PA/05908/23 & EA/00007/18

PROPOSED CONVERSION FROM A TEMPORARY TO A PERMANENT TUNA FARMING AREA AS ESTABLISHED IN PA/02175/18; RETAINING THE APPROVED TOTAL BIOMASS OF FISH AND ALL RELATIVE CONDITIONS

APPROPRIATE ASSESSMENT UPDATE

Version 1: February 2025

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Quality Assurance

PA/05908/23 & EA/00007/18 - Proposed Conversion from a Temporary to a Permanent Tuna Farming Area as Established in PA/02175/18; retaining the approved total biomass of fish and all relative conditions
Appropriate Assessment Update
February 2025

Report for: **Department of Fisheries & Aquaculture**

Revision Schedule

Rev	Date	Details	Written by:	Checked by:	Approved by:
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1. INTRODUCTION

1.1. This Appropriate Assessment (AA) update has been prepared following a request by the Environment & Resources Authority (ERA) in connection with a proposal by the Department of Fisheries & Aquaculture (DFA) to convert the tuna farming facility approved in PA/02175/18 from a temporary to a permanent one, as described in development permit application PA/05908/23. The DFA is the owner of the aquaculture zone and hence the applicant. The tuna farm is operated by AJD Tuna Ltd under two licences issued by the DFA (one for AJD Tuna Limited and one for Malta Mariculture Ltd). The original AA was commissioned by AJD Tuna Ltd for application PA/02175/18. Application PA/02175/18 was approved by the Planning Authority in May 2019.

1.2. In addition to an update to the original Appropriate Assessment, ERA also requested an update of the Environmental Impact Assessment (EIA) Report. This document makes reference to the EIA Update Report as appropriate.

BACKGROUND TO THE SCHEME

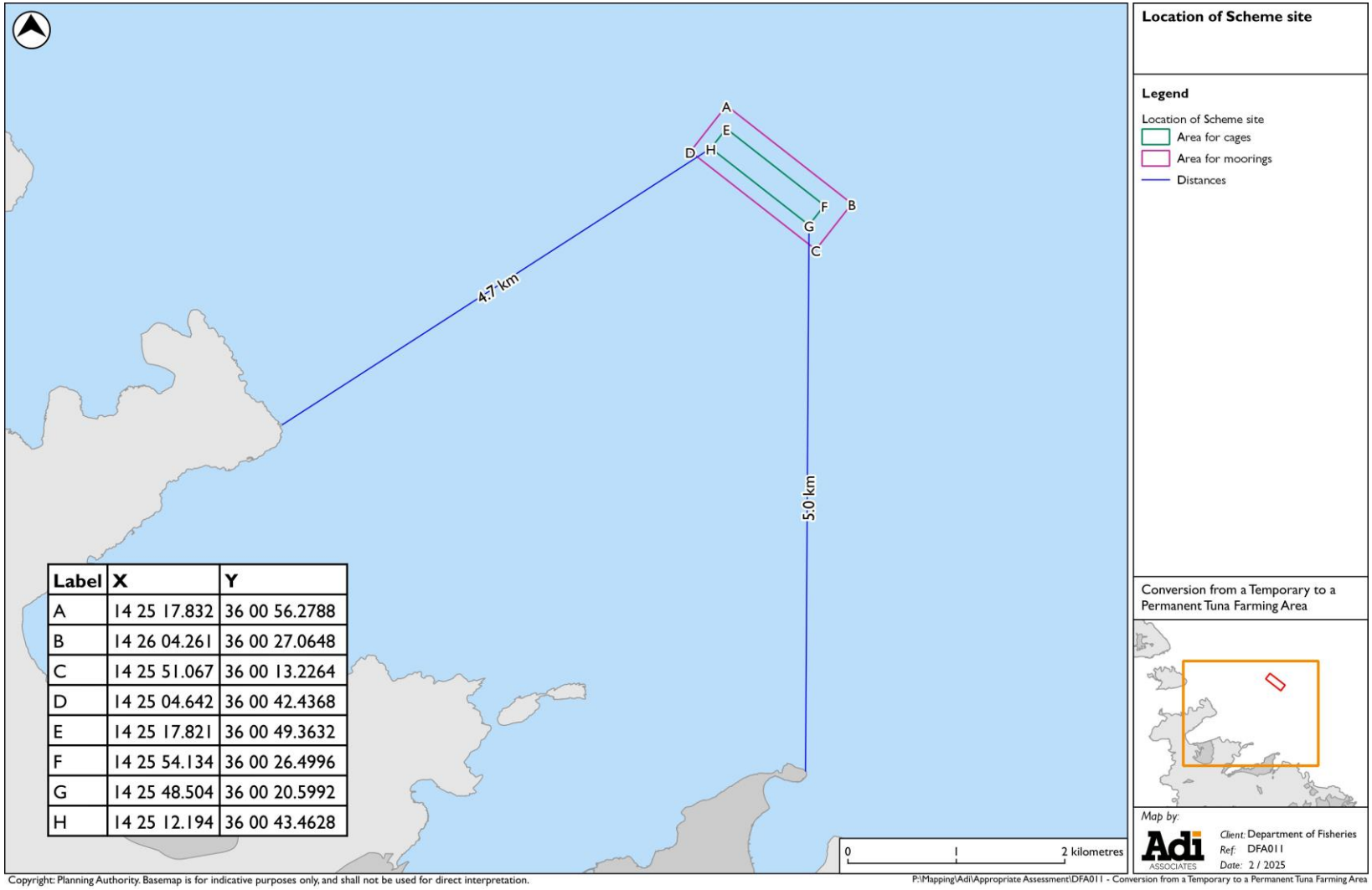
1.3. In 2017, AJD Tuna Ltd submitted a proposal to relocate its existing tuna penning farm from its former location approximately 1.5 km off Qawra Point, St Paul's Bay to a site further offshore. This was in response to a decision of the Planning Authority (PA) that all fish farms must relocate further offshore by May 2017 in order to mitigate the impacts that had been reported over the previous years, and in particular in summer 2016, on the marine environment, including social impacts related to amenity and nuisance from odour and water quality at affected areas of the coast. Previously, the farm had been operating since 1999 under permit PA 07377/98; however, in September 2016 the PA revoked this permit.

1.4. Furthermore, permit PA 01741/01, to substitute part of the breeding of sea bream with tuna in cages located in the South Comino channel was also revoked. Although a permit was in hand, the cages at this site only ever harboured tuna twice. This is because the site experienced strong currents and was not appropriate for tuna farming. The application to relocate farming operations further offshore incorporated the capacity of tuna permitted at this second farm as well.

1.5. In 2018, AJD Tuna Ltd submitted application PA/02175/18, which proposed the consolidation of the two tuna farming operations (approved under applications PA/03072/17 and PA/05858/17) into one while keeping the same biomass that had already been approved (3,300 tonnes).

1.6. The permit was approved in May 2019. **Figure 1.1** shows the location of the final approved consolidated area, subject of application PA/02175/18, which is the same location as that of the current proposal for conversion to a permanent facility.

Figure 1.1: Scheme location



Label	X	Y
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B	14 26 04.261	36 00 27.0648
C	14 25 51.067	36 00 13.2264
D	14 25 04.642	36 00 42.4368
E	14 25 17.821	36 00 49.3632
F	14 25 54.134	36 00 26.4996
G	14 25 48.504	36 00 20.5992
H	14 25 12.194	36 00 43.4628

1.7. The operation by AJD Tuna Ltd at the Scheme location includes an average of 24 cages, with each cage containing approximately 1,200 fishes with an average mass of 115 kg (or a total of 137.5 tonnes of fish per cage). This stocking density corresponds to the maximum capacity (3,300 tonnes) of the farm as defined by ICCAT.

Proposed changes to the Scheme

1.8. As explained by the project architect, the Scheme as proposed in development permit application PA/05908/23 is identical to that approved in PA/02175/18 in terms of the location of the Scheme, the number of cages / amount of biomass to be reared, and the number, type, and area of moorings for the cages deployed. The only difference is that instead of a temporary facility that would move to a further offshore location once the North Aquaculture Zone (NAZ) is established, it will become a permanent one at this same location.

1.9. The full set of plans for the Scheme as proposed are included in **Appendix 1**.

1.10. In a communication to the Planning Authority dated 6 November 2023, the Environment and Resources Authority (ERA) advised the following:

> *"ERA notes that the above-mentioned project proposes a change of use of the site from temporary as per in PA/02175/18 to a permanent one. In this regard, ERA requires a Statement from the EIA Coordinator outlining whether the said change will affect the conclusions of the EIA and AA Reports undertaken for PA/02175/18.*
>
> *Following the receipt of the said Statement, ERA would be in a position to determine whether the proposal (PA/ 05908/23) requires an EIA update or otherwise."*

1.11. On 29 January 2024, Adi Associates, as Coordinators of the original AA Report for PA/02175/18, submitted a statement to ERA assessing whether the proposed conversion of the tuna farming facility from a temporary one to a permanent one, as submitted to the Planning Authority and subject of development permit application PA/05908/23 would affect the conclusions of the original Appropriate Assessment Report.

1.12. The AA Statement concluded that the proposal to convert the tuna farming activity at the Scheme site from a temporary to a permanent one is considered to change the situation such that the impacts on the rhodolith / maerl habitat could be significant and long term compared to the original conclusions of the AA.

1.13. As regards the impacts on avifauna and the integrity of the SPA, these were not deemed to change, except if the change in the use of the Scheme site (from temporary to permanent) is coupled with the establishment of the NAZ (subject of

PA/04811/19[1]) further north. In this case, cumulative impacts would be expected to impact the bird populations through increased light population, noise, greater take up of sea surface used for rafting, and potential impacts on the gull populations that could lead to increased predation on the smaller seabirds.

1.14. On 9 February 2024, ERA issued a further instruction, which stated:

> *The assessment of long-term impacts on the seabed that can potentially occur as a result of the proposed conversion of AJD Tuna Limited cages from a temporary to a permanent installation, should be based on updated studies and compared with the baseline studies that were undertaken for the EIA/AA for the temporary sites.*
>
> *In this regard, the assessment should include the following potential impacts:*
>
> - *impacts on seabed habitats including rhodoliths/maerl beds and associated ecosystems from fish waste and uneaten feed;*
> - *impacts on water quality from nutrient loads and other pollutants;*
> - *the extent of the area affected throughout the operations and the recovery potential of such areas;*
> - *effect on the conservation objectives of Natura 2000 marine sites*

1.15. This AA Update Report addresses the impacts of the Scheme on the conservation objectives of the Natura 2000 marine sites.

APPROPRIATE ASSESSMENT OBJECTIVES

1.16. The aim of the Appropriate Assessment is to determine whether the Scheme will result in likely significant effects to the habitats and species for which the Natura 2000 site was protected. This will thus be determined on the basis of identifying reasonable links between the Scheme's effects and the qualifying interests of the Specially Protected Area (SPA) Żona fil-Baħar Madwar Għawdex as well as on the marine Special Area of Conservation (SAC) Żona fil-Baħar bejn il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet off the Northeast of Malta.

1.17. The ecology of breeding seabirds includes a reliance on the sea cliffs and therefore when considering potential impacts on avifauna, the context of the terrestrial SPAs upon which the breeding seabirds are also dependant will be considered insofar as it is within the scope of this impact assessment. Of note, in the context of the Scheme and the marine conservation area within which it is located, is the SPA Ramla tat-

[1] Development permit application PA/04811/19 is currently being processed for the establishment of a North East Aquaculture Zone (NEAZ) that will cater for a more sustainable form of aquaculture that targets closed cycle species. No bluefin tuna will be reared at this site.

Torri / Rdum tal-Madonna, located along the northeast coast of Malta, on the L-Aħrax tal-Mellieha promontory, Kemmuna, Kemmunett, il-Ħaġriet ta' bejn il-Kmiemen u l-Iskoll ta' Taħt il-Mazz, and Selmunett.

AREA & SCOPE OF STUDY

Avifauna

1.18. As described in the original AA, the Area of Influence (A of I) of relevance in terms of avifauna is illustrated in **Figure 1.2**. The A of I lies within two marine Natura 2000 sites as identified above and therefore both these marine Natura 2000 sites fall within the scope of the assessment. In the case of the avifauna assessment, certain coastal SPAs will also be considered insofar as they support breeding seabird colonies. This is because any impacts identified on the marine SPAs with regard to seabirds could impact the conservation status of the breeding colonies for which these terrestrial sites have been designated. The terrestrial sites of particular importance and located in the A of I include Kemmuna, Kemmunett, il- Ħaġriet ta' bejn il-Kmiemen u l-Iskoll ta' Taħt il-Mazz, Ramla tat-Torri / Rdum tal-Madonna, Selmunett, L-Inħawi tal-Imġiebah tal-Miġnuna, and L-Inħawi tal-Għadira.

Marine Ecology

1.19. The Area of Study (AOS) for marine ecology described in the original AA is shown in **Figure 1.3**. Surveys were undertaken for the original EIA through remote sensing and grab sampling within the area marked ABCD. Data on the physico-chemical attributes of the water column and of the soft sediment seabed in the vicinity of the farms were collected. The soft sediment habitat was also sampled to establish the associated species of flora and fauna.

Impact Assessment Criteria

1.20. The Terms of Reference for the original AA required '*An evaluation of the way in which the integrity of the site and their species, habitats and ecosystems are likely to be affected by the project...'*. There was also a requirement to discuss the significance of relevant impacts.

1.21. In assessing the significance of the potential negative impacts arising from the Scheme on the marine habitats and species of conservation interest in the area, the assessment is carried out with the ethos that the site integrity and conservation status should be maintained and there should not be a conflict with conservation objectives.

1.22. The following criteria[2] for determining significance have been used to guide the assessment:

- Areas of important habitat are destroyed or modified;
- Major and measurable change in the physico-chemical status of the marine environment;
- Invasive species are introduced.

1.23. In terms of species, in particular the breeding seabirds, impacts would be considered likely to be significant if:

- Any modification (including fragmentation, altering nutrient cycles or other physico-chemical dynamics) occurs to habitats of importance to the species' ecology;
- Introduces invasive species into a habitat that is important for the species;
- Seriously disrupts the lifecycle (breeding, feeding, migration or resting behaviour) of the species' population.

[2] Developed with reference to the Methodological Guidance on the provisions of Article 6 (3) and (4) of the Habitats Directive published by the European Commission in 2001.

Figure 1.2: Avifauna Area of Influence

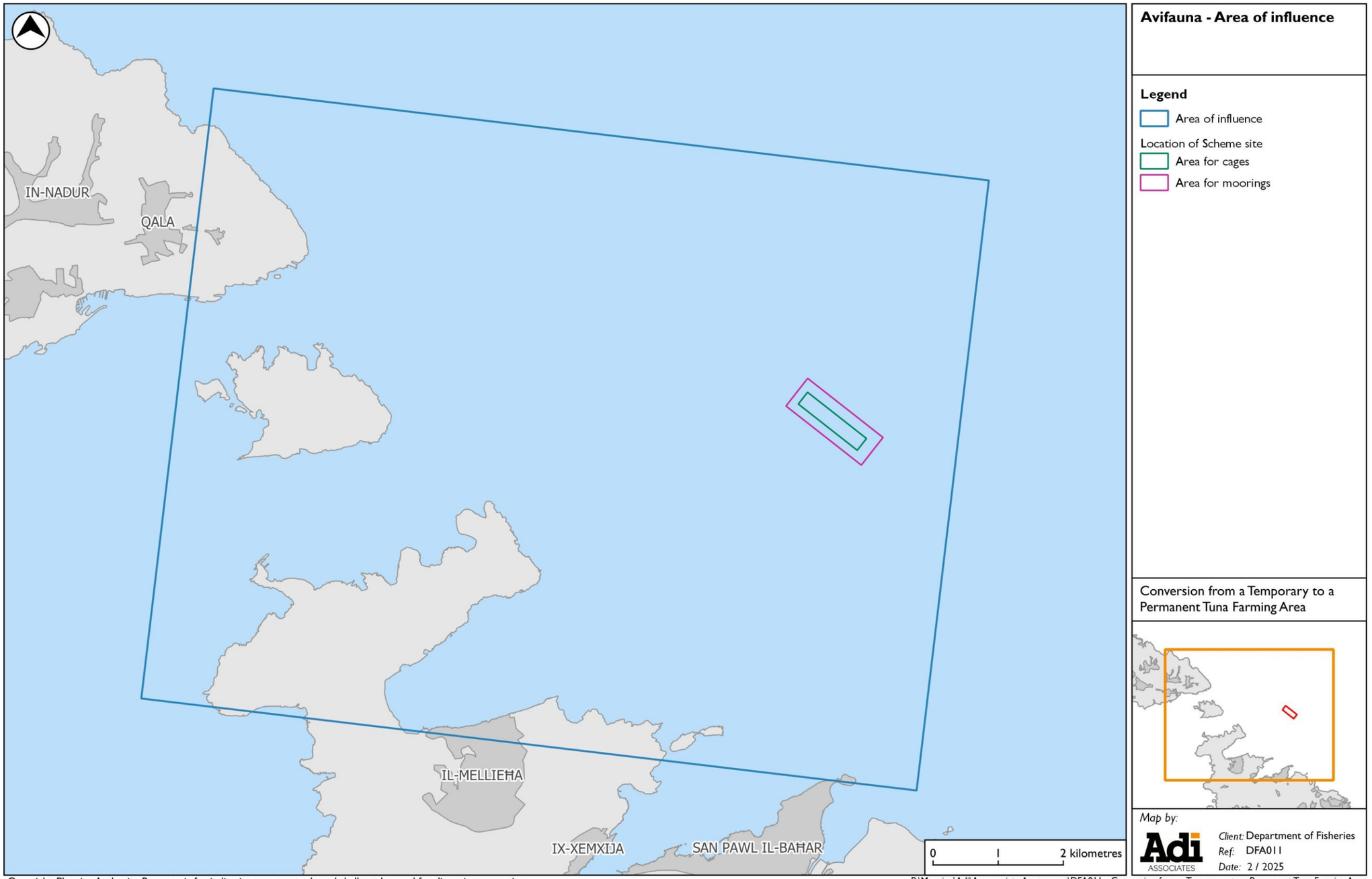

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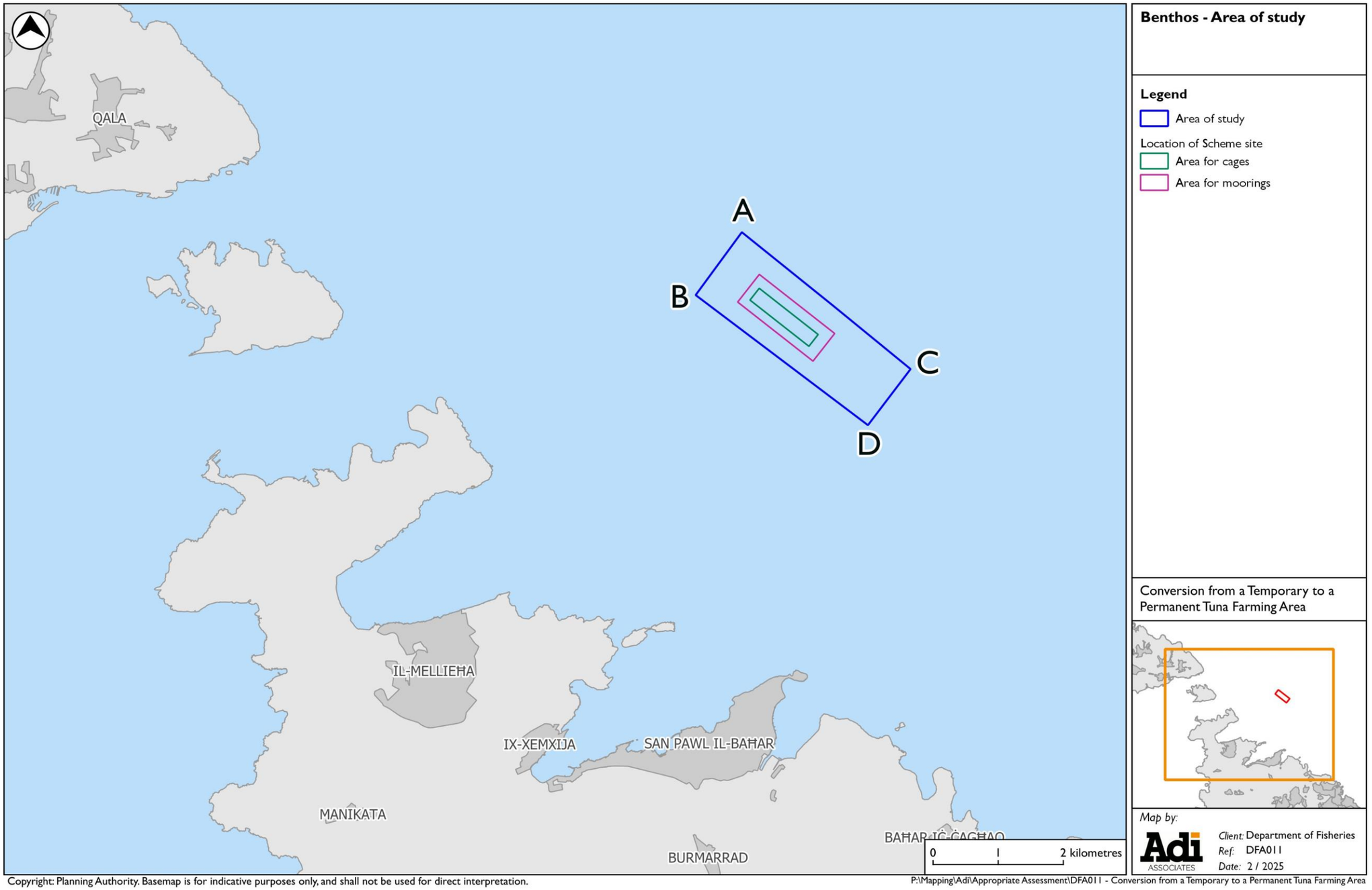
Figure 1.3: Marine Ecology Area of Study



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2. SCHEME DESCRIPTION

PURPOSE OF THE SCHEME

2.1. As explained in the original EIA of 2019, the purpose of the consolidation of the tuna farming operations into one operation was to improve the existing fish farm operation in an attempt to address some of the challenges that were encountered in previous years, which were largely a result of not having sufficient cage space to optimally support the farm's tuna quota. The proposed changes to the Scheme are intended to maintain the current operation in the longer term, with the facility being converted to a permanent one as opposed to the current temporary nature established by the development permit, which requires the tuna farm to be relocated to the new North Aquaculture Zone when this is established.

BACKGROUND TO THE SCHEME

Operations – the Tuna Penning Process

Tuna capture and transfer to farm

2.2. Tuna are caught by purse seining on the high seas. This activity is allowed under ICCAT[3] rules for a restricted time during the year as the fish are migrating through the Mediterranean Sea. There are no Maltese purse seiners and therefore the fish are caught by foreign vessels from whom the Applicant purchases stock.

2.3. The tuna caught in the purse seines normally range in size from 50 to 300 kgs, with the vast majority of the fish being between 100 and 200 kgs.

2.4. Once the tuna are caught in the purse seines and the required amounts are purchased, they are led through openings in the purse seine into the farm's fattening cages. Once the cages are filled with the required stock, they are slowly towed to the on-growing site[4] where they are anchored in position to the mooring system that would have already been deployed.

2.5. The entire operation is overseen by ICCAT international observers.

Penning

2.6. Once on the farm, the tuna are fed and fattened, largely a process of conditioning, through which the fat-to-protein ratio is adjusted through a high fat diet. The fish are kept in the pens for between 3 and 7 months, after which they are harvested and sold mainly to the Japanese market.

[3] ICCAT is the International Convention for the Conservation of Atlantic Tunas.

[4] Towing speeds rarely exceed 1 knot, with the transfer taking a number of weeks (depending on the distance between the catch area and the farm).

2.7. The transhipment of tuna to fattening pens is considered to be a landing operation and the catches involved must comply with regulations in force[5] as well as ICCAT requirements.

Feeding and feed management techniques

2.8. The tuna are fed small pelagic fish, usually, herring, mackerel, anchovy, sardines, etc. It is estimated that it takes 10-25 kgs of baitfish to produce 1 kg of tuna (EC, 2004)[6].

2.9. The feed is ordered from a number of suppliers and five reefer containers with feed arrive daily in Malta. These are stored at the Freeport. Every day a number of containers (usually between 1 and 4, depending on the stock) are transferred to the Kordin land base facility operated by AJD Tuna Ltd (**Figure 2.1**). The fish are transferred from their transportation packing and placed in impermeable jumbo bags (**Figure 2.2**) and then placed in sealed trucks, where they are allowed to partially thaw overnight (**Figure 2.3**).

2.10. Early next day (around 4:00 am), the fish are transferred to the Grand Harbour where they are loaded onto feeder vessels (**Figure 2.4**). Once loaded, the vessel sets sail towards the farm. The thaw water in the trucks is drained into IBCs and collected by a licensed waste contractor.

2.11. The tuna are fed once a day, at dawn. Semi-frozen baitfish are normally placed in small feeding cages floated at the centre of the pen (**Figure 2.5**), and once they have been thawed enough, the central cage is opened by divers and the fish dispensed into the pen. The divers monitor the tuna and control the amount of feed released into the pen to minimise wastage. Once the tuna are satiated, the diver stops feeding. The process may be repeated two hours later; however, if the tuna are satiated, any remaining fish can be lifted from the pen and transferred to other cages.

2.12. In order to optimise efficiency, it is necessary to ensure that when fed to the tuna the baitfish are not completely defrosted so that the high calorific oils are ingested too and not lost from the feed. Nonetheless, the process does involve the development of an oily slick originating from the semi-frozen feed. To address this issue, a number of measures have been taken throughout the past season. These include:

- The baitfish is being imported as IQF, i.e. "individually quick frozen." IQF foods are notable for the fact that each individual piece of food is frozen separately from all the others. In this case, rather than a block of frozen fish (as used to be the case in the past years, each baitfish is now individually frozen and delivered as a separate fish. They are also typically in a semi-frozen state, which minimise the

[5] Council Regulation (EU) 2016/72 of 22 January 2016 fixing for 2016 the fishing opportunities for certain fish stocks and groups of fish stocks, applicable in Union waters and, for Union fishing vessels, in certain non-Union waters, and amending Regulation (EU) 2015/104

[6] European Communities, 2004. Tuna: a global fishing activity. Fishing in Europe No. 23. Directorate-General for Fisheries, European Commission, September 2004.

production of oils in thaw water.

- The baitfish is retained in the impermeable jumbo bags in the sealed trucks while transported from the land base in Kordin to the farm to contain the thaw water;
- The jumbo bags are delivered to the farm onboard feeder vessels. These vessels are bunded / sealed so that the thaw water from the bags is contained onboard. The vessels are certified by NAS. The thaw water is then collected from the feeder vessel by the oil containment vessels;
- An oil boom is permanently deployed inside each cage to contain any fish oils that may be released from the feed;
- When the baitfish are transferred to the fattening cages, they are transferred inside the impermeable jumbo bags referred to above and their contents emptied inside the cage when the tuna are ready to be fed. This would release both the baitfish and some of the thaw water inside the cages; however, the presence of the oil boom along the entire internal diameter of the cage contains much of the oil that rises to the surface inside the cages[7];
- The oily material so released and contained in the cages is then collected from the surface of the sea inside the cages by means of a skimmer (see **Figure 2.6**) operated by divers inside the cages. The collected oil is stored in IBCs and transferred to land for onward transmission to a waste oil recycling company;
- The tuna farm operators also appointed Aquaculture Resources Ltd to deploy three oil containment vessels to patrol the seas between the tuna penning locations to help contain and collect any oils that escape, including oils that may rise to the surface outside the cages themselves[8].

Harvesting and processing

2.13. Harvesting of fresh tuna is largely on demand, although the vast proportion of the tuna is today being harvested for the frozen fish market.

2.14. When harvesting occurs, the bottom of the net is raised to a degree, forcing the fish closer to the surface. Slaughtering is particularly delicate since the amount of stress the fish are subjected to must be kept low because if the fish are stressed their body

[7] This would depend on the state of the sea. Under calm conditions, the surface slick is mostly retained inside the cage; on the other hand, strong swell could result in overtopping of the oily slick outside of the cage containment. In this case, external oil spill containment / spill collection vessels would need to be deployed.
[8] Unfortunately, as also confirmed by the Environment & Resources Authority (consultation meeting, December 2024), sometimes, the oils from the baitfish are released in deeper water as the baitfish sink inside the cage. This oil often drifts out of the cage (possibly also as a result of the swimming frenzy of the tuna during the feeding) and the oil ends up surfacing some distance from the cages. In these circumstances, the oily sheen and the possible formation of oily slime might not be noticed in time for the patrolling vessels to intervene and collect it resulting in the slimy material drifting away from the farm under the action of currents and waves.

temperature rises sharply, which would compromise the quality of the meat[9]. Slaughtering is carried out by divers who enter the cage and harvest the tuna one by one by shooting them in the head.

2.15. The tuna are transferred to a service vessel by crane (**Figure 2.7**) from where they are then quickly transported by service boats (**Figure 2.8**) to a waiting processing vessel anchored further out at sea (**Figure 2.9**). Onboard the ship, the tuna are weighed, heads and tails are cut off and the guts removed. The head, tails and guts of the tuna, which amount to approximately 30% by weight, are a waste by-product of the industry. These used to be disposed of at sea beyond the 12 nautical mile limit as directed by the Veterinary and Phytosanitary Regulation Department. However, following the establishment of Aquaculture Resources Ltd by the Federation of Maltese Aquaculture Producers and the construction of a rendering plant in Hal Far, this waste by-product is being collected and transformed into valuable products, including protein-rich fish meal and Omega-3 and Omega-6 fish oils. These materials are essential for the cosmetic, pharmaceutical, and agricultural industries (Aquaculture Resources Ltd, 2024[10]). The operation typically generates approximately 8-10 tonnes of offal per day during the peak fattening period.

2.16. Any tuna that die are either sent to the rendering plant (if still in a good state), incinerated at the Abattoir facility, or disposed beyond the 12 nm limit.

2.17. If the harvested fish are to be sold to the fresh fish market, they are normally processed onboard the service boats (not the processing vessels / freezer ships) and at the land base facility in Marfa or the Azzopardi fish shop in St Paul's Bay (**Figure 2.10**). In this case, processing must take place in a short time interval in order to minimise the length of time that the fish remain at ambient temperatures. The fish are processed in the same manner as described above, except that rather than blast frozen, the fish are cooled in an ice and salt mixture to the desired temperature and packed in purposely designed carton boxes for export.

2.18. The fresh fish produce is air freighted to its final destination, whereas the fish intended for the frozen fish market are transferred to a reefer vessel or exported on the same factory vessel on which they were processed.

Post-harvest

2.19. Following harvesting, between November and May, the Applicant is allowed to keep

[9] Tuna maintain body temperatures between 15 and 20 degrees centigrade above surrounding water. However, stress will lead to an alarm reaction and secretion of hormones in preparation for emergency action. As part of the process, the body temperature can rise up to 40 degrees centigrade above the surrounding water, compromising the redness of the flesh once the fish has been slaughtered (See http://www.niri.co.jp/agroup/maguro3.pdf).

[10] Aquaculture Resources Ltd website. https://aquacultureresources.com (last accessed on 20 December 2024).

up to 15% of the stock in the cages for research purposes[11]. The fish so retained are fed between two and three times a week during this period. However, over the past two years, no overwintering has taken place.

Stocking Density

2.20. The stocking density of the fish in the cages is a crucial factor in aquaculture that has an important bearing on mortality and the quality of the fish produced. With respect to the Scheme, each cage is proposed to contain approximately 1,200 fishes with an average mass of 115 kg, which means that each cage contains around 137.5 tons of fish. This stocking density in the cage corresponds to the maximum capacity of the farm, as defined by the ICCAT[12].

Antifouling and net cleaning

2.21. No anti-fouling or other chemicals are used on tuna nets, since unlike the nets of traditional finfish aquaculture units, which remain in the water for an extended time period, the tuna nets are removed at the end of the season for drying.

Feed supplements, chemicals and antibiotics

2.22. As explained earlier tuna are only fed baitfish. No feed supplements or other chemicals or vitamins are used to date. Equally, since the tuna are effectively wild and only kept on site for fattening, i.e. they are not actually farmed[13], no chemicals or antibiotics are used[14]. Mortalities are more effectively controlled by lowering stocking densities and monitoring the fish for any signs of stress.

Storage of feed and packing materials

2.23. The Applicant operates two land bases (see **Figure 2.11**). One land base is situated in Marfa and is used for packing and processing of fresh fish for export by air freight. The second land base is located at the Kordin industrial estate and is used to receive and prepare the bait fish as well as for the washing and storage of crates. A third site in Mağtab is used to store cage materials and nets and ancillary materials.

[11] Research in tuna spawning and farming of fry has been undertaken by the Applicant over the past years in conjunction with the Department of Fisheries and Aquaculture, MCAST and the University of Malta (Azzopardi, C., pers. comm., Oct 2016).

[12] However, in view of ICCAT Regulations that tuna caught under different jurisdictions / certification cannot be mixed, the farm requires a degree of flexibility in the number of cages it can deploy within the approved farm area to cater for the approved biomass.

[13] The process is more appropriately called tuna ranching than tuna farming.

[14] Had these to be used, they would be similar to those already in use in the other finfish aquaculture operations.

Figure 2.1: Kordin land-based facility

Figure 2.2: Frozen feed transferred to jumbo bags

Figure 2.3: Truck with feed in jumbo bags left to partially defrost

Figure 2.4: Feed being loaded on to feeder vessel

Figure 2.5: Loading of semi-frozen baitfish into feeding cage

Figure 2.6: Skimmer

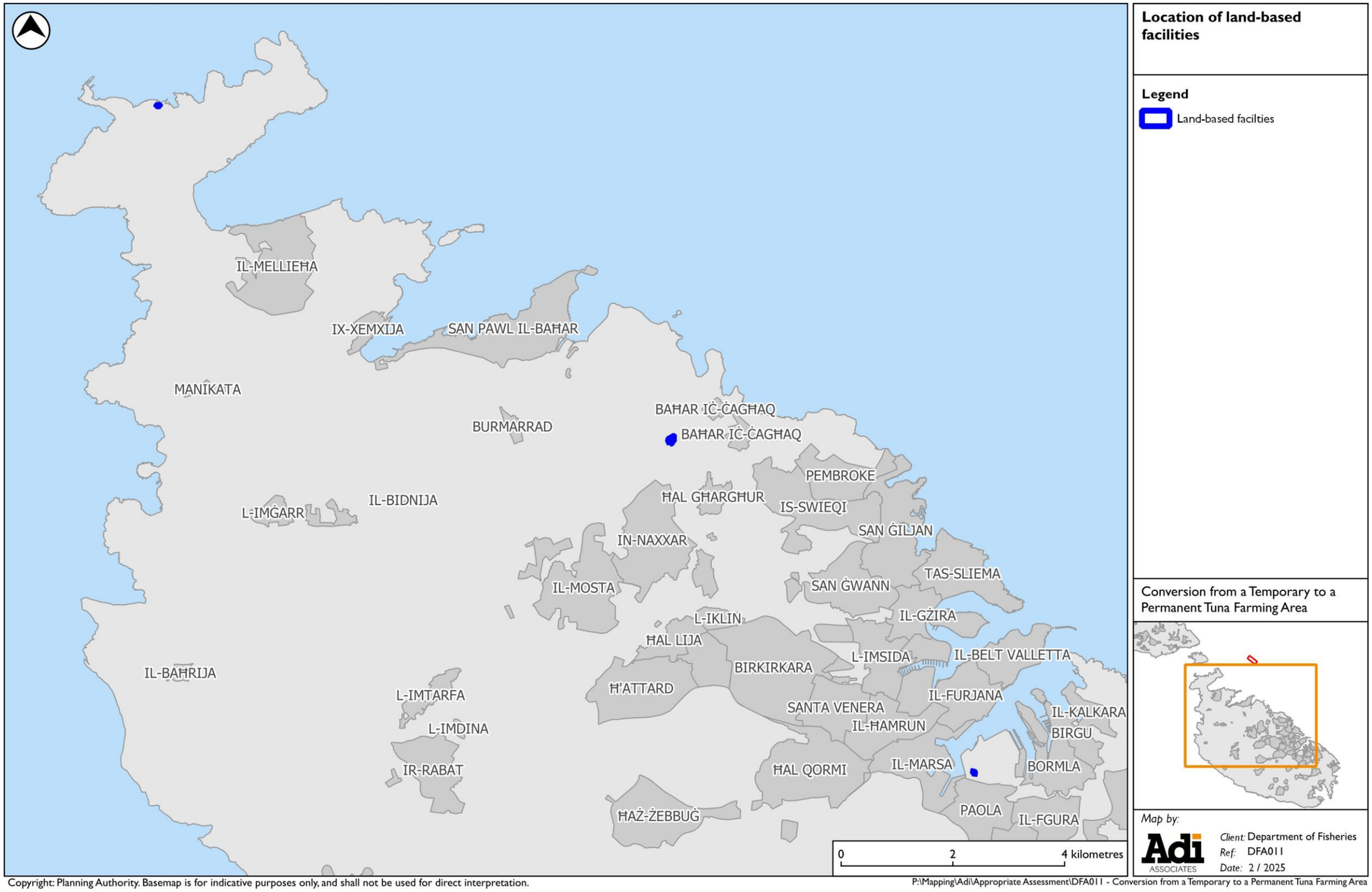
Figure 2.7: Tuna harvesting

Figure 2.8: Service boat transferring tuna to processing vessel

Figure 2.9: Processing ship

Figure 2.10: Marfa land-based facility

Figure 2.11: Map indicating location of land-based facilities in Marfa, Magħtab, and Kordin



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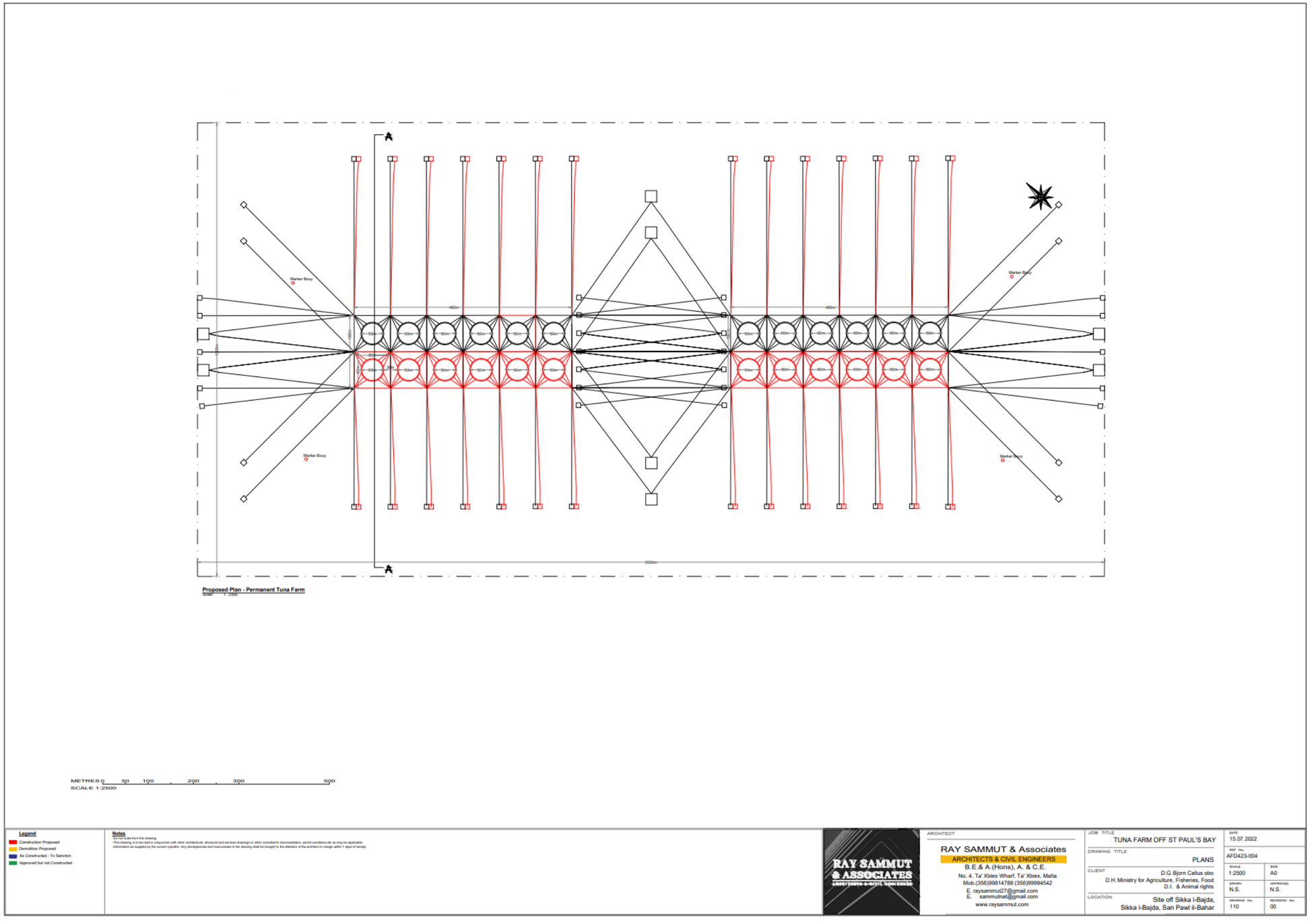
2.24. **Figure 2.12** illustrates the proposed cage layout of the Scheme, which is the same as that of the current temporary operation. Each cage is a circular area with a diameter of 50 metres. The distance between the sides of the nets from the cages is 30 metres. The mesh size of the net is 70 x 70 mm, and the twine diameter is 5 mm.

2.25. The Scheme will essentially operate in the same way as it does currently. The following lists the types of vessels used in the operations, all of which are registered with ICCAT, as per requirements:

- Three feeding vessels (one also used to collect and transport offal);
- Two service boats; and
- One vessel for oil collection operations.

2.26. The Applicant's main client sends over the processing ship where the fish are transferred and processed following harvesting.

Figure 2.12: Cage layout



Waste management

2.27. Wastes generated by the Scheme are likely to include:

- Packaging waste from importation of baitfish;
- Thaw water from baitfish preparation;
- Oily slick (from baitfish);
- Uneaten feed;
- Fish excreta;
- Dead tuna;
- Blood (during slaughtering);
- Wastewater from onboard processing of fish (mixture of blood, water, and offal);
- Offal (gutted heads, tails, and internal organs);
- Algal and other net fouling marine growth; and
- Marine litter.

Packaging waste and thaw water

2.28. This waste stream is generated at the land bases as a result of the importation of baitfish. The Applicant has a contract with a third party who takes the packaging waste away for reuse. Thaw water at the land base is collected in the sealed trucks (see earlier) and drained into IBCs. These are collected by a licensed waste contractor authorised to handle such wastes. The use of impermeable jumbo bags for the transportation of the baitfish from the land base to the farm ensures that this oily material is not lost to the environment until the baitfish is placed inside the cages, from where it is collected – see below.

Oily slick

2.29. The oily slick generated at the farm is essentially a combination of fish oils, melting ice, body fluids, and fish mucus released from the baitfish as it thaws in the feeding cage. Although this oily slick can extend over a considerable area as it is carried on the surface of the water by surface currents, it is restricted to the immediate surface of the sea and does not dissolve into the rest of the water column, until it is dispersed or evaporates. Nonetheless, this "slime" creates significant nuisance to bathers and other marine users and for the past years, the tuna farm operators have been taking measures to reduce these impacts through pre-feeding collection of thaw water, use of oil booms and skimmers at the farm and deployment of vessels to track and collect escaped oil slicks. These measures are reported in the farm's annual environmental report in line with their environmental permits. Unfortunately, despite the deployment of vessels and the increased reporting, the containment or collection of oily slime is not 100% effective and escapes of this material do take place. On 6 August 2024 a major incident fuelled by increased slime production and prolonged current action towards the coast resulted in the slime hitting the beach at Ħondoq ir-Rummien in Qala, Gozo. Following this incident, the ERA instructed the

Federation of Maltese Aquaculture Producers to increase its resources and cleaning vessels patrolling the coast (ERA, pers. comm, 2024[15]).

Uneaten feed

2.30. In addition to adding to the costs of the fish farming operation, uneaten feed (especially the baitfish used in tuna penning operations) passes through the net and settles on the seabed, which, depending on the amounts lost in unit time, can result in overloading of the scavenging community and an accumulation of organic carbon and nitrogen in the sediment beneath the cages or in the direction of the prevailing currents.

2.31. Uneaten baitfish that deposits on the bottom of the sea will start to decompose, releasing gases such as hydrogen sulphide[16] and ammonia. These gases are insoluble in seawater and therefore rise through the water column until they reach the surface where they produce unpleasant odours, which, depending on the prevailing wind currents at the time, could be blown towards the coast.

2.32. The capacity of the environment to assimilate the pollutants settling on the seabed depends largely on the amount of settlement of material and the capability of seabed bacteria and scavengers to utilise this material.

2.33. The Applicant has carried out monitoring of the seabed, sediment and water quality on an annual basis as per permit conditions at the Scheme site since 2019. In addition, the ERA have started to request annual sediment sampling at the tuna farms during the peak season.

Fish excreta

2.34. Like uneaten feed, fish excreta contain or release ammonia, nitrates, and phosphate in soluble form. These nutrients can enhance the growth of marine plants and algae (including phytoplankton). Some of these nutrients are taken up by algae and net-fouling assemblages and also by benthic dwellers and scavengers. Faeces are nitrogen depleted and phosphorus enriched compared with feed (Fernandes *et al*., 2007)[17]. Fernandes *et al* (2007) studying dissolved nutrient release from solid wastes of southern bluefin tuna (*Thunnus maccoyii*) identified that the phosphorus available for leaching from baitfish and faeces of baitfish-fed tuna was around 17-21% whereas the proportion of soluble nitrogen was 35-43%. They concluded that more than 90% of nitrogen loads and approximately 50% of phosphorus are likely to be released into seawater before solid wastes reach the seafloor.

[15] Consultation meeting with ERA held on 26 November 2024.
[16] Hydrogen sulphide is also very poisonous to farmed fish.
[17] Fernandes, M., Angove, M., Sedawie, T., Cheshire, A. 2007. Dissolved nutrient release from solid wastes of southern bluefin tuna (*Thunnus maccoyii*, Castelnau) aquaculture. Vol 36 (4). Aquaculture Research.

Dead tuna

2.35. Tuna deaths are mainly a result of stress or panic, especially when the nets billow under strong currents. The number of deaths is limited as far as possible by closely monitoring the tuna and culling any fish that shows signs of stress or are moribund. Hence, few if any deaths actually occur. Any dead tuna are either processed through the rendering plant (if still of good quality), or taken to the abattoir for incineration, or disposed of at sea beyond the 12 nm limit.

Blood

2.36. During harvesting, the tuna have to be killed in a very short time interval so as to avoid a sudden increase in body temperature that would negatively affect the quality of the meat. Some blood is released into the sea when the fish are killed and handled prior to being transported to the processing vessel.

Wastewater from onboard processing of fish (tuna)

2.37. The further processing of the tuna onboard the processing vessels invariably results in the generation of wastewaters mixed with blood and possibly some offal. The vessels have holding tanks (bilges) where wastewater is collected (Azzopardi, C., pers. comm.; Nov 2024). The bilge waters are typically released into the marine environment in international waters in line with IMO regulations.

Offal

2.38. Tuna processing creates a substantial amount of offal, which is composed of the internal organs, the tails, and the heads of the tuna. During harvesting, the current farm generates between 8 and 10 tonnes of offal per day. As explained, offal used to be disposed of beyond the 12 nm limit, whereas following the setting up of the rendering plant in Hal Far by Aquaculture Resources Ltd, the offal is being transferred to land and processed into other valuable products, such as fish meal or fish oils.

Net fouling marine growth

2.39. Marine growth on tuna nets is removed through air drying on the collars and later by scraping on land. The growth that is removed on land is disposed of as organic waste.

Marine litter

2.40. Other wastes generated by the farms could include anthropogenic material such as rope, boxes, and municipal-type wastes from the service vessels that may occasionally find their way overboard. The monitoring reports for this site have repeatedly made reference to the presence of anthropogenic waste associated with the fish farm operations on the seabed. Any such material will need to be collected and disposed onshore. In addition, the environment permit issued by ERA for the current operation also includes an obligation for the operator to collect any floating anthropogenic materials in the farm area, whether they originate from the operations or from outside.

Employment

2.41. The Applicant currently employs 55 full-timers and 40 part-timers. Employees include divers, boatmen, handymen, and drivers. This will not change.

ASSESSMENT OF ALTERNATIVES

Alternative Sites

2.42. Since the proposal for the Scheme is to retain the current site and operation and simply convert the operation from a temporary to a permanent one, no alternative sites have been considered for the Scheme. As mentioned, the North Aquaculture Zone (now referred to as Northeast Aquaculture Zone – NEAZ), which was originally intended to house the present operation, is now earmarked for a different form of aquaculture, focusing on other species and excluding bluefin tuna.

Zero Option (Do-nothing Scenario)

2.43. The Terms of Reference for EIA requires that the alternative assessment considers the zero option, or do-nothing scenario, which envisages there being no intervention in connection with the Scheme. Since the Scheme effectively proposes the continuation of the current operations at the same site indefinitely, two "do-nothing" scenarios can be considered: (i) not changing the status quo operationally, which is effectively the Scheme proposal; and (ii) not amending the policy direction, which would mean that the do-nothing scenario would entail the removal of the tuna farming operation from this site and its relocation elsewhere. This latter scenario would mean that the current site used by the Scheme would experience the elimination of impacts currently experienced from the farming operation and would likely revert to a state that very much approximates the situation prior to the installation of the farm (assuming that the site is not used for some other operation). In this scenario and seeing that the tuna farming operation is a permitted operation but has a condition for relocation, would mean that any impacts from the aquaculture operation would simply be transferred to another site. The impacts of this relocation would depend on the characteristics and conditions of the relocation site, which, as explained, will no longer be the site originally identified for the setting up of the NAZ.

2.44. The "Do nothing" scenario which leaves the current operations unaltered, is the Scheme proposal itself. In this scenario, which is further assessed in the following chapters, the impacts identified in the original EIA, and which were considered to be temporary and reversible, could become permanent and potentially irreversible. The impacts of the Scheme are considered in the next chapters.

Alternative Layouts and Techniques

2.45. The Scheme's retention at the site would not result in any change to the design or techniques used for its operation. The same moorings, mooring lines, cages etc, would be used for the permanent installation. The only change would be the shifting of some of the cages to be permanently outside of the Armed Forces of Malta firing arc.

3. DESCRIPTION OF THE SAC/SPA

MARINE

Żona fil-Baħar bejn Il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet SAC

3.1. The site falls within SAC MT0000105 *Żona fil-Baħar bejn Il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet*. The extent of this marine Natura 2000 site is illustrated in **Figure 3.1**. Given the relatively large size of this SAC, the seabed geomorphology within this site is particularly heterogeneous giving rise to a number of varied seascapes, bottom types, and a number of different habitat types.

Quality and importance of the SAC

3.2. Three Annex I habitats have been described within this SAC:

- ***Sandbanks which are slightly covered by sea water all the time*** (Habitat 1110) – There is little data available regarding this habitat type in the Maltese Islands and the Standard Data Form (SDF) specifies that the extent of this habitat type is not known. However, sandbanks with associations of *Cymodocea nodosa* have been recorded and the following subtypes occur:
    - Sandbanks with associations of *Cymodocea nodosa* on well-sorted fine sands;
    - Sandbanks with associations of *Cymodocea nodosa* on superficially muddy sands in sheltered waters; and
    - Facies with *Cymodocea nodosa* occurring within coarse sands and gravels with more or less mud.
- ***Posidonia beds*** (Habitat 1120) – This SAC hosts a large variety of Posidonia sub-types, and the SDF considers that the representativity of each is relatively superior. Subtypes noted to be present as reported in the SDF include:
    - *Posidonia* settled on matte, whose meadows are normally continuous and having a high density;
    - *Posidonia* settled on rock, showing a reticulate distribution of dense strands;
    - *Posidonia* settled on sand, with continuous beds generally showing low densities and variable percentage cover;
    - Mosaic morphology, intermixed between *Posidonia oceanica*, *Cymodocea nodosa* and coarse sand, showing a reticulate structure; and
    - Ecomorphosis of 'barrier reef' *Posidonia* meadows.

  The *Posidonia* within this SAC is described as having a high connectivity and percentage coverage. MEPA's *Posidonia* Baseline Survey carried out in 2002 revealed that *Posidonia* in various parts of this SAC are healthy and abundant. The meadows are dense and show a high degree of shoot density, particularly in

White Tower Bay, which, as reported in the SDF, seemingly hosts perhaps the highest shoot density in the Mediterranean. Records for the deepest areas where *Posidonia* has been recorded are held within this SAC, specifically off the south coast of Comino. Signs of regression of the meadows have, however, been reported at, for example, Mistra Bay and Mellieha Bay as a result of anthropogenic activities. *Steromphala nivosa*, considered as the only endemic marine mollusc of the Maltese Islands is associated with this SAC and has been found on *Posidonia* leaves as well as under stones.

- ***Reefs*** (Habitat 1170) – During the 2002 survey, reefs of the following subtypes were identified within this SAC:
    - Reefs with associations of *Dictyopteris polypodioides*;
    - Reefs with associations of *Halopteris scoparia* and *Padina pavonica*;
    - Reefs with associations of *Flabellia petiolata* and *Peyssonnellia squamaria*; and
    - Reefs with associations of *Cystoseira* spp.
- ***Partially submerged caves*** (Habitat 8330) – These are mostly located along the coast of Comino. Species of conservation interest associated with this habitat type include *Lithothamnion minervae*.

Pressures on and vulnerability of the SAC habitats

3.3. Threats, pressures and activities that result in impacts on the site as listed in the SDF include:

- Water pollution / pollution from run-off as a result of fertilisation, use of biocides, hormones and chemicals, household waste / recreational facility waste / discharges;
- Leisure and recreation facilities / recreational activities / nautical sports;
- Noise pollution;
- Collapse of terrain;
- Hunting / fishing / collecting activities;
- Professional fishing;
- Acid rain;
- Ports;
- Invasive, non-native species; and
- Shipping lanes.

Żona fil-Baħar madwar Għawdex SPA

3.4. Żona fil-Baħar madwar Għawdex (MT0000112) surrounds Gozo and Comino and the northern tip of Malta as shown in **Figure 3.2**. The SPA covers an area of approximately 556.7 km^2.

3.5. This SPA was included in the Maltese marine Important Bird Area (IBA) inventory as a result of the EU LIFE+ Malta Seabird Project (LIFE10NAT/MT/090) due to its importance for *Calonectris diomedea*, and *Puffinus yelkouan* during the breeding season.

3.6. The Standard Data Form reports a population of 7,300 for *Calonectris diomedea* and a population ranging from 3,270 to 4,650 birds for *Puffinus yelkouan*.

TERRESTRIAL

3.7. **Figure 3.3** shows the terrestrial sites located on the eastern coast of the islands. Those being considered within the scope of this AA in view of the populations of breeding seabirds within each, are discussed in more detail below.

L-Inħawi tar-Ramla tat-Torri u tal-Irdum tal-Madonna SPA

3.8. As reported in the Management Plan (2015), this site supports between 366 and 544 breeding pairs of *Puffinus yelkouan,* an Annex I species (Birds Directive). L-Irdum tal-Madonna supports the largest colony of breeding Yelkouan Shearwaters in the Maltese Islands. This species belongs to the family Procellariidae, whose characteristic feature is a pair of tube-like nostrils on the end of their beak to filter out salt. *P. yelkouan* feeds mainly on small fish, crustaceans and cephalopods. The birds start to arrive at the colony to breed in October, flying in at night. Eggs are laid at the end of February-beginning March. The egg is laid on bare ground in a burrow or crevice. Nesting sites are located from 2-120 m above sea level, although some nests are closer to the top of the cliffs. Incubation is carried out for about 50-52 days, and both partners participate. Chicks hatch in the third week of April. The birds leave the colony at the end of July. Birds reach breeding maturity in their third or fourth year, although some juveniles may return to the colony in the meantime. This species breeds alongside *Calonectris diomedea* at this site although only 8-10 breeding pairs of *C. diomedea* make use of this site. Direct competition is avoided because breeding seasons do not overlap exactly. *P. yelkouan* begin breeding earlier than *C. diomedea*. Each species is then undertaking different aspects of this phase and in this way competition for food is minimised, e.g. when *P. yelkouan* are feeding the young, *C. diomedea* are incubating. However, cases of nest eviction of *P. yelkouan* by *C. diomedea* have been recorded (Sultana *et al*, 2011). Fishermen have been known to take these birds at sea to use as bait. Between 2000 and 2006 the main cause of Yelkouan mortality was rat predation. Other causes included predation by domestic ferrets *Mustela putorius furo* and/or possibly wild weasels. Increased human disturbance results in reduced numbers returning to the breeding colony in following years. Another threat to this species is light sources on the mainland. Attracted by the light fledglings have been recovered inland where they were found to be disoriented (Sultana *et al*, 2011). In 2008, IUCN and Birdlife International revised this species' status from Secure to Near Threatened. The Management Plan assigns a

conservation status of A (favourable) for *P. yelkouan* at this site.

3.9. *C. diomedea* is also an Annex I seabird of the family Procellariidae. This species makes its first landfall just prior to breeding in late February. By the second week of March, many of the birds have reached the colony, paired up, set up nest and mating begins. A single egg is then usually laid at the end of May. The egg is laid on bare ground, although this is often surrounded by material such as dry twigs, feathers, and pebbles. All females lay their eggs within a few days of each other. Both parents incubate the eggs, with the male taking the first incubation sitting, which on average lasts 4.5 days (Sultana *et al*, 2011). Incubation lasts up to 52 days. The main fledging period is the first half of October, and the colony is generally deserted by the end of October. Males start to breed aged 4-6, whilst females reach maturity in their 5th or 6th year. This species exhibits strong site tenacity, with pairs using the same nests year after year. Lifespan can exceed 25 years. *C. diomedea* prefers nesting sites with extensive vegetation cover (Sultana *et al*, 2011). Breeding success in the Maltese Islands is deemed to be relatively low and is attributed to direct human persecution and predation by rats, cats, and dogs. This species has been provisionally rated as Vulnerable by Birdlife International. The Management Plan assigns a conservation status of B (inadequate) to *C. diomedea* at this site.

3.10. Metzger *et al* (2015) also reported the presence of a small breeding colony of the Storm Petrel (*Hydrobates pelagicus melitensis*[18]) at Rdum tal-Madonna of about 1-10 breeding pairs. As reported by Sultana & Borg (2011)[19], the Mediterranean Storm Petrel is asynchronous in its breeding behaviour whereby the egg-laying period spans four months (April to July) and courtship is still at its peak in mid-May. The latest birds leave by October.

3.11. As noted in the Management Plan as well as **Appendix 3** to this report, the marine environment in front of the colonies used for rafting is also an important consideration in the ecology of these seabirds and their breeding success.

Kemmuna u l-Gzejjer tal-Madwarha SPA

3.12. Kemmuna u l-Gżejjer ta' Madwarha is a Special Protection Area because of the important breeding *P. yelkouan* and *Calonectris diomedea* seabird populations located along the cliffs as well as other breeding species such as the Short-toed Lark which are ground nesting birds.

3.13. 50-60 breeding pairs of *P. yelkouan* have been recorded from this site as noted in the Management Plan. Colonies are found on Cominotto, north of Comino and west of Comino. Comino is an Important Bird Area of global importance based on this population. *P. yelkouan* colonies have a wider distribution than *C. diomedea* within this SPA. The Management Plan reports the conservation status of *P. yelkouan* as 'A'

[18] This is a Mediterranean subspecies of the European Storm Petrel (*Hydrobates pelagicus*).
[19] Sultana, J. Borg, J.J. 2011. The Mediterranean Storm-petrel *Hydrobates pelagicus melitensis* in Malta. Part 2: Ecology and Conservation of Mediterranean Storm-petrel and Mediterranean Shag. Proceedings of the 13th Medmaravis Pan Mediterranean Symposium

within this SPA.

3.14. 40-60 breeding pairs of *C. diomedea* occur in the northwest of Comino and its conservation status in this SPA is considered to be favourable.

Selmunett SAC

3.15. Selmunett is not an SPA, however, as noted in **Appendix 3**, in the last decade, a small colony of Yelkouan Shearwaters has been re-discovered breeding on the island.

Others

3.16. Whilst the Għadira and L-Inħawi tal-Imġiebah Natura 2000 sites lie within the A of I, they do not support breeding populations of the Annex I seabirds and therefore they do not fall within the scope of this AA.

Figure 3.1: Żona fil-Baħar bejn Il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet Special Area of Conservation

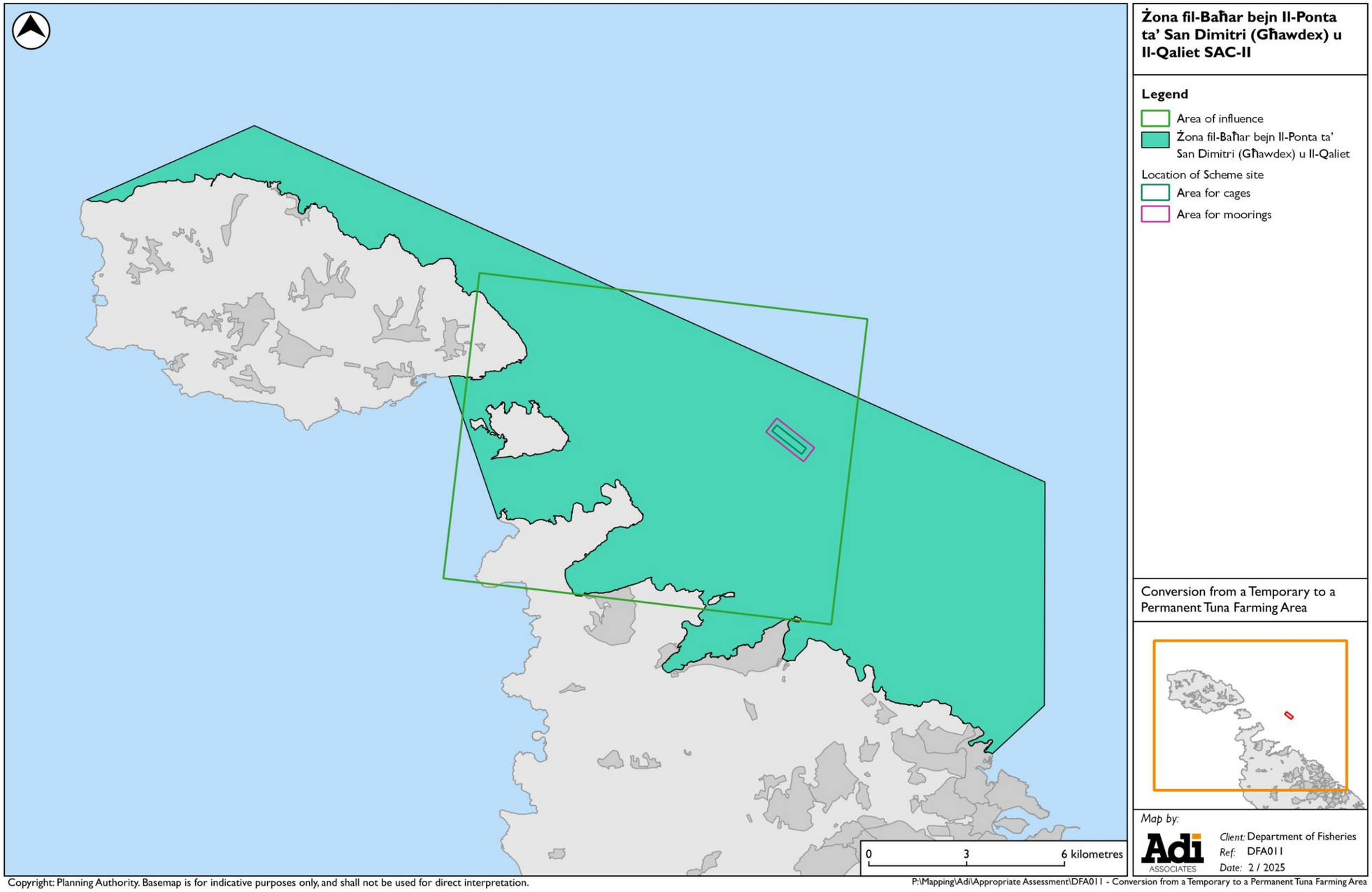
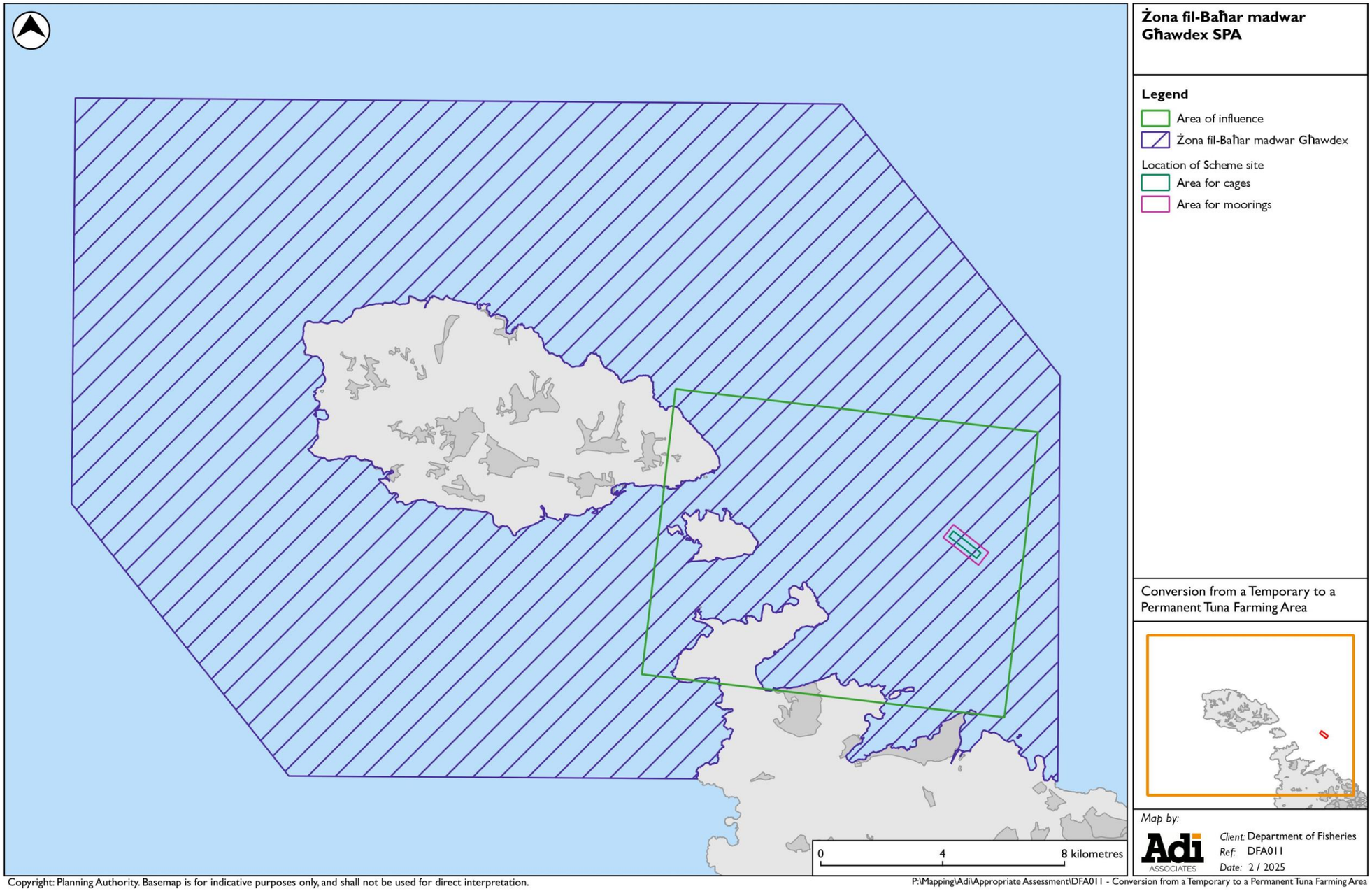


Figure 3.2: Żona fil-Baħar madwar Għawdex Special Protection Area



Copyright: Planning Authority. Basemap is for indicative purposes only, and shall not be used for direct interpretation.

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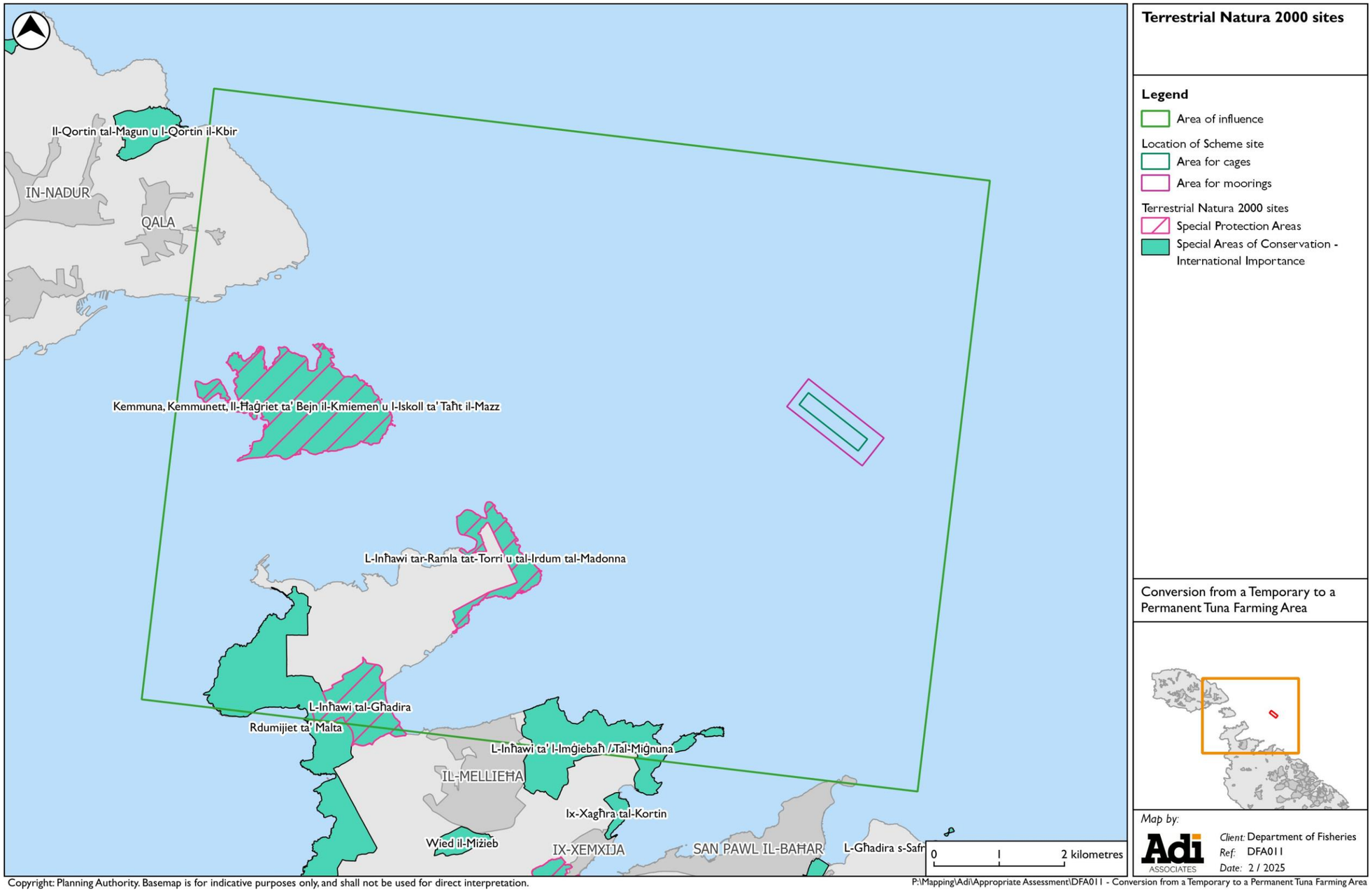
Figure 3.3: Terrestrial Natura 2000 sites



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4. BASELINE STUDIES

INTRODUCTION

4.1. This Chapter describes the ecological communities within the Area of Study considered for the marine ecology study and evaluates the significance of the site in terms of ecological dynamics, conservation status, and applicable policies. The evaluations for the marine environment are based on field studies undertaken for the original EIA/AA, literature reviews and the data from the monitoring reports for the period 2019-2023, whilst the evaluation of avifauna is based largely on existing data gathered over a period of time. No new baseline surveys were undertaken for this AA update.

METHODOLOGY

Baseline studies

4.2. A number of baseline studies on the marine environment were carried out as part of the original EIA for the AJD Tuna Ltd consolidation application (PA/02175/18). The data from these are relevant to the current Scheme and to this Appropriate Assessment. These studies included: (i) sediment and water quality sampling and analysis, (ii) marine ecology surveys (including benthic diversity and benthic habitats mapping), and (iii) avifauna studies.

Sediment and water quality

4.3. Fieldwork in relation to the water quality survey for the original EIA was carried out using a 12 m vessel equipped with hoisting jib and winch. The locations of the six sampling stations, A – D and R1 and R2, are shown in **Figure 4.1**, and their geographical coordinates and water depth are given in **Table 4.1**.

Table 4.1: Sampling locations

Station	Latitude / Longitude	Depth (m)
A	36° 00.584' / 14° 25.780'	50 m
B	36° 00.131' / 14° 26.127'	48 m
C	36° 00.163' / 14° 25.508'	45 m
D	36° 00.567' / 14° 25.367'	48 m
R1	36° 00.848 / 14 24.474'	46 m
R2	35° 59.597 / 14 26.815'	48 m

4.4. The list of physico-chemical parameters that were included in the water quality survey are given in **Table 4.2,** see **Appendix 2** for methods of analysis. Measurements of temperature, salinity, turbidity and dissolved oxygen in water were made *in-situ* at each of the six stations using a YSI 650 MDS meter connected to a 6920 V2 multi-parameter probe. The meter was calibrated according to the manufacturer's instructions immediately before use. Measurements using the *in-situ* meter were made at the surface (0.5 m below the surface). Two replicate

measurements were taken at each of the six stations A – D, and R1 and R2. Two replicate samples of seawater were then collected from each of the same six stations; samples were collected at a depth of 0.5 m, from each of the six stations using a standard Van Dorn water sampler of 3 L volume. All water samples were transported in a cooler box and maintained at a temperature of 4°C.

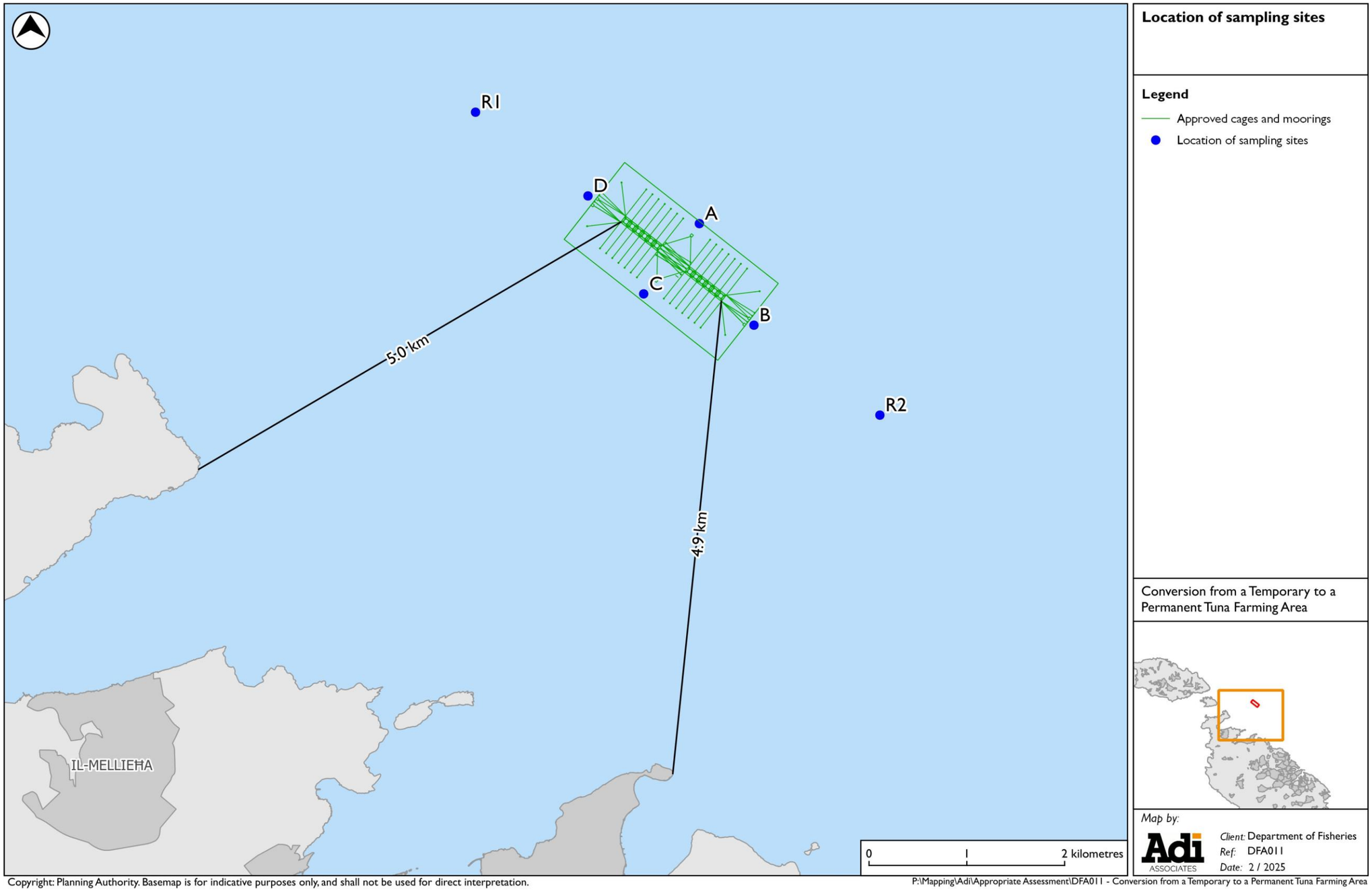
4.5. Estimates of current velocity and direction at the two reference stations (R1 and R2; see **Figure 4.1**) were made using drogues according to the La Grange method. The drogues employed for this purpose had four rectangular perspex vanes, each of which has a surface area of 0.2 m^2. The drogues were suspended from an inflatable surface float by means of a length of twine which was 1 m long. The position of the release point (determined using the GPS) and time of the release were recorded. After allowing the drogues to float for a given period of time, the position of the collection point and the time of collection were recorded.

4.6. For sediment granulometric and chemical studies, samples were collected using a 0.1 m^2 Van Veen grab that was deployed from a 12 m vessel equipped with hoisting jib and winch. Two replicate grab samples were collected from each of the six stations A – D, and R1 and R2.

Table 4.2: List of physico-chemical attributes which were considered in the water quality studies.

Parameter	Units
Temperature	°C
Salinity	psu
Dissolved Oxygen	%, mg/l
Turbidity	NTU
Turbidity (Secchi Depth)	m
pH	pH units
Chlorophyll a	µg/l
Total Nitrogen	µg/l
Total Phosphorus	µg/l
Total Carbon	µg/l
Total suspended matter	mg/l

Figure 4.1: Sampling stations for sediment and water quality analysis



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Marine ecological surveying

Benthic diversity

4.7. To collect data for benthic diversity studies, a grab sample was taken from each of the four stations A – D using a 0.1 m^2 Van Veen grab that was deployed from a 12 m vessel equipped with hoisting jib and winch. After the grab was brought on board, surplus seawater was drained from the sample by placing it on a 1 mm-mesh sieve; the retained sediment and biota were temporarily preserved in 10% formaldehyde in seawater. In the laboratory, each sample was first washed to remove the fine sediment (<0.5 mm fraction) and the preservative, and it was then sorted to separate out all macrofauna (animals larger than 0.5 mm). The motile macrofauna was then identified as far as possible. Where identification to species level was not possible, the different species present were labelled using an alphabetical code (e.g. Mysidacea sp. A, etc).

Benthic habitats map

4.8. The benthic assemblages were surveyed by ROV, towed underwater camera and side scan sonar between 2017 and 2018. Details of the surveys are included in **Appendix 2**.

4.9. Video footage and photographs of the benthic assemblages and species encountered along the transects were recorded on a PC hard drive and later analysed in the laboratory. Characterisation of the benthic assemblages was made using the scheme of Borg *et al.* (2013)[20], which is based on the EUNIS typology that has been adapted for local use.

Avifauna

4.10. The findings for the avifauna study are based on accumulated data obtained from long-term observations on the breeding biology and ecology of Malta's breeding seabirds (1982-2018) as well as published and unpublished reports from three EU LIFE funded projects:

- EU LIFE+ Progett Garnija (2006-2010);
- EU LIFE+ Malta Seabird Project (2012-2016); and
- EU LIFE funded Arcipelagu Garnija (2016-2020).

4.11. The technical report is reproduced in **Appendix 3**.

[20] Borg J.A., Knittweis L. & Schembri P.J. (2013) *Compilation of an interpretation manual for marine habitats within the 25 NM Fisheries Management Zone around the Republic of Malta.* [MEPA tender reference: T2/2013]. MEPA, Malta.

FINDINGS

Żona fil-Baħar bejn Il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet SAC

4.12. The findings from the surveys carried out are presented in detail in **Appendix 2** and **3**. The sections below describe the baseline conditions at the Scheme site.

Sediment and water quality

4.13. The results of the water quality survey and granulometric analysis are given in tables in **Appendix 2**.

4.14. The results of *in situ* measurement of physico-chemical parameters of the water column indicate temperature values and levels of salinity, water transparency, and dissolved oxygen that are expected of local pristine offshore coastal waters during spring. The Secchi Disc measurements indicated a high water transparency of between 24 m and 29 m.

4.15. Low, though detectable, levels of total organic carbon (TOC), total suspended solids (TSS), total nitrogen, and total phosphorous were recorded from the sampling stations, while levels of Chlorophyll *a* were below the limit of detection, thereby indicating a low phytoplankton abundance.

4.16. A weak southeasterly surface sea current having a speed of between 0.11 m/s and 0.13 m/s was recorded at the two reference stations R1 and R2.

4.17. The results of chemical analysis of sediments from the sampling stations indicated detectable though low levels of total organic carbon (TOC), total nitrogen, and total phosphorous, while levels of sulphide were below the limit of detection. Values of pH and redox potential were of an order that is expected of background levels for local offshore sediments.

4.18. The results of granulometric analysis indicate that the sediments characterising the six sampling stations comprise poorly sorted coarse sand having a mean grain size of between 0.55 mm and 0.95 mm.

Physical characteristics of the seabed

4.19. The bottom within the area surveyed consisted predominantly of coarse mobile sediments. A drop-off (some 10 m – 25 m high) that is characterised by rock exposed to sedimentation is present at the northwestern part of the study area.

4.20. What are often referred to as 'maerl[21] beds', however, more correctly termed

[21] 'Maerl' is a term used to describe calcareous sediments dominated by coralline algae. Maerl as used here describes sedimentary habitats in which living or dead unattached calcareous rhodophytes are a dominant component. These algae may take the form of nodules (rhodoliths) or fragmented thalli. However, according to Basso *et al.* (2016), 'rhodolith beds' should be identified and delimited as those areas of the sea floor with >10% cover of live rhodoliths over a minimum surface of 500 m^2, while the term "maerl" refers to a specific type of

'rhodolith beds', occupy a large part of the study area, which were denser and more continuous in the northeastern (and deeper) half of the survey area. In many places, the rhodolith beds were interspersed with a bare sand bottom that supported sparse rhodoliths[22]. In the southwestern half of the survey area, the rhodolith density varied such that they are less dense in the shallower part (45 m – 50 m) of the survey area, where large expanses of bare sand that supported little or no rhodoliths were present. Overall, the seabed had physical features that corresponded with the bathymetry: coarse sand with sparse accumulations of rhodoliths (0 % - 20 % rhodolith cover) was present at a water depth of between 43 m and 50 m; between a water depth of 50 m and 55 m, the seabed comprised coarse sediment having denser rhodolith accumulations (20 % - 50 % rhodolith cover); and in waters deeper than 55 m, the seabed mainly consisted of dense rhodolith beds (50 % - 100 % rhodolith cover). Beyond the rocky drop-off, at water depths exceeding 100 m, the seabed mainly consisted of bare muddy sand.

4.21. Depth varied between around 43 m and just over 100 m. The underwater visibility was good (25 – 30 m) throughout the study area; however, flocculate material was noted in the water column along some of the transects.

4.22. A current was present in places close to the seabed, as evidenced by debris and other material originating from benthic vegetation that were seen being moved on the bottom.

4.23. Some anthropogenic items were observed during the survey. These included glass and plastic beverage bottles, abandoned fish traps and fishing lines, and other unidentified items. However, no remains of tuna, feed fish used in tuna farming, or any other item that may have originated from tuna farming activities, was recorded on the seabed during the survey.

Benthic diversity

4.24. A classified list of species, and their abundance, recorded from the four grab samples collected from Stations A – D is given in **Appendix 2**. A total of 1,763 individuals comprising 79 macrofaunal species were recorded. A high diversity of macrobenthic fauna was recorded from the grab samples; the two most represented taxonomic groups, in terms of species richness and abundance, were the polychaetes and the crustaceans. No protected species were recorded from any of the grab samples

Benthic assemblages

4.25. **Figure 4.2** reproduces the benthic assemblages map drawn up for the original EIA for the Scheme site.

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rhodolith bed that is composed of non-nucleated, unattached growths of branching, twig-like coralline algae. 'Maerl' as used here conforms to the definition of Basso et al. (2016).

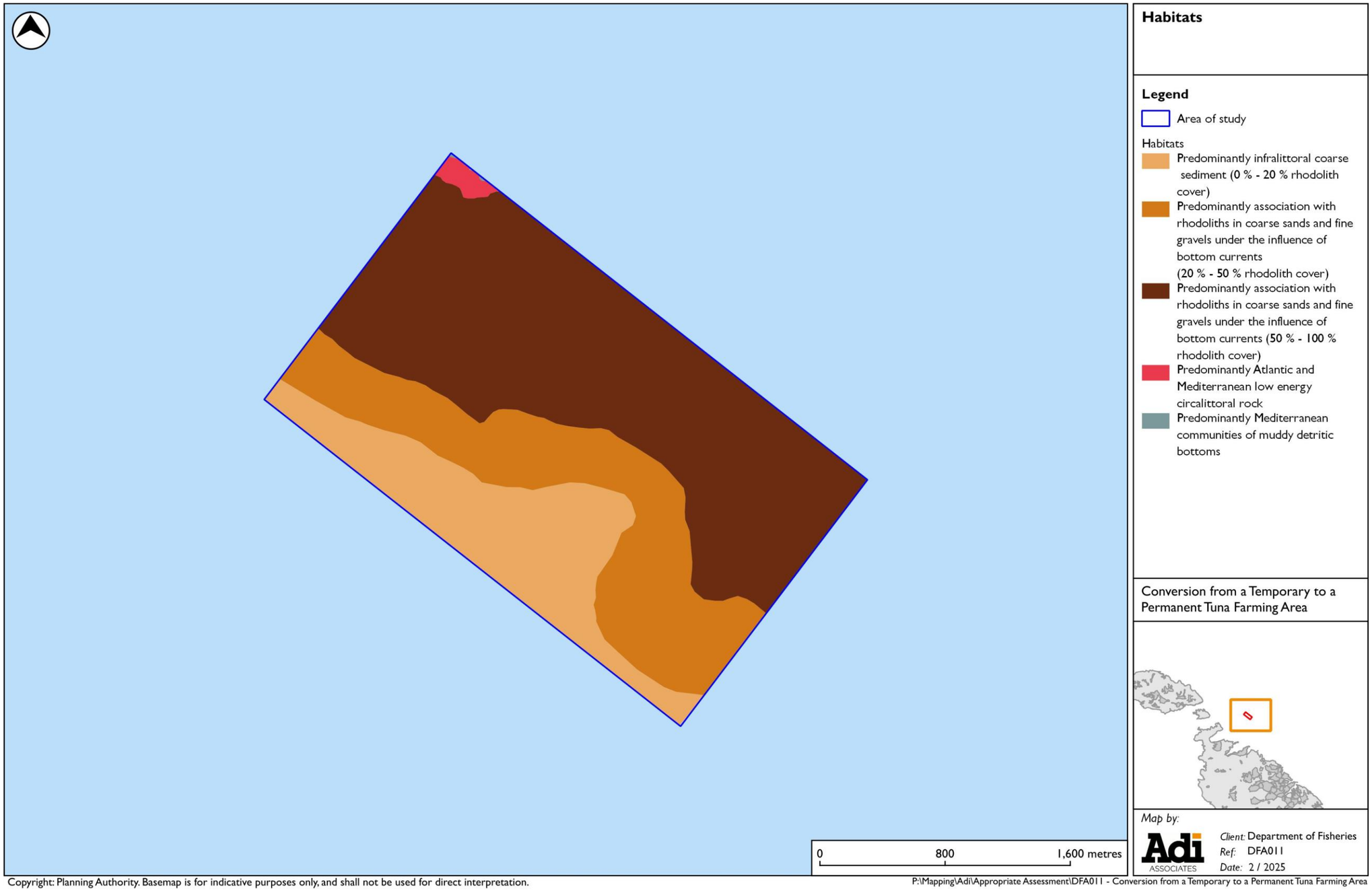
[22] Rhodoliths consist either of free-living calcareous rhodophytes (red algae), or else of an inner nucleus, such as stone or shell, encrusted by calcareous rhodophytes.

4.26. The main biotic assemblage types recorded from the study area were:

- Association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (EUNIS code A5.515)[23];
- Infralittoral coarse sediment (EUNIS code A5.13)[24];
- Mediterranean communities of muddy detritic bottoms (EUNIS code A5.38); and
- Atlantic and Mediterranean low energy circalittoral rock (EUNIS code A4.3).

[23] Equivalent to RAC/SPA 'Association with Rhodoliths'; code III.3.2.2.
[24] Equivalent to RAC/SPA 'Biocoenosis of coarse sands and fine gravels under the influence of bottom currents; code III.3.2.

Figure 4.2: Habitats map



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Association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents

4.27. This association was present as two subtypes: one which was predominantly characterised by a rhodolith-rich bottom in which the proportion of rhodoliths covering the bottom was dense (50% - 100% cover, see **Figure 4.3a**) and constituted a well-developed rhodolith bed, as described by Basso *et al.* (2016)[25]. This association subtype was mostly present in the deeper, northeastern half of the survey area within the 55 m – 80 m water depth range. The other subtype mainly consisted of a rhodolith bed in which the density of rhodoliths was sparser and predominantly formed accumulations such that the overall rhodolith cover was around 20 % - 50% (see **Figure 4.3b**); this association subtype was mainly present as a band in the central parts of the survey area within the 50 – 55 m water depth range.

4.28. Preliminary examination of rhodoliths that were retrieved from sediments collected by grab from Stations A, B and D indicated that the algal species that contribute to the rhodoliths include species from the following genera: *Lithophyllum, Lithothamnion*, *Mesophyllum* and *Sporolithon* (see Lanfranco *et al.*, 1999; Borg and Schembri 2002; Sciberras *et al.*, 2009).

4.29. Where present, the dense rhodolith beds appeared to comprise a pseudo-hard substratum that supported macroalgae; the predominant alga being *Flabellia petiolata* (see **Figure 4.3a**) and *Zonaria tournefortii*. Other algae including *Halimeda tuna*, *Peyssonnelia squamaria*, *Dictyota* sp. and unidentified filamentous forms, were also recorded in places.

4.30. The most abundant megafaunal species that were recorded from this association are the cidariid sea urchin *Stylocidaris affinis* and the Purple Heart Urchin *Spatangus purpureus* (see **Figure 4.3c**); other megafaunal species that were recorded during the survey included several species of sponges and bryozoans (including *Sertella* sp.), the Long-spined Urchin *Centrostephanus longispinus* (see **Figure 4.3d**), the Red Seastar *Echinaster sepositus* (see **Figure 4.3e**), the crinoid *Antedon mediterranea*, the crab *Inachus* sp., and the seastar *Luidia ciliaris*. Furthermore, the presence of openings to numerous burrows in places indicated an associated rich infauna.

[25] Basso D., Babbini L., Kaleb S., Bracchi V.A., Falace A. (2016). *Monitoring deep Mediterranean rhodolith beds*. 26(3). Aquatic Conservation: Marine and Freshwater Ecosystems.

Figure 4.3: Association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents *(Source: Borg, 2018)* [26]

<table>
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<td>a. Photograph of the seabed taken at a point along Transect 5, showing a close-up of a dense rhodolith bed. The green alga visible in the photo is Flabellia petiolata.</td>
<td>b. Photograph of the seabed taken at a point along Transect 12, showing a close-up of a sparse rhodolith bed.</td>
<td>c. Photograph of the seabed taken at a point along Transect 5, showing a close-up of a rhodolith bed intermixed with bare sediment. The five orange coloured long-spined urchins are individuals of Stylocidaris affinis. The large purple coloured urchin is a the Purple Heart Urchin Spatangus purpureus</td>
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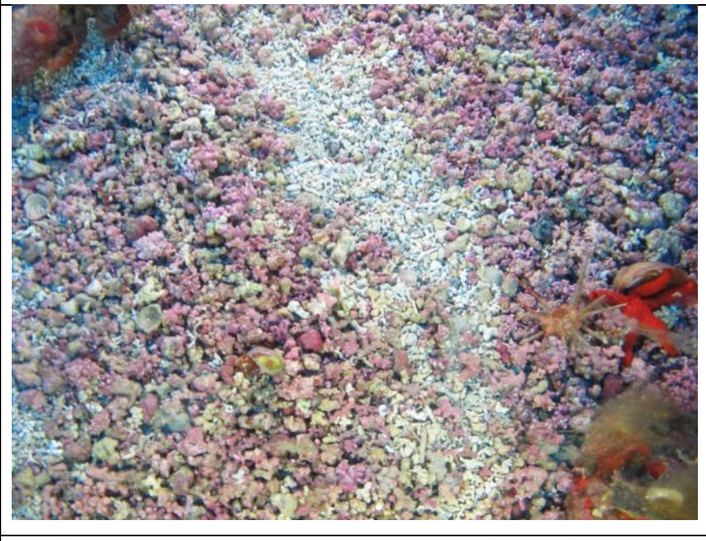
<td>  </td>
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<td>d. Photograph of the seabed at a point along Transect 3, showing a close-up of a rhodolith bed. A Long-spined Urchin Censtrostephanus longispinus is visible adjacent the alga Flabellia petiolata (green).</td>
<td>e. Photograph of the seabed taken at a point along Transect 5, showing a close-up of a rhodolith bed. An individual of the urchin Stylocidaris affinis and another of the Red Seastar Echinaster sepositus are visible on the right side of the photo.</td>
<td></td>
</tr>
</table>

[26] Borg, J.A. 2018. *Report on an ecological assessment of an area off the northeastern coast of Malta, proposed for designation as an offshore tuna penning site, undertaken as part of the Environment Impact Assessment in connection with PA 02175118: Extension to an existing tuna farm operation off the North East coast of Malta*. Ecoserv Ltd.

Infralittoral coarse sediment

4.31. This assemblage type occurred as a band at the southwestern part of the Area of Study, where the water depth was some 43 m – 50 m. In places, the sediment bottom supporting this assemblage type had small accumulations of rhodoliths or sparse rhodoliths, such that where these were present their cover was some 1 – 20% (see **Figure 4.4a** to **Figure 4.4d**). Detached algal and plant (seagrass) material was present in places on the seabed where this assemblage occurred; however, no attached fleshy algae or seagrasses were present. The epifauna associated with this assemblage was impoverished; the most abundant macrofaunal species was the Purple Heart Urchin *Spatangus purpureus* (see **Figure 4.4e**) and groups of the Purple Urchin *Sphaerechinus granularis*. However, the presence of openings to burrows present in many places indicated the presence of a rich infauna.

4.32. In general, the area surveyed mainly supported the assemblage types and subtypes as described above and as shown in **Figure 4.2**. However, certain parts supported patches with a different assemblage type with varying density of rhodolith beds.

Figure 4.4: Infralittoral coarse sediment *(Source: Borg, 2018)*

a. Photograph of the seabed taken at a point along Transect 2, showing a close-up of an assemblage of infralittoral coarse sediment.

b. Photograph of the seabed taken at a point along Transect 2, showing a close-up of an assemblage of infralittoral coarse sediment. An individual rhodolith is visible at the centre of the photo.

c. Photograph of the seabed taken at a point along Transect 11, showing a close-up of an assemblage of infralittoral coarse sediment. Individual rhodoliths are visible in places in the photo.

d. Photograph of the seabed taken at a point along Transect 11, showing a close-up of an assemblage of infralittoral coarse sediment. Three narrow strips with rhodoliths are visible in the photo.

e. Photograph of the seabed along Transect 11, showing a close-up of an assemblage of infralittoral coarse sediment. A few individual rhodoliths (Purple colour) – most of them having a very small size (few mm) – and an individual of the Purple Heart Urchin *Spatangus purpureus*, are visible in the photo.

Mediterranean communities of muddy detritic bottoms

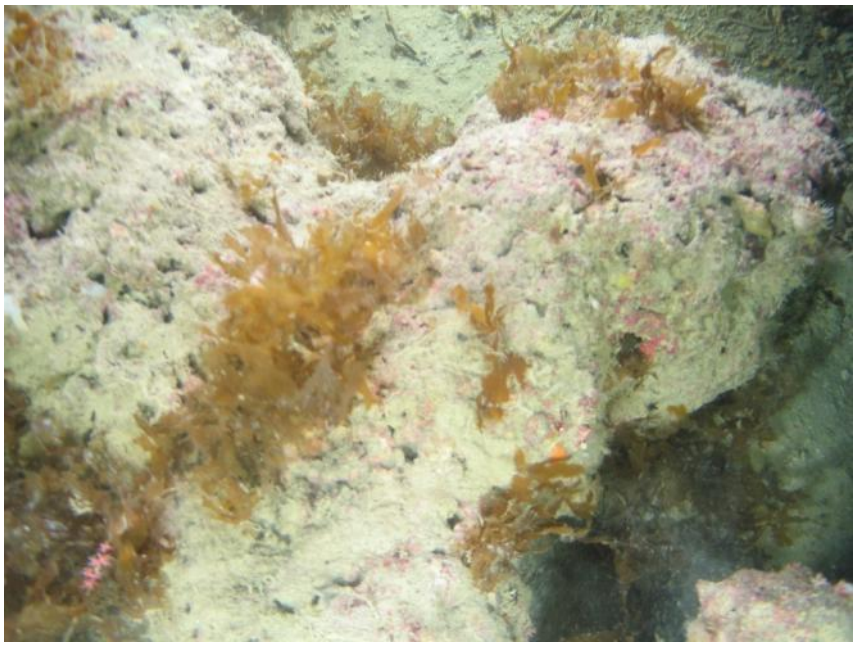
4.33. This assemblage type was recorded from the extreme northwestern corner of the Area of Study at a water depth exceeding 100 m and occurred at the base of the 10 m – 25 m high drop-off from where it extended further into deeper waters (**Figure 4.5**). No macroflora was recorded from this assemblage type, although detached macroalgae (mainly *Zonaria tournefortii*) were present on the sediment surface in various places. No macrofauna was recorded from this assemblage type but the presence of openings to burrows indicated an associated rich infauna.

Figure 4.5: Muddy detritic bottoms *(Source: Borg, 2018)*

Atlantic and Mediterranean low energy circalittoral rock

4.34. This assemblage type was recorded from the extreme northwestern corner of the Area of Study and formed part of the drop-off some 10 m to 25 m high that separated the assemblage of coarse sands and fine gravels under the influence of bottom currents and the assemblage of infralittoral coarse sediments (see **Figure 4.6**). The associated macroalgae mainly comprised *Zonaria tournefortii* and unidentified coralline algae (**Figure 4.6**). The associated macrofauna mainly comprised sponges, bryozoans, and other sessile macrobenthic species. Individuals of the echiuran worm *Bonellia viridis* were recorded in places from this assemblage type.

Figure 4.6: Atlantic and Mediterranean low energy circalittoral rock



Demersal and pelagic fauna

4.35. The demersal fish fauna recorded during the survey mainly comprised large shoals of Picarel *Spicara* sp. and individuals of the Comber *Serranus cabrilla*. Several individuals of the Mauve Stinger *Pelagia noctiluca* were recorded in the water column during the survey.

Ecological appraisal

4.36. In Maltese waters, the main rhodolith-forming algae in rhodolith/maerl beds are *Lithothamnion corallioides* and *Phymatolithon calcareum/Lithothamnion minervae*[27] with *Peysonnelia rosa-marina*, *Mesophyllum* sp., and *Neogoniolithon brassica-florida* constituting a minor component (Lanfranco *et al*., 1999)[28]. Associations with rhodoliths are a habitat type that qualifies sites for inclusion in national inventories of natural sites of conservation interest as required by the Protocol for Specially Protected Areas and Biodiversity in the Mediterranean (SPA/BD) of the Barcelona Convention[29].

[27] It is not possible to distinguish between *Phymatolithon calcareum* and *Lithothamnion minervae* using gross morphology alone.

[28] Lanfranco, E.; Rizzo, M.; Hall-Spencer, J.; Borg, J.A. & Schembri, P.J. 1999. *Maerl-forming coralline algae and associated phytobenthos from the Maltese Islands*. 3(1). The Central Mediterranean Naturalist.

[29] The *Convention for the Protection of the Mediterranean Sea against Pollution* (the Barcelona Convention) was adopted on 16th February 1976. Several protocols were adopted under this convention, amongst which is the *Protocol concerning Mediterranean Specially Protected Areas* done at Geneva on 3 April 1982. The parties later amended this protocol, and its name changed to *Protocol for Specially Protected Areas and Biodiversity in the Mediterranean* (SPA/BD). Malta ratified this new Protocol on 28th October 1999. A draft reference list of habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest was drawn up at the Fourth Meeting of National Focal Points for Specially Protected Areas (Tunis, 12-14 April 1999) [see UNEP(OCA)/MED WG.154/7]. The most recent '*Classification of benthic*

Furthermore, the coralline algae *Lithothamnion corallioides* and *Phymatolithon calcareum* are listed in Annex V (Animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures) of the European Union's 'Habitats Directive' as amended[30]. Both species probably occur in the rhodolith beds in the present study area; however, only microscopic examination of samples of rhodoliths collected from the area will confirm this.

4.37. *Lithothamnion corallioides*, *Phymatolithon calcareum*, together with *Lithothamnion minervae* are listed in Schedule III (Animal and plant species of national interest whose conservation requires the designation of Special Areas of Conservation), and the first two named also in Schedule VII (Animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures) of the *Flora, Fauna and Natural Habitats Protection Regulations, 2006* as amended[31], which transpose the requirements of the EU's Habitats Directive to local legislation.

4.38. Rhodolith and maerl beds are included in the UNEP/MAP/RAC-SPA "Reference list of marine habitat types for the selection of sites to be included in the national inventories of natural sites of conservation interest" (UNEP/MAP/RAC-SPA, 2006) while an action plan for their conservation has been formulated (UNEP/MAP/RAC-SPA, 2008), both within the ambit of the Barcelona Convention. Within European legislation, Council Regulation (EC) 1967/2006, concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, bans the use of specific fishing gear (trawl nets, dredges, shore seines or similar nets) on coralligenous or maerl beds[32]. In order to conform to the requirements of EC

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habitat types of the Mediterranean' dated 2006 is available from the UNEP RAC/SPA at http://rac-spa.org/sites/default/files/doc_fsd/lrhm_en.pdf

[30] The European Union's *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* is known as the 'Habitats Directive'. Annexes I and II of this Directive have been amended by Council Directive 97/62/EC of 27 October 1997. Annex I of the Habitats Directive lists natural habitats whose conservation requires the designation of Special Areas of Conservation. Annex II lists species of plants and animals whose habitats must be protected for their survival. Annex III lists criteria for selecting sites eligible for consideration as "Sites of Community Importance" and designation as Special Areas of Conservation, while Annex IV lists species of Union interest in need of strict protection. Annex V lists species of plants and animals of Union interest whose taking from the wild and exploitation is subject to management, and Annex VI lists prohibited methods and means of capture and killing of mammals and fish, and prohibited modes of transport. In anticipation of the 2004 enlargement of the EU, the Annexes of the Habitats Directive were modified by the Act of Accession signed in Athens on 16th April 2003, to take into account the expanded geographical area of the EU15+10. The annexes were further amended by Council Directive 2006/105/EC of 20 November 2006 in anticipation of Bulgaria and Romania joining the European Union in 2007 and then again by Council Directive 2013/17/EU of 13 May 2013 due to the accession of the Republic of Croatia.

[31] These regulations were last amended by the Flora, Fauna and Natural Habitats (Amendment) Regulations, 2013 (Legal Notice 322 of 2013).

[32] According to this Regulation, "Mäerl is a collective term for a biogenic structure due to several species of coralline red algae (Corallinaceae), which have hard calcium skeletons and grow as unattached free living branched, twig-like or nodule corallines algae on the seabed, forming accumulations within the ripples of mudflats or sandflats seabed. Maerl beds are usually composed of one or a variable combination of red algae, in particular, *Lithothamnion coralloides* and *Phymatolithon calcareum*". In this definition, 'maerl' is used in the

1967/2006, the local 'Implementation and Enforcement of Certain Fisheries Management Plans Order' (Legal Notice 354 of 2013) amends Zones C and G referred to in Annex V of EC 1967/2006 that originally overlapped with rhodolith beds as well as closed to trawling all areas where conclusive evidence exists for the presence of such beds (see Figure 44 in LN 354/2013).

4.39. The Needle-spined sea-urchin, *Centrostephanus longispinus* is listed in the Habitats Directive under Annex IV (Animal and plant species of Community interest in need of strict protection), in Appendix II of the Bern Convention[33], and in Annex II of the SPA/BD Protocol)[34]. This species is also protected locally under the *Flora, Fauna and Natural Habitats Protection Regulations, 2006* as amended, where it is listed in Schedule V (Animal and Plant Species of Community Interest in need of Strict Protection).

Environmental Monitoring Findings (2019 – 2023)

4.40. The tuna farming operations at the Scheme site (since 2019), have been the subject of environmental monitoring carried out by independent monitors. The results from this monitoring undertaken between 2019 and 2023[35] have been assessed against the baseline conditions described above, to determine the effects of the tuna farming operations on the benthic environment and the water quality at the site and its surroundings. This analysis has been described in the EIA Update Report prepared for the Scheme (Adi Associates, 2025[36]).

4.41. The monitoring results concluded the following:

Benthos

4.42. When one considers the findings of the environmental monitoring of the seabed over the five-year period from 2019 to 2023 (see also Technical Appendix 3 of the EIA update report[37]), it is evident that while the tuna penning activities have resulted in some alterations to the physical and biological characteristics of the seabed, the impact overall from fish wastes, uneaten feed fish, and tuna carcasses, is deemed to

wider sense to refer to 'rhodolith beds' as defined by Basso *et al.* (2016); true maerl is a particular type of rhodolith bed.

[33] The Bern Convention is the *Convention on the Conservation of European Wildlife and Natural Habitats*. Malta acceded to this Convention on 26 November 1993. Appendix II of the Bern Convention lists strictly protected species of fauna, and the Convention prohibits the deliberate capture, the destruction of breeding or resting sites, the deliberate destruction, and the deliberate killing of, and trade in, these species.

[34] A number of species are listed in annexes to the SPA/BD Protocol: Annex II lists endangered or threatened species and Annex III lists species whose exploitation is regulated.

[35] The monitoring report for 2024 was not available at the time of writing of this Appropriate Assessment.

[36] Adi Associates Environmental Consultants Ltd, 2025. PA/05908/23 & EA/00007/18 - Proposed Conversion from a Temporary to a Permanent Tuna Farming Area as Established in PA/02175/18; retaining the approved total biomass of fish and all relative conditions. Environmental Impact Assessment Update Report. Version 1. San Gwann, January 2025; vi + 101pp + 1 Appendix.

[37] Adi Associates Environmental Consultants Ltd, 2025. PA/05908/23 & EA/00007/18 - Proposed Conversion from a Temporary to a Permanent Tuna Farming Area as Established in PA/02175/18; retaining the approved total biomass of fish and all relative conditions. Environmental Impact Assessment Report – Technical Appendices. San Gwann, January 2025.

be insignificant to minor. These alterations are not large and are reversible, as has been confirmed when comparing data from the active tuna penning season against that from the following fallowing period. Also, no anoxic conditions or other indications of an adverse state of the seabed habitats and species were detected to date. However, it is important for the tuna farm operators to remain vigilant and to ensure good practices throughout the operations on the farm to minimise adverse impacts.

4.43. The main effect seems to be an increase in the abundance of the scavenger / detritivore community beneath the cages, with benthic and demersal megafaunal scavengers attracted to the area by the presence of organic matter (e.g. uneaten feed fish), see **Figure 4.7**.

4.44. The presence of anthropogenic litter on the seabed, mostly from the tuna penning activities, is of concern. From season to season, this litter seems to be increasing, and a greater effort needs to be made for this material to be collected and disposed of ashore.

Figure 4.7: Image grab from video footage showing a group of individuals of the Common Stingray under the tuna farm feeding on feed fish.

Source: Ecoserv Ltd, 2020

Water Quality & Sediments

4.45. The findings of the environmental monitoring on water quality and sediments over the five-year period from 2019 to 2023, show that while the tuna penning activities have occasionally resulted in impacts from foam, or oil slicks, the values of the water quality monitored attributes were generally within a range that would be expected of local pristine offshore waters for each of the monitored years. Furthermore, no appreciable differences in the levels of the monitored physico-chemical parameters were noted amongst the monitoring stations, including the 'up-current' station and the 'down-current' station. Accordingly, it can be concluded that the tuna farming

activities at the Scheme site have not resulted in appreciable alteration of water quality in terms of the monitored attributes. Nonetheless, increased vigilance during operations, and improved operational management practices are advisable to ensure against unmitigated impacts, especially with regards to fish slime production.

4.46. As regards sediments, which have only been monitored since 2023, it was concluded that the results of the two sediment quality monitoring sessions made at the Scheme site in 2023, which showed elevated levels of Phosphorus in the sediment beneath the cages, were in line with what one would expect for sediments below fish farms. Furthermore, it was encouraging to note that with respect to the monitored parameters, there were no appreciable differences in levels between sediments below the cages and those at reference sites located approximately two kilometres away from the Scheme site, nor were there appreciable differences between the results of chemical analyses of sediments when comparing the start of tuna penning operations, to those recorded in 2023. Overall, the recorded results indicated that the effects of tuna farming on the sediments below the farms, and the immediate surroundings are limited, and where present, appear to be mostly confined to the general footprint of the Scheme site and where elevated levels were recorded, these were deemed normal of what one would expect from an area located directly below the farm cages and hence under an 'allowable zone of effect'; sediments below farm cages are subject to organic enrichment, which will alter the sediment characteristics to some degree.

Marine and terrestrial Special Protection Areas

Breeding seabirds in the Maltese Islands

4.47. The Maltese coastal cliffs support four breeding seabird species, namely Scopoli's Shearwater (*Calonectris diomedea*), Yelkouan Shearwater (*Puffinus yelkouan*), Mediterranean Storm-petrel (*Hydrobates pelagicus melitensis*), and the Yellow-legged Gull (*Larus michahellis)*.

4.48. Shearwaters are members of the Order Procellariformes which includes also the albatrosses and petrels. They are pelagic species with the characteristic tubenoses on the base of the upper mandible. They visit land during the breeding season and do so under cover of darkness. A single egg is laid in a deep crevice or burrow or under loose boulders and vegetation. Sometimes, rabbit burrows are also used as breeding sites.

4.49. **Table 4.3** illustrates the breeding cycle of the three pelagic breeding seabird species and **Table 4.4** indicates their presence at the colonies throughout the year.

Table 4.3: Breeding biology and ecology of *P. yelkouan, C. diomedea*, and *H. pelagicus*

Arrival at colonies		Egg laying	Hatching	Fledging
Puffinus yelkouan	mid-October	early February	early May	mid-June/early July
Calonectris diomedea	end February	end May	mid July	mid-October
Hydrobates pelagicus	end February	April-June	May-August	August to October

Table 4.4: Presence in colonies of the three pelagic breeding seabird species

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calonectris diomedea			———	———	———	———	———	———	———	———		
Puffinus yelkouan	———	———	———	———	———	———	———			———	———	———
Hydrobates pelagicus			———	———	———	———	———	———	———	———		

Daily movements by Procellariiformes

4.50. Shearwaters travel vast distances to and from their breeding colonies in search of food. During the breeding season of *C. diomedea*, large numbers can be seen flying offshore in an east to west direction. Distance from land is conditioned by wind direction and strength. During strong North-westerly winds the shearwaters can be seen flying at a distance of less than 50 metres from the coast.

4.51. The same area is also used by Yelkouan Shearwaters, especially birds originating from the Rdum tal-Madonna colony (Borg *et al,* 2002[38], Borg *et al,* 2010[39], Raine *et al,* 2010[40], 2011[41] and 2012[42]) and more recently from the St Paul's islands (see **Appendix 3**).

Other bird species

4.52. Another regular visitor to the study area and immediate whereabouts is the Yellow-legged Gull (*Larus michahellis*). This resident breeding bird is present almost all year round.

Rafting

4.53. Rafting is the convergence of birds on water, normally in the vicinity of their breeding colonies. During calm afternoons these congregations of birds can reach impressive numbers with several hundreds of birds waiting for darkness. Birds start assembling about two to three hours before sunset and then start to dissipate around dusk when the whole congregation is within a few hundred metres from the cliffs. The main reason for birds rafting is to rest, and it is safest to do this in large numbers when

[38] Borg. J.J. & J. Sultana. 2002. Status and Distribution of the Breeding Procellariiformes in Malta. (30) Il-Merill.
[39] Borg, J.J., H., Raine, A.F. Raine, & N. Barbara, 2010. Protecting Malta's wind chaser: The EU LIFE Yelkouan Shearwater Project Report. Malta: EU LIFE Yelkouan Shearwater Project.
[40] Raine, A., H. Raine, A. Meirinho & J.J. Borg. 2010. Rafting behaviour of Yelkouan Shearwater *Puffinus yelkouan* breeding at Rdum tal-Madonna, Malta. (32) Il-Merill.
[41] Raine, A., H. Raine, J.J. Borg & A. Merinho. 2011. Post-fledging dispersal of Maltese Yelkouan Shearwaters *Puffinus yelkouan*. Vol.26 (2) Ringing & Migration.
[42] Raine, A., J.J. Borg, H. Raine & R.A. Philips. 2012. Migration Strategies of the Yelkouan Shearwater *Puffinus yelkouan* (154) Journal of Ornithology.

many birds are looking out for danger. For example, both the Scopoli's and Yelkouan Shearwaters raft offshore in the evenings, waiting to return to their breeding colonies under the safety of darkness. Rafting is a time to socialise and is an important aspect of a seabird's life. As noted in **Appendix 3**, it has also been hypothesised, that seabirds use these congregations to assess the health of their population, although this is now highly disputed considering the fact that individual birds from other colonies in other countries form part of these rafts.

Fish pens: supplementary food source for seabirds

4.54. Borg (2012) presented some preliminary results from studies into tuna farms acting as a supplementary food source for storm petrels. It was noted that the use of raw, unwashed fish food is fundamental in attracting storm petrels closer to these tuna pens. The same food supply attracts a constant presence of small fish around the pens which in turn attract gulls and terns, especially the Black Tern (*Chlidonias niger*).

4.55. Observations have shown that the majority of storm petrels frequenting the IBA are adult birds undergoing primary wing moult, suggesting breeders, probably not venturing far away from the colonies during the chick rearing period. A smaller number of birds seen during the site visits were juvenile birds covered in a fresh coat of dark plumage. These young birds are present from the latter part of August to early September. Tuna penning is locally carried out during the summer and autumn months (mid-July to November / December).

4.56. It was recommended that further investigations should focus to identify if this reliable food source has any effect on the breeding success and fledglings' survival in storm petrels. While adult storm petrels regularly fall prey to yellow-legged gulls on Filfla (Borg *et al*., 1992-94, Sultana *et al,* 2011) no interactions between gulls and storm petrels were ever noted near the tuna pens. Further research is required to determine the extent of dependency by storm petrels on this food source.

Threats

Light pollution

4.57. The use of light sources from land and at sea is of particular concern for seabirds. It is known that light interferes with the behaviour of birds and other animal groups, including bats. In those areas where electricity has been installed especially close to seabird colonies, birds have completely deserted the site. Birds and other animals found close to light sources are known to behave in an abnormal way; several species of birds remain active during nighttime. Light also disrupts the normal cycle of other vertebrates as well as numerous species of invertebrates making them susceptible to predation.

4.58. In some cases, seabird breeding colonies have been abandoned when electricity was introduced in the area, places like Xlendi Bay, Ħal-Far, Għar Lapsi and Wied iż-Żurrieq, where colonies of both Scopoli's and Yelkouan Shearwaters have been negatively affected.

4.59. The Scheme includes lights as a safety precaution to alert mariners to the presence of

the cages at nighttime. Being located adjacent to a major bunkering area, the Scheme will contribute cumulatively to the existing light pollution seaward of the breeding sites. However, the more extensive lighting visible on the shore would be expected to have a greater impact than the limited lighting on the Scheme site.

Noise

4.60. Noise has a negative effect on the normal patterns of incoming shearwaters during nighttime. Birds tend to fly away from any sound source as was observed on numerous occasions. When a boat passes close to a breeding colony, all activity stops until the boat (noise source) is no longer audible. The Scheme will be a source of noise generally as a result of the movement of the boats which will intensify during fattening and harvesting operations. Thus, the increase in noise will mostly be during the daytime when the seabirds are away from their colonies. Moreover, *Puffinus yelkouan* would have already left the colonies by the time harvesting operations start.

Oiling of birds from fish slime

4.61. Birdlife Malta[43] reported that they have had issues with seabirds oiled in fish slime, especially the storm petrels, which tend to visit the farms. The birds have their own oils to keep them waterproof, but the slime interacts with that, so we are finding either dead birds or some with hypothermia. See also note from Birdlife in **Appendix 4**.

Predation impacts from increaser species

4.62. The use of feed fish on the tuna farms and the attraction of additional prey species, could result in an increase in the population of the Yellow-legged gull, which could in turn result in an increase vulnerability of storm petrels to seagulls. Though evidence of such predation locally is restricted to nesting petrels, it is not known whether gulls would actively hunt storm petrels aggregating in a similar area.

Entanglement

4.63. Shearwaters and the storm petrel are all diving birds and therefore risk entanglement in the fish farm nets, resulting in drowning. Entanglement from any lost ropes or netting as well as other marine debris from operations is also a risk. Further data is required locally to provide a better understanding of the extent of this problem for the populations of breeding seabirds in the Maltese Islands. However, to date there have been no recorded evidence of any such incidences locally (Borg, J,J., personal communication). Impact is considered unlikely to be significant with the limited data available.

Ingestion of marine debris

4.64. Ingestion of marine litter, particularly plastics, is common among seabirds and can cause death by dehydration, blockage of the digestive tract, or toxins released in the

[43] Barbara Nicholas, personal communication, November 2024.

intestines (Sagar, 2013)[44]. Ingestion of plastics by adults may also be passed on to chicks when being fed through regurgitation. Fish farms could be a source of such marine debris. If unmanaged, this impact could be significant depending on the number of birds affected.

Importance of areas of ornithological conservation interest in the A of I

4.65. The following summarises the importance of the areas of conservation importance within the A of I:

- **Ramla tat-Torri/Rdum tal-Madonna area MT0000009**: This area holds the most important Yelkouan Shearwater (*Puffinus yelkouan*) colony in the Maltese Islands as well as a small colony of Scopoli`s Shearwater (*Calonectris diomedea*). **Figure 4.8** shows the cliff area occupied by the seabird colonies. In 2016 the Mediterranean Storm-petrel (*Hydrobates pelagicus melitensis*) was found breeding inside one of the numerous caves in the area. Other breeding bird species in this SPA are the Blue Rock Thrush (*Monticola solitarius*), Short-toed Lark (*Calandrella brachydactyla*), Sardinian Warbler (*Sylvia melanocephala*) and Spectacled Warbler (*Sylvia conspicillata*).

- **Kemmuna, Kemmunett, il- Ħa ġriet ta' Bejn il-Kmiemen u l-Iskoll ta' Taħt il-Mazz MT0000017**: The eastern coast is of particular interest for this study as it supports breeding colonies of Yelkouan and Scopoli`s Shearwaters, see **Figure 4.9**.

- **Il-Gżejjer ta' San Pawl (Selmunett) MT0000022**: In the last decade, a small colony of Yelkouan Shearwaters has been re-discovered breeding on the island.

- **Żona fil-Baħar madwar Għawdex MT0000112 and Żona fil-Baħar fil-Grigal MT0000107**: Two marine conservation areas identified during the EU Life funded project Malta Seabird Project (2012-2016) for their importance as feeding grounds for the three pelagic species, namely *Calonectris diomedea, Puffinus yelkouan* and *Hydrobates pelagicus*.

Priority areas in the marine environment for the three Procellariiformes

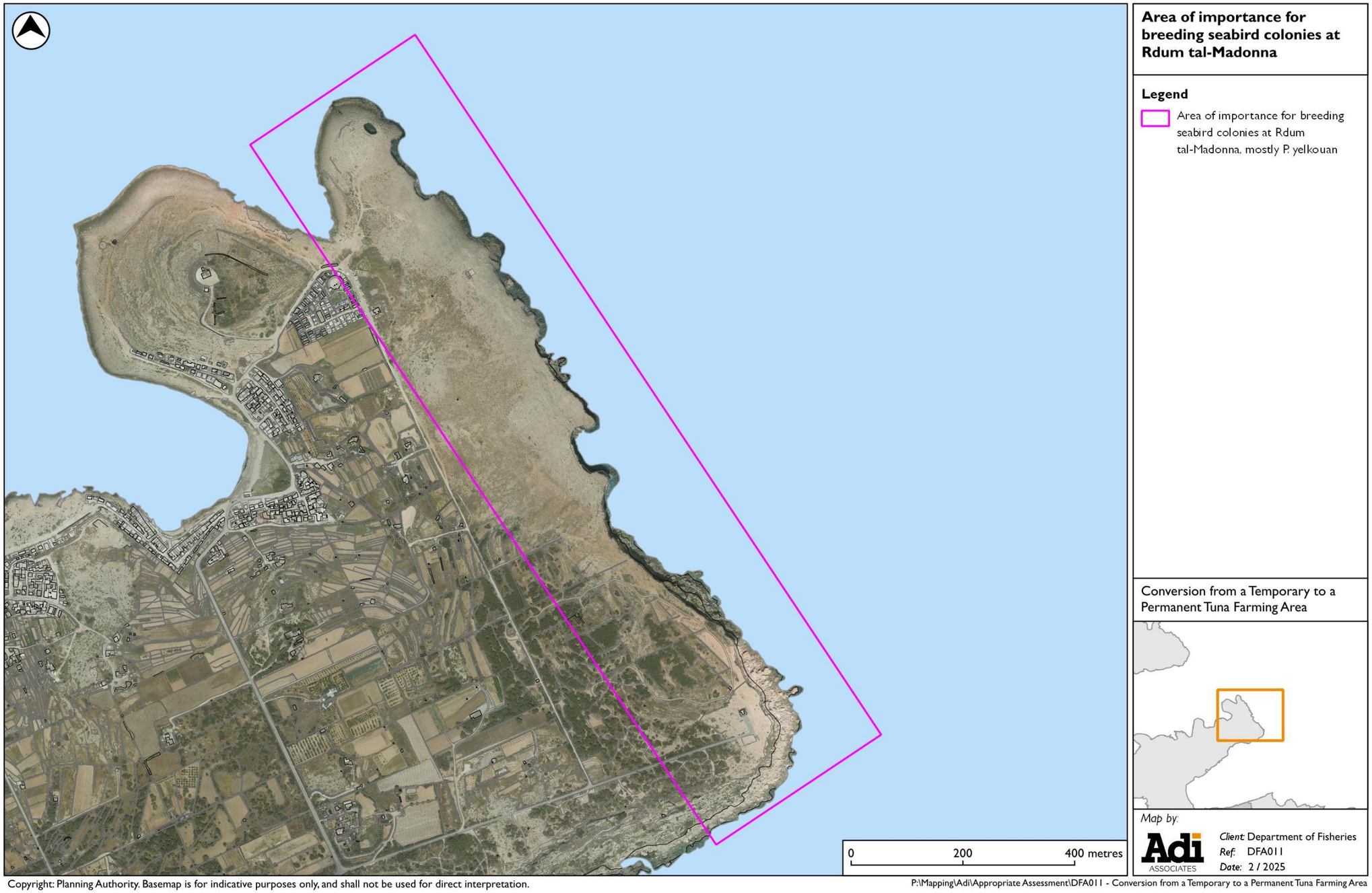
4.66. **Appendix 3** makes reference to the IBA Inventory, 2015 (Metzger *et al*., 2015) which provides additional detail about how each breeding seabird species uses the marine environment. This report helped to provide the basis for the designation of marine SPAs.

4.67. For the Maltese breeding population of *P. yelkouan*, three main hotspot areas were identified, one around Gozo, including the Gozo-Comino Channel and along the west- and southwest coast of Malta, a second one offshore in the northeast of Malta and a third one offshore in the southwest of Malta (see **Appendix 3**). For the

[44] Sagar P. 2013. *Literature Review of Ecological Effects of Aquaculture: Chapter 6 Seabird Interactions*. Cawthorn Institute & NIWA Taihoro Nukurangi for Ministry of Principal Industries, Mahatu Ahu Matua.

Maltese breeding population of *C. diomedea*, five priority areas were identified in the Maltese Exclusive Fishing Zone (EFZ), the first one around and north of Gozo and a second one along the west and southwest coast of Malta. In addition, three offshore areas were identified east, southeast, and south of Malta (see **Appendix 3**). For *H. pelagicus melitensis* breeding in the Maltese Islands the core area covers a coastal zone around Malta and a larger area of sea east of the island. Additionally, a small area is found in the Pantelleria channel northwest of Gozo as well as an area southwest of Malta (see **Figure 4.10** and **Appendix 3**).

Figure 4.8: Area of importance for seabird colonies at Rdum tal-Madonna



Area of importance for breeding seabird colonies at Rdum tal-Madonna

Legend

Area of importance for breeding seabird colonies at Rdum tal-Madonna, mostly P. yelkouan

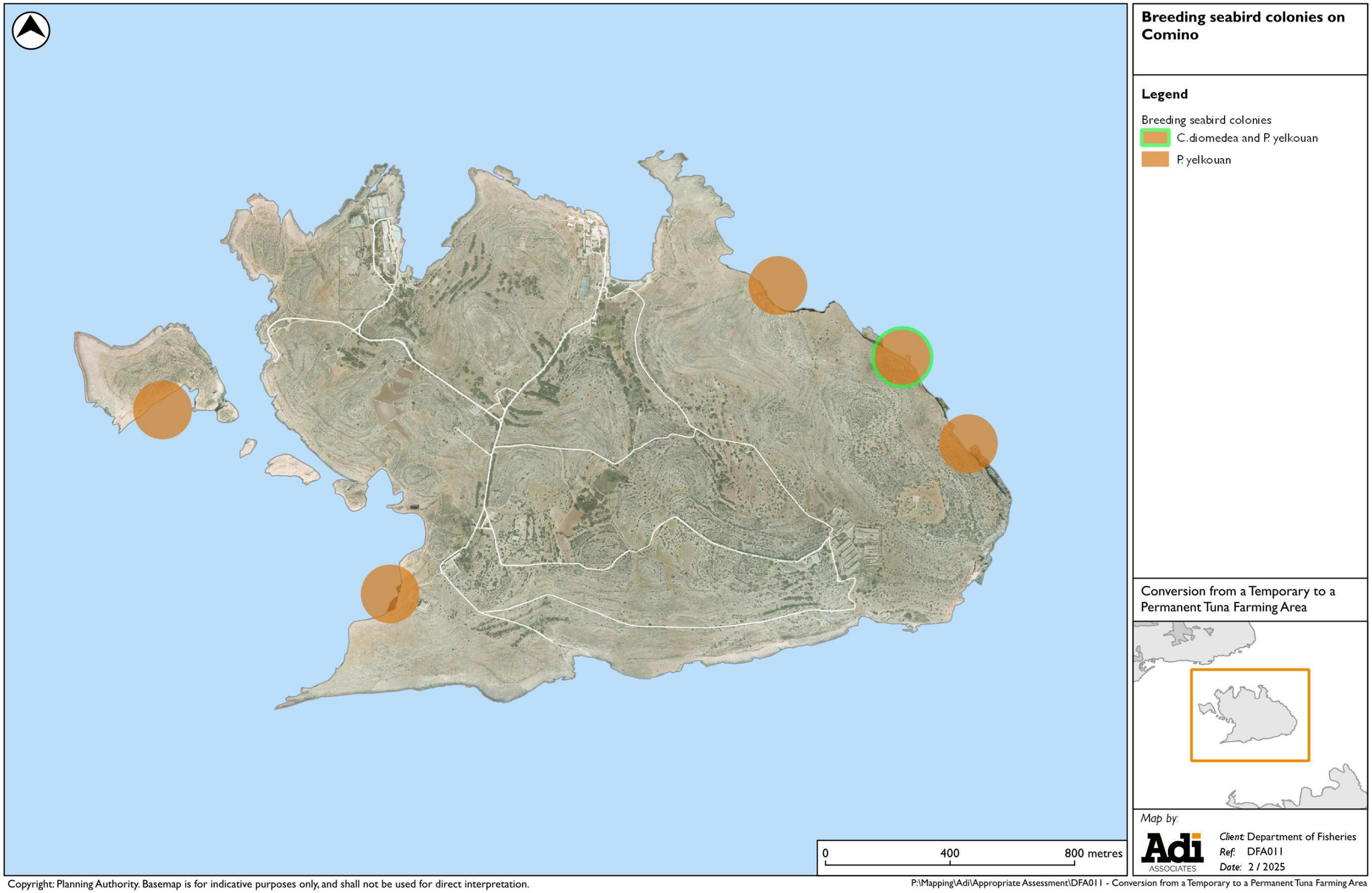
Conversion from a Temporary to a Permanent Tuna Farming Area

Map by:

Client: Department of Fisheries
Ref: DFA011
Date: 2 / 2025

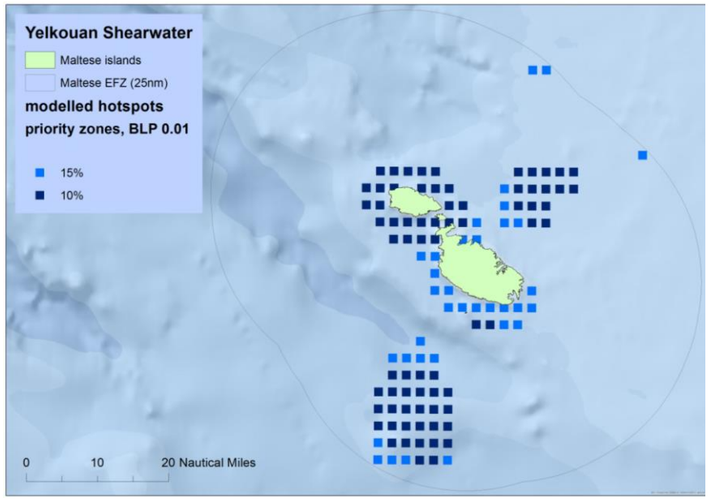
P:\Mapping\Adi\Appropriate Assessment\DFA011 - Conversion from a Temporary to a Permanent Tuna Farming Area

Figure 4.9: Seabird colonies on Comino

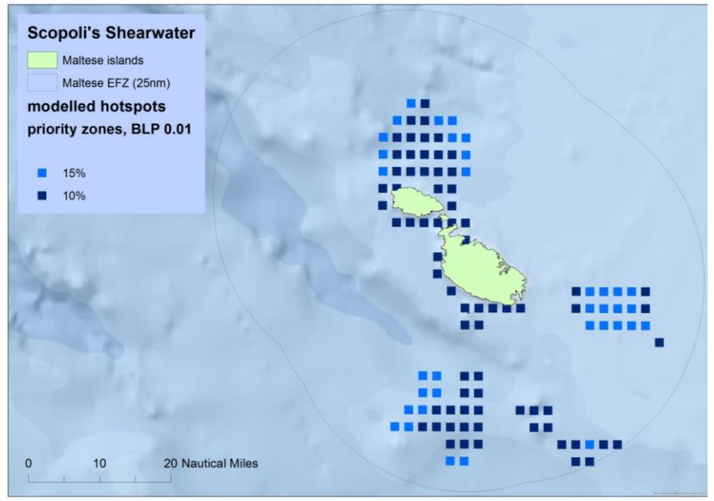


P:\Mapping\Adi\Appropriate Assessment\DFA011 - Conversion from a Temporary to a Permanent Tuna Farming Area

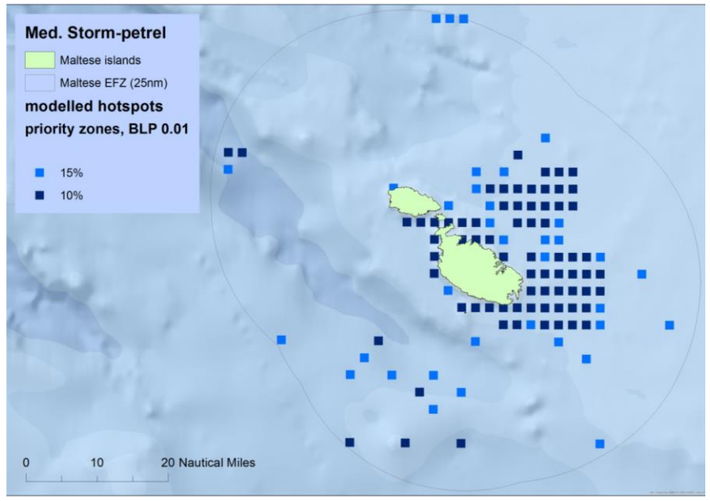
Figure 4.10: Maps showing priority areas for breeding Procellariiformes



Priority areas for *P. yelkouan* within the Maltese EFZ, dark blue squares: 10%, light plus dark blue squares: 15%



Priority areas for *C. diomedea* within the Maltese EFZ, dark blue squares: 10%, light plus dark blue squares: 15%



Priority areas for *H. pelagicus melitensis* within the Maltese EFZ, dark blue squares: 10%, light plus dark blue squares: 15%

Source: Metzger *et al*., 2015

5. ASSESSMENT

APPROPRIATE ASSESSMENT, CONSERVATION OBJECTIVES AND SIGNIFICANCE

5.1. In determining impacts on SACs and SPAs, an Appropriate Assessment is restricted to the effects of the project on the conservation objectives of the specific SAC or SPA. A conservation objective (CO) is "*the specification of the overall target for the species and/or habitat types for which a site is designated in order for it to contribute to maintaining or reaching favourable conservation status*". Favourable Conservation Status (FCS) is the level of the natural range of the habitat or species. Site specific conservation objectives (SSCOs) are set for all species and habitat types of Community Interest listed in the Habitats Directive and for all birds listed in Annex I of the Birds Directive and present in Natura 2000 sites. These specify the conditions that are targeted to be achieved by the habitat type or species to maximise the level of contribution of the respective sites in achieving the FCS.

5.2. In this context, the conservation status of a natural habitat and of species will be taken as "favourable" when:

Natural Habitat	**Species**
• its natural range and areas it covers within that range are stable or increasing, • the specific structure and functions, which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and • the conservations status of its typical species is favourable	• population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, • the natural range of the species is neither being reduced nor is it likely to be reduced for the foreseeable future, and • there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.3. **Table 5.1** lists the attributes used to elaborate the SSCOs on the basis of the current information (ERA, 2023[45])

[45] ERA, 2023. Conservation Objectives and Measures for Malta's Marine Natura 2000 sites. Marsa, January 2023; 73 pp.

Table 5.1: List of Attributes per Habitat and species relevant to the SAC & SPA subject of this AA

Name	Code	HD Parameters defining the FCS	Attributes used for SSCOs
Annex I Habitat Types			
Sandbanks	1110	Range & Extent	Area covered by the habitat type
Posidonia beds	1120	Range & Extent	Lower limit of meadow
			Area covered by the habitat type
		Structure & Functions	Shoot density
			Epiphytic load
			Maintenance of water quality
Reefs (Coastal)	1170	Range & Extent	Condition of macroalgae (CARLIT)
		Typical Species	Species composition
Reefs (Offshore)	1170	Range & Extent	Area covered by the habitat type
		Typical Species	Species composition
Submerged or partially submerged sea caves	8330	Operational Objectives Only	
Annex I Species			
Calonectris diomedea	A850	Range	Breeding Range
Puffinus yelkouan	A464	Population	Breeding Pairs
Hydrobates pelagicus	A014		Individuals

Source: ERA, 2023

Special Area of Conservation – MT0000105

5.4. As described in **Chapter 3**, of the Annex I Habitat Types present in the SAC *Żona fil-Baħar bejn Il-Ponta ta' San Dimitri (Għawdex) u Il-Qaliet* (MT0000105) (see **Table 5.1**), the only one present within or in the immediate vicinity of the Scheme site is the coastal reefs (1170).

5.5. "Coastal Reefs" are defined by ERA as "*reefs occurring within inshore coastal areas*" (ERA, 2023), as opposed to "Offshore Reefs", which occur at depths of 300-1,000 m.

5.6. The Standard Data Form for MT0000105 reports that this habitat has a good conservation status in terms of structure and functions and restoration possibilities (**Table 5.2**).

Table 5.2: Extract from Standard Data Form in relation to Reefs

MPA	Cover (ha)	Data Quality	Representativity	Relative Surface	Conservation	Global	Pressures relevant to protected site
MT0000105	84.44	Moderate	B	C	B	B	Professional active fishing Outdoor sports, leisure activities, recreational activities Professional passive fishing Marine macro-pollution (i.e. plastic bags, Styrofoam) Leisure fishing

5.7. **Table 5.3** reproduces the Site-Specific Conservation Objectives for coastal reefs in MPA MT0000105.

Table 5.3: Site-Specific Conservation Objectives for Reefs in MPA MT0000105

MPA	SSCO code	Conservation Objective	Attribute	Target	Unit of Measurement
MT0000105	SSCO_Rc_105a	Maintain the structure and functions of coastal reefs found in MT0000105 by achieving the targets by 2030	Condition of macroalgae	The macroalgal communities associated with littoral rock are dominated by sensitive species (including *Cystoseira* spp), resulting in 'high' or 'good' status as per CARLIT index along >75% of the coastline of the protected area.	CARLIT (Cartography of littoral rocky shore communities) for communities up to 1 m depth
			Species composition	The presence and coverage of typical species (structuring algal communities and/or coralligenous communities) associated with	Density/cover of typical species on the basis of representative sampling

MPA	SSCO code	Conservation Objective	Attribute	Target	Unit of Measurement
				infralittoral reefs as listed hereunder are stable throughout a period of 6 years: • *Cystoseira* spp. • *Dictyopteris polypodioides* • *Flabellia petiolata* • *Sargassum vulgare* • *Halopteris* spp. • *Zonaria tournefortii* • Mesophyllum *spp.* • *Astroides calycularis*	

Source: ERA, 2023

5.8. The Operational Objectives for Reefs deal with studies to increase knowledge on the reefs, development of indicators for the assessment of conservation status, studies on impacts from anthropogenic activities and pressure reduction. These are further elaborated into Conservation Measures that target habitats/features that are most at risk. **Table 5.4** reproduces these Operational Objectives and **Table 5.5** reports on the relevant Conservation Measures applicable to the Scheme site.

Table 5.4: Operational Objectives for coastal reefs

MPA	Operational Objective code	Conservation Objective
MT0000105	OO_Rc_1	Undertake studies between 2024 – 2026 to comprehensively map the extent of reefs within the coastal protected areas and enable elaboration of site-specific conservation objectives in terms of this attribute.
	OO_Rc_2	Continue to develop adequate indicators by 2027 for the assessment of conservation status of coastal reefs based on 'structure and functions' parameters.
	OO_Rc_3	Undertake studies to improve knowledge, by 2024, on the impacts and extent of anchoring/mooring activity on coastal reefs and best available management options.
	OO_Rc_4	Reduce pressures on coastal reefs from *inter alia*: • Abandoned, Lost, or Discarded Fishing Gear (ALDFG) • Diving Activity

Table 5.5: Relevant Conservation Measures for Reefs in MPA MT0000105

Measure name	Prevention of Abandoned, Lost or Discarded Fishing Gear and removal of litter form areas supporting reefs (coastal and offshore)
Measure code	CM_R_1
Category (Art. 17)	CF08: Reduce/eliminate marine contamination with litter
Actions for measure implementation	• Enhance and facilitate reporting scheme(s) for ALDFG by 2024 • Continue and step up efforts for removal of ALDFG from reef areas (ongoing)
Lead / supporting parties	ERA, DFA
Timeframe	2024-2025
Performance indicator	Amount of ALDFG in areas supporting reefs

Assessment of effects of the Scheme on the Conservation Objectives of the SAC

5.9. From the above SSCO, the Scheme site contributes to the species composition attribute only since the attribute relating to the condition of macroalgae is not relevant since the Scheme site has a depth that is much greater than 1 m. As regards species composition, as also described in **Chapter 4**, the Scheme site supports:

- Associations with rhodoliths in coarse sands and fine gravels under the influence of bottom currents;
- Infralittoral coarse sediments;
- Mediterranean communities of muddy detritic bottoms; and
- Atlantic and Mediterranean low energy circalittoral rock.

5.10. Typical species associated with infralittoral reefs encountered at the Scheme site include:

- *Flabellia petiolata* and *Zonaria tournefortii,* which were mainly associated with the dense rhodolith beds, which provided a pseudo-hard substratum that supported the macroalgae.
- *Halimeda tuna*, *Peyssonnelia squamaria*, *Dictyota* sp., also associated with the rhodolith beds habitat.
- *Zonaria tournefortii* and unidentified coralline algae associated with the circalittoral rock habitat.
- The presence of rhodolith beds (ranging from dense to sparse) within the Scheme site and its surroundings, included species of the genera *Lithophyllum, Lithothamnion*, *Mesophyllum* and *Sporolithon.*

5.11. The SSCO requires the species composition for these reefs (in terms of presence and coverage of the typical species) to remain stable. The original EIA for the current

tuna farm had categorised the habitat into areas with sparse or dense rhodolith cover, differentiating between areas with a 0-20% cover, areas with a 21-50% cover, and areas with a 50-100% cover. While the subsequent monitoring undertaken between 2019 and 2023 has not re-evaluated this percentage cover[46], the findings of the environmental monitoring indicated that while the tuna penning activities have resulted in some alterations to the physical and biological characteristics of the seabed, including from the placing of the mooring blocks holding the cages in place, the overall impact from fish wastes, uneaten feed fish, and tuna carcasses, has been not significant to minor, with the alterations being small and reversible. This has been confirmed when comparing data from the active tuna penning season against that from the following fallowing period. Also, no anoxic conditions or other indications of an adverse state of the seabed habitats and species were detected to date.

5.12. Nonetheless, the increasing presence of anthropogenic litter on the seabed, mostly from the tuna penning activities, is of concern and requires greater vigilance by the farm operators, improved training of farm operatives, and attempts to collect this material for disposal onshore also in line with Operational Objective OO_Rc_4 and Conservation Measure CM_R_1.

5.13. In the event that the tuna farm is moved from its current location in view of its overlap with the firing arc of the Armed Forces of Malta (see Adi Associates, 2025), it is important that any seabed moorings are carefully retrieved (not dragged) and any movement of mooring blocks or anchors is done with the least damage possible to the rhodolith beds and associated algal assemblages on Is-Sikka l-Bajda.

Special Protection Areas for the conservation of seabirds

5.14. Eight marine sites have been designated as Special Protection Areas (SPAs) for the conservation of the three seabird species breeding on the Maltese Islands (ERA, 2023). Of these, one (MT0000112 – Żona fil-Baħar madwar Għawdex) is relevant to the Scheme site. Another SPA (MT0000107 – Żona fil Baħar fil-Grigal ta' Malta) is indirectly relevant in view of its importance for rafting / feeding of the Scopoli's shearwater.

5.15. **Table 5.6** reproduces the information in the Standard Data Forms for MT0000107 and MT0000112 as they refer to the three seabird species. **Tables 5.7** to **5.9** reproduce the SSCOs relevant to the three species of seabirds. Operational Objectives are listed in **Table 5.10** and relevant Conservation Measures described in **Table 5.11**.

5.16. The Standard Data Forms for MT0000112 and MT0000107 give an average or reduced conservation status with respect to features of the habitats which are important for the species concerned and possibilities for restoration. However, knowledge on the ecological functions of the sites in question is still very limited and hence the SSCOs seek the maintenance of the existing seabird populations pending

[46] This can be repeated in future to provide a comparative analysis of the before and after situation.

further knowledge on the required improvements through studies on the ecological functions of the sites.

5.17. As noted in ERA 2023, SPAs MT0000111 and MT0000112 are aligned with the shoreline along which the three seabird species breed. Hence, these marine areas complement the terrestrial SPAs they are contiguous with and the management processes for the terrestrial and marine sites need therefore to be coherent. Only SPA MT0000112 is relevant to the Scheme site. This SPA supports breeding populations of two of the seabirds – Scopoli's shearwater (*Calonectris diomedea*) and Yelkouan Shearwater (*Puffinus yelkouan*). The SSCOs for these sites therefore reflect the SSCOs for the terrestrial SPAs in terms of breeding distribution and breeding population of the seabirds, as relevant.

5.18. Although the Scheme site does not overlap with SPA MT0000107, the latter is still of relevance in view of its use by two of the seabirds (European Storm Petrel and Yelkouan Shearwater) for feeding and rafting. Relevant SSCOs are therefore included in the tables below.

Table 5.6: Extract from Standard data forms

MPA	Size: Individuals				Site assessment				Pressures relevant to protected site
	Min	Max	Category	Data Quality	Representativity	Relative Surface	Conservation	Global	
Scopoli's shearwater (*Calonectris diomedea*)									
MT0000112	7300	7300	Common	Good	A	C	C	A	Shipping Lanes Other sport, leisure complexes Outdoor sports and leisure activities and recreational activities
Yelkouan shearwater (*Puffinus yelkouan*)									
MT0000112	3270	4650	Common	Good	A	C	C	A	Shipping Lanes Other sport, leisure complexes Outdoor sports and leisure activities and recreational activities

MPA	Size: Individuals				Site assessment				Pressures relevant to protected site
	Min	Max	Category	Data Quality	Representativity	Relative Surface	Conservation	Global	
MT0000107	380	450	Common	Good	B	C	C	B	N/A
European Storm Petrel (*Hydrobates pelagicus*)									
MT0000107	1700	1700	Common	Good	B	C	C	C	N/A

Table 5.7: Site-Specific Conservation Objectives for Scopoli's Shearwater (*Calonectris diomedea*)

MPA	SSCO code	Conservation Objective	Attribute	Target	Unit of Measurement
MT0000112	SSCO_CD_112a	Maintain the breeding distribution range of *Calonectris diomedea* along the shoreline of MT0000112, by achieving the following target by 2030	Distribution	The breeding colony of *Calonectris diomedea* covers at least 10% of the total coastline of the protected area.	Length of coastline occupied by breeding colonies
	SSCO_CD_112b	Maintain the breeding population of *Calonectris diomedea* along the shoreline of MT0000112, by achieving the following target.	Breeding population	The population trend over a period of six years is stable with number of breeding pairs reflecting current minimum and maximum estimates of 1,700 – 2,600 pairs within the site in question.	Estimates of breeding pairs

MPA	SSCO code	Conservation Objective	Attribute	Target	Unit of Measurement
	SSCO_CD_112c	Population dynamics of *Calonectris diomedea* in the marine part of MT0000112 are maintained or improved by achieving the following targets by 2030.	Abundance	The average number of individuals recorded over a period of six years reflects current estimates within the marine part of the site, ranging between 6,000 and 8,000.	Number of individuals

Table 5.8: Site-Specific Conservation Objectives for Yelkouan Shearwater (*Puffinus yelkouan*)

MPA	SSCO code	Conservation Objective	Attribute	Target	Unit of Measurement
MT0000112	SSCO_PY_112a	Maintain the breeding distribution range of *Puffinus yelkouan* along the shoreline of MT0000112, by achieving the following target by 2030	Distribution	The breeding colony of *Puffinus yelkouan* covers at least 15% of the total coastline of the protected area.	Length of coastline occupied by breeding colonies
	SSCO_PY_112b	Maintain the breeding population of *Puffinus yelkouan* along the shoreline of MT0000112, by achieving the following target.	Breeding population	The population trend over a period of six years is stable with number of breeding pairs reflecting current minimum and maximum estimates of 1,400 – 2,250 pairs within the site in question.	Estimates of breeding pairs

	SSCO_PY_112c	Population dynamics of *Puffinus yelkouan* in the marine part of MT0000112 are maintained or improved by achieving the following targets by 2030.	Abundance	The average number of individuals recorded over a period of six years reflects current estimates within the marine part of the site, ranging between 3,000 and 5,000.	Number of individuals
MT0000107	SSCO_PY_107a	The use of MT0000107 by the breeding population of *Puffinus yelkouan* is retained by achieving the following targets by 2030	Distribution	Sightings or tracking data of *Puffinus yelkouan* are distributed throughout the MPA.	Area covered by sightings / tracking data
	SSCO_PY_107b	Population dynamics of *Puffinus yelkouan* in the marine part of MT0000107 are maintained or improved by achieving the following targets by 2030.	Abundance	The average number of individuals recorded over a period of six years reflects current estimates within the site ranging between 350 and 500.	Number of individuals

Table 5.9: Site-Specific Conservation Objectives for European Storm Petrel (*Hydrobates pelagicus*)

MPA	SSCO code	Conservation Objective	Attribute	Target	Unit of Measurement
MT0000107	SSCO_HP_107a	The use of MT0000107 by the breeding population of *Hydrobates pelagicus* is retained by achieving the following targets by 2030	Distribution	Sightings or tracking data of *Hydrobates pelagicus* are distributed throughout the MPA.	Area covered by sightings / tracking data

MPA	SSCO code	Conservation Objective	Attribute	Target	Unit of Measurement
	SSCO_HP_107b	Population dynamics of *Hydrobates pelagicus* in the marine part of MT0000107 are maintained or improved by achieving the following targets by 2030.	Abundance	The average number of individuals recorded over a period of six years reflects current estimates within the site ranging between 1,500 and 2,000.	Number of individuals

5.19. The Operational Objectives have been set for seabirds as a group. These refer to specific SPAs, as shown in **Table 5.10** below. As was the case with the reefs, these mainly deal with studies for the improvement of knowledge on the ecological functions of the protected sites and to understand the effects of human interactions with the seabirds and the impact of anthropogenic activities. These are elaborated into Conservation Measures focusing on activities impacting the seabirds (see **Table 5.11**).

Table 5.10: Operational Objectives for seabirds within Special Protected Areas MT0000107 and MT0000112

MPA	Operational Objective code	Conservation Objective
MT0000107	OO_SB_1	Undertake studies between 2024 – 2025 to improve knowledge on the ecological functions of the protected sites for the three seabird species and enable further elaboration of site-specific conservation objectives.
MT0000112	OO_SB_2	Improve knowledge, by 2024, on the interactions of seabirds with fishing activity, with a view to quantify the scale and extent of fisheries' bycatch through the involvement of fishers.
	OO_SB_3	Disturbance due to light pollution and other anthropogenic activities within MT0000112 is reduced.

Table 5.11: Relevant Conservation Measures for Seabirds in SPA MT0000112

Measure name	Regulation of Activities that may cause disturbance to seabirds
Measure code	CM_SB_1
Category (Art. 17)	CF09: Reduce/eliminate noise, light, heat or other forms of pollution from industrial, commercial, residential and recreational areas and activities
Actions for measure implementation	• Development, by 2024, of a Code of Conduct outlining best practices and behaviour within the Marine Protected Areas, primarily targeting disturbance to seabirds from boating activity and commercial vessels. • Assess the adequacy of existing regulations to reduce

	disturbance, and extend as necessary, by 2025, in cooperation with relevant stakeholders. • Development, by 2026, of a digital service providing the relevant information to facilitate compliance by recreational boaters/commercial vessels. The information may also be promulgated through the issuance of related Notices to Mariners. • By 2026, install a set of surveillance cameras within nesting/breeding sites to support enforcement/monitoring of regulation compliance.
Applicable sites:	MT0000112
Lead / supporting parties	ERA, TM
Timeframe	2024-2026
Performance indicator	Number of maritime users aware of the codes of conduct and regulations

Measure name	Reduction of light pollution in coastal marine protected areas
Measure code	CM_SB_3
Category (Art. 17)	CF09: Reduce/eliminate noise, light, heat or other forms of pollution from industrial, commercial, residential and recreational areas and activities
Actions for measure implementation	• By 2024, se areas which are subject to light pollution from land-based sources. • Explore the availability of funding to incentivise retrofitting of light fixtures in the selected priority areas. • Implement such retrofitting in collaboration with site owners by making use of funding opportunities. • Promote the installation of alternatives to street lighting, such as reflective signs, to guide driving at night. • In parallel, continue to recommend mitigation measures to address light pollution from new development as part of permitting processes.
Applicable sites:	MT0000112
Lead / supporting parties	ERA
Timeframe	2024-2026
Performance indicator	Extent of light pollution in coastal MPAs

Assessment of effects of the Scheme on the Conservation Objectives for the seabirds in the SPAs

5.20. The SSCO for the three seabirds aim for the maintenance of the population to current estimates in terms of abundance, breeding population, and distribution. In view of the lack of information, the Operational Objectives target the collection of data for the improvement of knowledge on the ecological functions of the protected sites for the three seabird species. This would enable further elaboration of site-specific conservation objectives. Furthermore, the impacts of interactions of the seabirds with fishing activities is another area of study identified.

5.21. Though data is scarce, there is evidence of tuna farms attracting seabirds. The impact

of this interaction is not known, and it would be advisable to carry out targeted studies to understand this situation better as an extension of OO_SB_2 to include aquaculture activity as well.

5.22. Impacts of light from navigational markers at the Scheme site is also an unknown, although the low light intensity is unlikely to be of concern, especially compared to the light pollution impacts from nearby land sources.

5.23. As reported by Birdlife (Malta) in consultation meetings[47], there have been instances of oiling of birds by fish slime over the past years, as the seabirds seem to be increasingly attracted to the tuna farms. This impact is likely a result of the seabirds diving through slime patches that would have escaped the farm, and hence, while the impact is directly linked to the tuna farming operations (of all tuna farms), they are not exclusive to the scheme site.

5.24. The proposal to convert the tuna farm from a temporary facility that would eventually be relocated to another site in the same SPA to a permanent installation, is not expected to create a significant difference in the impacts on the seabirds. As explained, these impacts are mostly uncertain due to the lack of data, though the current state of knowledge points towards a minor to not significant impact on seabirds, with the main concerns being related to the interactions with the farms rather than the farms' location *per se*., such that the impact would be the same wherever the farm is located (assuming it is within the feeding / rafting area for the seabirds).

CONCLUSION

5.25. As has been evidently indicated through the monitoring at the Scheme over the past 5 years, the way the fish farm is managed has an important influence on the significance of any residual impacts.

5.26. The proposal to change the Scheme from a temporary tuna farming facility (that would be relocated to another location within the same SAC/SPA once a North Aquaculture Zone is set up), to a permanent installation, will not result in any appreciable changes to the protected areas beyond the current assessed impacts.

5.27. The effects of the Scheme on the Conservation Objectives of the Annex I habitats – 1170 -Reefs, or on the protected seabird species are not such as to result in a negative impact that could affect the conservation status of the habitats or species.

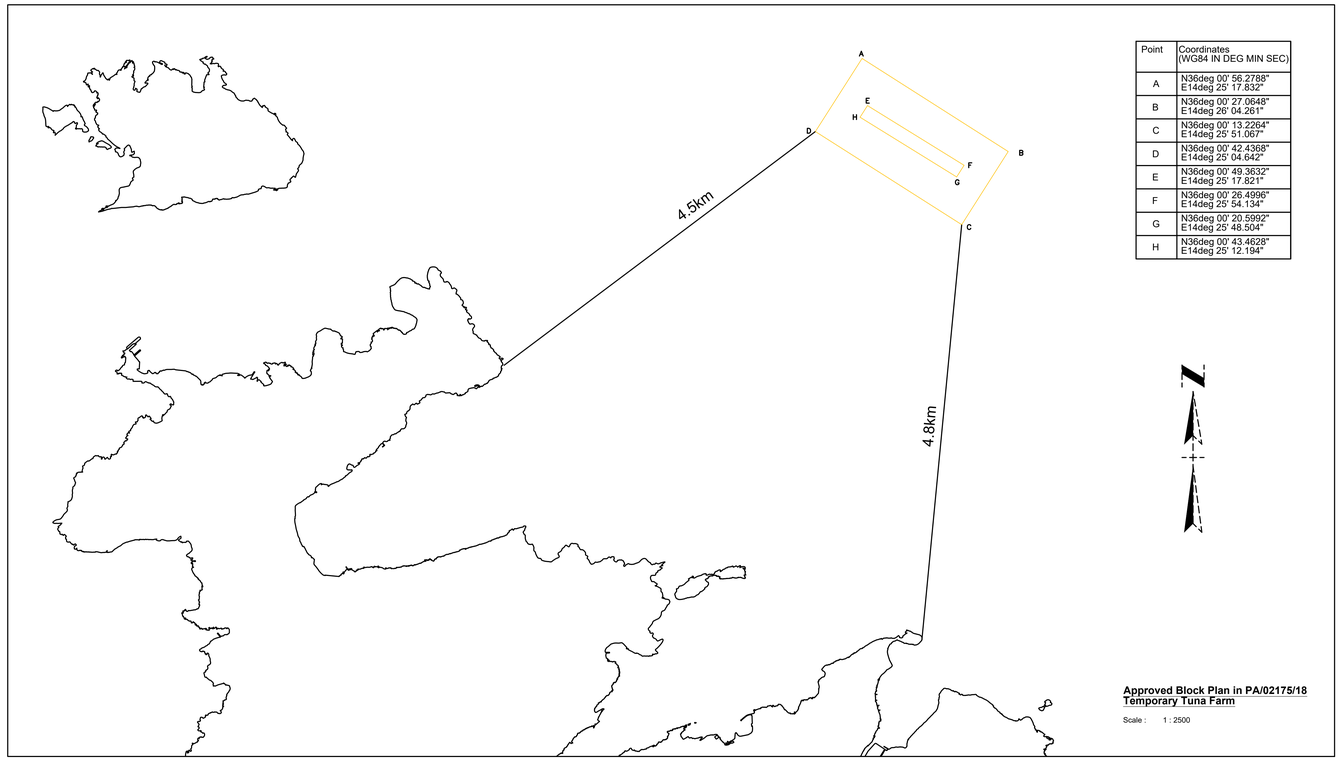
5.28. The monitoring at the Scheme site has shown that the farming activity has not to date resulted in impacts on the reef habitat, except for the initial impact during the placement of the mooring blocks; however, greater attention needs to be had by the farm operators to ensure that fishing gear and other anthropogenic materials are not lost overboard. In line with the Operational Objectives and Conservation Measures

[47] Barbara, Nicholas, personal communication; November 2024.

for coastal reefs, the retrieval of lost gear is an important mitigation measure in this regard.

5.29. As regards the seabirds, there is no evidence to date of impacts on the populations of the three seabirds in terms of distribution and abundance; however, further studies and monitoring are advisable to improve the knowledge in this regard, in particular on the interaction of the seabirds with fisheries and aquaculture. This would be in line with Operational Objective OO_SB_2.

APPENDIX 1: SCHEME PLANS



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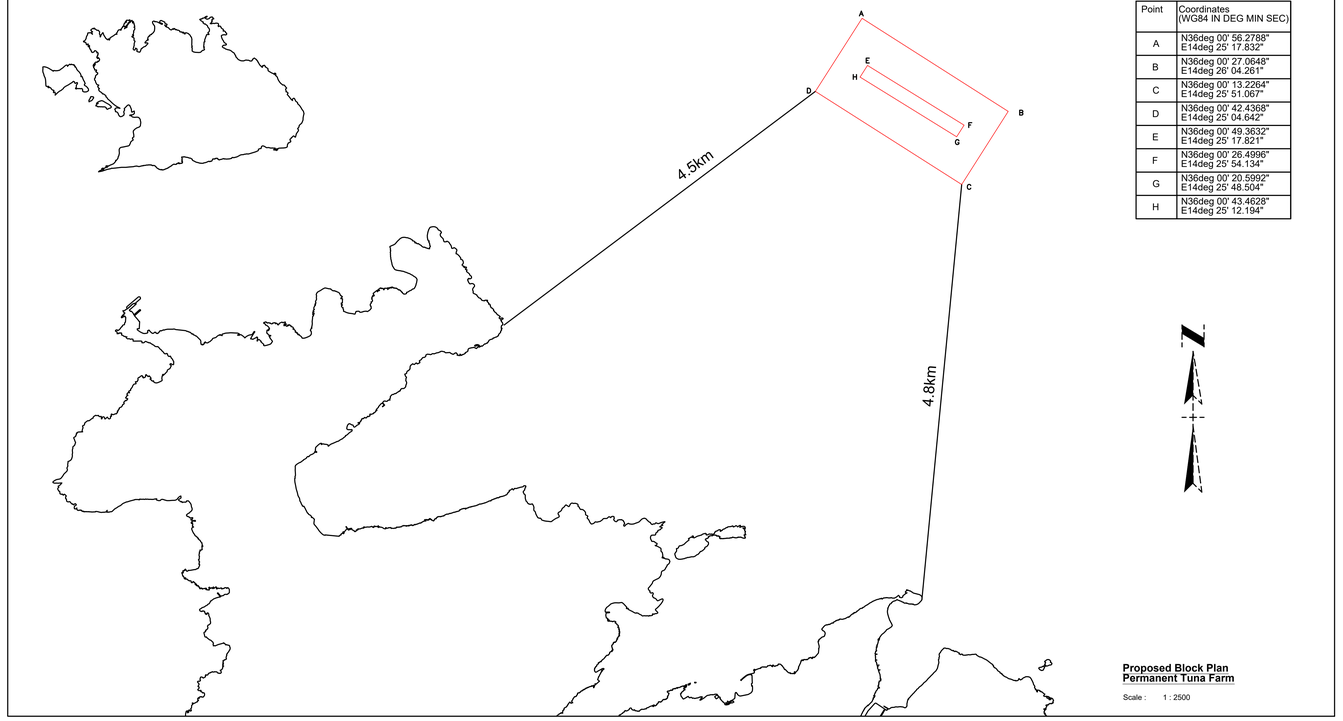
B	N36deg 00' 27.0648" E14deg 26' 04.261"
C	N36deg 00' 13.2264" E14deg 25' 51.067"
D	N36deg 00' 42.4368" E14deg 25' 04.642"
E	N36deg 00' 49.3632" E14deg 25' 17.821"
F	N36deg 00' 26.4996" E14deg 25' 54.134"
G	N36deg 00' 20.5992" E14deg 25' 48.504"
H	N36deg 00' 43.4628" E14deg 25' 12.194"

Approved Block Plan in PA/02175/18
Temporary Tuna Farm

Scale : 1 : 2500



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Proposed Block Plan
Permanent Tuna Farm

Scale : 1 : 2500

METRES 0 500 1000 2000 5000
SCALE 1:25,000

Legend

- Construction Proposed
- Demolition Proposed
- As Constructed - To Sanction
- Approved but not Constructed

Notes

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JOB TITLE
TUNA FARM OFF ST PAUL'S BAY

DRAWING TITLE
PLANS

CLIENT
D.G.Bjorn Callus obo
D.H.Ministry for Agriculture, Fisheries, Food
D.I. & Animal rights

LOCATION
Site off Sikka l-Bajda,
Sikka l-Bajda, San Pawl il-Bahar

DATE	
15.07.2022	
REF No.	
AFD423-004	
SCALE	SIZE
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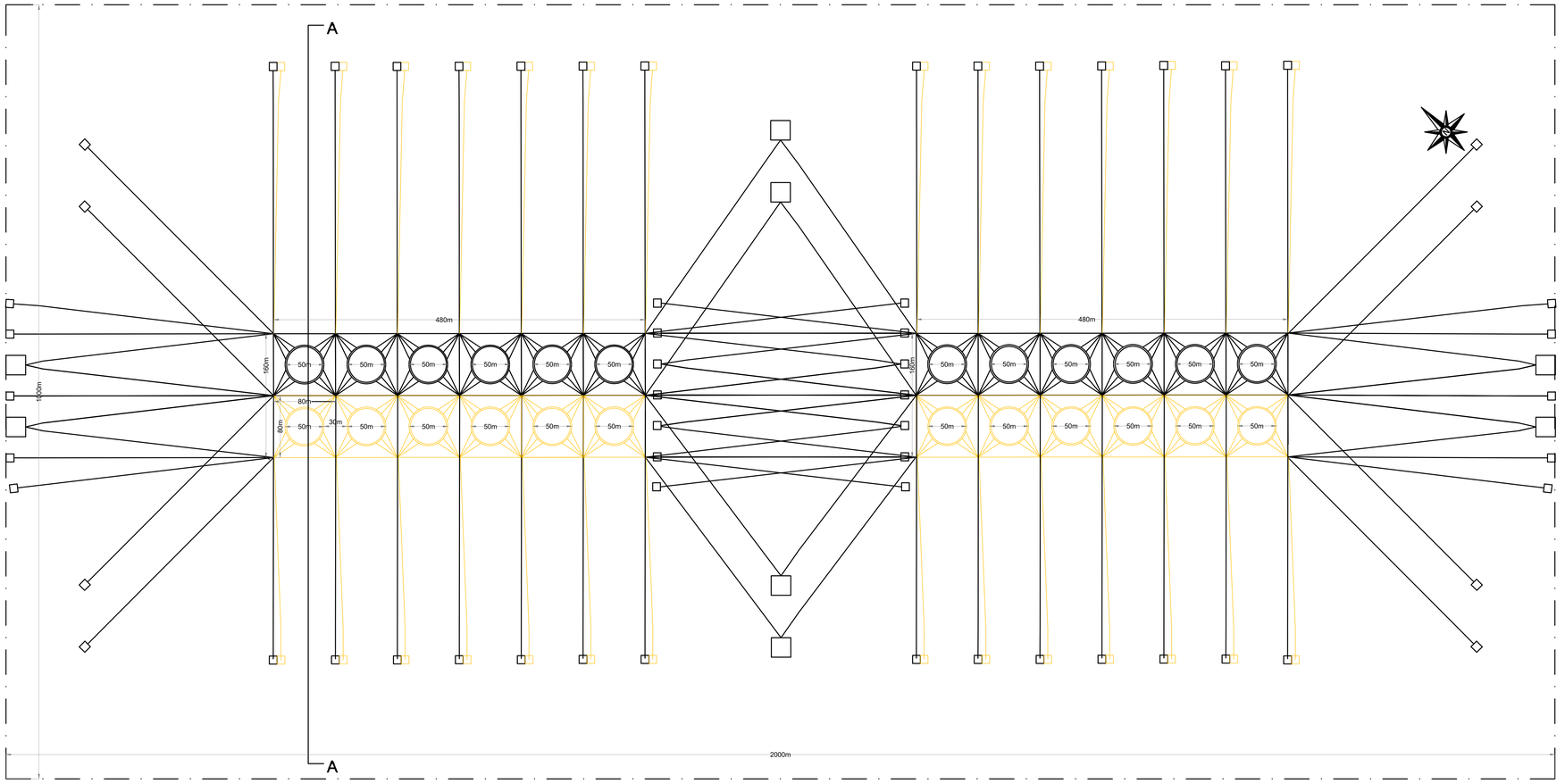
N.S.	N.S.
DRAWING No.	REVISION No.
110	00



Approved Plan in PA/02175/18 - Temporary Tuna Farm
Scale : 1 : 2500

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- Demolition Proposed
- As Constructed - To Sanction
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LOCATION
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Sikka l-Bajda, San Pawl il-Bahar

DATE	
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DRAWING No.	REVISION No.
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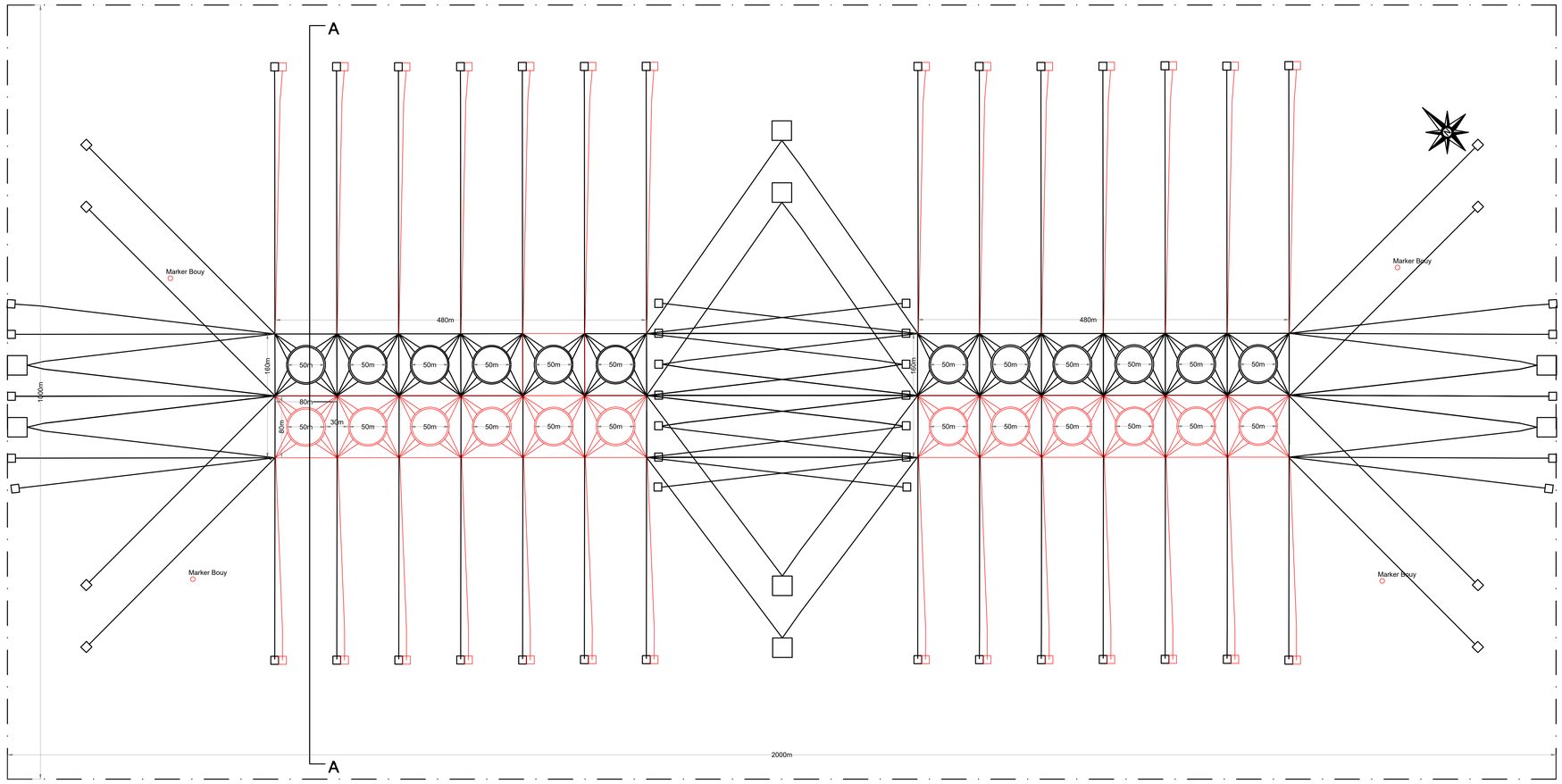

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Legend

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JOB TITLE: TUNA FARM OFF ST PAUL'S BAY
DATE: 15.07.2022
DRAWING TITLE: PLANS
REF. No.: AFD423-004
CLIENT: D.G.Bjorn Callus obo D.H.Ministry for Agriculture, Fisheries, Food D.I. & Animal rights
SCALE: 1:2500
SIZE: A0
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APPROVED: N.S.
LOCATION: Site off Sikka l-Bajda, Sikka l-Bajda, San Pawl il-Bahar
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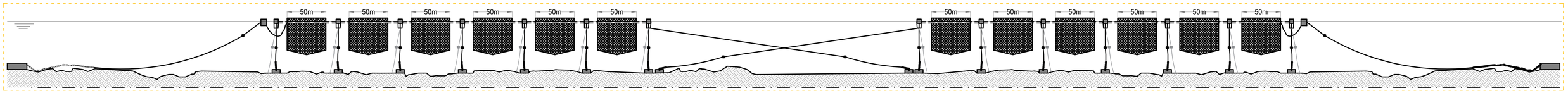
REVISION No.: 00



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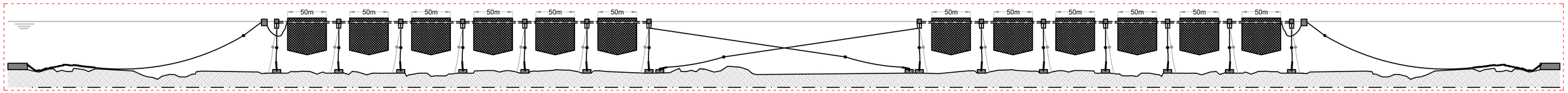

Proposed Anchoring Detail in PA/02175/18 - Permanent Tuna Farm
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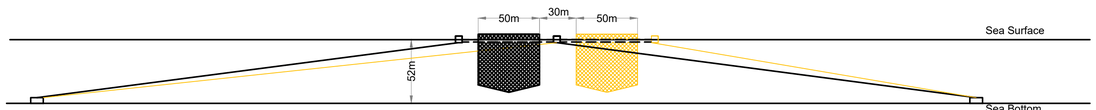

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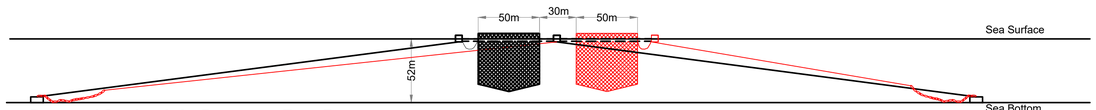

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Legend

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JOB TITLE
TUNA FARM OFF ST PAUL'S BAY

DRAWING TITLE
SECTIONS

CLIENT
D.G.Bjorn Callus obo
D.H. Ministry for Agriculture, Fisheries, Food
D.I. & Animal rights

LOCATION
Site off Sikka l-Bajda,
Sikka l-Bajda, San Pawl il-Bahar

DATE	15.07.2022
REF No.	AFD423-004
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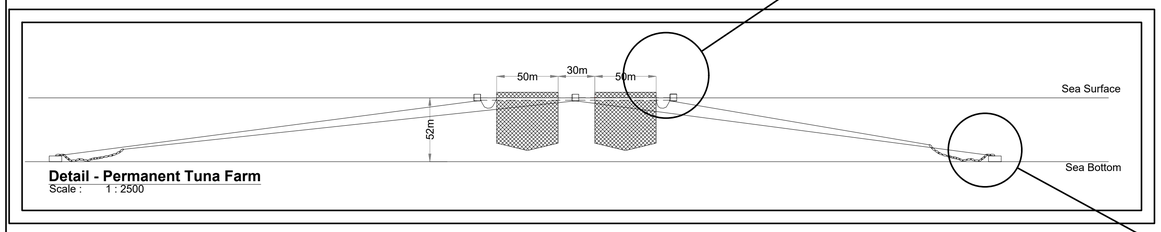
REVESION No.	00



Detail - Permanent Tuna Farm
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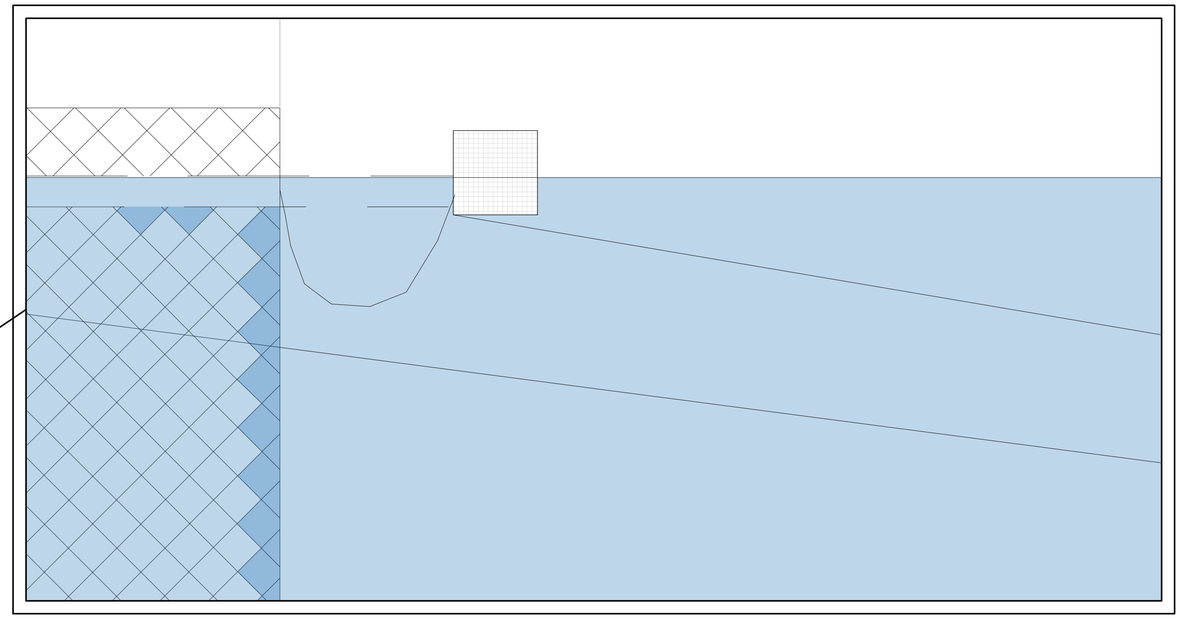

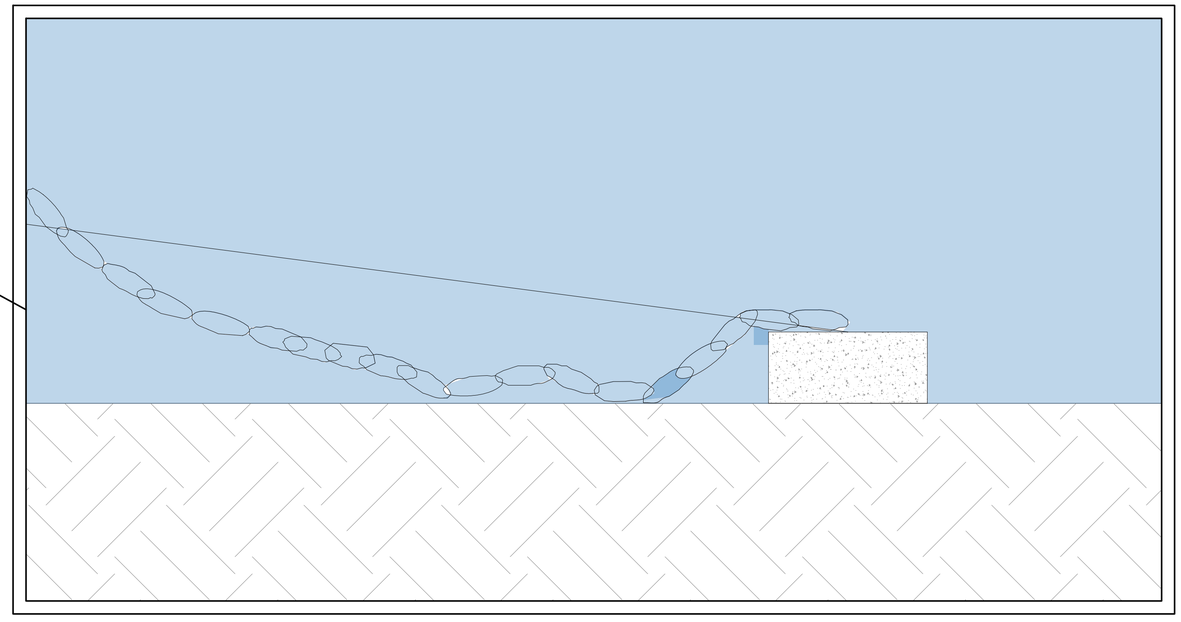

Approved in PA/02175/18 - Temporary Tuna Farm

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Legend
- Construction Proposed
- Demolition Proposed
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DATE	15.07.2022
REF. No.	AFD423-004
SCALE	1:2500
SIZE	A1
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APPROVED	N.S.
DRAWING No.	120
REVESION No.	00

APPENDIX 2: MARINE ECOLOGY BASELINE REPORT

Report on an ecological assessment of an area off the northeastern coast of Malta, undertaken as part of the Environment Impact Assessment in connection with GF00250/07: Proposal for a new aquaculture zone in the North of Malta, Zone offshore Malta

Prepared by

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ECOSERV'S REPORT REFERENCE NO: 066-18

JULY 2018

1. INTRODUCTION

1. Adi Associates Environmental Consultants Ltd (hereafter 'ADI') have been awarded a tender for the provision of services in relation to the compilation of an Appropriate Assessment and an Environmental Impact Assessment, and their presentation to stakeholders, as per the ERA requirements for the planning application for a proposed new offshore aquaculture zone (OAZ) located off the northeastern coast of Malta; see Figure 1. In turn, ADI have commissioned Ecoserv Ltd to undertake an ecological assessment of the areas of interest. The main aims of the assessment are to collect and analyse data on general physico-chemical attributes of the sediments and water column, and on the ecological characteristics of the concerned areas, and to provide ADI with the findings and assist the consultants with predicted potential impacts of aquaculture activities on the ecology of the site. Ultimately, the present document will feed into the Environment Impact Assessment for the concerned project; i.e. GF00250/07: Proposal for a new aquaculture zone in the North of Malta, Zone offshore Malta.

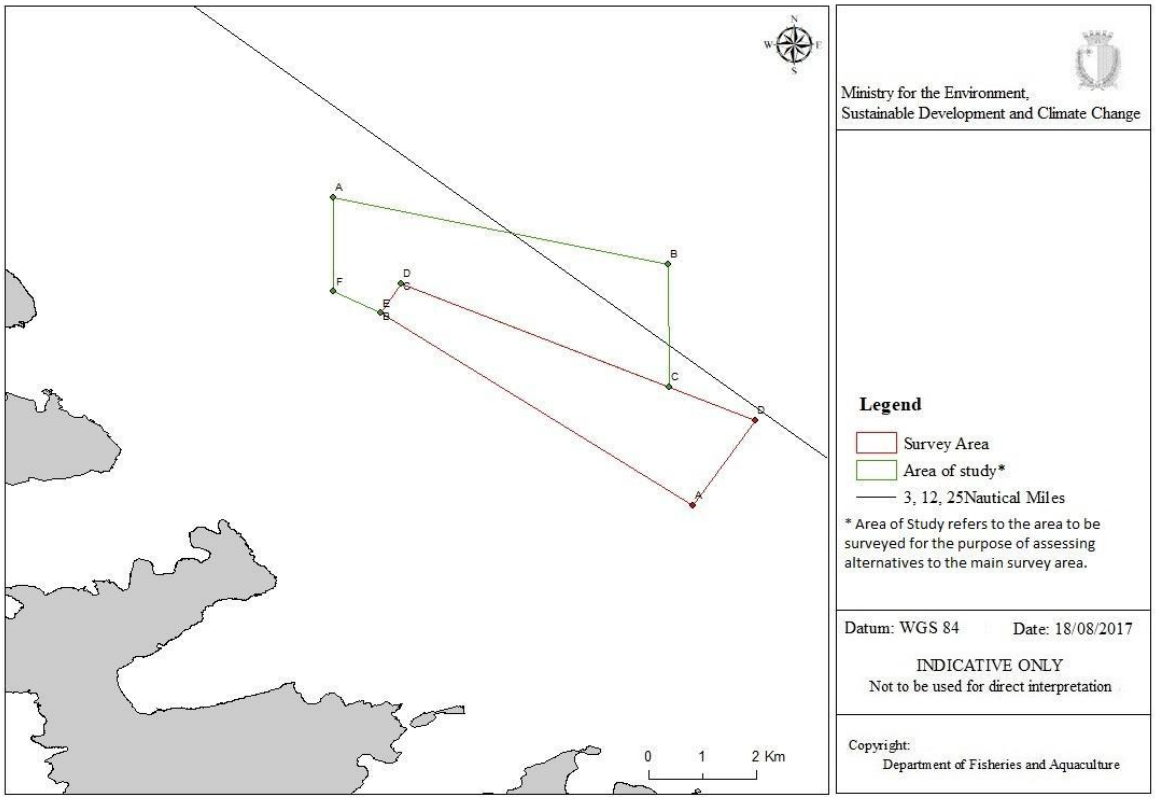

Figure 1. Map showing the areas of interest that are the subject of the present assessment. Map source: Tender document 99/2017.

2. The areas of interest that are the subject of the required studies have been selected on the basis of: (i) Technical requirements (i.e. deployment of cages in water deeper than 50 m but not exceeding 100 m); (ii) Constraints associated with existing marine uses off the north and east coasts of the island; (iii) Constraints associated with the relocation as specifically

directed by relevant Authorities or entities. The proposed North OAZ will be located at a minimum distance of 4.5 km from the shore and the main scope is for use for capture-based aquaculture, in particular of *Thunnus thynnus* (Atlantic Bluefin Tuna). Utilisation of the site for other finfish is likely to be limited, although there is the possibility of farming *Seriola dumerili* (Amberjack) within the area.

3. A survey of the marine benthic habitats present within an area that forms part of the areas that are the subject of the present assessment was carried out in May 2017 (Borg & Evans, 2017); see the area enclosed by the blue boundary in Figure 2. Part of the area currently occupied by AJD Tuna Ltd's 12 tuna cages, and where a further 12 cages are planned to be deployed, falls within the area surveyed by Borg & Evans in May 2017, however, the area delineated by the green boundary and area delineated by the orange boundary had not yet been surveyed (see Figure 2). A main aim of the present study was to map the marine benthic assemblages present within these two areas using data from a survey by Seastar Survey Ltd undertaken in May 2018, and from Borg & Evans' survey made in May 2017. Furthermore, the present document also reports on data of physico-chemical attributes of the water column, and of the soft sediment seabed in the vicinity of the area currently occupied by AJD Tuna's cages (Figure 2). A further aim was to sample the soft sediment habitat in the vicinity of the area currently occupied by AJD Tuna's cages (Figure 2) to establish the species of benthic flora and fauna present.

4. The findings from the survey made in May 2017 that was undertaken using a remotely operated vehicle (ROV) and which entailed collection of underwater footage of the seabed along transects within part of the area bounded by blue (Figure 2) indicated the following (see Borg & Evans, 2017):

   - In terms of physical characteristics, the bottom within the area surveyed consisted predominantly of coarse mobile sediments. A drop-off (some 10 m – 25 m high) is present just outside the study area on its northeastern side. What are usually referred to as 'maerl[1] beds' but which are more properly termed 'rhodolith beds' occupied a large part of the study area, which were more dense and continuous in the northeastern (and deeper) (outer) half of the survey area; in many places, the rhodolith beds were interspersed with a bare sand bottom that supported sparse rhodoliths[2]. "Rhodolith beds were densest in the central parts of the study area but the rhodolith density varied, such that they were less dense in the southwestern (shallower) parts of the survey area. A large stretch of predominantly bare sand was present in the southwesterly extreme part of the study area. Depth varied between 46 m and 72 m. The underwater visibility was good (25 – 30 m) throughout the study area, and an appreciable current was noted close to the seabed along some of the transects; as evidenced by debris and other material originating from benthic vegetation that were seen being moved rapidly on the bottom.

[1] 'Maerl' is a term used to describe calcareous sediments dominated by coralline algae. Maerl as used here describes sedimentary habitats in which living or dead unattached calcareous rhodophytes are a dominant component. These algae may take the form of nodules (rhodoliths) or fragmented thalli. However, according to Basso *et al*. (2016), 'rhodolith beds' should be identified and delimited as those areas of the sea floor with >10% cover of live rhodoliths over a minimum surface of 500 m^2, while the term "maerl" refers to a specific type of rhodolith bed that is composed of non-nucleated, unattached growths of branching, twig-like coralline algae. 'Maerl' as used here conforms to the definition of Basso *et al*. (2016).

[2] Rhodoliths consist either of free-living calcareous rhodophytes (red algae), or else of an inner nucleus, such as stone or shell, encrusted by calcareous rhodophytes.

Some anthropogenic items were observed during the survey; these included glass and plastic beverage bottles, fish traps and other unidentified items.

- In terms of biological characteristics, the following two main biotic assemblage types were recorded from the study area (see Figure 2):

  (i) Association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (EUNIS code A5.515)[3]

  (ii) Infralittoral coarse sediment (EUNIS code A5.13)[4]

  The association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents was present as two subtypes: one which was characterised by a rhodolith-rich bottom in which the proportion of rhodoliths covering the bottom was dense, constituting a well developed rhodolith bed, *sensu* Basso *et al*. (2016). This association subtype was present in the deeper parts (> 60 m) of the survey area (Figure 2). The other subtype consisted of a rhodolith bed in which the density of rhodoliths was sparser and in which the rhodoliths formed accumulations or were dispersed as single rhodoliths amongst other sediment components; this association subtype was present in areas having an intermediate water depth (50 m – 60 m); see Figure 2. Although no samples of rhodoliths were collected from the survey area, it is well established that a variety of coralline algal species that completely coat coarse sediment granules to form 'cored rhodoliths', contribute to local rhodolith beds; these include *Lithophyllum incrustans*, *Lithothamnion valens*, *Mesophyllum alternans* and *Sporolithon ptychoides*. Where present in the survey area, the rhodolith-rich bottom appeared to comprise a pseudo-hard substratum that supported macroalgae; the predominant alga being *Flabellia petiolata*. The main megafaunal species that was recorded from this association is the cidariid sea urchin *Stylocidaris affinis*. The rhodolith beds occupied the greater part of the area surveyed but the density of the rhodoliths varied greatly, with the general tendency being for the beds to be less dense with a decrease in water depth and on moving from the northeastern parts of the study area to the southwestern parts. Where dense, the rhodolith beds supported the alga *Flabellia petiolata* and, in places, an unidentified filamentous alga. The most abundant megafaunal species recorded from this association were the cidariid sea urchin *Stylocidaris affinis*, the Heart Urchin *Spatangus purpureus*, and the Long-Spined Urchin *Centrostephanus longispinus*. Individuals of the crinoid *Antedon mediterranea*, and single individuals of the seastar *Luidia ciliaris* and of the seaslug *Pleurobranchia meckeli* were also recorded from this assemblage. Burrows of the Common Octopus *Octopus vulgaris* were recorded in some places.

  The infralittoral coarse sediment assemblage occurred at the southwestern part of the area surveyed, where the water depth was some 46 m – 50 m. In places, the sediment bottom supporting this assemblage type had current ripples; in places the trough of such ripples had small accumulations of rhodoliths or sparse rhodoliths. Detached algal and plant (seagrass) material was present in places on the seabed where this assemblage occurred but no attached fleshy algae or seagrasses were present. The epifauna associated with this assemblage was impoverished; the only recorded macrofauna comprised the Heart Urchin *Spatangus purpureus* and groups of the Purple Urchin *Sphaerechinus granularis*.

[3] Equivalent to RAC/SPA 'Association with Rhodoliths'; code III.3.2.2.
[4] Equivalent to RAC/SPA 'Biocoenosis of coarse sands and fine gravels under the influence of bottom currents; code III.3.2.

5. The present submission comprises a report surveys of the main marine benthic habitats present within the three areas indicated in Figure 2. A survey of benthic diversity and water quality, undertaken in the vicinity of the area that is currently being used by AJD Tuna Ltd for tuna farming is also reported on in the present document. Video footage collected during the underwater videographic component of the present survey is appended to the present document and is titled '*Video transects of the seabed in an area off Mellieha Bay proposed for designation as an offshore aquaculture zone, made in May 2018'*.

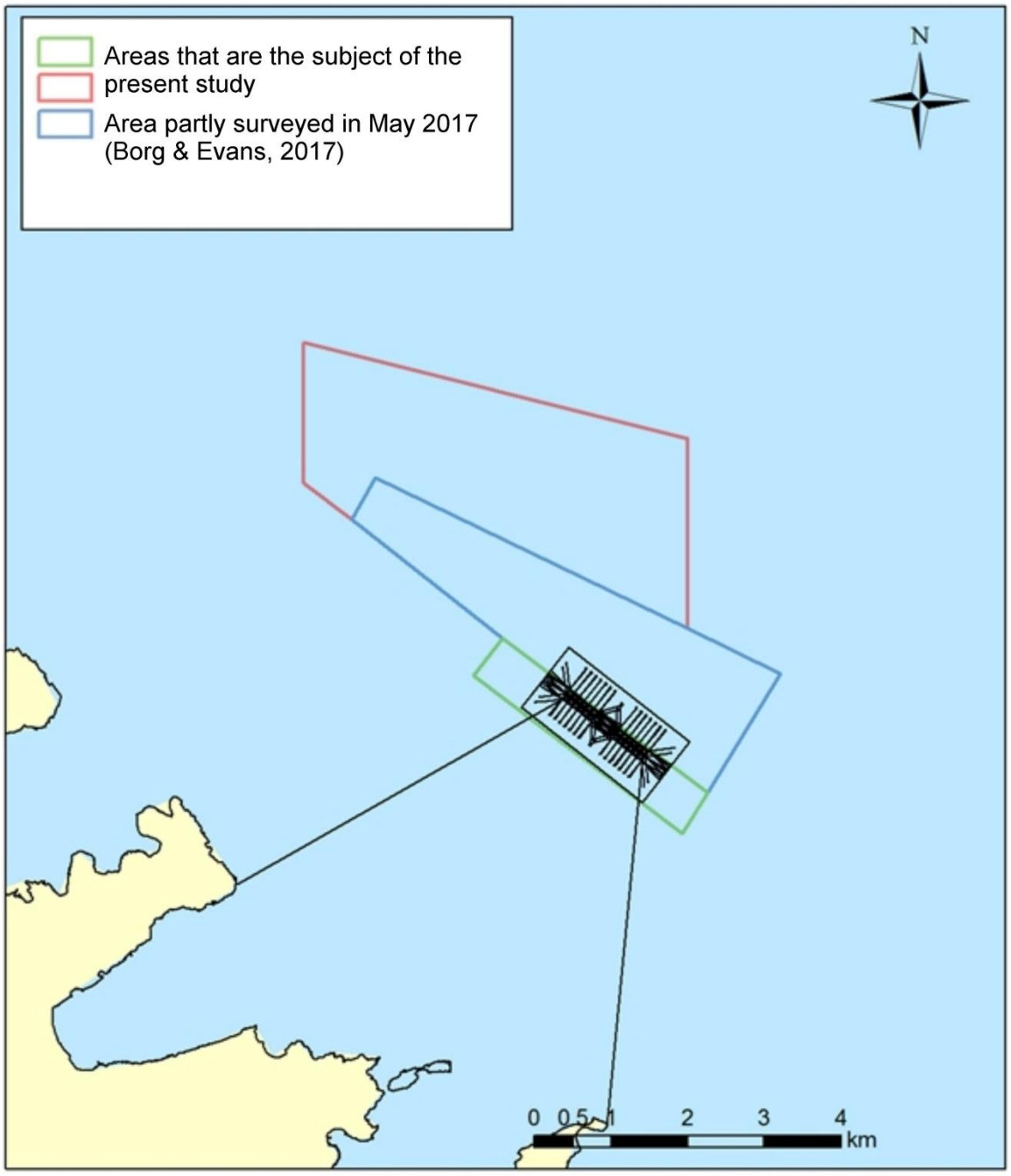

Figure 2. Map showing: the three areas (orange, blue and green boundaries) from where environmental data were collected and are assessed in the present report. The location of the tuna farm site that is currently being used by AJD Tuna Ltd is also shown. Map source: Seastar Survey Ltd, UK.

2. METHODOLOGY

SEDIMENT AND WATER QUALITY

6. Fieldwork in relation to the water quality survey was undertaken on 4th April 2018. The day during which fieldwork was made was chosen at random but subject to good sea conditions to ensure successful undertaking of fieldwork and data collection. Fieldwork was carried out using a 12 m vessel equipped with hoisting jib and winch. The locations of the six sampling stations, A – D and R1 and R2, and shown in Figure 3, and their geographical coordinates and water depth are given in Table 1.

7. The list of physico-chemical attributes that were included in the water quality survey are given in Table 2. Measurements of temperature, salinity, turbidity and dissolved oxygen in water were made *in-situ* at each of the six stations using a YSI 650 MDS meter connected to a 6920 V2 multi-parameter probe. The meter was calibrated according to the manufacturer's instructions immediately before use. Measurements using the *in-situ* meter were made at the surface (0.5 m below the surface). Two replicate measurements were taken at each of the six stations A – D, and R1 and R2. Two replicate samples of seawater were then collected from each of the same six stations; samples were collected at a depth of 0.5 m, from each of the six stations using a standard Van Dorn water sampler of 3 L volume. All water samples were transported in a cooler box and maintained at a temperature of 4^{o}C.

8. Estimates of current velocity and direction at the two reference stations (R1 and R2; see Figure 3) were made using drogues according to the La Grange method. The drogues employed for this purpose had four rectangular perspex vanes, each of which has a surface area of 0.2 m^2. The drogues were suspended from an inflatable surface float by means of a length of twine which was 1 m long. The position of the release point (determined using the GPS) and time of the release were recorded. After allowing the drogues to float for a given period of time, the position of the collection point and the time of collection were recorded.

9. For sediment granulometric and chemical studies, samples were collected using a 0.1 m^2 van Veen grab that was deployed from a 12 m vessel equipped with hoisting jib and winch. Two replicate grab samples were collected from each of six stations A – D, and R1 and R2; see Figure 3 and the corresponding geographical coordinates given in Table 1. The list of physico-chemical attributes that were included in the water quality survey are given in Table 3.

BENTHIC DIVERSITY

10. To collect data for benthic diversity studies, a grab sample was taken from each of the four stations A – D using a 0.1 m^2 Van Veen grab that was deployed from a 12 m vessel equipped with hoisting jib and winch. After the grab was brought on board, surplus seawater was drained from the sample by placing it on a 1mm-mesh sieve; the retained sediment and biota were temporarily preserved in 10% formaldehyde in seawater. In the laboratory, each sample was first washed to remove the fine sediment (<0.5 mm fraction) and the preservative, and it was then sorted to separate out all macrofauna (animals larger than 0.5 mm). The motile macrofauna was then identified as far as possible. Where identification to species level was

not possible, the different species present were labelled using an alphabetical code (e.g. Mysidacea sp. A, etc.).

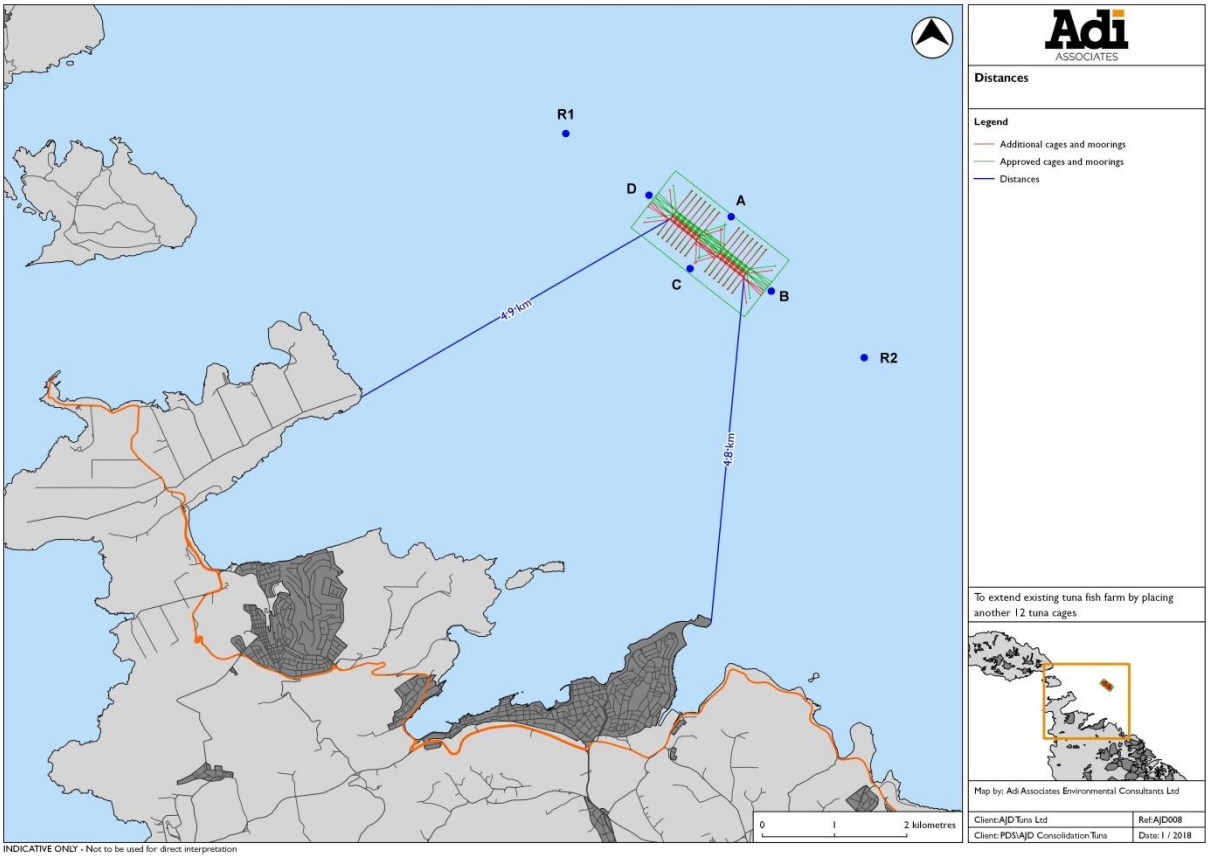

Figure 3. Map showing the six stations used for collecting samples for sediment and water quality, and benthic diversity. Stations A – D are located in the vicinity of the farm cages, while Stations R1 and R2 are reference sites. Map source: Adi Associates Environmental Consultants Ltd.

BENTHIC HABITATS MAP

11. Fieldwork in relation to the videographic survey to map the distribution of benthic habitats in those areas had not been surveyed by Borg & Evans (2017) was undertaken by personnel from Seastar Survey Ltd (UK) using the Maltese registered vessel MV Awrata, a 14 m steel workboat owned and operated by Azzopardi Fisheries. During the survey, a towed underwater camera system was used, which had the following specifications:
    - Kongsberg 14-208 camera and flash
    - Four video LED lights
    - Seastar Survey camera frame
    - EdgeDVR Digital video recorder with overlay
    - 300 m umbilical

Table 1

Latitude/longitude coordinates and depth of the six sampling stations shown in Figure 3. In the field, readings were taken using the boat's Global Positioning System (GPS)[5] set.

Station	Latitude / Longitude	Depth (m)
A	36° 00.584' / 14° 25.780'	50 m
B	36° 00.131' / 14° 26.127'	48 m
C	36° 00.163' / 14° 25.508'	45 m
D	36° 00.567' / 14° 25.367'	48 m
R1	36° 00.848 / 14 24.474'	46 m
R2	35° 59.597 / 14 26.815'	48 m

12. The camera and lights were set up on the camera frame so as to optimise field of view and video lighting. At each site, the vessel was manoeuvred to the transect position and first taken out of gear so as to determine the direction and speed of drift. Once the drift direction was determined, the vessel was manoeuvred to a distance of around 300 m from the transect position in the direction of drift, and then turned so that the camera transect was driven into the current. The positions of the video transects are shown in Figure 4; a total of twenty six (26) transects were used in the survey. No transects were made within the area occupied by AJD Tuna Ltd's cages since the cages and mooring lines prevented deployment of the video camera along transects, but in any case most of the area had already been surveyed in 2017 (Borg & Evans, 2017). At the start of a transect, the vessel slowed to between 0.5 and 1.0 knot. The camera frame was deployed using the DT winch, wire tow-line and the vessel's crane, and the camera umbilical was bulldog taped to the winch wire at regular intervals to prevent it streaming out in the water column. During deployment, a layback position was calculated and recorded in Hypack, and an output of layback position and GPS time (GMT) was sent to the video overlay and recorded along with the video using EdgeDVR software. At regular intervals (approximately every minute), the camera frame was landed on the seabed and a high resolution still image was taken of the seabed. The still images were saved on the camera and downloaded at the end of each survey day. The position of the still images was recorded by noting the time of the photograph with the layback position from the navigation log for the same time.

13. Video footage and photographs of the benthic assemblages and species encountered along the transects were recorded on a PC hard drive and later analysed in the laboratory. Photographs taken during the survey were used to illustrate the present report.

14. Characterisation of the benthic assemblages was made using the scheme of Borg *et al*. (2013), which is based on the EUNIS typology that has been adapted for local use.

[5] Chart datum set to European 1950; accuracy degeneration = *ca* 15m.

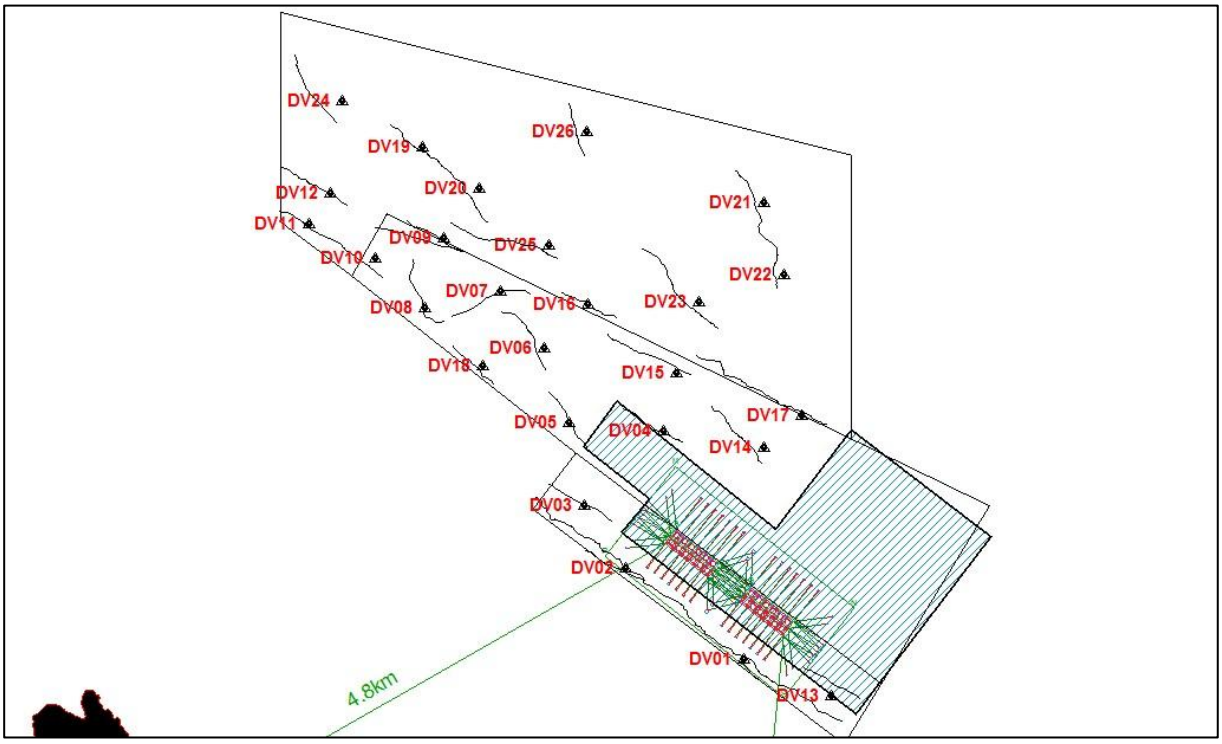

Figure 4. **Map showing the locations of the 26 video transects that were used to survey the marine benthic habitats present in the areas of interest. Map source: Seastar Survey Ltd (UK). The area already surveyed in May 2017 (Borg & Evans, 2017) is indicated by the green hatching.**

Table 2. List of physico-chemical attributes, together with the corresponding method of analysis, which were considered in the water quality studies.

Parameter	Method	Units
Temperature	In-situ / Portable Meter	°C
Salinity	In-situ / Portable Meter	psu
Dissolved Oxygen	In-situ / Portable Meter	%, mg/l
Turbidity	In-situ / Portable Meter	NTU
Turbidity (Secchi Depth)	Secchi Disk	m
pH	pH meter	pH units
Chlorophyll a	APAT CNR IRSA 9020 Man 29 2003	µg/l
Total Nitrogen	APAT CNR IRSA 5030 Man 29 2003 + APAT CNR IRSA 4040 A1 Man 29 2003 + APAT CNR IRSA 4050 Man 29 2003	µg/l
Total Phosphorus	APAT CNR IRSA 4110 Man 29 2003	µg/l
Total Carbon	UNI EN 1484:1999	µg/l
Total suspended matter	APAT CNR IRSA 2090 B Man 29 2003	mg/l

Table 3. List of physico-chemical attributes, together with the corresponding method of analysis, which were considered in the sediment quality studies.

Parameter	Method	Units (on D.M.)
Granulometry	Buchanan 1984	g
Total Organic Carbon (TOC)	UNI EN 13137:2002	%
Redox Potential	CNR IRSA 2 Q 64 Vol 3 1985	mV
Sulphide	CNR IRSA 12 Q 64 Vol 3 1986	µg
pH	CNR IRSA 1 Q 64 Vol 3 1985	pH units
Total Nitrogen	CNR IRSA 6 Q 64 Vol 3 1985	mg/g
Total Phosphorus	DM 13/09/1999 SO n°185 GU n°248 21/10/1999 Met XV.I	mg/g

3. RESULTS

15. Ecoserv's laboratory report reference for the present document is **066-18**.

16. The sample reference codes for the water quality and sediment surveys are as follows:
    - Water in-situ parameters: W-158-18
    - Secchi depth readings: W-159-18
    - Water chemical parameters: W-160-18 to W-171-18
    - Sediment chemical parameters: S-063-18 to S-074-18
    - Sediment granulometry: S-051-18 to S-062-18
    - Benthic diversity: S-075-18, S-077-18, S-079-18 and S-081-18
    - Video footage: D-025-18 to D-031-18

SEDIMENT AND WATER QUALITY

17. The results of the water quality survey are given in Tables 4 to 6, while those for the sediment quality survey are given in Table 7. The results of granulometric analysis are given in Table 8.

18. The results of *in situ* measurement of physico-chemical parameters of the water column indicate temperature values and levels of salinity, water transparency and dissolved oxygen that are expected of local pristine offshore coastal waters during spring. The Secchi Disc measurements indicated a high water transparency of between 24 m and 29 m.

19. Detectable but low levels of total organic carbon (TOC), total suspended solids (TSS), total nitrogen, and total phosphorous were recorded from the sampling stations, while levels of Chlorophyll *a* were below the limit of detection, thereby indicating a low phytoplankton abundance.

Table 4. Mean values (± standard deviation) of physico-chemical attributes recorded from the water column at the six sampling stations.

Parameter	Temperature (°C)		Salinity (ppt)		Turbidity (NTU)		Dissolved Oxygen (%)	
Station	**Mean**	**± SD**	**Mean**	**± SD**	**Mean**	**± SD**	**Mean**	**± SD**
SA1	15.82	0.02	37.80	0.28	0.28	0.00	99.94	0.09
SA2	15.79	0.00	37.81	0.00	0.28	0.00	99.80	0.07
SB1	15.89	0.03	37.95	0.01	0.36	0.04	100.32	0.08
SB2	15.86	0.02	37.95	0.01	0.36	0.04	100.30	0.10
SC1	15.91	0.01	37.96	0.00	0.32	0.09	100.38	0.08
SC2	16.05	0.11	37.97	0.02	0.28	0.00	100.60	0.23
SD1	15.96	0.03	37.96	0.01	0.18	0.07	100.40	0.10
SD2	15.92	0.01	37.95	0.00	0.26	0.04	100.30	0.00
R1a	15.83	0.00	37.94	0.00	0.28	0.00	100.16	0.05
R1b	15.83	0.00	37.94	0.00	0.28	0.00	100.10	0.00
R2a	15.86	0.00	37.95	0.02	0.00	0.63	100.06	0.05
R2b	15.85	0.00	37.88	0.01	0.26	0.04	100.00	0.07

Table 5. Mean values (± standard deviation) in metres for water transparency recorded from the six sampling stations using the Secchi Disc method.

Station A		Station B		Station C		Station D		Station R1		Station R2	
Mean	**± SD**	**Mean**	**± SD**	**Mean**	**± SD**	**Mean**	**± SD**	**Mean**	**± SD**	**Mean**	**± SD**
24.00	0.00	29.25	0.35	25.00	0.00	26.00	0.00	26.00	0.00	26.25	0.35

Table 6. Mean values (± standard deviation) of chemical parameters recorded from water samples collected from the six sampling stations.

Parameter	Units	Station A		Station B		Station C		Station D		Station R1		Station R2	
		Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD
TOC	mg/L	0.75	0.35	0.50	0.00	0.55	0.35	0.60	0.14	0.90	0.14	0.60	0.14
TSS	mg/L	0.20	0.00	0.20	0.00	0.20	0.00	0.20	0.00	0.20	0.00	0.20	0.00
pH		8.50	0.00	8.50	0.00	8.55	0.07	8.55	0.07	8.55	0.07	8.45	0.07
Chlorophyll a	µg/L	< 0.01	0.00	< 0.01	0.00	< 0.01	0.00	< 0.01	0.00	< 0.01	0.00	< 0.01	0.00
Total Nitrogen	mg/L	3.94	0.43	4.30	0.58	4.03	0.71	3.50	0.10	3.51	0.07	3.96	0.15
Total Phosphorus	µg/L	6.90	0.85	10.10	0.42	10.85	0.35	12.95	2.05	8.25	0.07	7.00	0.42

Table 7. Mean values (± standard deviation) of chemical parameters recorded from sediment samples collected from the six sampling stations.

Parameter	Units	Station A		Station B		Station C		Station D		Station R1		Station R2	
		Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD	Mean	± SD
pH	unit	8.75	0.07	8.75	0.35	9.30	0.00	9.00	0.14	8.90	0.14	8.85	0.21
TOC	%	0.45	0.00	1.90	0.99	0.80	0.71	0.36	0.04	0.58	0.47	0.63	0.40
Sulphide	mg/kg	< 2	0.00	< 2	0.00	< 2	0.00	< 2	0.00	< 2	0.00	< 2	0.00
Total nitrogen	% S.S.	0.04	0.00	0.04	0.00	0.04	0.00	0.04	0.00	0.05	0.00	0.06	0.00
Total Phosphorous	% S.S.	0.02	0.00	0.02	0.01	0.02	0.00	0.02	0.00	0.03	0.00	0.03	0.00
Redox Potential	mV	266.05	6.58	245.65	3.04	233.15	4.60	227.50	3.54	202.30	22.34	167.15	4.03

Table 8. Mean values (± standard deviation) of grain size and sorting, together with classification of sorting and sediment classification for sediment samples collected from the six sampling stations.

Station	Ecoserv sample ref.	Mean sediment grain size (mm)	Wentworth grade classification	Mean Sorting (Ø)	Degree of sorting
A	**S-051-18 / S-052-18**	0.716 ± 0.042	Coarse Sand	2.11 ± 0.09	Very Poorly Sorted
B	**S-053-18 / S-054-18**	0.550 ± 0.055	Coarse Sand	2.29 ± 0.04	Very Poorly Sorted
C	**S-055-18 / S-056-18**	0.751 ± 0.082	Coarse Sand	1.95 ± 0.10	Poorly Sorted
D	**S-057-18 / S-058-18**	0.693 ± 0.072	Coarse Sand	2.14 ± 0.05	Very Poorly Sorted
R1	**S-059-18 / S-060-18**	0.763 ± 0.023	Coarse Sand	1.74 ± 0.10	Poorly Sorted
R2	**S-061-18 / S-062-18**	0.937 ± 0.222	Coarse Sand	2.14 ± 0.33	Very Poorly Sorted

20. A weak southeasterly surface sea current having a speed of between 0.11 m/s and 0.13 m/s was recorded at the two reference stations R1 and R2.

21. The results of chemical analysis of sediments from the sampling stations indicated detectable but low levels of total organic carbon (TOC), total nitrogen, and total phosphorous, while levels of sulphide were below the limit of detection. Values of pH and redox potential were of an order that is expected of background levels for local offshore sediments.

22. The results of granulometric analysis indicate that the sediments characterising the six sampling stations comprise poorly sorted coarse sand having a mean grain size of between 0.55 mm and 0.95 mm.

BENTHIC DIVERSITY

23. A classified list of species, and respective abundance, recorded from the four grab samples collected from Stations A – D (Figure 3) is given in Table 9. A total of 1,897 individuals comprising 111 macrofaunal species were recorded. The Polychaeta and Crustacea were the most common taxonomic groups, both in terms of total number of species and in abundance of individuals.

Table 2

Classified list of species recorded from the respective stations, and respective abundance (number of individuals per 0.1 m^2 grab sample).

Classified Species List	Station			
	A	B	C	D
Ecoserv Sample no.	S-075-18	S-077-18	S-079-18	S-081-18
SIPUNCULIDA				
Aspidosiphon muelleri		2		1
MOLLUSCA				
Gastropoda				
Ascobulla fragilis		1		
Caecum armorium		1		
Caecum auriculatum				2
Cerithidium submamillatum	1	1		
Euspira nitida	1			
Haminoea hydatis	3			
Opistobranchia sp.	3			
Parthenina interstincta	1	1		
Parvioris ibizenca	1			
Sticteulima jeffreysiana	2		2	
Vitreolina sp.		1		
Volvarina mitrella		2		

Table 2. Continued…

Classified Species List	Station			
	A	B	C	D
Ecoserv Sample no.	**S-075-18**	**S-077-18**	**S-079-18**	**S-081-18**
Polyplacophora				
Acanthochitana fascicularis	7		1	
Callochiton calcatus	32			
Chiton corallinus	1			
Ischnochiton rissoi	1			
Leptochiton cancellatus	5	6		
Parachiton africanus	4			5
Bivalvia				
Astarte fusca	2		2	4
Coripia corbis		2	3	6
Digitaria digitaria	4			
Diplodonta trigona	1			
Gari costulata		1		
Glans trapezia	1			
Gonilia calliglypta		2	2	2
Hiatella arctica		2		
Loripes orbiculatus				1
Modilula phaseolina	2	1		
Musculus costulatus	2			
Papillicardium papillosum		1		
Thracia phaseolina				1
Timoclea ovata	1	1	1	1
NEMERTEA				
Nemertea sp.	1		3	5
POLYCHAETA				
Ampharetidae sp.				1
Aphroditidae sp.			1	
Lepidonotus	2	5		
Capitellidae sp.	30	23	41	14
Cirratulidae sp.	5	3	6	
Dorviliidae sp.	11	21	7	8
Eunice sp.		5	5	4
Marphysa sp.	4			
Glycera sp.	1	5	1	5
Glyceridae sp.	1	2		
Lacydoniidae sp.	13	52	35	9
Lumbrineridae sp. A	2	1		
Lumbrineridae sp. B		1		1

Table 2. Continued…

Classified Species List	Station			
	A	B	C	D
Ecoserv Sample no.	**S-075-18**	**S-077-18**	**S-079-18**	**S-081-18**
Lumbrineridae sp. C		1		
Maldanidae sp. A				1
Maldanidae sp. B		1		
Nematonereis unicornis	5	4	3	
Nephtydae sp. A	38	38	29	15
Nephtydae sp. B		3	7	10
Nephtydae sp. C				1
Nereidae sp.			1	
Nereis rava	7	1		1
Notomastus sp.	11	9	3	2
Opheliidae sp.	1			16
Orbiniidae sp.		3		
Paraonidae sp.	33	26	65	41
Pectinaridae sp.	1	1		
Phyllodocidae	10	5	4	5
Polychaeta sp.	6	9	17	26
Polynoinae sp.			1	
Sabellidae	20	16	3	9
Scalibregmidae sp.	1	3	1	1
Sthenlais sp.				2
Syllidae	56	38	28	68
Terebellidae sp.	2	14		2
CRUSTACEA				
Leptostraca				
Nebalia bipes			1	
Decapoda				
Achaeus sp.		1		
Alpheus dentipes	1			
Anapagurus sp.		1	3	
Cestopagurus timidus	3	3	2	2
Galathea intermedia	2	2	1	
Ilia nucleus	1			
Liocarcinus sp.	1			
Parthenope sp.	5		1	
Processa sp.		1		
Mysidacea				
Mysidacea sp. B	1	1		1
Tanaidacea				
Apseudes sp.	9	1		
Leptochelia savignyi	28	47	20	18

Table 2. Continued…

Classified Species List	Station			
	A	B	C	D
Ecoserv Sample no.	**S-075-18**	**S-077-18**	**S-079-18**	**S-081-18**
Isopoda				
Anthuridae sp.	4	1	1	6
Cymodoce sp.	39	1	2	2
Eurydice sp.	3	1		
Gnathia sp.		2		1
Janiridae sp.	13	10	10	3
Synisoma sp.	1	2		
Amphipoda				
Amphilochus sp.	4	1	4	2
Aoridae sp.		2	6	4
Apherusa bispinosa		1		1
Caprellidae sp.		17	7	11
Cheirocratus sundevallii	4	1	1	
Elasmopus sp.	39	24	33	18
Harpinia sp.	1		1	
Hippomedon oculatus	18	9	8	3
Leptocherius sp.	15	2	8	10
Leucothoe spinicarpa	7	6	7	1
Lysianassa sp.	13	3	3	1
Maera sp.	8	2	9	3
Melita sp.	1	2	5	2
Monoculodes sp. F			1	
Pereionotus testudo	6	3	1	2
Phoxocephalidae sp.	5	10	13	11
Socarnes filicornis	10	1	7	
Stenothoe sp.	1			
Urothoe sp.		1		
Cumacea				
Cumacea sp.	1	2	2	1
ECHINODERMATA				
Echinoidea				
Genocidaris maculata	5	6	1	14
Spatangus purpureus			1	
Stylocidaris affinis	1	1		
CEPHALOCORDATA				
Branchiostoma sp.		3	2	2

VIDEO SURVEY

Physical characteristics of the seabed

24. The bottom within the area surveyed consisted predominantly of coarse mobile sediments in its southwestern half and very fine mobile sediments in its northeastern half. A drop-off (some 10 m – 25 m high) characterised by rock exposed to sedimentation separates the two aforementioned soft sediment bottoms and runs along a northwest – southeast direction.

25. Water depth varied between around 43 m and over 145 m. The underwater visibility was good (25 – 30 m) but flocculate material was noted in the water column in places. A current was present in places close to the seabed, as evidenced by debris and other material originating from benthic vegetation that were seen being moved on the bottom.

26. What are usually referred to as 'maerl[6] beds' but which are more properly termed 'rhodolith beds' occupy a great part of the area surveyed. In the shallower parts of the area surveyed, the rhodolith beds were interspersed with a bare sand bottom that supported sparse rhodoliths[7]. In the southwestern half of the survey area, the rhodolith density varied such that they are less dense in the shallower part (45 m – 50 m) of the survey area, where large expanses of bare sand that supported little or no rhodoliths were present. Overall, the seabed had physical features that corresponded with the bathymetry: coarse sand with sparse accumulations of rhodoliths (0 % - 20 % rhodolith cover) was present at a water depth of between 43 m and 50 m; coarse sand and denser rhodolith accumulations (20 % - 50 % rhodolith cover) were present within the 50 m to 55 m depth range; and dense rhodolith beds (50 % - 100 % rhodolith cover) were present in waters deeper than 55 m. Beyond the rocky drop-off, at water depths exceeding 100 m, the seabed mainly consisted of bare muddy sand.

27. Some anthropogenic items were observed during the survey. These included glass and plastic beverage bottles, abandoned fish traps and fishing lines, and other unidentified items. However, no remains of tuna, fish used to feed tuna or any other item that may have originated from tuna farming activities, was recorded on the seabed during the survey.

BENTHIC ASSEMBLAGES

28. The main outcome of the benthic survey carried out in May 2018, in combination with data from the survey carried out by Ecoserv in May 2017 (Borg & Evans, 2017) is a map showing the distribution of the main benthic habitats and assemblages (Figure 5) present in the survey area.

[6] 'Maerl' is a term used to describe calcareous sediments dominated by coralline algae. Maerl as used here describes sedimentary habitats in which living or dead unattached calcareous rhodophytes are a dominant component. These algae may take the form of nodules (rhodoliths) or fragmented thalli. However, according to Basso *et al*. (2016), 'rhodolith beds' should be identified and delimited as those areas of the sea floor with >10% cover of live rhodoliths over a minimum surface of 500 m^2, while the term "maerl" refers to a specific type of rhodolith bed that is composed of non-nucleated, unattached growths of branching, twig-like coralline algae. 'Maerl' as used here conforms to the definition of Basso et al. (2016).

[7] Rhodoliths consist either of free-living calcareous rhodophytes (red algae), or else of an inner nucleus, such as stone or shell, encrusted by calcareous rhodophytes.

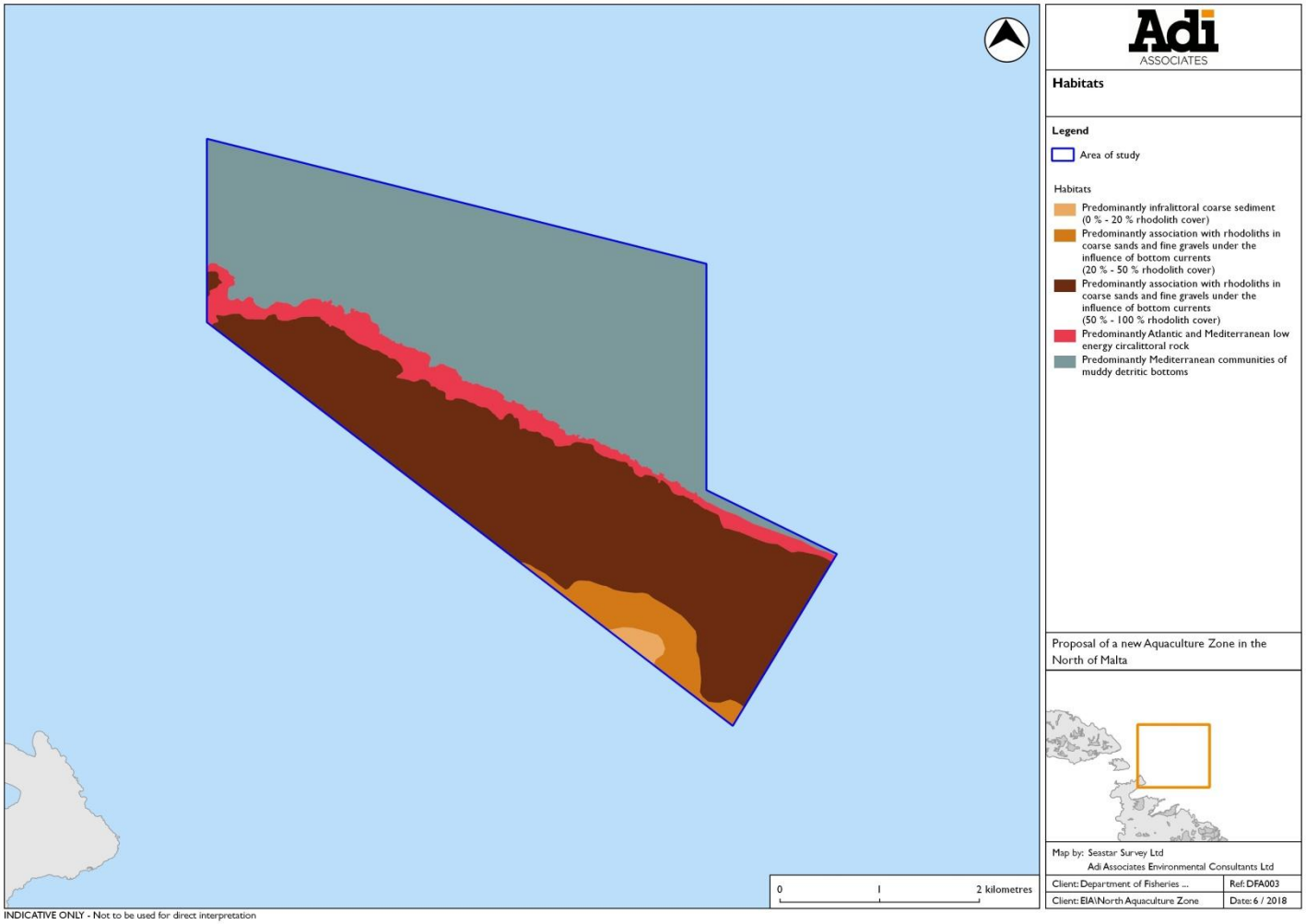

Figure 5. Map showing the main benthic habitats present in the areas of interest.

29. The following four main biotic assemblage types were recorded from the study area (see Figure 5):

(i) Association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (EUNIS code A5.515)
(ii) Infralittoral coarse sediment (EUNIS code A5.13)
(iii) Mediterranean communities of muddy detritic bottoms (EUNIS code A5.38)
(iv) Atlantic and Mediterranean low energy circalittoral rock (EUNIS code A4.3)

A description of each of the above four assemblage types follows.

Association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents

30. This association was present as two subtypes: one which was predominantly characterised by a rhodolith-rich bottom in which the proportion of rhodoliths covering the bottom was dense (50 % - 100 % cover; see Figure 6) and constituted a well-developed rhodolith bed, *sensu* Basso *et al*. (2016). This association subtype (see the brown shaded area in Figure 5) was mostly present within the 55 m – 80 m water depth range. The other subtype mainly consisted of a rhodolith bed in which the density of rhodoliths was sparser and predominantly formed accumulations such that the overall rhodolith cover was around 20 % - 50% (see Figure 7); this association subtype (see the orange shaded area in Figure 5) was mainly present within the 50 – 55 m water depth range.

31. Preliminary examination of rhodoliths that were retrieved from sediments collected by grab from Stations A, B and D (see Figure 3) indicated that the algal species that contribute to the rhodoliths include species from the following genera: *Lithophyllum, Lithothamnion*, *Mesophyllum* and *Sporolithon* (see Lanfranco *et al*., 1999; Borg and Schembri 2002; Sciberras *et al*., 2009).

32. Where present, the dense rhodolith beds appeared to comprise a pseudo-hard substratum that supported macroalgae; the predominant alga being *Flabellia petiolata* (Figure 6) and *Zonaria tournefortii* but other algae including *Halimeda tuna*, *Peyssonnelia squamaria*, *Dictyota* sp. and unidentified filamentous forms, were also recorded in places.

33. The most abundant megafaunal species recorded from this association are the cidariid sea urchin *Stylocidaris affinis* and the Purple Heart Urchin *Spatangus purpureus* (Figure 8); other megafaunal species that were recorded during the survey included several species of sponges and bryozoans (including *Sertella* sp.), the Long-spined Urchin *Centrostephanus longispinus* (Figure 9), the Red Seastar *Echinaster sepositus* (Figure 10), the crinoid *Antedon mediterranea*, the crab *Inachus* sp., and the seastar *Luidia ciliaris*. Furthermore, the presence of openings to numerous burrows in places indicated an associated rich infauna.

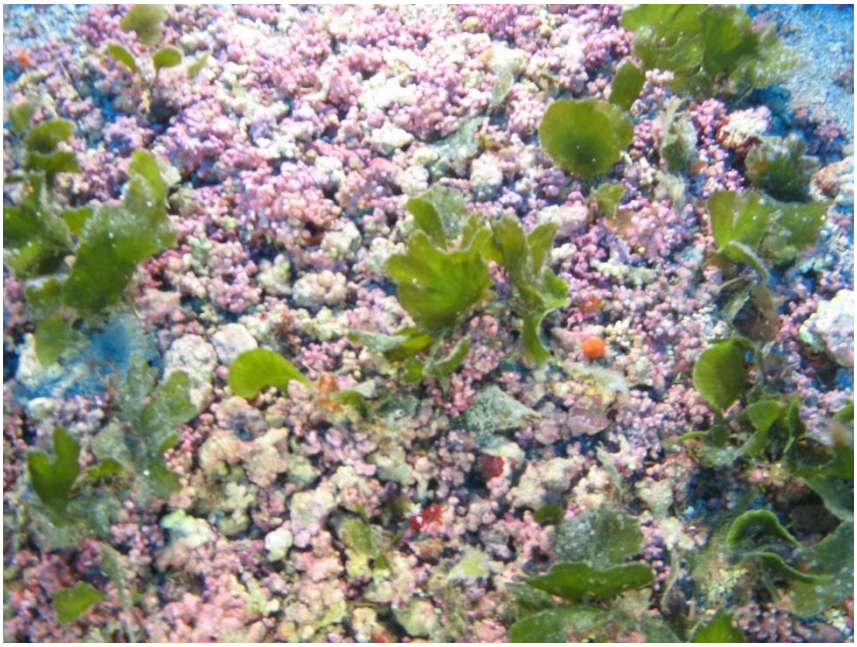

Figure 6. Photograph of the seabed taken at a point along Transect 5, showing a close-up of a dense rhodolith bed. The green alga visible in the photo is *Flabellia petiolata*.

Figure 7. Photograph of the seabed taken at a point along Transect 12, showing a close-up of a sparse rhodolith bed.

Figure 8. **Photograph of the seabed taken at a point along Transect 5, showing a close-up of a rhodolith bed intermixed with bare sediment. The five orange coloured long-spined urchins visible in the photo are individuals of *Stylocidaris affinis*. The large purple coloured urchin on the right hand side of the photo is an individual of the Purple Heart Urchin *Spatangus purpureus*.**

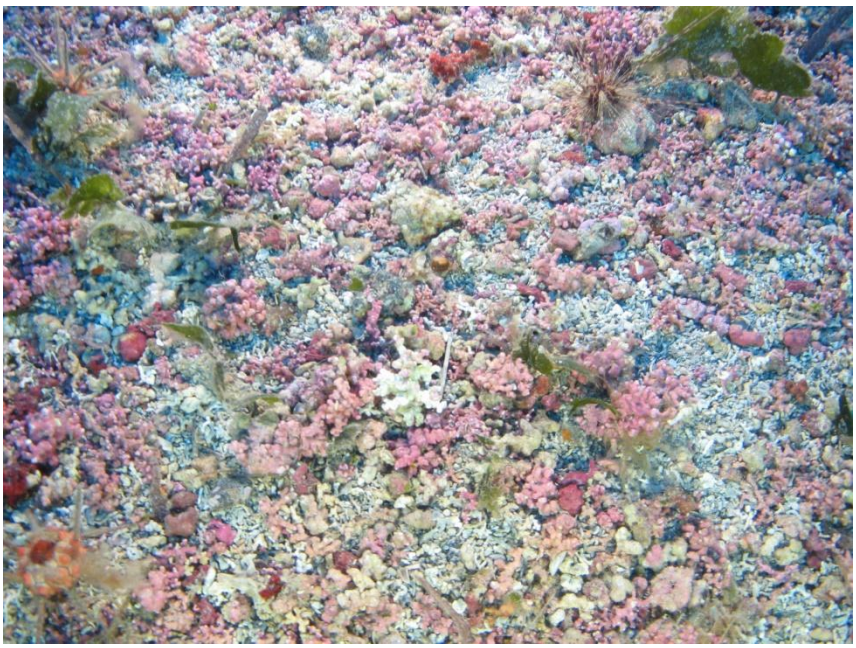

Figure 9. **Photograph of the seabed taken at a point along Transect 3, showing a close-up of a rhodolith bed. An individual of the Long-spined Urchin *Censtrostephanus longispinus* is visible at the top right hand corner of the photo adjacent the alga *Flabellia petiolata* (green).**

Figure 10. Photograph of the seabed taken at a point along Transect 5, showing a close-up of a rhodolith bed. An individual of the urchin *Stylocidaris affinis* and another of the Red Seastar *Echinaster sepositus* are visible on the right side of the photo.

Infralittoral coarse sediment

34. This assemblage type occurred at the southwestern part of the study area (see the yellow-brown shaded area in Figure 5), where the water depth was some 43 m – 50 m. In places, the sediment bottom supporting this assemblage type had small accumulations of rhodoliths or sparse rhodoliths, such that, where present, their cover was some 1 – 20% (see Figures 11 - 14). Detached algal and plant (seagrass) material was present in places on the seabed where this assemblage occurred but no attached fleshy algae or seagrasses were present. The epifauna associated with this assemblage was impoverished; the most abundant macrofaunal species was the Purple Heart Urchin *Spatangus purpureus* (Figure 15) and groups of the Purple Urchin *Sphaerechinus granularis*. However, the presence of openings to burrows present in many places indicated the presence of a rich infauna.

Figure 11. Photograph of the seabed taken at a point along Transect 2, showing a close-up of an assemblage of infralittoral coarse sediment.

Figure 12. Photograph of the seabed taken at a point along Transect 2, showing a close-up of an assemblage of infralittoral coarse sediment. An individual rhodolith is visible at the centre of the photo.

Figure 13. Photograph of the seabed taken at a point along Transect 11, showing a close-up of an assemblage of infralittoral coarse sediment. Individual rhodoliths are visible in places in the photo.

Figure 14. Photograph of the seabed taken at a point along Transect 11, showing a close-up of an assemblage of infralittoral coarse sediment. Three narrow strips with rhodoliths are visible in the photo.

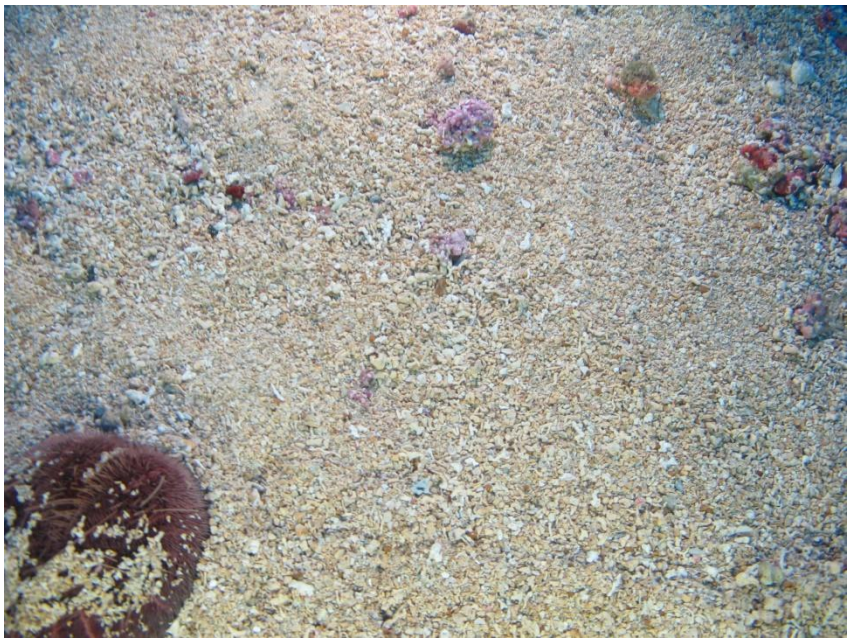

Figure 15. Photograph of the seabed taken at a point along Transect 11, showing a close-up of an assemblage of infralittoral coarse sediment. A few individual rhodoliths (Purple colour) – most of them having a very small size (few mm) – and an individual of the Purple Heart Urchin *Spatangus purpureus*, are visible in the photo.

35. Although in general the area surveyed mainly supported the assemblage types and subtypes as described above and as depicted in Figure 5, parts within the shaded areas shown in the habitat map (Figure 5) supported patches with a different assemblage type, such that:

- The area which supported the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (dense rhodolith bed) had, in places, patches with the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (sparse rhodolith bed) ;
- The area which supported the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (sparse rhodolith bed) had, in places, patches with the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (dense rhodolith bed) or patches with the assemblage of coarse infralittoral sediment;
- The area which supported the assemblage of coarse infralittoral sediment had, in places, the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (sparse rhodolith bed).

Furthermore, comparison between data from video transects made during Borg & Evans' 2017 survey and data from the survey made by Seastar Survey Ltd in May 2018 indicate some

differences in the spatial distribution of the assemblage of coarse infralittoral sediment and the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (sparse rhodolith bed); these differences are discussed in the discussion section below.

Mediterranean communities of muddy detritic bottoms

36. This assemblage type was recorded from the northeastern half of the study area (Figure 5) at a water depth exceeding 100 m and occurred at the base of the 10 m – 25 m high drop-off from where it extended further into deeper waters (Figure 16). No macroflora was recorded from this assemblage type, although detached macroalgae (mainly *Zonaria tournefortii*) were present on the sediment surface in various places. No macrofauna was recorded from this assemblage type but the presence of openings to burrows indicated an associated rich infauna.

Figure 16. Photograph of the seabed taken at a point along Transect 21, showing a close-up of a Mediterranean community of muddy detritic bottoms.

Atlantic and Mediterranean low energy circalittoral rock

37. This assemblage type was recorded along a band running along a northwest – southeast direction in the central part of the area surveyed (Figure 5) and is associated with the drop-off that is some 10 m – 25 m high and which separates the assemblage of coarse sands and fine gravels under the influence of bottom currents and the assemblage of infralittoral coarse sediments (Figure 17). The associated macroalgae mainly comprised *Zonaria tournefortii* and unidentified coralline algae (Figure 17). The associated macrofauna mainly comprised sponges, bryozoans, and other sessile macrobenthic species. Individuals of the echiuran worm *Bonellia viridis* were recorded in places from this assemblage type.

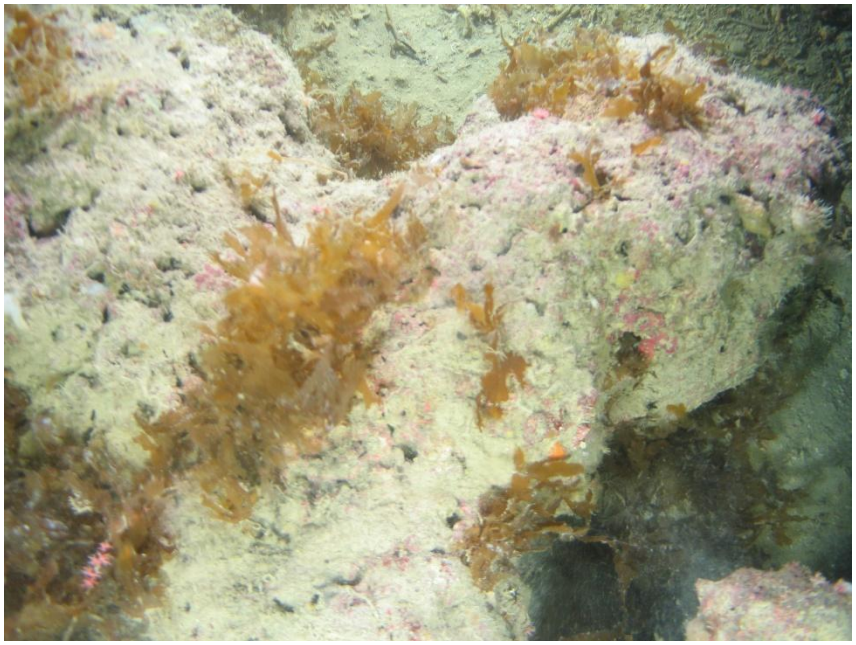

Figure 17. Photograph of the seabed taken at a point along Transect 21, showing a close-up of a Mediterranean community of muddy detritic bottoms.

Demersal and pelagic fauna

38. The demersal fish fauna recorded during the survey mainly comprised large shoals of Picarel *Spicara* sp. and individuals of the Comber *Serranus cabrilla*. Several individuals of the Mauve Stinger *Pelagia noctiluca* were recorded in the water column during the survey.

4. APPRAISAL

SEDIMENT AND WATER COLUMN

39. The results of the sediment and water quality surveys indicate physico-chemical characteristics that are typical of marine waters and the seabed off the northeastern coast of Malta. Water depth varies between around 43 m and just over 100 m. The underwater visibility was good (25 – 30 m) throughout the study area but flocculate material (of unknown origin) was present in the water column along some of the transects. A weak southeasterly surface sea current having a speed of between 0.11 m/s and 0.13 m/s was present in the study area.

PHYSICAL CHARACTERISTICS OF THE SEABED

40. The bottom within the area surveyed consists predominantly of coarse mobile sediments; in the vicinity of the site currently used by AJD Tuna Ltd, the seabed comprises poorly sorted coarse sand having a mean grain size of between 0.55 mm and 0.95 mm. A drop-off, some 10 m – 25 m high, and characterised by rock exposed to sedimentation is present in the northwestern part of the study area. The base of this drop-off is characterised by a bare muddy sand bottom. A large part of the seabed in the study area comprises rhodolith beds, which are more dense and continuous beyond the 55 m depth contour. The density of the rhodolith beds varies such that they are less dense within the 45 m – 50 m depth range, where large expanses of bare sand that supported little or no rhodoliths are present. Overall, the seabed has physical features that correspond with the bathymetry: coarse sand with sparse accumulations of rhodoliths (0 % - 20 % rhodolith cover) is present at a water depth of between 43 m and 50 m; between a water depth of 50 m and 55 m, the seabed comprises coarse sediment having denser rhodolith accumulations (20 % - 50 % rhodolith cover); and in waters deeper than 55 m, the seabed mainly consists of dense rhodolith beds (50 % - 100 % rhodolith cover). A current was present in places close to the seabed, as evidenced by debris and other material originating from benthic vegetation that were seen being moved on the bottom.

41. Some anthropogenic items were observed during the survey. These included glass and plastic beverage bottles, abandoned fish traps and fishing lines, and other unidentified items. However, no remains of tuna, feed fish used in tuna farming, or any other item that may have originated from tuna farming activities, was recorded on the seabed during the survey.

BENTHIC DIVERSITY

42. Analysis of the grab samples showed the presence of macrofauna that is typical of the benthic biotic assemblages that characterisize the lower infralittoral to circalittoral transition zone and the upper circalittoral zone that occurs off the northeastern coast of the Maltese islands. (cf. Borg *et al.*, 1998; Schembri 1998; Sciberras *et al.*, 2009). A high diversity of macrobenthic fauna was recorded from the grab samples; the two most represented

taxonomic groups, in terms of species richness and abundance, were the polychaetes and the crustaceans. No protected species were recorded from any of the grab samples.

BENTHIC ASSEMBLAGES

43. Overall, the benthic biotic assemblages in the study area are characteristic of ones present in the infralittoral and circalittoral zones off the northeastern coast of the Maltese Islands (e.g. Borg *et al*., 1998; Schembri 1998; Sciberras *et al.,* 2009; Schembri, 2011).

44. Four main biotic assemblage types were recorded from the study area: (i) Association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (EUNIS code A5.515); (ii) Infralittoral coarse sediment (EUNIS code A5.13); Mediterranean community of muddy detritic bottoms (EUNIS code A5.38); and Atlantic and Mediterranean low energy circalittoral rock (EUNIS code A4.3). The former association was present as two assemblage subtypes: (i) dense rhodolith beds (having a rhodolith cover of between 50 % and 100 %), some of which may possibly be classified as maerl (sensu Basso *et al*., 2016), which are present in water deeper than 55 m; and (ii) sparser rhodolith beds (having a rhodolith cover of between 20 % and 50 %), present within the 50 m – 55 m depth range. The assemblage of infralittoral sediment was present in the shallower (< 45 m – 50 m) parts of the area surveyed and in places supported sparse rhodolith accumulations (having a rhodolith cover of between 1 % and 20 %). The Mediterranean community of muddy detritic bottoms and the assemblage of Atlantic and Mediterranean low energy circalittoral rock were present at around a water depth of 100 m and beyond.

45. It is emphasised that although the area surveyed mainly supported the assemblage types and subtypes described above, parts within the different areas that represent different habitats (Figure 5) support patches with a different assemblage type, for example within the 43 m – 55 m depth range:
    - The area which supported the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (dense rhodolith bed) had, in places, patches with the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (sparse rhodolith bed);
    - The area which supported the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (sparse rhodolith bed) had, in places, patches with the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (dense rhodolith bed) or patches with the assemblage of coarse infralittoral sediment;
    - The area which supported the assemblage of coarse infralittoral sediment had, in places, the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (sparse rhodolith bed).

    Furthermore, differences in the spatial distribution of the assemblage of coarse infralittoral sediment and of the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (sparse rhodolith bed) were evident when comparing data from video transects made during Borg & Evans' 2017 survey with data from the survey made by Seastar Survey Ltd in May 2018. These differences, which are mostly applicable to the

shallower (43 m – 55 m) parts of the study area indicate that the soft sediment seabed there is dynamic and undergoes changes that involve shifting of accumulations of rhodoliths from one place to another, possibly even over large distances of several hundred metres. Such changes would happen during very strong wave action, typically during strong northeasterly winds, such as ones that characterised autumn 2017 and winter 2018. As a result, the spatial distribution of the aforementioned two habitat types changes.

46. Although video footage collected from the present survey enabled recording of several macroalgal species, including *Flabellia petiolata* and *Zonaria tournefortii* which appeared to be the most abundant, several other algal species are known to be associated with the association with rhodoliths in coarse sands and fine gravels under the influence of bottom currents (see Borg *et al*., 1998; Borg & Schembri, 2008; Schembri, 2011). Likewise, apart from the megafauna, including the urchin *Stylocidaris affinis,* the Heart Urchin *Spatangus purpureus,* the crinoid *Antedon mediterranea* and the Needle-Spined urchin *Centrostephanus longispinus*, and other species recorded from the present survey, numerous other mega- and macrofaunal species occur in association with the rhodolith habitats (see Borg *et al*., 1998; Borg & Schembri, 2008; Schembri, 2011). Apart from these mega- and large macrofaunal species, rhodolith beds support numerous small macrofaunal species including polychaete, mollusc, crustacean, and echinoderm taxa (e.g. Schembri, 2011).

47. No fleshy algae were recorded from the assemblage of infralittoral sediment but very sparse accumulations of rhodoliths or single rhodoliths were present in places, especially in the troughs formed by the current ripples. The megafauna recorded from this assemblage type comprised the Heart Urchin *Spatangus purpureus* and the Purple Urchin *Sphaerechinus granularis.* However, this assemblage undoubtedly supports a rich infauna as evidenced by the macrofaunal species (Table 9) recorded from the grab samples collected from Stations A – D (Figure 3). The recorded species are typical of the assemblage of infralittoral to circalittoral coarse sediment assemblages present of the northeastern coast of Malta within the 45 m to 80 m depth range.

48. The study area is located within the boundaries of the '*MT0000105 Marine Area in the Northeast of Malta*' Special Area of Conservation of International Importance declared by Government Notice 851 of 2010[8] under the provisions of the *Flora, Fauna and Natural Habitats Protection Regulations, 2006*. This area forms part of the European Union's NATURA 2000 network.

49. In Maltese waters, the main rhodolith-forming algae in rhodolith/maerl beds are *Lithothamnion corallioides* and *Phymatolithon calcareum/Lithothamnion minervae*[9] with *Peysonnelia rosa-marina*, *Mesophyllum* sp., and *Neogoniolithon brassica-florida* constituting a minor component (Lanfranco *et al*., 1999). Associations with rhodoliths are a habitat type that qualifies sites for inclusion in national inventories of natural sites of conservation interest as required by the Protocol for Specially Protected Areas and Biodiversity in the Mediterranean (SPA/BD) of the Barcelona Convention[10]. Furthermore, the coralline algae

[8] *Malta Government Gazette* No.18,633, 17 August 2010.

[9] It is not possible to distinguish between *Phymatolithon calcareum* and *Lithothamnion minervae* using gross morphology alone.

[10] The *Convention for the Protection of the Mediterranean Sea against Pollution* (the Barcelona Convention) was adopted on 16th February 1976. A number of protocols were adopted under this convention, amongst which is the *Protocol*

Lithothamnion corallioides and *Phymatolithon calcareum* are listed in Annex V (Animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures) of the European Union's 'Habitats Directive' as amended[11]. Both species probably occur in the rhodolith beds in the present study area; however, only microscopic examination of samples of rhodoliths collected from the area will confirm this.

50. *Lithothamnion corallioides*, *Phymatolithon calcareum*, together with *Lithothamnion minervae* are listed in Schedule III (Animal and plant species of national interest whose conservation requires the designation of Special Areas of Conservation), and the first two named also in Schedule VII (Animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures) of the *Flora, Fauna and Natural Habitats Protection Regulations, 2006* as amended[12], which transpose the requirements of the EU's Habitats Directive to local legislation.

32. Rhodolith and maerl beds are included in the UNEP/MAP/RAC-SPA "Reference list of marine habitat types for the selection of sites to be included in the national inventories of natural sites of conservation interest" (UNEP/MAP/RAC-SPA, 2006) while an action plan for their conservation has been formulated (UNEP/MAP/RAC-SPA, 2008), both within the ambit of the Barcelona Convention. Within European legislation, Council Regulation (EC) 1967/2006, concerning management measures for the sustainable exploitation of fishery resources in the Mediterranean Sea, bans the use of specific fishing gear (trawl nets, dredges, shore seines or similar nets) on coralligenous or maerl beds[13]. In order to conform to the requirements of EC 1967/2006, the local 'Implementation and Enforcement of Certain Fisheries Management Plans Order' (Legal Notice 354 of 2013) amends Zones C and G referred to in Annex V of EC

concerning Mediterranean Specially Protected Areas done at Geneva on 3 April 1982. The parties later amended this protocol and its name changed to *Protocol for Specially Protected Areas and Biodiversity in the Mediterranean* (SPA/BD). Malta ratified this new Protocol on 28th October 1999. A draft reference list of habitat types for the selection of sites to be included in the National Inventories of Natural Sites of Conservation Interest was drawn up at the Fourth Meeting of National Focal Points for Specially Protected Areas (Tunis, 12-14 April 1999) [see UNEP(OCA)/MED WG.154/7]. The most recent '*Classification of benthic habitat types of the Mediterranean*' dated 2006 is available from the UNEP RAC/SPA at http://rac-spa.org/sites/default/files/doc_fsd/lrhm_en.pdf

[11] The European Union's *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* is known as the 'Habitats Directive'. Annexes I and II of this Directive have been amended by Council Directive 97/62/EC of 27 October 1997. Annex I of the Habitats Directive lists natural habitats whose conservation requires the designation of Special Areas of Conservation. Annex II lists species of plants and animals whose habitats must be protected for their survival. Annex III lists criteria for selecting sites eligible for consideration as "Sites of Community Importance" and designation as Special Areas of Conservation, while Annex IV lists species of Union interest in need of strict protection. Annex V lists species of plants and animals of Union interest whose taking from the wild and exploitation is subject to management, and Annex VI lists prohibited methods and means of capture and killing of mammals and fish, and prohibited modes of transport. In anticipation of the 2004 enlargement of the EU, the Annexes of the Habitats Directive were modified by the Act of Accession signed in Athens on 16th April 2003, to take into account the expanded geographical area of the EU15+10. The annexes were further amended by Council Directive 2006/105/EC of 20 November 2006 in anticipation of Bulgaria and Romania joining the European Union in 2007 and then again by Council Directive 2013/17/EU of 13 May 2013 due to the accession of the Republic of Croatia.

[12] These regulations were last amended by the Flora, Fauna and Natural Habitats (Amendment) Regulations, 2013 (Legal Notice 322 of 2013).

[13] According to this Regulation, "Mäerl is a collective term for a biogenic structure due to several species of coralline red algae (Corallinaceae), which have hard calcium skeletons and grow as unattached free living branched, twig-like or nodule corallines algae on the seabed, forming accumulations within the ripples of mudflats or sandflats seabed. Maerl beds are usually composed of one or a variable combination of red algae, in particular, *Lithothamnion coralloides* and *Phymatolithon calcareum*". In this definition, 'maerl' is used in the wider sense to refer to 'rhodolith beds' as defined by Basso *et al.* (2016); true maerl is a particular type of rhodolith bed.

1967/2006 that originally overlapped with rhodolith beds as well as closed to trawling all areas where conclusive evidence exists for the presence of such beds (see Figure 44 in LN 354/2013).

32. The Needle-spined sea-urchin, *Centrostephanus longispinus* is listed in the Habitats Directive under Annex IV (Animal and plant species of Community interest in need of strict protection), in Appendix II of the Bern Convention[14], and in Annex II of the SPA/BD Protocol)[15]. This species is also protected locally under the *Flora, Fauna and Natural Habitats Protection Regulations, 2006* as amended, where it is listed in Schedule V (Animal and Plant Species of Community Interest in need of Strict Protection).

5. IMPACTS ON MARINE ECOLOGY

51. The present assessment of impacts will consider the following phases:
    (i) Cage deployment phase
    (ii) Operational (tuna farming) phase

    Where details on the proposed activity are not available or insufficiently detailed, hence resulting in a degree of uncertainty, the 'precautionary principle' is applied and the worse case scenario is considered. The present assessment of impacts considers the study area within which the ecological assessment described above was made.

52. In making the present assessment of impacts, the procedure will be as follows:
    - The main source of impact will be identified and described, and specifically established as adverse or beneficial.
    - The likely severity and extent, as well as the receptors and sensitivity of the latter will be described.
    - Any possible mitigation measures will be indicated.
    - The following criteria will be used to determine the level of overall impact:
        - **Insignificant**: no impact or change is predicted in space and time;
        - **Low**: low level of impact that is localised in space, i.e. within the area of interest (AoI), and occurring over a short time period of a few days to a few weeks, and which may be mitigated.
        - **Moderate:** moderate level of impact that may extend beyond the area of influence and occurring over a longer time period of several months, and which may not necessarily be mitigated.

[14] The Bern Convention is the *Convention on the Conservation of European Wildlife and Natural Habitats*. Malta acceded to this Convention on the 26th November 1993. Appendix II of the Bern Convention lists strictly protected species of fauna and the Convention prohibits the deliberate capture, the destruction of breeding or resting sites, the deliberate destruction, and the deliberate killing of, and trade in, these species.

[15] A number of species are listed in annexes to the SPA/BD Protocol: Annex II lists endangered or threatened species and Annex III lists species whose exploitation is regulated.

- **High**: high level of impact that may extend well beyond the area of influence, which will probably leave some permanent/residual effects, and which may not necessarily be mitigated.

- The duration of the impact and residual effects will be considered.

The above procedure will be adopted using knowledge of marine ecology of the study area as baseline.

POTENTIAL IMPACTS DURING THE CAGE DEPLOYMENT PHASE

Source of impact

- **Disturbance to marine fauna resulting from increased vessel activity during deployment of cage moorings, ropes and tuna pens**
- **Accidental and/or deliberate spillage of toxic substances and contaminants from vessels used to deploy cage moorings**
- **Deployment of cage moorings**

Disturbance to marine fauna resulting from increased vessel activity during deployment of cage moorings, ropes and tuna pens

53. An increase in vessel activity is envisaged in the vicinity of the tuna penning site to enable deployment of the cage moorings, mooring ropes and tuna pens. This is expected to result in disturbance to pelagic fauna present in the general area where the new tuna pens will be deployed. Although detailed data on the pelagic fauna that occur within the study area are lacking, it is expected that several species of pelagic fish, turtles and cetaceans migrate in its vicinity. Such fauna will be exposed to disturbance from the increased vessel activity and from deployment of the cage moorings, ropes and tuna pens. However, the fauna that are expected to be affected are mobile and will swim away from the affected area such that there will be a small deviation of the migratory route without significant adverse effects to the animals.

54. Good practice and measures to reduce disturbance to a minimum are the only mitigation measures to reduce potential adverse impacts.

55. Taking the above into consideration, the overall level of impact is predicted to be **insignificant to low**.

56. With respect to the duration of impact and residual effects; the impacts will be temporary and effective during deployment of the cage moorings, ropes and tuna pens.

Accidental and/or deliberate spillage of toxic substances and contaminants from vessels used to deploy cage moorings

57. Given that vessels, including ones used to deploy the cage moorings, ropes and tuna pens, will be used during installation of the pens, there is a potential for introduction of hazardous substances and chemicals, whether deliberate, accidental or indirect into the marine environment. However, excepting an accident, whether such introduction of hazardous substances and chemicals into the marine environment will actually occur will largely depend on good management and work practices, and effectiveness of environmental protection measures.

58. The introduction of hazardous substances and chemicals (for example, fuel and lubricants, amonsgt others) may have toxic effects on the marine flora and fauna, which could include reduction in reproductive potential and capacity, fertilisation success, development and physiological function. However, the site concerned is located in deep offshore waters that are characterised by a high hydrodynamic regime, hence any small spillage of hazardous substances and chemicals will be rapidly dispersed and are not expected to have a significant impact on the marine biota present in the vicinity.

59. Any introduction of toxic substances and contaminants will depend heavily on application of precautionary measures, and on the toxicity and levels of substances and contaminants potentially introduced to the marine environment. Therefore, good practice and measures to reduce spillage into the marine environment, hence ones that prevent the introduction of toxic substances and contaminants to the marine enviroment will be important to mitigate potential adverse impacts.

60. Taking the above into consideration, the overall level of impact is predicted to be **insignificant** unless there is large accidental or deliberate spillage, in which case the level of impact is predicted to be **low to medium.**

61. With respect to the duration of impact and residual effects; the impact of potential introduction of toxic substances and contaminants will be temporary and of very short duration (few days), as long as there is no large accidental or deliberate spillage.

Deployment of cage moorings

62. Deployment of the cage mooring is expected to impact the benthic habitat when the concrete block ends up resting on the seabed as there will be direct physical contact with the latter, although the area of the seabed that will be significantly impacted is that which will be occupied by the mooring block. All benthic flora and fauna, the latter mostly comprising sessile and slow moving invertebrates, that will end up underneath the mooring block will be decimated. The more motile fauna, such as fast moving invertebrates and fishes are expected to move away rapidly from a mooring block that is being deployed and will not be affected adversely.

63. On making contact with the soft sediment seabed, disturbance of the latter will lead to suspension of sediment in the water column. Settling of the suspended sediment on the bottom will lead to smothering of flora and sessile fauna, resulting in potential adverse

effects on such organisms, although the concerned species are usually adapted to disturbance from suspended sediment and will recover quickly, while the high energy environment of the area will help rapid removal of any sediment particles that may have been deposited on the biota.

64. Good practice and measures to reduce the adverse impact of deployment of the mooring on the seabed, for example, by avoiding dragging the mooring block on the seabed during deployment, are the only mitigation measures to reduce potential adverse impacts.

65. Taking the above into consideration, the overall level of impact is predicted to be **high** within the area that will be occupied by the mooring block, but **insignificant to low** on the sessile benthic species present in the vicinity (a few metres away) of the deployed mooring block.

66. With respect to the duration of impact and residual effects; the impact on the flora and fauna that will end up beneath the mooring clock will be permanent, while impacts on the flora and sessile fauna present in the immediate vicinity of the block will be temporary and of very short duration (few days).

POTENTIAL IMPACTS DURING THE OPERATIONAL (TUNA FARMING) PHASE

Source of impact

- **Disturbance to marine fauna resulting from increased vessel activity during tuna farming**
- **Accidental and/or deliberate spillage of toxic substances and contaminants from vessels used in connection with the tuna penning operations**
- **Decreased light reaching the seabed as a result of shading by the tuna cages**
- **Increased nutrient input, originating from the farmed tuna's waste and feed fish, to the water column**
- **Deposition of organic matter, originating from the farmed tuna's waste and feed fish, on the seabed**
- **Generation of a surface slick comprising fish oils released from the feed fish**
- **Littering of the seabed underneath the tuna cages and in their vicinity**
- **Attraction of wild fauna to the tuna farm**

Disturbance to marine fauna resulting from increased vessel activity during tuna farming

67. An increase in vessel activity is envisaged in the vicinity of the tuna penning site in connection with the tuna farming activity. A number of vessels are expected to operate in the vicinity of the tuna penning site in connection with the farming activity. These include work boats that will be used to transport the feed fish and to feed the caged tuna, boats used for general maintenance of the tuna pens, and vessels used during the period when the tuna are harvested. The latter vessels will be the largest ones used in connection with the tuna farming activity but will only be present during the 2 – 3 month period during which harvesting of the tuna will be carried out and normally anchor some distance offshore from

the tuna farm. The presence of vessels is expected to result in disturbance, mainly through generation of underwater noise, to pelagic fauna present in the general area where the new tuna pens will be deployed. Although detailed data on the pelagic fauna that occur within the study area are lacking, it is expected that several species of pelagic fish, turtles and cetaceans migrate in its vicinity. Such fauna will be exposed to disturbance, mainly through generation of underwater noise, from the increased vessel activity in the vicinity of the tuna farm. However, the fauna that are expected to be affected are mobile and will swim away from the tuna penning site such that there will be a small deviation of the migratory route without significant adverse effects to the animals.

68. Good practice and measures to reduce disturbance to a minimum are the only mitigation measures to reduce potential adverse impacts.

69. Taking the above into consideration, the overall level of impact is predicted to be **insignificant to low**.

70. With respect to the duration of impact and residual effects; the impacts will be effective throughout the period when tuna farming is carried out.

Accidental and/or deliberate spillage of toxic substances and contaminants from vessels used in connection with the tuna penning operations

71. A number of vessels are expected to operate in the vicinity of the tuna penning site in connection with the farming acvitiy. These include work boats that will be used to transport the feed fish and to feed the caged tuna, boats used for general maintenance of the tuna pens, and vessels used during the period when the tuna are harvested. The latter vessels will be the largest of the ones used in connection with the tuna farming activity but will only be present during the 2 – 3 month period during which harvesting of the tuna will be carried out. Because of the regular presence of such vessels in the vicinity of the tuna penning site, there is a potential for accidental or deliberate introduction of hazardous substances and chemicals (for example, fuel and lubricants, amonsgt others), whether deliberate, accidental or indirect, into the marine environment. However, excepting an accident, whether such introduction of hazardous substances and chemicals into the marine environment will actually occur will largely depend on good management and work practices, and effectiveness of environmental protection measures.

72. The introduction of hazardous substances and chemicals may have toxic effects on the marine flora and fauna, which could include reduction in reproductive potential and capacity, fertilisation success, development and physiological function. However, the site concerned is located in deep offshore waters that are characterised by a high hydrodynamic regime; hence, any small spillage of hazardous substances and chemicals will be rapidly dispersed and are not expected to have a significant impact on the marine biota present in the vicinity.

73. Any introduction of toxic substances and contaminants will depend heavily on application of precautionary measures, and on the toxicity and levels of substances and contaminants potentially introduced to the marine environment. Therefore, good practice and measures to reduce spillage into the marine environment, hence ones that prevent the introduction of

toxic substances and contaminants to the marine enviroment, will be important to mitigate potential adverse impacts.

74. Taking the above into consideration, the overall level of impact is predicted to be **insignificant** unless there is a large accidental or deliberate spillage, in which case the level of impact is predicted to be **low to medium.**

75. With respect to the duration of impact and residual effects; the impact of potential introduction of toxic substances and contaminants will be temporary and of very short duration (few days), as long as there is no large accidental or deliberate spillage.

Decreased light reaching the seabed as a result of shading by the tuna cages

76. Tuna cages typically have a diameter of around 50 m and support a cage net that is some 35 m high. The cage net and the tuna they hold are expected to produce a shading effect and reduce the amount of light reaching the seabed. The reduced light availability will have an adverse effect on any rhodoliths present on the seabed, even if these are present in small accumulations or are sparsely distributed on the bottom, given that the photosynthetic capacity of the algae making up the rhodoliths will be decreased such that they will stop growing or die. With regard to any associated megafauna and macrofauna; the sparse rhodolith accumulations recorded from the site identified for tuna penning are not known to support a high diversity of associated fauna, at least compared to dense rhodolith beds, while the fauna that occurs in association with such habitat is more typical of lower infralittoral and upper circalittoral coarse sediments. Therefore, the main adverse impact is expected to be mostly on the rhodoliths.

77. The shading effect cannot be mitigated unless the cages are removed and is a consequence of the presence of a floating structure – the tuna pen - which cannot be modified or replaced by another structure that does not cause shading.

78. Taking the above into consideration, the overall level of impact is predicted to be **high** on any rhodoliths present within the area that will be occupied by a tuna cage, but **insignificant** in other areas at the tuna penning site.

79. With respect to the duration of impact and residual effects; the impact will be effective throughout the period when the tuna pens are in place (c. 6 months); however, once the latter are removed, recovery (which will require at least a few months) is expected since coralline algae will rapidly recolonise any rhodoliths whose algal component would have demised.

Increased nutrient input, originating from the farmed tuna's waste and feed fish, to the water column

80. The tuna farming operations are expected to result in some nutrient and organic loading of the water column; the nutrients and organic matter will mainly originate from faecal matter excreted by the farmed tuna and from decomposition of any uneaten feed fish that will end

up on the seabed. Water quality surveys have been carried out at local tuna penning sites since the early 2000's. During these surveys, standard water quality attributes, namely dissolved oxygen, temperature, salinity, turbidity, nitrates, phosphates, Chlorophyll *a*, ammonia, and counts of intestinal bacteria, as well as sea currents, were measured at a number of sampling stations located in the immediate vicinity of the tuna farms and at up-current and down-current reference stations. The results of such surveys indicate that, very rarely, lowered levels of oxygen, reduced water transparency and elevated nutrient (nitrates and/or phosphates and/or ammonia) levels were recorded from the tuna penning sites during the farming season (July – December). However, the observed changes in the monitored attributes were often sporadic and not statistically significant, and have not resulted in appreciable alteration of water quality. Elevated counts of intestinal bacteria have also been occasionally recorded but since such organisms do not originate from the tuna but from sewage, their presence were not attributed to the tuna penning activities *per se*, although there is the possibility that large ships (e.g. the processing ships present during harvesting of the tuna) may be the source of such contamination through discharge of sewage from their holding tanks. Such favourable results with respect to water quality are attributed to the high energy environment, particularly strong sea currents present, that characterise the offshore area where the proposed tuna penning site is located, and which lead to rapid and effective dispersal of nutrients that may originate from the tuna farming activity.

81. Nevertheless, good practice and measures to reduce loading of the water column with nutrients and organic matter are recommended; in particular excessive loading by organic matter can be reduced by ensuring that overfeeding is avoided, such that the amount of uneaten feedfish that are introduced to the marine environment will be minimal.

82. Taking the above into consideration, the overall level of impact of nutrient and organic matter loading of the water column on water quality and associated biota (e.g. plankton) is predicted to be **insignificant to low**.

83. With respect to the duration of impact and residual effects; the impact will be effective throughout the period when tuna farming is carried out (4 - 6 months), with progressively reduced effects as the tuna is harvested and the reared biomass reduced.

Deposition of organic matter, originating from the farmed tuna's waste and feed fish, on the seabed

84. The tuna farming operations are expected to result in organic loading of the seabed; the organic matter will mainly originate from decomposition of uneaten feed fish that may end up on the seabed. Such organic loading is expected to have a large impact on benthic habitat, which would result in changes to sediment quality and to the species composition of biotic assemblages associated with lower infralittoral/upper circalittoral coarse sediment habitat. In cases where the impact is large and adverse, loss of habitat and biodiversity may occur.

85. Video surveys of the seabed underneath tuna cages have been undertaken regularly at local tuna since the early 2000's. The main aim of such surveys was to gather qualitative and semi-quantitative data, using direct observation, on the physical and biological characteristics of the seabed underneath the tuna pens. The results of these surveys have indicated that

towards the end of each penning season (in autumn) considerable amounts of uneaten feed fish littered the seabed in the area lying directly below the tuna pens, but not in areas beyond the perimeter of the tuna pens. This resulted in alterations in the physical and biological characteristics of the seabed under the pens, namely: (i) changes in biological characteristics, which typically consist of high population densities of detritus-feeding and scavenging benthic (i.e. associated with seabed) fauna, and whose occurrence is unusual considering the benthic habitat type present at the tuna penning sites surveyed; (ii) alterations in physical characteristics, which typically consist of the presence of large quantities of fish bones and baitfish that are gradually consumed by scavengers or eventually decompose. The results of the video surveys also indicated that the amount of uneaten feed fish present varied considerably between the different pens, and between different farms, with some only having a few feed-fish beneath them and others having multiple layers of decomposing feed-fish. Once the tuna farming season is over (late winter), a negligible amount of uneaten feed-fish remain on the seabed below the pens. However, thick layers of fish bones and of decomposing organic material persist under some of the pens. These observations indicate a consistent pattern, with the volume of uneaten feed-fish on the seabed decreasing only when the tuna have been harvested (and therefore there is no further addition of feed-fish). Any uneaten fish remaining on the seabed at this time will continue to decompose slowly and, if present in large numbers, form a continuous layer of decomposing organic material. Sometimes, following storms and possibly due to strong bottom currents, this layer is admixed with the underlying mobile sediment. In places where the decomposition process is complete, the only remains are fish bones that eventually disperse in the sediment leaving little or no trace of the original uneaten fish on the surface. Once the source of the impact (periodic addition of new uneaten food) is removed, slow recovery to the original state is characterised by the re-appearance of certain megafaunal species (e.g. the irregular sea urchin *Spatangus purpureus* and the crinoid *Antedon mediterranea*) that form part of the original fauna that characterise the bare muddy sand bottom of the areas where the tuna farms are located.

86. Monitoring of sediment quality at local tuna penning sites has also been carried out regularly since the early 2000's. The main aim of such monitoring is to assess the levels of organic carbon content and organic nitrogen content of the sediments, as well as sediment granulometric characteristics. Moreover, at least one survey involving assessment of levels of pollutants, including heavy metals and organic pollutants, was carried out at some of the extant tuna penning sites. The monitoring design of the surveys to assess organic carbon content and organic nitrogen content of the sediments, and sediment granulometric characteristics, was based on a Beyond **BACI**[16] layout, in which the results of quantitative analyses of sediment samples collected from the tuna farming site and from a number of control sites before the start of the farming operations are compared with those obtained after a farming season using advanced statistical analyses. Overall, the findings from surveys that were aimed at assessing organic carbon content and organic nitrogen content of the sediments, and sediment granulometric characteristics, indicated 'pulse' (i.e. short duration) changes in the physico-chemical properties of the sediment following some but not all of the

[16] **B**efore **A**fter **C**ontrol **I**mpacted; see Underwood (1992): Underwood, A. J. (1992) Beyond BACI: the detection of environmental impacts on populations in the real, but variable, world. *Journal of Experimental Marine Biology and Ecology* 161: 145 –178.

tuna penning seasons; when these changes were recorded they were restricted to the seabed area located in the immediate vicinity of the tuna pens and/or in the general area occupied by the pens but no significant permanent alterations of the sediment characteristics at the operational sites have been recorded to date. Where significant changes were detected, these appeared to have resulted from accumulation of large amounts of uneaten feed-fish in the vicinity of the tuna pens, which decompose slowly causing alterations in the physico-chemical properties of the sediments. The results of the surveys aimed at assessing levels of heavy metals and pollutant organics indicated that no elevated levels were present in the sediments in the vicinity of the tuna farms.

87. Monitoring of benthic diversity at local tuna penning sites has also been carried out regularly since the early 2000's. The main aim of such monitoring is to assess for potential changes in benthic species populations and habitat that may result from the tuna penning activities. The monitoring design was based on assessing total species richness and total abundance of selected benthic faunal species, as these are deemed good indicators of the overall state of species and habitats associated with the seabed. As in the case of the physico-chemical attributes monitoring component, the design for monitoring of benthic diversity was based on a Beyond **BACI** layout, in which the results of quantitative analyses of samples collected from the tuna farming site and from a number of control sites **before** the start of the farming operations are compared with those obtained **after** a farming season using advanced statistical analyses. Overall, the findings from monitoring of benthic diversity indicate a significant 'press' (i.e. long-lasting) adverse impact (manifested as a significant decrease in total macroinvertebrate species richness and/or decrease in the abundance of one or more of the indicator species) following some but not all of the tuna penning seasons; when these changes were recorded they were restricted to the seabed area located in the immediate vicinity of the tuna pens and/or in the general area occupied by the pens. Furthermore, enhanced productivity in the general area of the tuna farms and beyond, as a result of the tuna-penning activities, was evident from significant increases in the abundance of some of the indicator species recorded in some of the monitoring sessions. These observations are a strong indication that, where present, adverse impacts on the benthic macroinvertebrate assemblages and habitat at the tuna penning sites have resulted from processes that are mainly attributed to accumulation of large amounts of uneaten feed-fish and slow decomposition of same, in the vicinity of the tuna pens. The uneaten feed-fish attract scavengers and other opportunistic fauna that cause changes to the original species composition of the benthic assemblages, while slow decomposition of the accumulated material causes alterations in the physico-chemical properties of the sediments, and presumably of the sediment-water interface, leading to adverse conditions for the biota originally present. A number of scientific publications, which present detailed results – mainly as described above - of the influence of local tuna penning activities on marine benthic habitat, are available; see Manion *et al* (2014; 2017; 2018).

88. Good practice and measures to reduce excessive loading of the seabed by organic matter are the main mitigation measures that can be adopted to avoid or at least reduce adverse impacts on the benthic biota and habitat present in the vicinity of the tuna penning site. Essentially, good feed management procedures will be very important to mitigate adverse impacts resulting from organic loading of the seabed. The following measures are deemed particularly important: (i) Feeding of the tuna should be carefully monitored and stopped as soon as the fish are satiated, in order to avoid as much as possible uneaten feed ending up on the bottom. The tuna operators may want to implement a procedure to ensure proper

feed management by having random checks of the seabed below the tuna pens made by an independent environmental monitor; (ii) In the case of accident, should an inordinate amount of dead uneaten feed-fish end up on the bottom, every attempt should be made to recover as much of the material as possible using techniques that do not have an adverse effect on the seabed habitat.

89. Taking the above into consideration, the overall level of impact of organic matter loading of the seabed, and hence on benthic biota and habitats present at the tuna penning site, is predicted to be **medium to high** within the seabed area directly underneath the cages; and **insignificant to low** in the seabed area beyond.

90. With respect to the duration of impact and residual effects; the impact will be effective throughout the period when tuna farming is carried out.

Generation of a surface slick comprising fish oils released from the feed fish

91. The tuna farming activity is expected to generate oils and fats that are released from the thawing feed-fish when these are fed to the tuna. Release of such substances occurs when the semi-frozen feed fish are introduced in the tuna pens, and when uneaten feed-fish end up outside the fish cages. The resulting floating slick of fatty substances that accumulate on the surface may be transported offshore or inshore, depending on sea current strength and direction. Such substances, commonly known as 'fish farm slime', have caused much public concern and outcry. Although they are not deemed to have any toxic effects on pelagic marine species and habitats, they are aesthetically unpleasing and a nuisance to bathers, divers and coastal recreational activities, because of their sheer presence in the water and since they deposit on the shore and on artificial surfaces (e.g. boat hulls etc.). The deposition of such substances on the shore is not envisaged to have any large adverse effects on marine species and habitats, given that they will rapidly biodegrade; however, this has not yet been assessed given the complete lack of studies that deal specifically with this aspect.

92. Good practice and measures to reduce the release of oils and fats from the feed fish, restrict their presence to the immediate vicinity of the tuna farm (e.g. by using booms), and carrying out immediate collection of the substances (e.g. using skimmers) when appreciable amounts of them are released to the marine environment, are the main mitigation measures that can be adopted to avoid or at least reduce their presence on the surface in coastal areas close to the fish farms and inshore.

93. Taking the above into consideration, the overall level of impact when floating oily and fatty substances originating from the feed fish end up on the surface in offshore waters and are potentially transported inshore, is predicted to be **medium to high** from the aesthetics and water quality for recreational activities points of view, but **insignificant to low** with respect to adverse impacts on marine ecology, including shore habitat where they may be deposited.

Littering of the seabed underneath the tuna cages and in their vicinity

94. The results of video surveys made below tuna cages at local tuna penning sites have indicated that, in places, a considerable amount of anthropogenic items is present below the pens that appear to originate from the farm operations; these include concrete weights with ropes attached, sheets and sacks of fabric and other material, car tyres, lengths of rope and other unidentified items. While plastic items are known to be hazardous to marine life, items deposited on the seabed lead to physical alteration of the bottom leading to potential changes to the benthic habitat present in the vicinity of the fish farm.

95. Good practice and measures to reduce littering of the seabed by anthropogenic items originating from the tuna penning activities are the main mitigation measures that can be adopted to avoid littering of the seabed. Should any items originating from the fish farm accidentally end up in the sea, whether floating or deposited on the seabed, these should be recovered immediately.

96. Taking the above into consideration, the overall level of impact when anthropogenic items originating from the fish farm end up in the sea, whether floating or deposited on the seabed, is predicted to be **low** to **medium**.

Attraction of wild fauna to the tuna farm

97. Fish farms, including tuna ranches, are known to attract a variety of wild marine pelagic fauna. These include: shoals of small pelagic fish (such as Clupeid species) which eat the fragments of feed fish that are released in the water, and the biota growing on the tuna pen nets; medium-sized predators such as *Coryphaena hippuris* and *Seriola dumerilii* which feed on the small pelagic fish that aggregate in the vicinity of the tuna cages; large pelagic predators including cetaceans (namely dolphins), which feed on the medium-sized predators and uneaten feed fish present outside the tuna pens; and wild tunas that are attracted to the caged tuna and also feed on uneaten feed fish that end up outside the tuna pens. Such aggregations of wild pelagic fauna are not envisaged to be adversely affected by the tuna penning activities *per se*, since they will be acquiring food that will potentially lead to enhanced local production. However, the aggregations tend to attract fishermen who carry out fishing activities in the vicinity of tuna farm such that they will harvest the wild fish present there; indeed because of such 'facilitated' harvesting of wild fish, fish farms have been described by marine ecologists as serving as 'ecological traps'. The problem at local tuna farms gets more complicated since fishermen who target the wild tunas and carry out their activities in the vicinity of the farms may actually be the cause of whole dead tunas ending up on the seabed in the vicinity of the tuna farms. This problem is highlighted in Arechavala-Lopez *et al*. (2015); fishermen deploy fishing lines in the vicinity of the tuna farms with an aim to catch wild tuna that aggregate there. Any tunas that are caught may: (i) either break free but will have the hook and a length of fishing line attached to their mouth, which may eventually become entangled against the cage mooring ropes, such that the fish will be restricted in its ability to swim or get exhausted trying to break free but in both cases will end up dying; or (ii) become entangled against the cage mooring ropes and, being unable to

retrieve them, the fishermen[17] cut the tuna, however, the hook and length of fishing line attached to their mouth may, again, eventually become entangled against the cage mooring ropes, leading to (i) as stated previously. Fishermen have also been observed to clean tunas they would have caught and discard the head and offal overboard.

98. Prohibition/strict control of fishing activities in the vicinity of the tuna farms is the main mitigation measure that can be adopted to avoid detrimental (and sometimes) illegal harvesting of wild fish, including tunas) in the vicinity of the fish farms.

99. Taking the above into consideration, the overall level of impact of uncontrolled fishing activities that are aimed at harvesting pelagic wild fauna, including tunas, which aggregate in the vicinity of the tuna farms, leading to the adverse effects described in para 100 above, is predicted to be **low**.

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APPENDIX 3: AVIFAUNA BASELINE REPORT

GF00250/07: Proposal for a new aquaculture zone in the North of Malta, Zone offshore Malta

Baseline study on Avifauna

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1.1 TERMS OF REFERENCE

An Environmental Impact Statement (EIS) is to be prepared *for GF00250/07: Proposal for a new aquaculture zone in the North of Malta, Zone offshore Malta* as required by Schedule IA Section 6.3.1.1 of the Environmental Impact Assessment Regulations, 2007 (S.L. 549.46). May 2017

3.3 to 3.7 Light, noise and vibration: with respect to possible impacts on avifauna

The impacts on avifauna including (but not restricted to) disturbance, noise, vibration, loss of habitat, shadow flicker and lighting, collision risks.

The impact of the fish pens as barriers/hazards to movement shall be assessed in terms of the seabird colonies and other marine avifauna. The impact on prey availability for breeding and "visiting" seabirds shall also be assessed.

The assessment shall analyze the disruption of ecological links between feeding, breeding and roosting areas. An assessment of collision risks for seabirds shall be taken into account.

The assessment shall also investigate the annual change in populations of birds if necessary through modeling and the decline in territory occupancy.

1.2 SCOPE OF THIS WORK

The scope of this work is to present an updated report on any possible direct and indirect interactions and impacts by the fish pens on the avifauna, particularly the breeding pelagic seabirds. If any such impacts are identified, the report will propose mitigation measures.

1.3 AREA OF INFLUENCE

The North Aquaculture Zone will be located in an area of sea offshore Mellieha / St Paul's Bay and on the seaward side of Is-Sikka l-Bajda. The exact location is still to be determined but the minimum distance of the Zone from the shore will be 4.5 km and the maximum distance 7 km (see Figure 1). The main scope of the zone would be for capture-based aquaculture. The area lies in a straight line of sight from two Natura 2000 shearwater colonies which are: Ramla tat-Torri/Rdum tal-Madonna area MT0000009, Kemmuna, Kemmunett, il-Ħaġriet ta' Bejn il-Kmiemen u l-Iskoll ta' Taħt il-Mazz MT0000017 and il-Gzejjer ta' San Pawl (Selmunett) MT0000022 as well as two Marine N2K sites; il-Bahar madwar Ghawdex MT0000112 and il-Bahar tal-Grigal MT0000107.

1.4 COMPETENCE OF CONSULTANT

This report was prepared by John J. Borg:

- Senior Curator of the Natural History Unit (Heritage Malta);
- Member of the Royal Society of Biologists UK (2013 -)
- Licensed Bird Ringer BirdLife Malta (1981 -) ISPRA (Italian Ringing Scheme 2010 -)
- Researcher in the fields of Ornithology and animal ecology, author of over 100 scientific papers and books;
- Participated in numerous local and foreign E.I.A.s and technical reports related to Ornithology and other vertebrates; and
- Holds a number of posts in local and foreign scientific institutions.

2. STUDY METHODOLOGY

2.1 Desk Study:

This assessment is based on accumulated data obtained from long-term observations on the breeding biology and ecology of Malta's breeding seabirds (1982-2018).

Published and unpublished reports from three EU LIFE funded projects:

EU LIFE+ **Progett Garnija** (2006-2010)

EU LIFE+ **Malta Seabird Project** (2012-2016) and

EU LIFE funded **Arcipelagu Garnija** (2016-2020)

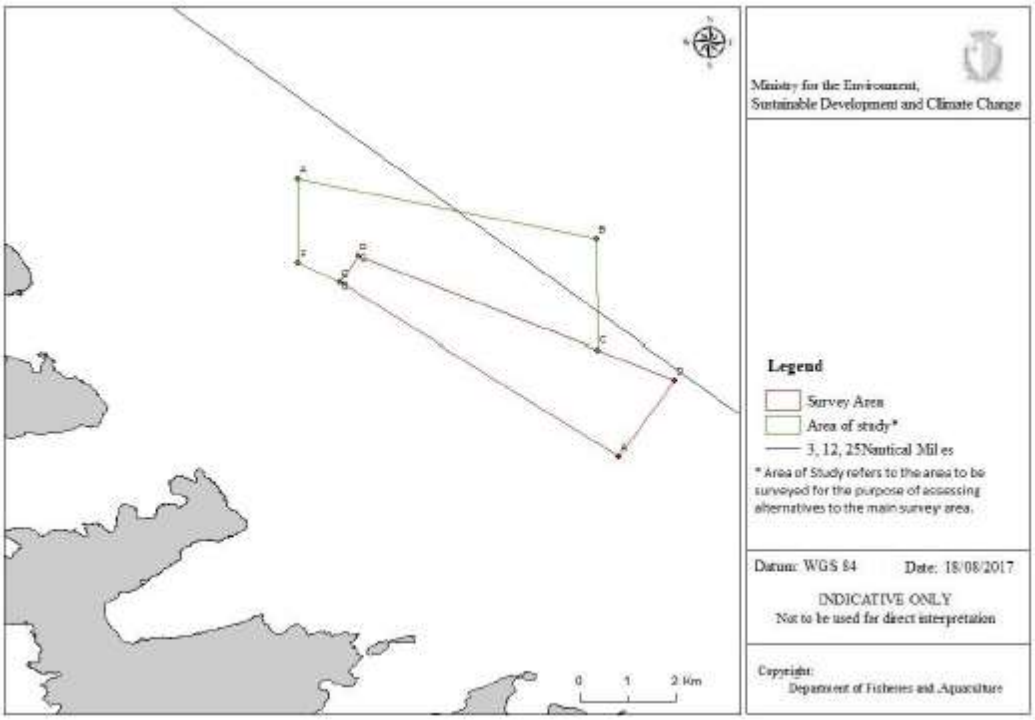

Fig. 1 Area of study

Fig 2. Area of Influence

3 Study Area

Ramla tat-Torri/Rdum tal-Madonna area MT0000009

Rdum tal-Madonna (35°59'28.76"N, 14°22'15.02"E) is located along the north-east coast of Malta, situated on the l-Ahrax tal-Mellieha promontory (Fig 3). The geological formations are composed entirely of Upper Coralline Limestone formations, with the result that the cliffs are honey-combed with caves, crevices and fissures as well as extensive rubble scree. There are stretches of karst garrigue and patches of woodland. One also finds remnants of sand-dune habitat at White Tower Bay. The area holds the most important Yelkouan Shearwater *Puffinus yelkouan* colony in the Maltese Islands as well as a small colony of Scopoli`s Shearwater *Calonectris diomedea*. In 2016 the Mediterranean Storm-petrel *Hydrobates pelagicus melitensis* was also found breeding inside one of the numerous caves in the area. Other breeding bird species are the Blue Rock Thrush *Monticola solitarius*, Short-toed Lark *Calandrella brachydactyla,* Sardinian Warbler *Sylvia melanocephala,* and Spectacled Warbler *Sylvia conspicillata*.

Fig 3. Seabird breeding colonies at Rdum tal-Madonna

Kemmuna, Kemmunett, il-Ħaġriet ta' Bejn il-Kmiemen u l-Iskoll ta' Taħt il-Mazz MT0000017

Kemmuna u l-Gzejjer ta' Madwarha (Comino and its islets): Kemmuna is a small island lying mid-way between Malta and Gozo surrounded by a number of small islets known as Kemmunett, Il-Hagriet ta' Bejn il-Kmiemen and l-Iskoll ta' Taht il-Mazz. The cliff sides in the southern area of Kemmuna are characterised by scarps and boulders. The cliffs, especially areas that are shady, support the Cliff Groundsel (*Senecio leucanthemifolius* - a very rare species having a restricted distribution in the Maltese Islands as well as the Mediterranean, protected under national legislation. Cliffs are colonised by typical rupestral vegetation. The coastline between the northern and western areas of Kemmuna is indented with coves and inlets. The eastern coast is of particular interest for this study as it supports breeding colonies of Yelkouan and Scopoli`s Shearwaters (see Figure 4).

Fig.4 = *C.diomedea & P. yelkouan* = *P. yelkouan*

Il-Gzejjer ta' San Pawl (Selmunett) MT0000022

Il-Gzejjer ta' San Pawl (Selmunett) (35°57'54.40"N; 14°24'06.35"E) lie about 85 metres off the coast of Malta (Figure 5). The "islands" are linked by a shallow and narrow isthmus whose depth varies according to the sea level. Geologically the island is made up of Upper Coralline Limestone. The vegetation consists of a mixture of maritime garigue dominated by Golden Samphire, Maltese fleabane and various other species. The eastern side is more exposed and has less vegetation than the main island. A population of the land snail *Trochoidea spratti* can be found on the islands. Wild rabbits used to live on the island but the population died off due to Myxomatosis and overhunting. The endemic population of the Maltese wall lizard *Podarcis filfolensis kieselbachi*, which was restricted to these islets, has not been recorded since 2005. In the last decade, a small colony of Yelkouan Shearwaters has been re-discovered breeding on the island.

Fig 5. Il-Gzejjer ta` San Pawl / Selmunett

- il-Bahar madwar Ghawdex MT0000112 and il-Bahar tal-Grigal MT0000107.

Two marine conservation areas identified during the EU Life funded project Malta Seabird Project (2012-2016) for their importance as feeding grounds for the three pelagic species, namely *Calonectris diomedea, Puffinus yelkouan* and *Hydrobates pelagicus* (Fig 6).

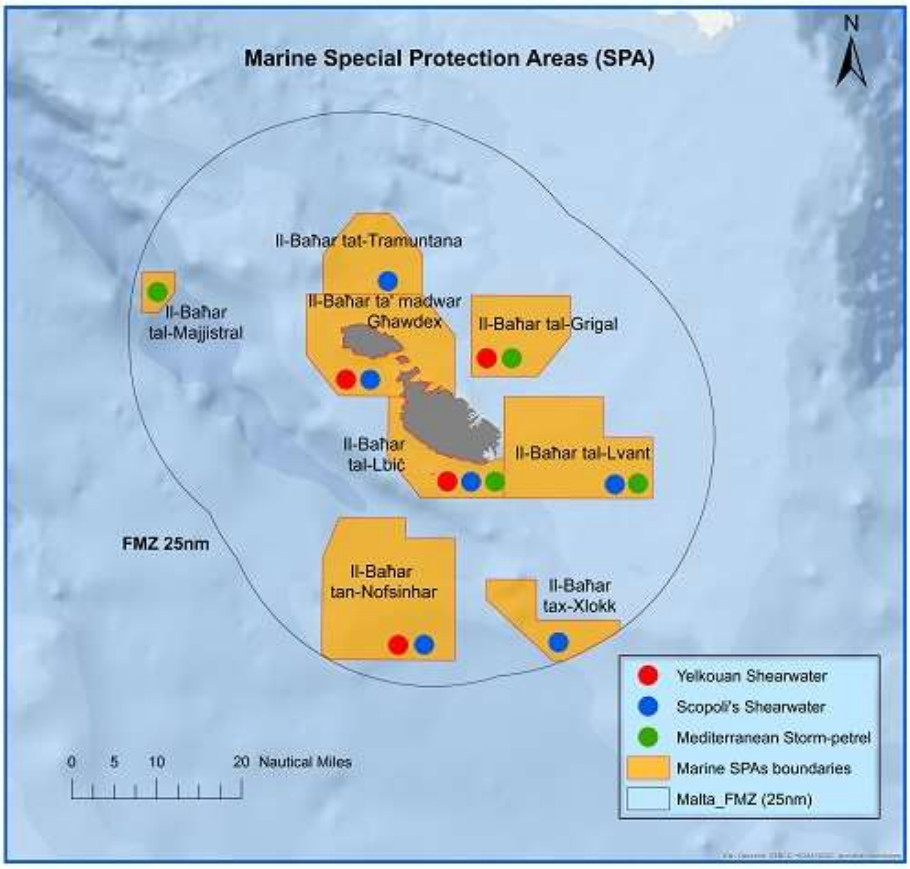

Fig 6. Marine Special Protection Area (SPA) and N2K sites, designated under Govt. Notice 1311 of 2016.

4. Marine IBAs

Seabirds face a wide range of threats during their lifecycles and have undergone one of the most rapid declines of any bird group in the past 20 years (Lascelles, 2007). This has been recognised by the European Union and consequently, all Member States have a duty to designate Marine Special Protection Areas (SPAs) under the Birds Directive by 2008 (European Commission 2004).

Malta is a particular hotspot for seabirds. The island of Filfla is home to the largest colony of breeding European Storm-petrels in the Mediterranean. The Maltese Islands also host approximately 10% of the world's population of breeding Yelkouan Shearwaters and approximately 5% of the Mediterranean population of Cory's Shearwaters. This gives Malta a high global responsibility for the conservation of seabirds. Furthermore, the Gozo Channel is very important for Ferruginous Ducks (*Aythya nyroca*), with over 1% of the global population passing through the channel annually, as well as a range of other species of conservation concern (Coleiro, unpublished data). *Aythya nyroca* is classified as globally Near Threatened by BirdLife International, the official authority on birds for the IUCN Red List.

In order to assist the Government in the task of identifying and designating Marine SPAs, one of the primary outputs of the EU LIFE Yelkouan Shearwater Project was to produce a report outlining the mechanisms being used to develop Marine SPA programmes across Europe. The report also proposed a roadmap for the designation of Marine SPA sites in the Maltese Islands, in order to protect these critically important seabird populations.

For both marine and terrestrial IBAs, the function of the Important Bird Areas (IBAs) programme of BirdLife International is '*to identify and protect a network of sites, at a biogeographic scale, critical for the long-term viability of naturally occurring bird populations, across the range of those bird species for which a sites-based approach is appropriate'*.

The selection of IBAs has been a particularly effective way of identifying terrestrial conservation priorities across Europe. Marine IBAs are intended to extend this protection to the marine environment. Marine IBAs must have one or more of the following characteristics:

- Hold significant numbers of one or more globally threatened species
- Be one of a set of sites that together hold a suite of restricted-range species or biome restricted species
- Have exceptionally large numbers of migratory or congregatory species (Lascelles & Fishpool, 2007)

4.1. Marine SPAs

SPAs are areas of international importance for the conservation of wild birds, classified under the EU Directive on the Conservation of Wild Birds (the 'Birds Directive'). They are usually, but not always, based on IBAs.

Once a site is designated as an SPA the legal protective requirements defined in Article 6 (2), (3), and (4) of the Habitats Directive apply to it. Member States must send to the Commission all relevant information so that it may take appropriate initiatives to ensure that the SPA network forms a coherent whole

4.2 Types of Marine IBA / SPA

The classification for Marine SPAs by BirdLife International currently focuses on four types of Marine IBAs:

- Seaward extensions of breeding colonies
- Non-breeding coastal concentrations
- Migratory bottlenecks
- Areas for pelagic species

(BirdLife International 2007c)

protection and will suggest which areas are inappropriate for heavy recreational use or offshore wind-farms, for example.

The identification of Marine IBAs will make a vital contribution to global initiatives to gain greater protection and sustainable management of the oceans, including towards the designation of Marine Protected Areas (MPAs) of which Marine SPAs will form a large part. The intention is that Marine IBAs will be the precursors for Marine sites of the Natura 2000 network (Lascelles, 2007).

There is a clear obligation that EU Member States classify appropriate SPAs in the marine environment In Malta, the identification of Marine SPAs is of particularly pressing importance because the limited land resources and high population density of the Maltese Islands have made the coastal zone and contiguous marine area a focal point for resource use conflicts (MEPA, 2005). To ensure that these conflicts are resolved in a sustainable way, Marine SPAs and SACs will be an invaluable tool.

Prioritization and zonation modeling for the three Procellariiformes (From Metzger *et al*, 2016)

Figure 7-9 present the results of the prioritisation modelling of core areas of seabird distribution inside the Maltese Exclusive Fishing Zone EFZ, including the zonation approach with a moderately low 0.01 border length penalty. Shown are the 10% and 15% core areas within the Maltese EFZ representing the areas of highest importance for each of the three species.

For the Maltese breeding population of *P. yelkouan*, three main hotspot areas are identified, one around Gozo, including the Gozo Channel and along the west- and southwest coast of Malta, a second one offshore in the northeast of Malta and a third one offshore in the southwest of Malta (see Fig. 7). For the Maltese breeding population of *C. diomedea*, The Life project team identified five priority areas in the Maltese EFZ, the first one around and north of Gozo and a second one along the west and southwest coast of Malta. Additionally to that, three offshore areas are found east, southeast, and south of Malta (see Fig. 8). For *H. pelagicus melitensis* breeding in the Maltese islands

the core area is covering a coastal zone around Malta and a larger area of sea east of the island. Additionally, a small area is found in the Pantelleria channel northwest of Gozo and several fragmented squares are spread over an area southwest of Malta (see Fig. 9).

Fig 7. Priority areas for *P. yelkouan* within the Maltese EFZ, dark blue squares: 10%, light plus dark blue squares: 15%.

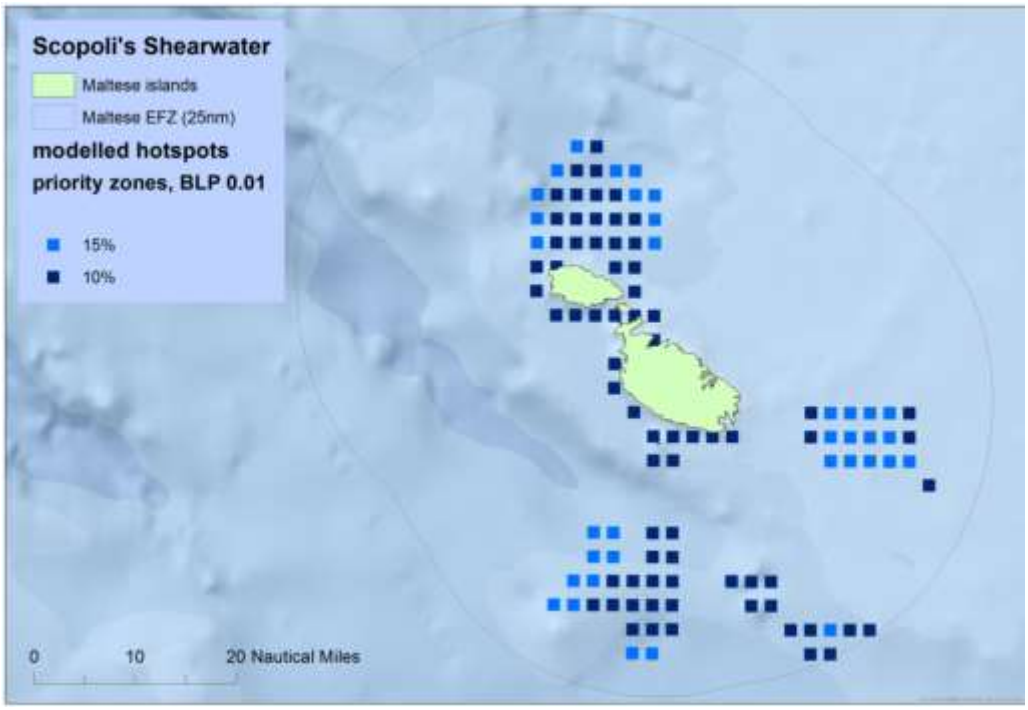

Fig 8. Priority areas for *C. diomedea* within the Maltese EFZ, dark blue squares: 10%, light plus dark blue squares: 15%.

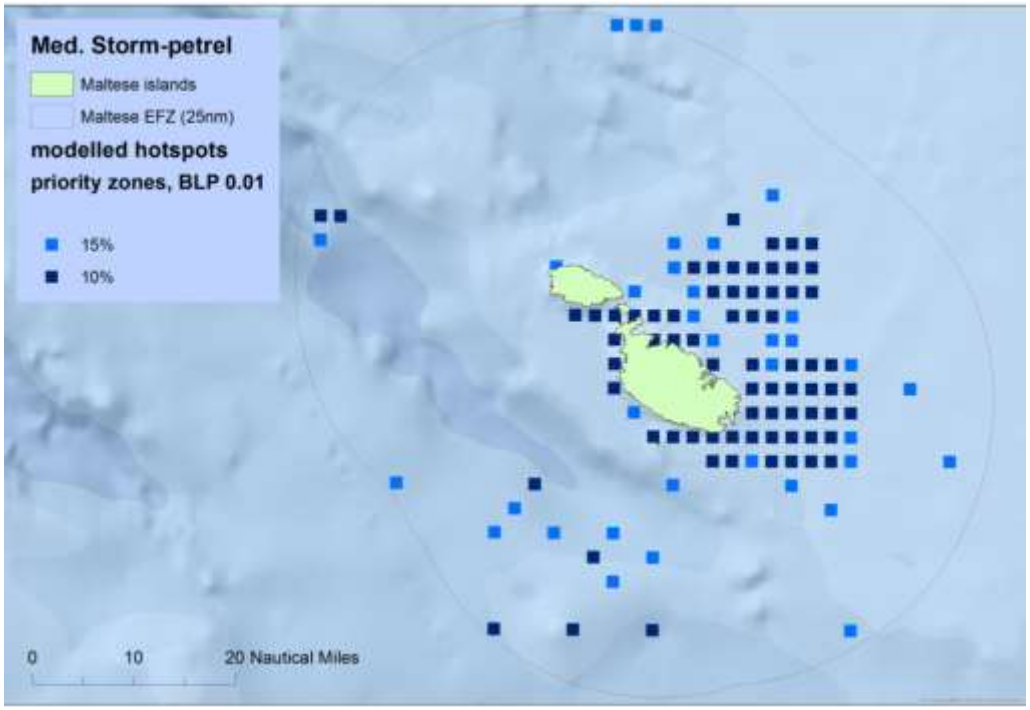

Fig 9. Priority areas for *H. pelagicus melitensis* within the Maltese EFZ, dark blue squares: 10%, light plus dark blue squares: 15%.

5.1 Breeding Species

The Maltese coastal cliffs support four seabird species, namely: Scopoli's Shearwater *Calonectris diomedea*, Yelkouan Shearwater *Puffinus yelkouan*, Mediterranean Storm-petrel *Hydrobates pelagicus melitensis*, and the Yellow-legged Gull *Larus michahellis*.

The Storm Petrel and the Yellow-legged Gull have not been recorded breeding in the Ghar Lapsi area in the last 50 years but both the Scopoli's and the Yelkouan shearwaters still breed there.

Shearwaters are members of the Order Procellariformes which includes also the albatrosses and petrels. They are pelagic species with the characteristic tube-noses on the base of the upper mandible. They visit land during the breeding season and do so under cover of darkness. A single egg is laid in a deep crevice or burrow or under loose boulders and vegetation. Sometimes, rabbit burrows are also used as breeding sites.

5.1 Scopoli's Shearwater *Calonectris diomedea*

Scopoli's Shearwater is a breeding visitor to the Maltese islands. The first birds make landfall in the last ten days of February. The single egg is laid in a crevice, fissure, or under boulders and vegetation in the latter half of May. Incubation lasts 52 days (Cachia-Zammit & Borg 1986) and the chicks hatch in mid-July. By the end of October all the colonies are deserted (Tab 1). The estimated breeding population of this bird in the Maltese Islands has been estimated at less than 5,000 pairs (Sultana *et al*., 2011) and the Ghar Lapsi cliffs and boulder scree hold about 51-100 breeding pairs (Borg & Sultana 2002, Raine *et al*, 2009). Because of increasing human pressure (direct persecution, noise and light pollution on the cliffs) these birds are being pushed down the more inaccessible cliff sites. In the last 10 years several "accessible" nest sites located on the top parts of the cliffs have been deserted.

Every evening from March to October, streams of flying birds, coming from their feeding grounds, pass within 1-4 km offshore on their way to their breeding colonies. The distance from land is

conditioned by climatic factors mainly the presence or absence of strong winds. At certain times of the year; especially during the incubation and the fledging period, the two species of shearwaters frequent specific areas for feeding and these areas lie primarily off the south-eastern coast of Malta at distances ranging from 12 to 500 km away.

Fig 10 Scopoli`s Shearwater *Calonectris diomedea*

5.2 Yelkouan Shearwater *Puffinus yelkouan*

The Yelkouan Shearwater is endemic to the central and eastern Mediterranean. The world population is estimated at 13,000-33,000 breeding pairs with Malta holding an estimated population of 1,500 pairs that is 10% of the global population (Borg *et al,* 2010). The population at Ghar Lapsi has been estimated at 10 to 50 pairs (Borg & Sultana 2004, Raine *et al*, 2009).

The first birds start to visit the colonies in October and egg laying takes place from the last days of February through the first two weeks of March. Chicks hatch in mid-May and by the third week of June the chicks start to abandon the nesting sites. The colonies are deserted by mid-July (Table 1). Ringing recoveries and satellite tracking of young birds, have shown that Maltese birds head towards the Aegean and Black Seas in the post breeding period while observations confirmed that an

unknown number of adult birds remain around the Maltese Islands to moult their feathers (Borg *et al*., 2002).

Fig 11. Yelkouan Shearwater *Puffinus yelkouan*

5.3 European Storm-petrel *Hydrobates pelagicus melitensis*

Filfla island lies just 5 km off the Ghar Lapsi shore and holds the largest known breeding population of this tiny seabird in the Mediterranean with an estimated breeding population of 5,000 to 8,000 pairs (Raine *et al*, 2009, Sultana *et al*, 2011).

Birds visit the colonies at night, from February to late October (Table 1), and like its larger cousins, under the cover of darkness. On Filfla, egg laying is asynchronous which is quite unusual in the procellariiformes. On Filfla, the Yellow-legged Gull is the main predator of Storm petrels while rats influence the breeding on the main islands (Sultana *et al*., 2011).

Fig 12. Mediterranean Storm-petrel *Hydrobates pelagicus melitensis*

Arrival at colonies		**Egg laying**	**Hatching**	**Fledging**
Puffinus yelkouan	mid October	early February	early May	mid June/early July
Calonectris diomedea	end February	end May	mid July	mid October
Hydrobates pelagicus	end February	April-June	May-August	August to October

Table 1: Synthesis of breeding biology and ecology of *P.yelkouan, C.diomedea & H.pelagicus*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calonectris diomedea		—	—	—	—	—	—	—	—	—		
Puffinus yelkouan	—	—	—	—	—	—	—			—	—	—
Hydrobates pelagicus		—	—	—	—	—	—	—	—	—		

Table 2 Presence in Colonies by the three pelagic seabird species

5.2. Daily movements by Procellariiformes

Shearwaters travel vast distances to and from their breeding colonies in search of food. During the breeding season of *P. diomedea*, large numbers can be seen flying offshore in an east to west direction. Distance from land is conditioned by wind direction and strength. During strong North-westerly winds the shearwaters can be seen flying at a distance of less than 50 metres from the coast.

The same area is also used by Yelkouan Shearwaters, especially birds originating from the Rdum tal-Madonna colony (Borg *et al,* 2002, Borg *et al,* 2010, Raine *et al,* 2010, 2011 and 2012) and more recently from the St. Paul's islands (Pers Obs) (see Fig 13).

Another regular visitor to the study area and immediate whereabouts is the Yellow-legged Gull *Larus michahellis*. This resident breeding bird is present almost all year round and double figures normally congregate in and around the now defunct fish farm off the South-west coast of Comino to rest on the floating "cages" and buoys. The terminal area is frequented by birds coming from the breeding colonies at Filfla and Dingli Cliffs, heading towards the fish farm and *vice-versa*.

Fig 13. Daily evening movements by the two Procellariids from their feeding grounds to the breeding colonies.

5.3. Rafting

Rafting is the convergence of birds on water, normally in the vicinity of their breeding colonies. During calm afternoons these congregations of birds can reach impressive numbers with several hundreds of birds waiting for darkness. Birds start assembling about two to three hours before sunset and then start to dissipate around dusk when the whole congregation is within a few hundred metres from the cliffs. In spite of several decades of research, very little is known about this behaviour. The main reason for birds rafting is to rest, and it is safest to do this in large numbers when many birds are looking out for danger. For example, both the Scopoli's and Yelkouan Shearwaters raft offshore in the evenings, waiting to return to their breeding colonies under the safety of darkness. Rafting is a time to socialise, an important aspect of a seabird's life.

It has also been hypothesised by some, that seabirds use these congregations to assess the health of their population, although this is now highly disputed considering the fact that individual birds from other colonies in other countries form part of these rafts.

Fig 14 Rafting *C. diomedea*

5.4 Fish Pens: Supplementary food source for seabirds

Borg (2012) presented some preliminary results on Tuna farms as a supplementary food source for Storm-Petrels. In July and August of 2006, very small numbers of storm-petrel were reported to the author, while an increase was noted in July 2007, but with fewer numbers in autumn. In the summer of 2008, again in the months of July and August, single birds where noted almost daily with up to 30 counted on several occasions. The use of raw, unwashed fish food is fundamental in attracting storm petrels closer to these tuna pens. The same food supply has attracted a constant presence of small fish around the pens which in-turn attract gulls and terns, especially the Black Tern *Chlidonias niger*.

Observations have shown that the majority of storm petrels frequenting the area are adult birds undergoing primary wing moult, suggesting breeders, probably not venturing far away from the colonies during the chick rearing period. A smaller number of birds seen during the site visits were juvenile birds covered in a fresh coat of dark plumage. These young birds are present from the latter part of August to early September. Tuna penning is locally carried out during the summer and autumn months (mid-July to November / December).

It was recommended that further investigations should focus to identify if this reliable food source has any effect on the breeding success and fledglings survival in storm petrels. While adult storm petrels regularly fall prey to yellow-legged gulls on Filfla (Borg *et al*., 1992-94, Sultana *et al,* 2011) no interactions between gulls and storm petrels were ever noted near the tuna pens. Further research is required to determine the extent of dependency by storm petrels on this food source.

6. THREATS

6.1 LIGHT POLLUTION

The use of light sources from land and at sea is of particular concern. It is known that light interferes with the behaviour of birds and other animal groups, including bats. In those areas where electricity has been installed especially close to seabird colonies, birds have completely deserted the site. Birds and other animals found close to light sources are known to behave in an abnormal way; several species of birds remain active during night time. Light also disrupts the normal cycle of other vertebrates as well as numerous species of invertebrates making them susceptible to predation.

In some cases, seabird breeding colonies have been abandoned when electricity was introduced in the area, places like Xlendi Bay, Hal-Far, Ghar Lapsi and Wied iz-Zurrieq, where colonies of both Scopoli's and Yelkouan Shearwaters have been negatively affected.

6.2 SOUND POLLUTION

Noise has a negative effect on the normal patterns of incoming shearwaters during night time. Birds tend to fly away from any sound source as was observed on numerous occasions. When a boat passes close to a breeding colony, all activity stops until the boat is out of "earshot".

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18/04/2018

APPENDIX 4: NOTE FROM BIRDLIFE (MALTA)

Rising cases of birds rescued at sea with compromised waterproofing: Investigating potential links to Aquaculture expansion

17th February 2025

The Expansion of Tuna Farming in Malta

Globally, aquaculture is experiencing significant growth. In Malta, according to the latest publication by the National Statistics Office (NSO), 91% of aquaculture production is dominated by tuna farming. The quantity of farmed tuna has increased substantially in recent years, with a 10% rise in farmed tuna production between 2021 and 2022, followed by an additional 15.4% increase between 2022 and 2023. This expansion in tuna farming corresponds to a higher demand for fish feed (Figure 1)[1].

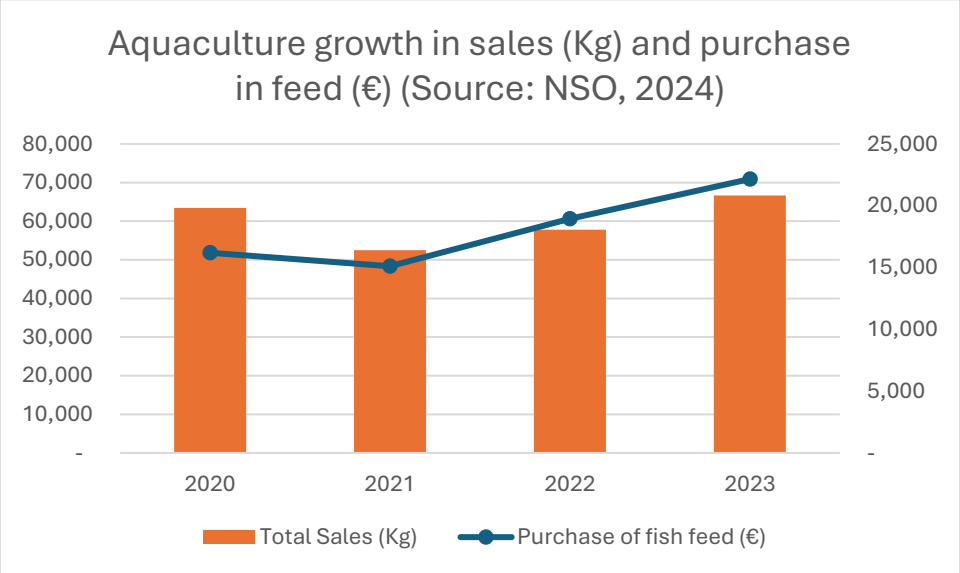

Figure 1: Aquaculture growth in sales (Kg) and purchase in feed (€) in Malta

The Issue of Oil-Slicks and Birds' Risk of Exposure to the Oil

The Environmental Impact Assessment for the proposed aquaculture zone in northern Malta (GF00250/07) highlights that operations in local tuna farms release considerable amounts of natural fish oils and mucus from frozen baitfish. These oils disperse into the marine environment when fed to tuna and, unless contained, rapidly spread over the sea

[1] NSO (2024). Aquaculture: 2023. https://nso.gov.mt/aquaculture-2023/.

surface, forming an oily film. Such slicks can drift towards coastal areas, coating marine life, divers, and bathers[2].

Oily residues from stock and feed will form dense oil-slicks which was noted to attract seabirds, particularly olfactory foragers such as shearwaters and storm-petrels, as well as gulls and terns which are attracted to shoals of juvenile fish typically attracted to pens[3,4]. Attraction to these oil-slicks puts seabirds at risk of exposure to the oil. When birds are exposed to oil, their waterproofing ability and thermoregulation is impaired as a result of damage to the insulative properties of their feathers. If an oiled bird is unable to maintain thermal homeostasis, hypothermia and death can follow rapidly. A small amount of oil on seabirds is sufficient to break down the feather barrier that is necessary to prevent water penetration and hypothermia. In a study in Britain, it resulted that seabird feathers exposed to the thinnest fish oil resulted in measurable feather weight gain (from oil and water uptake) and significant feather microstructure disruption. Both feather weight gain and microstructure disruption increased with increasing fish oil thickness. In addition, interviews conducted with wildlife rehabilitation professionals with experience rehabilitating sea birds after edible oil exposure indicated that physical contact with fish and other 'edible oils' in the marine environment is at least as harmful to seabirds as petroleum oils[5].

The Increase in Incidents of Birds Covered in Oily Residues

In recent years, BirdLife Malta has recorded an increase in birds reported with (a) compromised waterproofing and/or (b) covered in oily residues and with compromised waterproofing. Between 2020 and 2024, a total of 50 affected birds with compromised waterproofing were recovered from coastal and offshore areas (Figure 2). Despite rehabilitation efforts, only 42% survived.

[2] Adi Associates. (2018). GF00250/07: PROPOSAL FOR A NEW AQUACULTURE ZONE IN THE NORTH OF MALTA, ZONE OFFSHORE MALTA. ENVIRONMENTAL IMPACT ASSESSMENT REPORT.
[3] Morandin, L. A., & O'Hara, P. D. (2014). Fish oil disrupts seabird feather microstructure and waterproofing. *Science of the Total Environment*, *496*, 257-263.
[4] Borg, J. J. (2012). Tuna farms - A seasonal supplementary food source for storm petrels *Hydrobates pelagicus melitensis*. Avocetta 36: 91-94.
[5] Tuarze, P., Stephenson, M., Mazzocco, P., & Knopper, L. (2021). A Physiologically Based Oiling Model (PBOM) to Predict Thermoregulatory Response in Birds. *Environmental Toxicology and Chemistry*, *40*(1), 251-260.

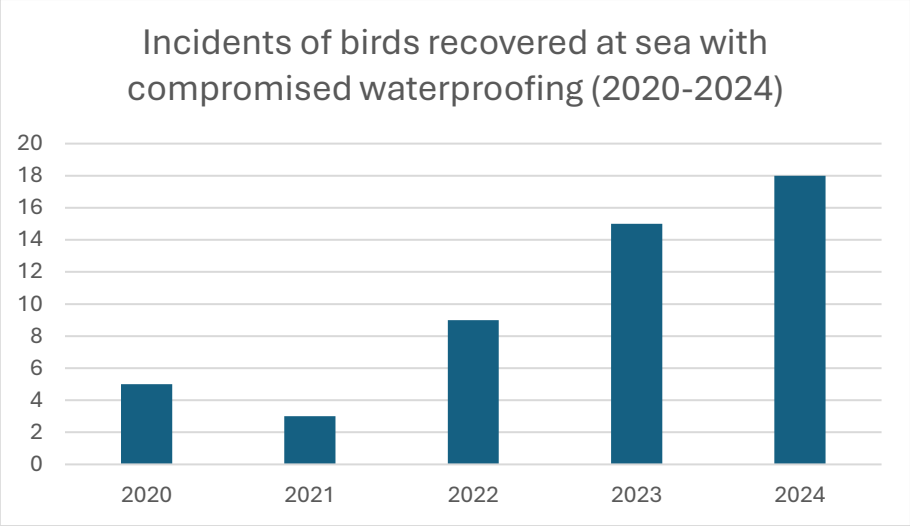

Figure 2: Incidents of birds recovered at sea with compromised waterproofing between 2020 and 2024

Among these collected birds, 36% were Mediterranean Storm-Petrels (*Hydrobates pelagicus melitensis*), 18% Scopoli's Shearwaters (*Calonectris diomedea*), and 26% Yelkouan Shearwaters (*Puffinus yelkouan*), all of which rely on olfactory foraging and are known to be attracted to fisheries (Figure 3).

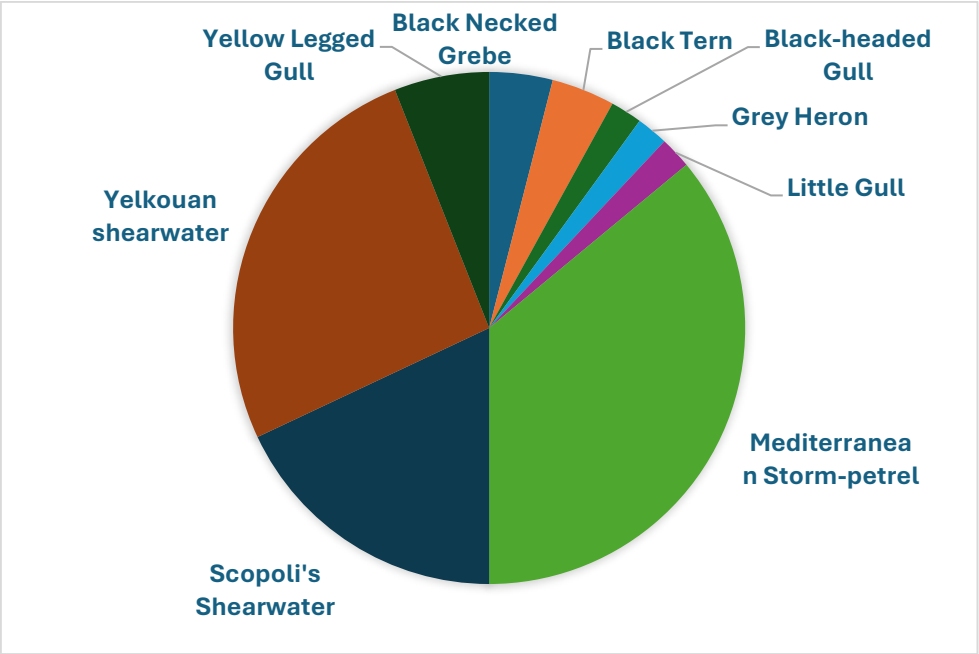

Figure 3: Species composition of affected birds

The majority of affected birds were collected between June and November, with July and August showing the highest numbers between 2020 and 2024 (Figure 4). These months coincide with the fattening phase of the tuna farming cycle, during which caged tuna are fed intensively before being harvested and sold.

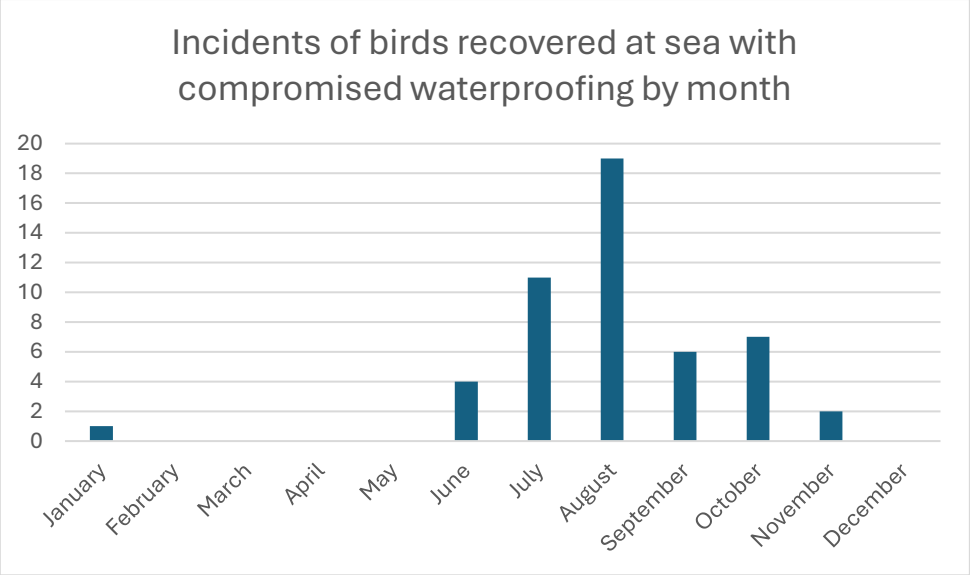

Figure 4: Incidents of birds recovered at sea with compromised waterproofing by month

All birds were retrieved at sea from offshore waters or near the coastline. Any birds rescued on land are not included in such an analysis. Figure 5 below highlights the localities associated with these recoveries, indicating where oiled seabirds were found. A significant number were collected from the waters off San Pawl il-Baħar and Marsaskala, areas that also coincide with the locations of offshore fish farm cages.

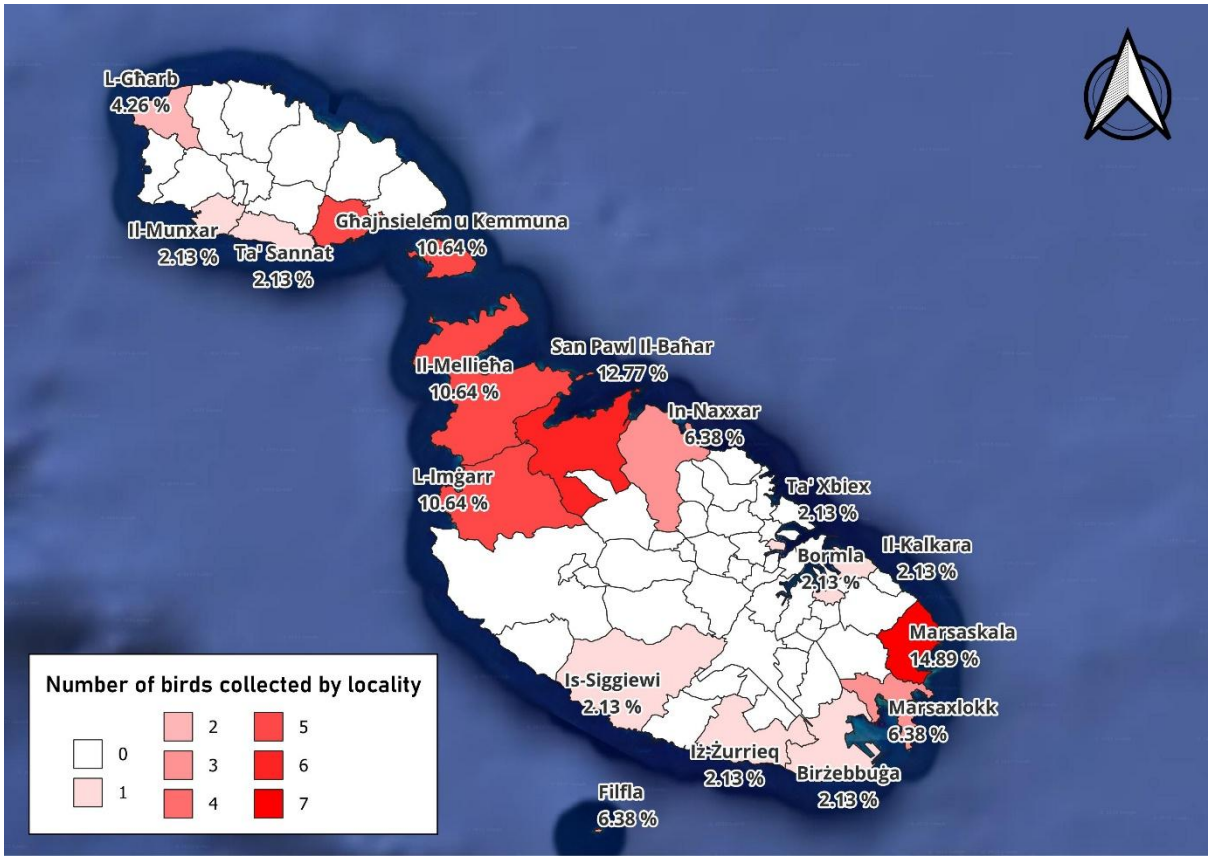

Figure 5: Number of birds collected by locality between 2020 and 2024

Further assessments to understand the Implications of Tuna Farming on Malta's Seabirds Populations

The seasonal overlap between seabird oiling incidents and tuna farm operations, the geographical correlation between bird collection sites and fish farms, and the rising trends in both tuna farming and reported oiled seabirds suggest a potential causal relationship. Given the risks posed by oil-slicks accumulating around tuna farms, further assessments are required to determine the extent of seabird exposure to oil-slicks and fish farm oil-related mortality. BirdLife Malta has begun collecting feather samples from affected birds for potential future chemical analysis to determine whether the oil originates from fish farm operations. Quantifying this risk is essential, as large-scale oiling events could compromise entire seabird rafts. Ultimately, further assessments are required to better understand the implications of tuna farming on Malta's seabird populations, as should the industry keep expanding its operations, and especially if these are close or coincidental with seabird rafting areas, it is possible that we will see an increase in numbers of compromised seabirds with an increased mortality on various protected species.