CHAPTER 10

The Surrounding Habitat of Marine Algae in Malta

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Introduction

The study of algae has been conducted throughout the ages recreating multiple times scientific research with the latest technology and development that renders the results more efficient and reliable. In the Maltese scenario certain advances have not been backed up with the local situation and therefore they lack the real counterpart issue of what in reality we can observe. The Maltese Islands have undergone several infrastructural changes, which in some cases altered the natural setting. The arena of algae in relation to the anthropogenic disturbance being imposed on them has not been scrutinised in depth. This study aims to focus on such field in order to have real life analyses of the environment that surrounds us. In order to homogenise an array of features, biotic and abiotic factors have been emphasised on. Chemical tests are part of the lab analysis that consume most of the time since the water samples are very critical to the study. The time span required for the data collection and tests to be carried out is one of the issues for such data to create a determinative pattern.

Theoretical Issues

An inevitable infrastructural change was bound to be carried along the Maltese and Gozitan coastline, such improvements were made as a detriment upon the environment. In effect 17 factors are being investigated in order to analyse whether anthropogenic influence on the marine environment, especially the alga habitat was affected. These biotic and abiotic factors will be reflecting how the alga population is counter effected over the period of summer and winter weather, two climatic extremities. In such perspective it is the promotion of what conditions are favourable and which are inhibiting the growth of algae across the coastal zone, which is accurately defined in The Coastal Strategic Topic Paper (2002);

"...a geographical space incorporating land and sea areas within which the natural processes interact to create a unique dynamic system. It also incorporates those activities on land and at sea where human activities are directly influenced by or can influence the quality

of the natural resources."

The biological spectrum classifies algae as being marine plants, as they form part of the kingdom Chromista, specifically Metaphytae. In reality algae are free floating when compared to other that are attached to the seafloor within the inner continental shelf. This favourable position gives abundant isolation for photosynthesis since they are mainly found in the neritic zone which forms part of the photic zone, hence the sunlight. Although they were considered to be plants, they lack the true roots, stems, leaves, flowers, or seeds and embryos of a real plant. The anatomical research on algae considers them as primitive plants and can be found in the colour spectrum of red, green, and brown. The vast majority of these algae are phytoplankton, microscopic, and unicellular, which can reach the size of giant kelp. Algae are part of an ecosystem and as Durrant (2003) defines, it is an "*....ecological community together with its environment, functioning as a unit*".

Whilst simultaneously using the whole biosphere as its support. They can be considered organisms since they fit the criteria of being an individual form of life. Furthermore, algae have a body of organelles as well as other parts that can work together in order to carry out the various processes of life that form part of an ecosystem.

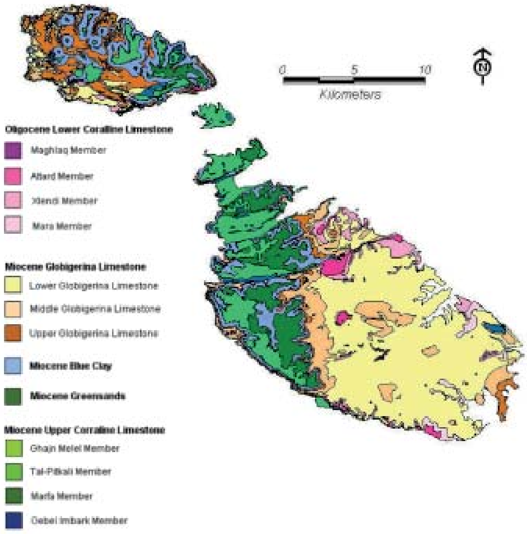
Methodology

The Maltese archipelago consists of a relatively small land cover, this gave the possibility to select beaches that represent the islands' local context. In this regard, Dwejra Bay (inland), Dahlet Qorrot, Anchor Bay, Gnejna Bay, Manoel Island, and Pretty Bay were chosen. The coast along the Maltese Islands was defined by Waugh (2002) as: "*...the narrow zone where the land and sea overlap and directly interact. Terrestrial, atmospheric, marine and human processes ad their interrelationship affect its overall development. The coast is the most varied and rapidly changing of all landforms and ecosystems.*"

The geological period of the Maltese Islands composed of five strata dates back to 24 million years ago as visualised in Figure 1. The Islands' coastline was throughout this period of time hit by constant wave actions, hence altered to the present coast formations. Meaning that this creates all the different habitats for the algae.

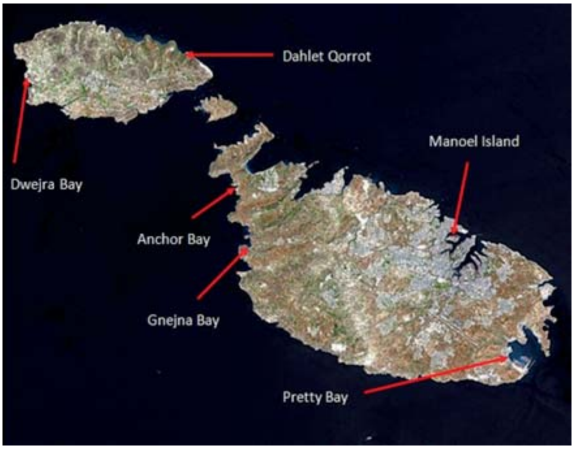
Malta having a Northeast tilt exposes the different layers to the different meteorological conditions and which therefore makes certain areas more susceptible to erosion and metamorphosis (land alteration). Such effects takes place due to the diverse unconsolidated sediments that the layers are formed of, thus the terminology of sedimentary rocks. The different composition gives each stratum a different time span in which the degree of erosion can make distinctive effect on the rock. As a matter of fact each study site presents a unique geological formation and according to the specific stratum found exposed on site, it will incorporates a different level of erosion, due to the climatic conditions that it encounters.

Figure 1: A geological map of Malta showing the different layers across the island



Source: http://english.fossiel.net/system/images/geolkaart/malta.png

Figure 2: NASA satellite image showing the Maltese Islands marked with the sites under investigation



In Figure 2 spatiality of the selected study sites is shown. Starting from the Gozitan Island the selected beach is Dwejra Bay in particularly the inland sea that is enclosed within the steep cliffs. The only way that such sea water can be replenished is through a small natural tunnel. The study site was broken down into three segments, in which distinctive level of anthropogenic disturbance can be noticed. On opposing scenery characteristics, Dahlet Qorrot, has an open sea and a high wind factor that is distinguished easily. The study site from where data collection was taken is a jetty. It is continuously disturbed as it is a man made jetty, nevertheless algae formation can be easily noted. The third study site is located on the Northwest side of Malta, Anchor Bay at Popeye's Village. The close relationship that this bay has with the aforementioned village brings a negative anthropogenic disturbance specifically during the summer. Also when noting the presence of ducks in the bay.

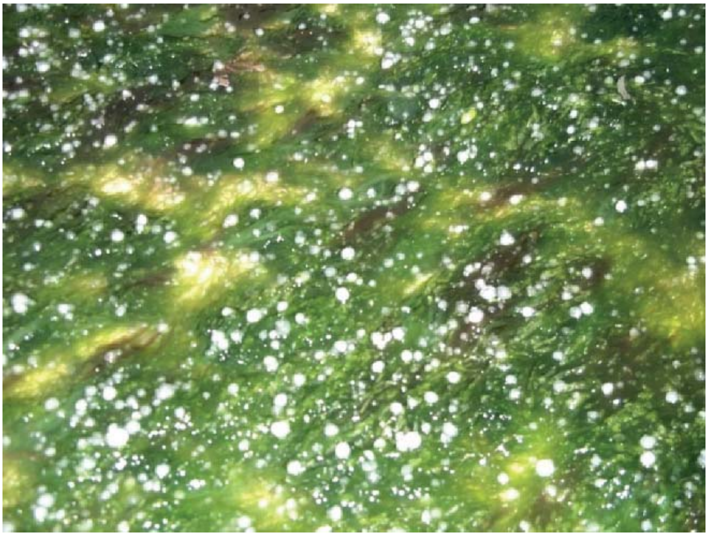
Another study site is Gnejna Bay, a different perspective is the fact that the location of data collection is sheltered. This aspect renders the majority of the litter to be transported with more ease with certain climatic conditions. Next is Manoel Island which is divided into three segments. This was made due to the high degree of anthropogenic and animal influence present in the area. The last study site was Pretty Bay, at the very end of the bay. This was made intentionally due to the transportation and the breakdown of the pollutants. An important feature in this study site is the presence of the Malta Freeport exactly opposite to the focused points. The study site was segmented into two points since purposes of the site vary from swimming to horse cleaning or as a jetty; this highlights the degree of anthropogenic disturbance that this area has. Also to be noted is the very close proximity to dwellings.

A comparison of the two weather extremities that the Maltese Islands face during the year was also under investigation. Analysis of data collection revealed that during the time span of the study, both weather conditions had reached an extra pitch into their extremity. This is due to the highest temperature on July 18th 2011 with a figure of 37.7^{O}C , while coldest and wettest during February 2012 since 1923 , with an actual mean temperature of 10.2^{O}C whereas normally is 12.4^{O}C. The latter month reached its highest temperature of 15.9^{O}C on February 3rd and the lowest on the 14th of February with a temperature of 3.6^{O}C. As a matter of fact even hail on *Enteromorpha* (ref. Figure 3) was found during the winter season. Also the amount of rainfall during this month was twice as much the average expected, with a figure of 132.6mm. Whilst the sea temperature was almost one degree higher than it normally should be.

A characteristic of this study was the utilisation of lab analysis through a water quality test of chlorophyll a, Nitrates, Turbidity and Phosphates. One vital fact while conducting lab analysis would be, not to have the water sample tainted with human intervention, as this could result in distorted data. The offsite analyses were done at San Lucjan Laboratories (Malta Aquaculture Research Centre) where they needed to be carried out within a short time span. Other tests such as sea temperature, *p*H and dissolved oxygen were done in situ through the utilisation of digital instruments. The other data factors were recorded on paper onsite as well. Standard procedure practice of the aforementioned tests and observations were carried out as to follow guidelines. A photographic evidence to show algae captured in their natural environment was also taken, as to serve as a point of reference if any further investigation was needed during the identification of the algae specie under the microscope. Once the algae were collected, drying and identification was needed to be followed. The drying method needed to be done as soon as possible so that they would not die in prior to the drying process, otherwise identification of specie would be much more difficult. The latter identification would serve as a benefit to cross-reference it with the water quality data gathered in situ.

Limitations are experienced primarily through the uncontrollable weather conditions and the delay in arrival of the quartz cuvettes.

Figure 3: Hail on *Enteromorpha*



Source: M. Refalo

Results and Discussion

The relation of algae with the anthropogenic disturbance and the surrounding environmental results can be analysed as implementation is finalised. The structure of this chapter incorporates three approaches of the results; the summer and winter physical conditions found on the study sites while carrying out a comparative analysis. Next would be the chemical lab analysis. The findings were finalised after an extensive laboratory tests and mathematical formulas incorporated in the procedure.

1. A comparative analysis of summer and winter conditions

Data collection handled throughout the summer season collected specimens of macro-algae organisms. In these climatic conditions diverse algae species flourished more, reaching collection data of eighteen alga species. The data regarding temperature showed that the highest sea temperature reached 28^{O}C which is almost 10^{O}C lower than that of the air temperature recorded. A vital component for a healthy ecosystem, is, the level of dissolved oxygen in water, this plays a crucial part in also determining the water quality. Results showed that for the summer period the mean sea dissolved oxygen level was that of 104.7%, meaning it is a considerable ample amount in the sea water. On the other hand the lowest mean sea dissolved oxygen level is that of 90% in Dwejra and Manoel Island. Such results shows that as a fact no presence of Hypoxia could be recorded.

Throughout the summer season the *p*H level of the water was recorded to average 8.3. This is a reflection that the water quality is also within the desirable level. During the summer season, in all the study sites anthropogenic disturbance could be recorded, as such this may have contributed to the abundance of macro algae. The highest level of specimens collected in one site was at Dahlet Qorrot. A noticeable factor was that two dominant species stood out, namely, *Jania rubens* and *Ulva sp*. Nevertheless the latter were not found in all the study sites.

2. Results emerging from the data collected during the winter season

The winter season showed a decrease in the amount of algae collected throughout the study sites, which resulted into one prevailing alga specie, *Enteromorpha* (Figure 4).

During the winter season, weather conditions decreased considerably, this may be the cause of the five less algae species collected. A factor that should be taken into notice is the fact that the average sea temperature was one degree higher than the air temperature, even if it was one of the coldest winters after a considerable amount of years.

Parameters such as dissolved oxygen and *p*H were also recorded having a positive result. The levels are 117% being the highest level reached at Manoel Island even though anthropogenic disturbance remained as that of summer, whereas the last one still ranged at eight respectively. Another influential parameter is the albedo level that decreases due to the fact that winters having a considerable degree of cloud overcast shadowing most of the light intensity magnitude. A positive remark to this season was the fact that pollution decreased at a substantial level due to the diminished pupil flow.

3. Summer and winter compared

The desirable level of *p*H has been reached throughout the data collection as the levels attained varied between 7.6 and 8.4. This gave an underlying perspective of the habitat within which the algae live. For the dissolved oxygen levels healthy standard levels were collected as levels should not be less than 80%. The aspects of orientation, open/closed sea comes into conjunction with wind force since it comes into effect to the way everything collides together and creates a fluctuating environment unique to every bay. Along with this, it is to mention that such movements created currents and therefore turbulence within the water, acting as an advantage since pollutants would be broken down. On the other hand the sea at Dahlet Qorrot, was both agitated during the summer and winter season, having the latter with stronger winds. With regards to the other parameters, minimal flux was recorded throughout both seasons. The most evidential change was seen in the temperature drop from summer to winter, alongside with this alga (Figure 5) also decreased respectively.

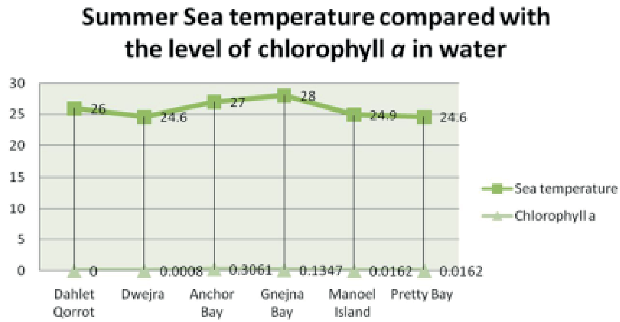
Figure 4: An abundance of *Enteromorpha* during the winter season

The temperature distinction that was recorded in the seasons shows that algae needs warm climate in order to flourish and grow over a shorter period of time, meaning that winter is a hibernation stage for these marine organisms (Figure 5). Nevertheless the reduction of anthropogenic disturbances may have also had an impact on which algae flourish most. As a result to this there were mainly temperature, wind force and pollution that directly affected the environment; meaning that the physical indicators were almost within the same degree.

Figure 5: Summer and Winter respectively showing the difference between the two temperature results and analysis within the two seasons

From the physical factors that were chosen in the study, temperature stood out prominently. As a result to the latter fact, chlorophyll a was another indicator which can help detect the state of the marine habitat. Correlation of these two parameters is presented in Graph 1.

Graph 1: Summer sea temperature compared with the level of chlorophyll a in water

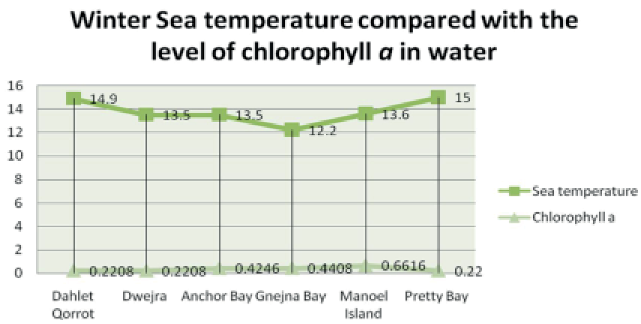


The fluctuations as seen in Graph 1 , shows that the level of chlorophyll a increased as temperature did so too. The highest level of chlorophyll a was found at the second highest temperature which stood at 27^{O}C. An interesting factor with this result is that both readings were taken on the same day of data collection, nevertheless the study sites made a distinctive difference in the chlorophyll a results.

Winter sea temperature compared to chlorophyll a level in water

In the winter season the results for chlorophyll a results reached the highest level recorded in this study. With a contradicting factor of rough winds, cold temperatures and also hail throughout the data collection. Manoel Island study site had the highest chlorophyll a level. In comparison with the other study sites in perspective of this chemical, a relatively higher levels were recorded, this means that such climatic conditions favoured chlorophyll a (Graph 2).

Graph 2: Winter sea temperature compares with the level of chlorophyll a in water



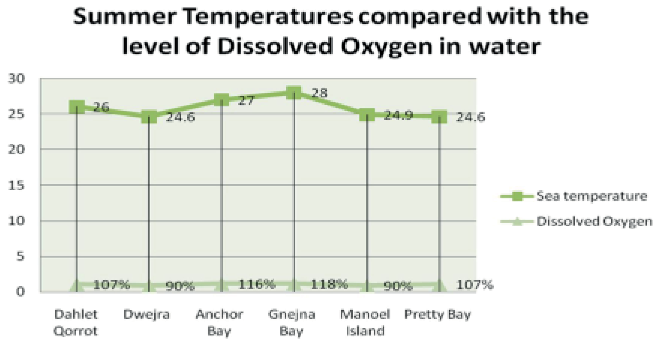
In relation of the seasons chlorophyll a results showed that the environment for the marine algae was not compromised, hence the desirable levels were reached especially during the winter season for photosynthesis to be carried out.

The next comparison of results will focus on the dissolved oxygen level present in the sea water in perspective of the sea temperatures recorded. The presence of dissolved oxygen helps to create a sustainable life within the aquatic nature.

Summer sea temperatures compared with the level of Dissolved Oxygen in water

The collected results of dissolved oxygen when compared with the sea temperatures obtained, a simultaneous increase could be observed in both variables. The healthy parameter of dissolved oxygen can be low as 90% in marine water (Graph 3).

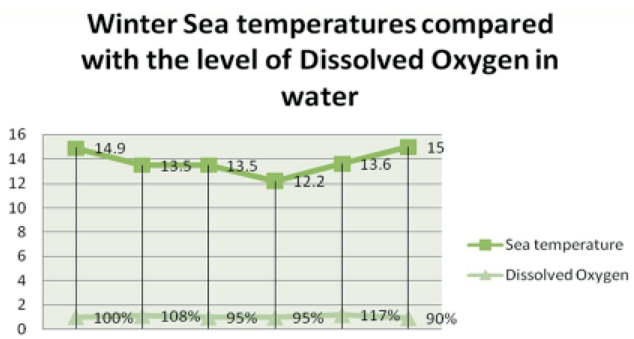
Graph 3: Summer temperatures compared with the level of Dissolved Oxygen in water



Winter Sea temperatures compared with the level of Dissolved Oxygen in water

On the contrary to the previous results the comparison between the winter season and dissolved oxygen did not indicate any correlation. The dissolved oxygen results showed that they decreased throughout the winter season, hence cold temperatures do not favour the marine environment. The most favourable levels of dissolved oxygen in this study stood at 117%, at Manoel Island study site. A contradicting comparison is, the fact that the same study site mentioned had the lowest (90%) dissolved oxygen during the summer data collection. An inverse proportion could also be observed with the highest level of dissolved oxygen in summer, and same site having one of the lowest levels of dissolved oxygen during the winter season, at Gnejna study site. Results of both seasons have shown that dissolved oxygen fluctuates according to the sea temperature present at the surface of the water (Graph 4).

Graph 4: Winter sea temperatures compared with the level of Dissolved Oxygen in water

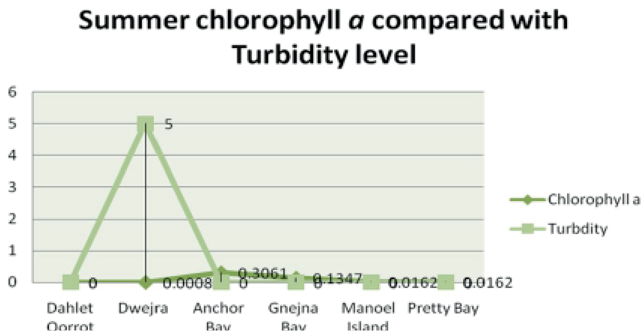


The presented results will show the data collection of chlorophyll a compared with turbidity during both seasons.

Summer chlorophyll a compared with Turbidity level

Carrying out analyses with the results of chlorophyll a and turbidity was not easy to be defined as most of the turbidity levels stood at zero, there was only one reading that differed from the rest, which stood at five which was recorded at Dwejra inland sea. A favourable aspect of the latter mentioned study site was the fact that the water was stable and undulations were minimal. A comparable result was that the highest turbidity level was found at the same site of the second lowest result for the chlorophyll a.

Graph 5: Summer chlorophyll a compared with Turbidity level



Winter chlorophyll a compared with Turbidity level

On the contrary to the first data collection, the winter season rendered results to be rather high. As collated from the summer season results same study site was also with a high degree of turbidity, being Dahlet Qorrot (Graph 6). As predicted for the winter season, strong winds prevailed, so much that even large amount of brown algae was washed along the shore. This helped to also note that the wind force and turbidity created in the water, contributed to pull off *Posidonia oceanica* from the open sea (Figure 6).

The level of turbidity recorded at Dahlet Qorrot was relatively high to the point that it has affected the level of chlorophyll a at the same time. Such results were expected as both indicators are inversely proportional when collecting data. As a matter of fact, the highest chlorophyll a level had a zero level of turbidity. The difference between the turbidity levels and chlorophyll a varied with that of turbidity mark 17, chlorophyll a tripled in its rate (0.6616Cμg/L vs. 0.2208 Cμg/L) (Graph 6).

Graph 6: Winter chlorophyll a compared with Turbidity level

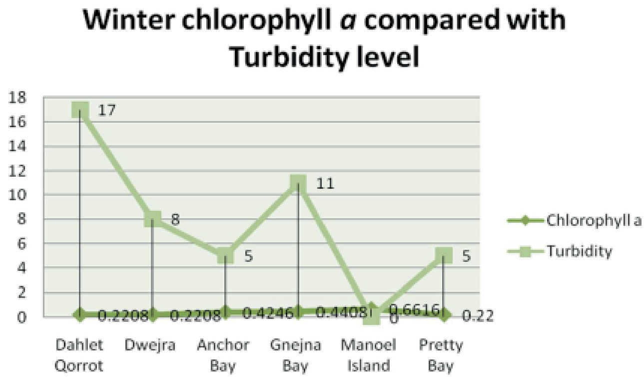


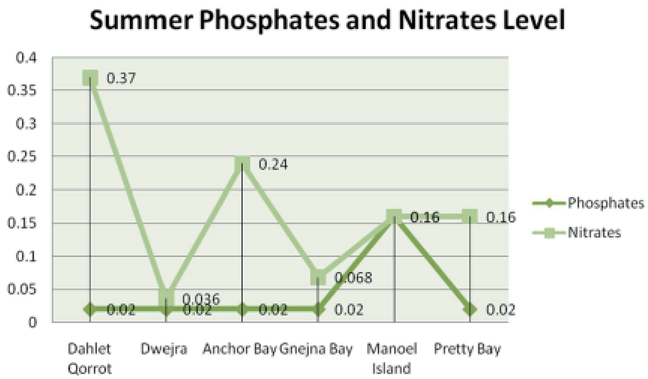
Figure 6: A photo showing the huge amount of Posidonia oceanica in Dahlet Qorrot (photo taken by author)

The next section shows the results and comparison between Phosphates and Nitrates.

Summer Phosphates compared with Nitrates level

The summer reason obtained results reveilved that Phospates were almost all 0.02mg/L, this signify that limited correlation exists with Nitrates. As from the Nirates level results show that they have fluctuated hence correlation between the these two variants could not be established (Graph 7).

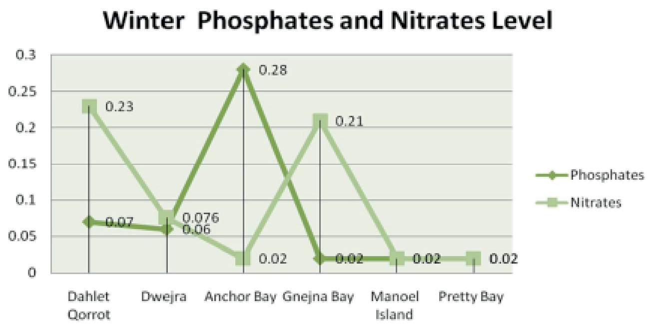
Graph 7: Summer Phosphates and Nitrates level



Winter phosphates compared with Nitrates level

Throughout the winter season results showed that there has been an alteration. In comparison of these two, correlation could not be established since in both cases, the highest results were with almost every lowest variable of the other. In view of the Phosphates and Nitrates results relationship between the two was negligible (Graph 8).

Graph 8: Winter Phosphates and Nitrates Level

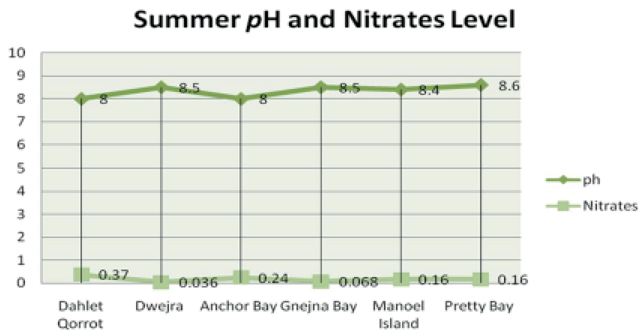


Next section depicts the comparison between pH and Nitrates levels have been compared.

Summer pH compared with Nitrates level

In this study the *p*H levels remained relatively consistent, varying around the figure of eight. As it is projected in Graph 9 when the variable of *p*H level decreases, the other variable does not fluctuate accordingly. It was noted that the lowest two readings of *p*H had a difference of almost 10mg/L among them. It must be noted that in these both readings they had different orientations, since the sites were Dahlet Qorrot and Anchor Bay. In another point of view the highest *p*H reading (8.6) obtained when correlated with the Nitrates results showed that there is 0.21mg/L difference between the highest level of the same test. The final view of this comparison showed that the *p*H level does not affect the level of Nitrates in the sea water.

Graph 9: Summer pH and Nitrates level



Winter pH compared with Nitrates level

Graph 10 is showing that *p*H levels during the winter season have all nearly changed, this gives an indication that the sea water have undergone some chemical changes. Whilst the level of Nitrates in the water have decreased by more than half of the results obtained in the summer season. Graph 10 shows that there is a correlation, as the highest pH level had the lowest Nitrates level and the minimum level of *p*H level had the highest Nitrates level. Simply showing that Nitrates level decreases as the *p*H level increases.

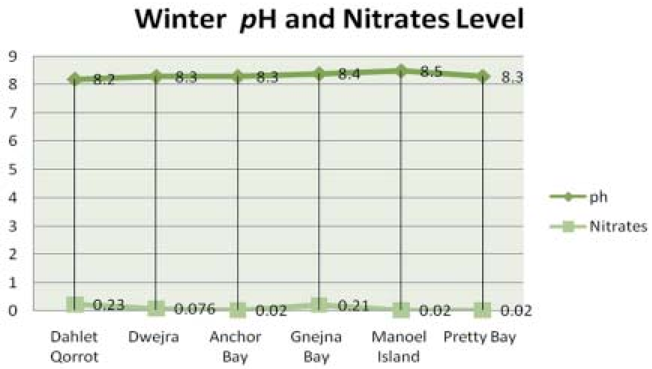
Analysing the *p*H results, they show that during the winter season the constant figure has slightly increased along the different study sites.

The final set of graphs will present the Dissolved oxygen and Nitrates level results for both seasons.

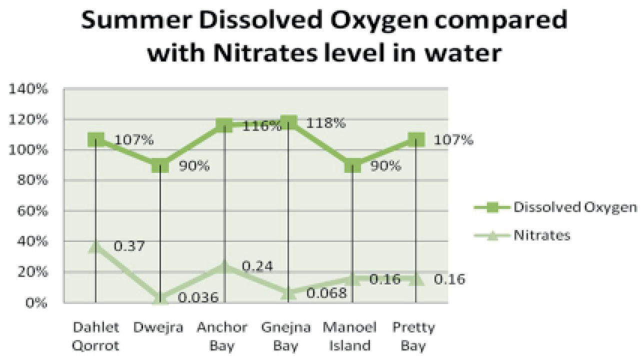
Summer Dissolved Oxygen compared with Nitrates in water

The dissolved oxygen and Nitrates levels in Graph 11 indicate that there is a negative correlation, this is due to the fact that there is no stable relationship between the two variants. In locations where the same results were obtained for the dissolved oxygen, the change in Nitrate value did not always correspond. This is especially true when taking into account the fact that two of the results for dissolved oxygen and Nitrates were both taken in Malta; this variation was noted to be substantial. As a result, the researcher could not establish a relationship between these two variants for the summer season.

Graph 10: Winter *p*H and Nitrates level



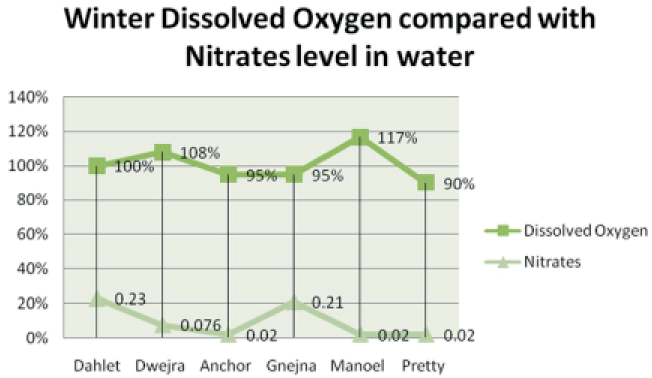
Graph 11: Summer Dissolved Oxygen compared with Nitrates level in water



Winter Dissolved Oxygen compared with Nitrates

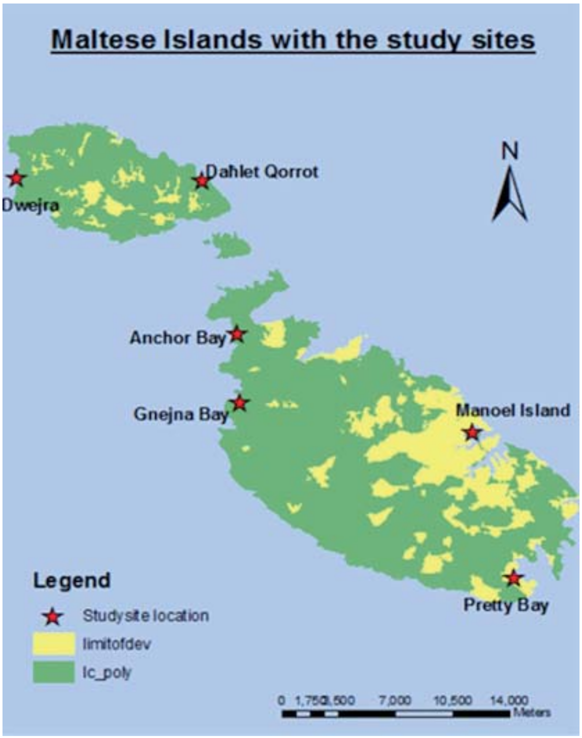
The same scenario of the summer season (Graph 12) was repeated throughout the winter season, although the Nitrates levels has decreased considerably. A variation in the results was that the highest and lowest readings both had the lowest reading of Nitrates. whereas the highest levels of Nitrates correspond with the medial values of the results. This means that both values have declined during the seasonal period, hence it concludes that no relationship exists between the two variants.

Graph 12: Winter Dissolved Oxygen compared with Nitrates level in water



GIS visualisation of study sites compared with a set anthropogenic boundary

Map 1: Maltese Islands with the study sites



A representation of the Maltese Islands is shown in Map 1, showing the study sites with a red star which better visualise the location of the site. The map also incorporates the limits of the development of buildings. It is clear that the Central-South of Malta is highly developed. In accordance to this it can be easily estimated the degree of anthropogenic disturbance on the area on daily basis. Certain locations are not surrounded with a yellow layer, however at a micro scale of the town area reveals the habitation area.

Dahlet Qorrot study site with anthropogenic disturbance

Dahlet Qorrot is a small location at the end of its council, as Map 2 indicates the area of Dahlet Qorrot on the Gozo Island is not within the yellow layer parameter, however adjacent council is. At the study site a summer residence can be noticed, also in the area there is a main jetty in order to disembark boats into the sea. The buffer indicated in the insert shows the radius of the anthropogenic disturbance that the area is prone to. The main disturbance happens on land however the sea aspect is also compromised. It is shown through the seaward zone which becomes the supralittoral zone on the study site.

Dwejra Study site with anthropogenic disturbance

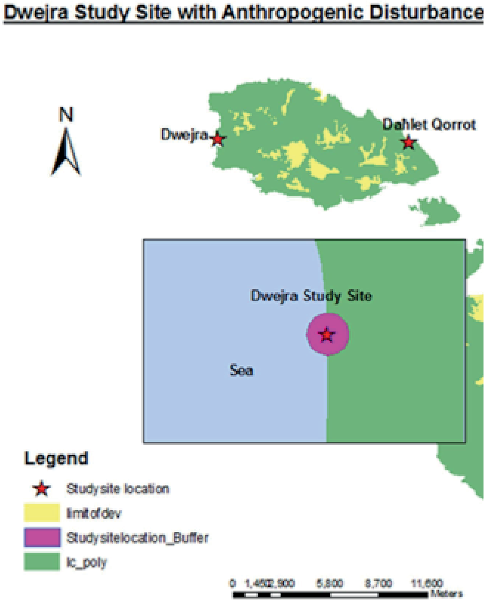
The second study site at Gozo is Dwejra, the inland sea (Map 3). This locality is not permanently habituated, nevertheless tourists and Maltese citizens visit all year round, hence anthropogenic disturbance is compromised on daily basis. The study site is located near the summer residences and in the inland sea area, which gives a great deal of anthropogenic disturbance especially during the summer season. Furthermore during good weather conditions and throughout the summer period boat trips are made routinely to go outside the inland through the natural tunnel. A positive note, activity diminishes in winter.

Anchor Bay study site with anthropogenic disturbance

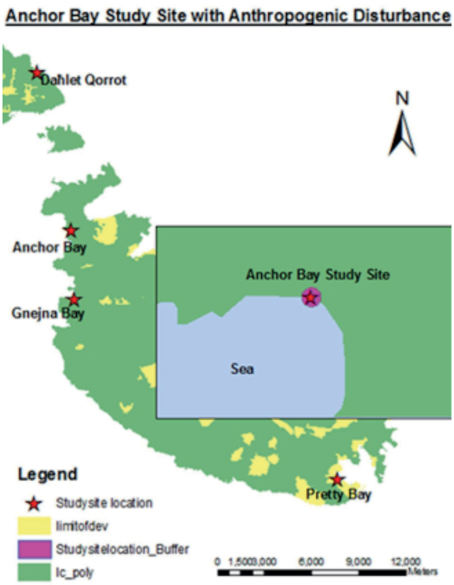
This study site is part of the only permanent structure (Popeye's Village) present in the area. As presented in Map 4 , the area does not have the yellow layer since there is not any residents. The peak season for Popeye's Village is throughout the summer season, hence Anchor Bay is also automatically compromised due to the heavy influx of people. This gives the anthropogenic disturbance a higher degree of how to be maintained, since summer is busy and in winter no activity takes place. The buffer zone visualised in Map 4 is therefore only present for the summer season. For the purpose of this study only a part of the bay was chosen, however the entire bay is affected since it is retreated in the cliffs and takes the form of a basin.

Map 2: Dahlet Qorrot

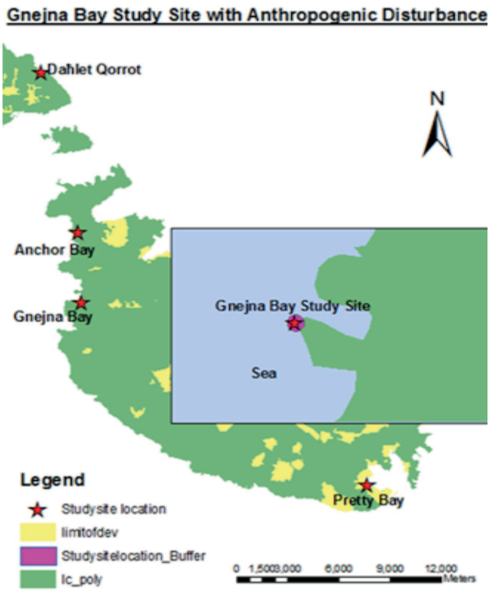
Map 3: Dwejra



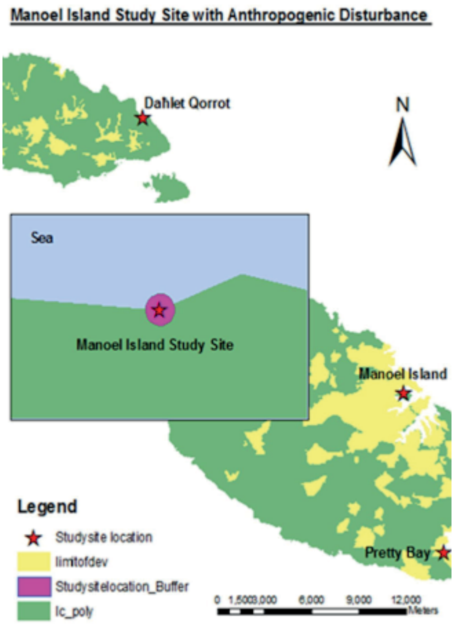
Map 4: Anchor Bay



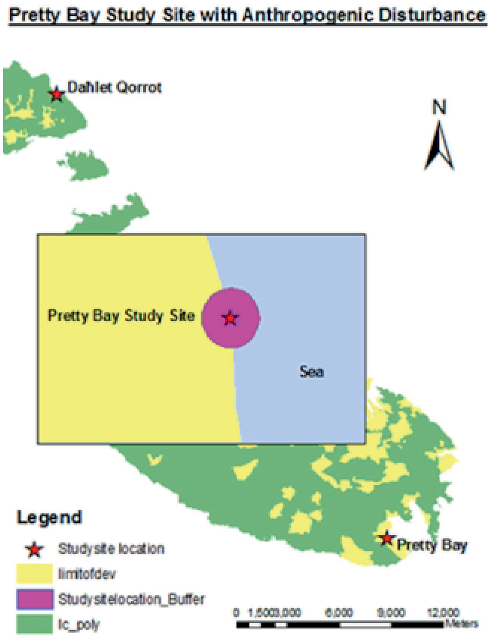
Map 5: Gnejna Bay



Map 6: Manoel Island



Map 7: Pretty Bay



Gnejna Bay study site with anthropogenic disturbance

The study site of Gnejna Bay is situated in the outskirts of Mgarr town area (ref. Map 5), at the mouth of the stream . Surrounding the bay there are numerous summer residences, and as a matter of fact there is a summer residence in front of the chosen area for data collection. Being a popular bay throughout the summer season it brings with it numerous anthropogenic disturbances. During the winter season the bay is restored to its natural attributes, and for this reason the buffer representing the anthropogenic disturbance was eliminated.

Manoel Island study site with anthropogenic disturbance

The location of this study site is situated on another island in very close proximity to the mainland through a man-made bridge. The actual island is not layered with yellow, however the surrounding area of Sliema is densely populated and very busy (ref. Map 6). The nearby area of the study site is surrounded by maintenance works on boats that are regularly performed on land. The island has no residential buildings, however the site is used for bathing horses as well, apart from being a jetty. In this regard anthropogenic disturbance cannot go unnoticed throughout the year, therefore full buffer all year round.

Pretty Bay study site with anthropogenic disturbance

For the South of Malta, Pretty Bay was chosen for the study site, as shown in Map 7. It is being highlighted with the yellow layer, due to the urbanised location it is situated in. As seen in the insert map, the development limit of the area is in very close proximity to the sea side. The bay is quite stretched out, however the study site chosen was the last part of the bay. This chosen site purposes are for swimming, being a jetty and also bathing of horses, apart from this, opposite to study site there is the Freeport operating around the clock. The scenario shows that anthropogenic disturbance is carried throughout the year. An adverse impact is the waste collected from the street, which is washed off to the sea. The buffer zone outlined in the GIS map is utilised in both seasons due to the disturbance created.

Conclusion

Implementation of the physical factors and chemical tests were completed in order to analyse if any correlation exists between the variables, also with the algae aggregation. The data collection of the marine algae showed that they increased during the summer season whereas they decreased during the winter season. The difference in the species abundance between the seasons was that of five marine algae, as a result for the summer season *Jania rubens* and *Ulva sp.* were the dominant throughout the summer season and *Enteromopha* during the winter season.

In each of the six study sites distinguishing environmental factors were imposed on them, this reacted in a contradicting way in certain areas. Weather extremities were faced having the lowest sea temperature of 12.2^{o}C, which was last recorded 89 years ago. From all sites as expected wind forces increased as light density decreased, in comparison with the summer data collection. Anthropogenic disturbance showed that it has contributed to the blooming of algae.

The chemical tests determined that *p*H was stable for both seasons. Healthy parameters were observed for Dissolved Oxygen, during the summer season, the highest percentage recorded was that of 118, while during the winter season showed a slight decline, having the lowest percentage stood at 90.Turbidity, results remained zero for the summer season and reached the 17 mark for the winter season.

Lab analysis showed that chlorophyll a increased considerably during the winter season, particularly Manoel Island results, being that 0.06616Cμg/L is double the result of the summer season. Results for chlorophyll a were noted to be contradicting. Within the same perspective Phosphates results showed that winter season had more elevated outcomes when compared with the summer season. Having 0.28mg/L during the winter and close to none during the summer season. Contrarily Nitrate levels increased in the summer season and decreased throughout the winter season.

The aim of this study was proven correct as the interrelationship between the mentioned environmental factors and the habitat of algae does in reality exist since the macro-algae increased during the summer season. A longer time frame is suggested for cross-analysis in order to conclude a pattern for the Maltese Islands.

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