1976). To cope with changes in water temperature, fish can migrate to an environment where temperatures match the temperature range that can be adapted by the body. According to Coutant, water temperature has big impact for the fish life. Temperature has roles as a lethal agent, stressing factor, controlling factor, limiting factor, masking factor, and directing agent. The fluctuation of water temperature occurs dynamically, by location (geographical) and time (seasonally even daily).

Because temperature is an important factor in the life and existence of fish, we can make temperature as one of the important considerations in detecting fishing ground.
Searching from the Sky

We can do this by focusing on results. Aspects of the environment that we need to know include Sea Surface Temperature (SST), Sea Surface Chlorophyll-a (SSC), and Sea Surface Height Anomalies (SSHA) (Zainuddin et al. 2008). SST, as described above, is an important factor in the presence of fish. There is an optimal water temperature for the presence of fish so we can estimate where the fish are spatial with optimal temperature distribution. SSC describes the distribution of chlorophyll in which chlorophyll shows the presence of phytoplankton as the primary producer in the aquatic food chain. The presence of chlorophyll can be the basis for analysis of the presence of fish at higher tropical levels. Sea surface temperature (SST), sea surface chl-a concentration (SSC), and sea surface height anomalies (SSHA) can be derived from the Tropical Rainfall Measuring Mission (TRMM)/TRMM Microwave Imager (TMI), Orbview-2/SeaWiFS and TOPEX/POESIDON-ERS merged (AVISO), respectively.

In addition to obtaining the data, we can also analyze the oscillation that occurs at sea. It is important to understand the changes or dynamics of marine ecosystems and their impact on organisms including fish (Mantua et al. 1997).

We can combine satellite data and fisheries data for analysis (J.J. Agenbag et al. 2003). The catch data would be compared with those environmental parameters in order to figure out the relationship. The methods used here are Generalised Additive Models (GAM) and General Linear Models (GLM).

Searching from the Sea

From the sea, we use multibeam sonar to detect fish schooling (Misund, 1990). This is useful to ensure the size of the fish schooling in accordance with fishing efforts that will be done by the fishermen. Once fish schooling is detected, the fisherman can start the set of his fishing gear.

Some sonar limitations are inaccuracies because of the angle projection made on fish schooling. This can be overcome by adjusting beamwidth and pulse length.

Conclusion

GIS and RS can help us detect the best environment for fish. This can then be used as an estimate of the existence of fish. However, further efforts are needed to ensure the presence of fish. The follow-up efforts include searching in situ data, for example with sonar. Another data used to enrich the analysis is fishing data. This data is important because it explains the location, time, and size of the fish caught.

References


Annotated Bibliography


Agenbag and team investigated the density variation of anchovy (Engraulis capensis), sardine (Sardinops sagax), and round herring (Etrumeus whiteheadi) from catch data and suite of environmental variables. The location was in South Africa waters. They took catch data from 1987 through 1997 and environmental variables are in term of temporal (year, month, time of day or hour), spatial (geographical position and water depth), lunar (moon phase and elevation), and thermal condition (sea surface temperature – SST). Catch data were collected to describe the fish abundance. The catch data would be compared with those environmental parameters in order to figure out the relationship. The methods used here are Generalised Additive Models (GAM) and General Linear Models (GLM). GAM is good in analyzing the functional relationship because it accommodates a very wide range of functional forms and requires no assumptions as to the shape of the function. Meanwhile the GLM is statistical analytic tool which has less complex mathematical expressions, better for predictive purposes, but requires preliminary exploration of the functional relationships.


Zainuddin and his team examined fishing ground characteristics to figure out the most suitable environmental aspects for Albacore tuna (Thunnus alalunga). The fishing ground characteristics examined here were Sea Surface Temperature (SST), Sea Surface Chlorophyll-a concentration (SSC), and Sea Surface Height Anomaly (SSHA). Those three remotely sensed data were combined with catch data in order to figure out which oceanographic aspects get highest catch. Catch data used was Catch per Unit Effort (CpUE).


Misund conducted research on the Sonar technology uses in searching the fish schooling in Norway waters in order to figure out the herring’s swimming behavior and their response toward the fishing gear and vessel. Sonar can be used to detect the fish schooling and its biomass. Misund used two purse seine vessels which had different vessels’ and gears’ dimensions, such as the length and tonnage of vessels and length, depth, and mesh size of purse seine. The Sonar gear was Simrad SM600, the first Multibeam sonar. The research was conducted during the winter fishery for Norwegian spring-spawning herring in 1985 and 1986, and during the summer fishery for North Sea herring in 1984 and 1985. Misund discussed several important points, such as the herring’s swimming behavior and the limitation of Sonar uses.


This paper reveals that fish production in an aquatic ecosystem is closer correlated with primary production than morphoedaphic index. Primary production indicators consist of phytoplankton productivity, total phosphorus, nitrogen and chlorophyll-a concentrations in the water column, and conductivity. Meanwhile morphoedaphic index is total dissolved solids in mg/liter divided by mean depth in meters. Morphoedaphic index indicators were collected here were lake area, volume, mean and maximum depth, and area watershed.

Platt and Shubha discussed about how to get primary production algorithm from remote sensing data. The phytoplankton biomass was assessed by the Coastal Zone Color Scanner (CZCS). Then, Platt and Shubha explained step by step the algorithm process. They calculate photosynthetic rate with considering the depth and region (subtropical, equatorial, and transitional).


Coutant explained about the temperature roles toward the aquatic organism live. According to Coutant, fish have a range of temperature that suitable for their life. Each stages of fish life has different optimum temperature. Optimum here means the most suitable point of temperature. Coutant presented that temperature is important as lethal agent, stressing factor, controlling factor, limiting factor, masking factor, and directing agent.