AQABA MARINE RESERVE

Nomination File

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AQABA SPECIAL ECONOMIC ZONE AUTHORITY
P. O. Box 2565, Aqaba. Jordan

Contents

List of Abbreviations

Abbreviation	Extension
ACT	Aqaba Container Terminal
ADC	Aqaba Development Company
AMP	Aqaba Marine Park
AMR	Aqaba Marine Reserve
ARA	Aqaba Regional Authority
ASEZ	Aqaba Special Economic Zone
ASEZA	Aqaba Special Economic Zone Authority
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Plants and Animals
CoP	Conference of Parties
CoT	Crown of Thorns
CSR	Corporate Social Responsibility
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
FENGO	Jordan's Federation for Environmental NGOs
GCF	Green Climate Fund
GEF	Global Environmental Facility
GoA	Gulf of Aqaba
GoJ	Government of Jordan
IBA	Important Birds Area
ICZM	Integrated Coastal Zone Management
IMO	International Maritime Organization
IUCN	International Union for the Conservation of Nature
IUCN ROWA	International Union for the Conservation of Nature/ West Asia Office
JNPAs	Jordan's Network of Protected Areas
JREDS	The Royal Marine Conservation Society of Jordan
MAB	UNESCO Man and Biosphere Reserve
MAC	Mean Absolute Cover
MAM	Multi-Annual Mean
MARPOL	International Convention for the Prevention of Pollution from Ships
MEA	Multilateral Environmental Agreements
MOA	Ministry of Agriculture
MOE	Ministry of Environment
MOTA	Ministry of Tourism and Antiquities
MOU	Memorandum of Understanding
MOU	Memorandum of Understanding
MSL	Mean Sea Level
MSS	Marine Science Station
NAP	National Adaptation Plan
NDC	National Detrimental Contribution
NMP	National Monitoring Program
PAs	Protected Areas
PERSGA	The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
RHC	Royal Hashemite Court
RSCN	Royal Society for the Conservation of Nature

SDG	Sustainable Development Goals
SEB	Skeleton Eroding Band
SME	Small and Medium Enterprise
UN	United Nation
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WHC	World Heritage Convention

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Summary

The Gulf of Aqaba is the only maritime area in Jordan, with a shoreline that extends for almost 27 km. This limited stretch provides Jordan with the only access to the sea for activities such as ship transport, fishing, and industrial development that requires large amounts of cooling water. Across the Gulf (into Egypt) is a small but thriving tourism industry that is served by a number of hotels, an airport and ferry services to adjacent localities, which include the towns/resorts of Dahab, Taba and Nuweiba. Along this coastal stretch includes the presence of 13 km of a discontinuous series of fringing reefs, which contains unique marine and coastal ecosystems, habitats and rich biodiversity composition.

In order to protect this unique ecosystem, the Aqaba Special Economic Zone Authority (ASEZA) established the Aqaba Marine Park (AMP) in 1997 with its boundaries extending over 7km length from the Passenger Terminal in the north to the Royal Dive Club in the south. Despite this establishment, the site was not included within the Jordan Network of Protected Areas (JNPAs), which was issued by the Government of Jordan (GoJ). In June 3rd, 2020, His Majesty King Abdulla II gave his directive to declare the AMP as a national Marine Protected Area to be included as part of Jordan's critically important areas for protection. Therefore, ASEZA has initiated the process of declaring the reserve after receiving generous support from the United Nations Development Program (UNDP), under the supervision from the Royal Hashemite Court and the Ministry of Environment. The process has achieved the inclusion of the Aqaba Marine Reserve (AMR) within the JNPA in August 18th 2020, and this has triggered the initiation of the preparation of this nomination file, which is a requirement based on the Protected Areas and National Parks Bylaw No. 29 for the year 2005 to declare the site officially as a protected area.

The nomination file is composed of six parts including which are now summarized in more detail.

Part one includes the introductory part where all background information related to the mission of establishing the reserve, history of establishment, governance and legal framework are provided. The Aqaba Marine Park was first proposed for establishment in 1977, when the first proposal was made to conserve the area, which is located between the Marine Science Station (MSS) as its northern border and the coast guard to the south. This site was approved for establishment by ASEZA "which was formerly known as the Aqaba Regional Authority" in 1997. Currently, the site is managed by the beaches directorate, which is part of the Environmental Commission, and is equipped by the Aqaba Marine Park bylaw No. 22 issued in 2001, which was issued in accordance with the ASEZA Law No. 32 of 2000. Several other instructions are supporting the marine reserve, and other directorate established under the same commission will aid the management which are the environmental and Ben Hayyan directorates. The lands of the proposed reserve is belong to ASEZA, and they are part of the ASEZA master plan. The vision of establishing the reserve was agreed to achieve a marine reserve that supports the protection of health coral reefs and marine ecosystems whilst supporting the vibrant socio-economic development of Aqaba. This will be achieved following five objectives which are i) achieve a sustainable management of natural resources, ecosystems and biodiversity composition to maintain the reserve values, ii) integrate and mainstream the conservation efforts within a healthy and sustainable socio- economic development, iii) achieve international recognitions through setting models and best practices in nature conservation management, iv) maintain effective and

cooperative relations with the reserve stakeholders to facilitate the achievement of its vision and mission, and v) encourage scientific research and foster scientifically based management, including citizen science.

Part Two deals with the environmental characteristics, where abiotic and biotic factors have been discussed. The Gulf of Aqaba is part of the Wadi Araba – Dead Sea Rift Zone, and the area of the proposed marine reserve is a Precambrian granitic rock that is partly covered by quaternary alluvial, wadi sediments and shore deposits consisting of gravel sand and clay beds of up to 100 m thickness. The deepest point reaches 1825 m with an average depth of 800 m, and the continental slopes at the Gulf of Aqaba are among the steepest in the world. The sediments within the proposed reserve area are mainly black reflecting the mineralogy of the surrounding geology, (i.e. high calcium carbonate content give whiter sediment colours). The alluvial fans are divided into two zones; active and inactive, with a minimal age of the alluvial fans at the proposed reserve of more than 20,000 years ago. The beach composition at the proposed reserve is composed from finer grained materials being washed offshore, and larger stones and reef blocks making up a higher percentage of the beach intertidal area. The maximum sea level range reference to global Mean Sea Level (MSL) during the year 2013 was 154.3 cm, where the highest value reported at 101.7 cm observed in December 12th, and the lowest value was -52.6 cm recorded on April 23rd. In addition, the gulf is characterized by a sea surface temperatures range from winter lows of 20.5°C to highs in late summer of over 27°C, and the salinity ranges from 40.3 to 41.6 psu. The dissolved oxygen levels are near saturation (i.e. 4.8–6.5 ml O2 L^{-1}) in surface waters, and the pH fluctuate around 8.3.

The biotic characteristics is also rich where 73 species included in 45 genera within 10 taxa of zooplankton have been recorded. The nutrients of nitrogen, phosphorous, and silica are poor at Aqaba due to the inflow of nutrient-rich waters. Several habitats can be observed including sandy and rocky beaches as well as the fossilized corals. The most significant feature of Jordan's marine environment is undoubtedly its coral reef ecosystems, and the associated corals species. Aqaba reefs also lie within this Red Sea biogeographic zone, which is designated as a World Wide Fund for Nature (WWF) "Global 200 Eco-Region" because of its unique marine biodiversity. The Gulf of Aqaba contains 157 hard coral species composed of 153 scleractinian corals, one organ pipe coral, and 3 fire corals. Among these, 15 endemic species in the Red Sea were recorded, and various localities within the proposed reserve such as the North First Bay, Marine Science Station, and King Abdullah Reef were found to contain the highest diversity of coral species. The seagrass stands along the proposed AMR are small in comparison with the magnitude of coral reef extent, and the greatest extent of seagrass beds are found at the Al-Mamlah Bay (Tala Bay) area which is located at the southern edges of the proposed reserve. Within this, three species have been recorded in the proposed AMR, where the most common and distributed species is the *Halophila stipulacea*. For microalgae, eighteen genera of benthic macroalgae including seven chlorophytes, eleven Rhodophytes, and ten Phaeophytes, and a total of 507 fish species in total belonging to 109 families have been recorded. It is important to note that the seagrass meadow in Al-Mamlah Bay contributed to record extremely rare species for the first time, which is the Sea Grass Wrasse *Novaculichthys macrolepidotus* in 2004. Moreover, three turtle species have been recorded at the Gulf of Aqaba, and a fourth is expected to be encountered, where the most abundant and widely distributed species is the hawksbill turtle *Eretmochelys coriacea*. The proposed reserve maintain

the presence of two keystone and threatened giant clams species, 72 species of sponges, four common species of Chaetognatha, 20 species of urochordates and 645 species of mollusks.

The terrestrial ecosystem is very limited and confined to the beach area that surround the coastal water. However, this area hold the presence of various species and habitats especially after considering the surrounding areas. The proposed reserve is located within Jordan's Sudanian Penetration Zone, and is part of the Acacia and Sudanian rocky vegetation type. Several flora species can be observed, which are confined to some shrubs and saline plants such as *Zygophyllum dumosum*, *Anabasis articulate*, *Juncus mariümus* and *Fagonia* spp. Although a single wild common species of mammals have been recorded in the proposed reserve, and is represented by the red fox; *Vulpes vulpes* but the feral dogs *Canis familiaris* can be encountered frequently. Seven other mammalian species can be also encountered in the vicinity of the proposed reserve area. In addition, the proposed reserve was declared as an Important Birds Area since 250 different species, and up to 1.5 million birds flying over it. For reptiles, eight species are expected to occur inside the reserve boundaries or in the adjacent areas where the threatened Egyptian spiny-tailed lizard *Uromastyx aegyptia* is considered the most important one.

Part Three addresses the social and cultural characteristics at the proposed reserve. In summary these is confined to specific local community groups such as the fishermen, diving centers and glass boats owners. In addition, the visitors are considered a key stakeholder to the site. Several underwater sites are supporting marine biodiversity by acting as artificial reefs such as the Cedar Pride Shipwreck, Tarmac Five and Hercules C-130. In addition, around 30 diving sites have been allocated by ASEZA to support the diving industry at Aqaba, and bait fishing is allowed within the proposed reserve in specific time duration and after approval from ASEZA.

Part Four outlines several pressures that are identified as affecting or will potentially affect the proposed reserve if no effective management is applied. The resident population growth, and the exponential increase in number of visitors to Aqaba will create pressures over the limited resources. Due to this pressure, North King Abdullah Reef is found to be the highest site affected by diving and snorkeling activities. The established and planned projects are also expected to reduce the area of available beaches and therefore focus visitors more on those beaches managed under the proposed reserve. In addition, the existence of the passenger port and its adjacent Aqaba Container Terminal port might pose negative effects on the proposed reserve especially with the generated wastes. However, positive indicators could be utilized especially with the environmental best practices at the Aqaba Container Terminal, and to capitalize on the social corporate responsibility program to aid the management of the proposed reserve. Sea level raise is expected at the Gulf of Aqaba, which will have several consequences if no proper planning and mitigation measures are in place. ASEZA has managed to establish 40 dams to protect the city from the flooding, but the potential of having sedimentation is still possible in the proposed reserve.

Low tide is expected to a lesser extent and it will cause corals to be exposed during daylight hours, which in consequence will lead to overheat and dry out of its tissues. The water quality is very sensitive criteria which might be affected by any leaks from sewer system and/or because of water discharged from fish farm or fertilizer plume. Few incidents of oil spill has been recorded at Aqaba, due to the zero-discharge policy but careful monitoring, preparedness and enforce the strict regulations are required. In addition, the national strategy of ballast water has been developed, and

the ballast water Convention is effective which in consequence supported a well-implementation and control. The marine debris is considered as a major cause of pollution and it lead to serious effects on the ecosystem and species. For that, continuous awareness programs are required associated with strict enforcement and innovative cleanup campaigns.

Part Five outlines the potential significance of establishing the AMR at the national, regional and international level. It will support the government of Jordan represented by the MOE to fulfil its requirements toward Multilateral Environmental Conventions especially the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change as well as it will aid the government of Jordan to achieve the Sustainable Development Goals and specifically SDG14 on life underwater. Several other convention and memorandum of understanding will be achieved as well such as Convention on International Trade in Endangered Species of Plants and Animals, Convention on Migratory Species, Jeddah Convention and World Heritage Convention. Moreover, declaring the reserve will conserve biodiversity composition and the ecosystems services. Finally, various partnership opportunities can be established at various levels such as those with the private sector, local communities, international accreditation, and fundraising opportunities.

Finally, Part Six presents the current structure of the AMP including the role of ASEZA (the Beach Department etc) and how the proposed AMR needs to be revised and what capacity building programs need to be implemented in order to raise the skills, knowledge and awareness of staff members toward achieving effective reserve management.

الملخص باللغة العربية

يعتبر خليج العقبة المنفذ البحري الوحيد للأردن، ويمتد الساحل الأردني على الخليج لحوالي 27 كم. يوفر هذا الخط الساحلي المحدود للأردن العديد من الأنشطة مثل عبور السفن وصيد الأسماك والتنمية الصناعية التي تتطلب كميات كبيرة من مياه التبريد. كما ويتميز هذا الساحل بوجود النشاطات السياحية المتعددة حيث تتواجد العديد من الفنادق وخدمات المطارات والعبارات التي تسهل نقل الزوار إلى المناطق المجاورة ومن أهمها مدن طابا ونويبع على الجانب المصري من الخليج. ويمتد على طول المنطقة الشاطئية من خليج العقبة حيود مرجانية متقطعة ومشاطئة تمتد على مسافة 13 كم وتحتوي على أنظمة بيئية فريدة وموائل وتنوع حيوي غني وفريد.

ومن أجل حماية منطقة ممثلة من الأنظمة البيئية في خليج العقبة، فقد قامت سلطة منطقة العقبة الاقتصادية الخاصة بتأسيس متنزه العقبة البحري في عام 1997 على شريط ساحلي بطول 7 كيلومترات من مبنى الركاب في الشمال إلى نادي الغوص الملكي في الجنوب. وعلى الرغم من هذا التأسيس، إلا أن الموقع لم يتم إدراجه ضمن شبكة المحميات الأردنية التي أصدرتها الحكومة الأردنية. وفي الثالث من يونيو للعام 2020 أصدر جلالة الملك عبد الله الثاني بن الحسين المعظم توجيهاته بإعلان متنزه العقبة البحري كمنطقة محمية بحرية وطنية ليتم تضمينها كجزء من كنوز الأردن القابعة ضمن شبكة المحميات الطبيعية. وبناء على الأوامر الملكية، فقد باشرت سلطة منطقة العقبة الاقتصادية الخاصة عملية إعلان المحمية بعد الحصول على دعم مهم من برنامج الأمم المتحدة الانمائي (UNDP)، والعمل تحت إشراف الديوان الملكي الهاشمي ووزارة البيئة. وقد حققت هذه العملية لغاية الآن إدراج محمية العقبة البحرية ضمن شبكة المناطق المحمية في 18 أغسطس 2020، مما دفع السلطة للبدء بإعداد ملف الترشيح هذا، وهو مطلب مهم يستند لنظام المناطق المحمية والمتنزهات الوطنية رقم 29 لسنة 2005 الصادر عن وزارة البيئة. يتكون ملف الترشيح من ستة فصول هي المقدمة، والخصائص البيئية، والعوامل التي قد تؤثر على المحمية وأثر تأسيس المحمية المحتمل ونظام الإدارة الحالي. وتالياً تلخيصاً لهذه الفصول بمزيد من التفاصيل

تضمن الفصل الأول الجزء التمهيدي، حيث تم توفير جميع المعلومات الأساسية المتعلقة بأهمية إنشاء المحمية وتاريخ التأسيس والحوكمة والإطار القانوني. تم اقتراح إنشاء متنزه العقبة البحري لأول مرة في عام 1977، عندما تم تقديم الاقتراح الأول للحفاظ على المنطقة التي تقع بين محطة العلوم البحرية كحدوده الشمالية وخفر السواحل في الجنوب. وقد تمت الموافقة على إنشاء هذا الموقع من قبل سلطة منطقة العقبة الاقتصادية الخاصة "التي كانت تُعرف سابقًا باسم سلطة إقليم العقبة " في عام 1997. تتم إدارة الموقع حالياً من قبل مديرية الشواطئ، وهي جزء من مفوضية البيئة والإقليم، وقد تم تدعيم المتنزه بموجب نظام متنزه العقبة البحري رقم 22 الصادر في عام 2001، والذي تم إصداره وفقًا لقانون منطقة العقبة الاقتصادية الخاصة رقم 32 لعام 2000. هناك العديد من التعليمات الأخرى التي تدعم عمل المحمية البحرية وقد تم الحديث عنها أيضاً، كما تم التطرق لمجموعة من المديريات الأخرى التي تم إنشاؤها ضمن مفوضية البيئة والاقليم وهي مديريات البيئة ومختبرات بن حيان. تعود أراضي المحمية المقترحة إلى سلطة منطقة العقبة الاقتصادية الخاصة، وهي جزء من المخطط الرئيسي لمنطقة العقبة الاقتصادية الخاصة. تم الاتفاق على رؤية إنشاء المحمية لتحقيق محمية بحرية تدعم حماية الشعاب المرجانية والنظم البيئية البحرية بما ينسجم مع دعم برامج التنمية الاجتماعية والاقتصادية في العقبة. سيتم تحقيق ذلك باتباع خمسة أهداف وهي: 1) تحقيق إدارة مستدامة للموارد الطبيعية والنظم البيئية وما يرتبط بها من تنوع حيوي للحفاظ على قيم المحمية الرئيسية، 2) دمج وتعميم جهود الحفظ ضمن تنمية اجتماعية واقتصادية صحية ومستدامة، 3) تحقيق الاعترافات الدولية من خلال وضع النماذج وأفضل الممارسات في إدارة الحفاظ على الطبيعة، 4) الحفاظ على علاقات فعالة وتعاونية مع أصحاب العلاقة في المحميات لتسهيل تحقيق رؤيتها ورسالتها، و5) تشجيع البحث العلمي وتعزيز الإدارة القائمة على أسس علمية.

تناول الفصل الثاني الخصائص البيئية، حيث تمت مناقشة العوامل غير الحيوية والحيوية. إن خليج العقبة هو جزء من وادي عربة - منطقة صدع البحر الميت، ومنطقة المحمية البحرية المقترحة عبارة عن صخور جرانيتية تعود إلى ما قبل عصر الكمبري وهي مغطاة جزئياً بالرواسب الغرينية الرباعية والوديان والرواسب الساحلية التي تتكون من رمل حصوي وطبقات طينية يصل سمكها إلى 100 متر. تصل أعمق نقطة في خليج العقبة في الأردن إلى 1825 م بمتوسط عمق 800 م، والمنحدرات القارية في خليج العقبة هي من بين الأكثر انحدارًا في العالم. تكون الرواسب داخل منطقة المحمية المقترحة باللون الأسود بشكل أساسي مما يعكس وجود المعادن في الجيولوجيا المحيطة. وتنقسم المدشات إلى منطقتين إحداهما نشطة والأخرى غير نشطة مع حد أدنى لعمر المدشات في المحمية المقترحة منذ أكثر من 20000 عام. يتكون الشاطئ في المحمية المقترحة من مواد ذات حبيبات

دقيقة يتم غسلها بعيدًا عن الشاطئ، وتشكل الأحجار الكبيرة وكتل الشعاب المرجانية نسبة أعلى من منطقة المد والجزر على الشاطئ. كان الحد الأقصى لمدى مستوى سطح البحر المرجعي لمتوسط مستوى سطح البحر العالمي خلال عام 2013 هو 154.3 سم، حيث سجلت أعلى قيمة عند 101.7 سم في 12 ديسمبر، وأقل قيمة تم تسجيلها في 23 أبريل عند - 52.6 سم. بالإضافة إلى ذلك، يتميز الخليج بدرجات حرارة لسطح البحر تتراوح من أدنى مستوياتها في الشتاء عند 20.5 درجة مئوية إلى أعلى مستوياتها في أواخر الصيف والتي تزيد عن 27 درجة مئوية، وتتراوح الملوحة من 40.3 إلى 41.6. وبالنسبة لمستويات الأكسجين المذاب فإنها قريبة من التشبع (أي 4.8-6.5 مل O2 L-1) في المياه السطحية، ويتقلب الأس الهيدروجيني حول 8.3.

الخصائص الحيوية غنية أيضًا، حيث تم تسجيل 73 نوعًا يندرج ضمن 45 جنسًا ضمن 10 أصناف من العوالق الحيوانية. تعتبر العناصر الغذائية من النيتروجين والفوسفور والسيليكا فقيرة في العقبة بسبب عدم تدفق المياه الغنية بالمغذيات. ويمكن ملاحظة العديد من الموائل بما في ذلك الشواطئ الرملية والصخرية وكذلك الشعاب المرجانية المتحجرة. إن أهم ما يميز البيئة البحرية في الأردن هو بلا شك النظم البيئية للشعاب المرجانية وأنواع المرجان المرتبطة بها حيث تقع شعاب العقبة أيضًا ضمن هذه المنطقة الجغرافية الحيوية للبحر الأحمر، والتي تم تصنيفها على أنها ضمن المناطق الحيوية 200 بحسب الصندوق العالمي لحماية الطبيعة وذلك بسبب تنوعها الحيوي البحري الفريد. يحتوي خليج العقبة على 157 نوعًا من أنواع المرجان الصلب تتكون من 153 نوعًا من المرجان المتصلب، ومرجان أنبوبي واحد، وثلاثة أنواع من المرجان الناري. من بين هذه الأنواع، تم تسجيل 15 نوعًا متوطن في البحر الأحمر كما ووجد أن المواقع المختلفة داخل المحمية المقترحة تحتوي على أعلى تنوع في الأنواع المرجانية. تتواجد الأعشاب البحرية على طول محمية العقبة البحرية المقترحة ولكنها تحتل مساحات أصغر مقارنة بحجم وامتداد الشعاب المرجانية، ويوجد أكبر امتداد من طبقات الأعشاب البحرية في منطقة خليج المملح (تالا باي) التي تقع على الحواف الجنوبية من المحمية المقترحة. ضمن هذا، تم تسجيل ثلاثة أنواع من الأعشاب البحرية في المحمية المقترحة وهو ذاته عدد أنواع الأعشاب البحرية في كامل خليج العقبة الأردني، وأكثرها شيوعًا وتوزيعًا هو من نوع (*Halophila sterulacea*). بالنسبة للطحالب الدقيقة، تم تسجيل ثمانية عشر جنسًا من الطحالب القاعية بما في ذلك سبعة أنوع من الطحالب الخضراء، و11 نوع من الطحالب الحمراء وعشرة أنواع من الطحالب البنية، وما مجموعه 507 نوعًا من الأسماك تنتمي إلى 109 عائلة. وتجدر الإشارة إلى أن منطقة الأعشاب البحرية في منطقة المملح قد ساهمت في تسجيل نوع نادر للغاية من الأسماك تسجل لأول مرة وهي سمكة كيدمية الأعشاب (*Novaculichthys macrolepidotus*) في عام 2004. كما تم تسجيل ثلاثة أنواع من السلاحف في خليج العقبة، ومن المتوقع تواجد نوع رابع، وتعتبر سلحفاة منقار الصقر هي أكثرها وفرة وانتشارًا. أيضاً تتضمن المحمية نوعين أساسيين من أنواع المحار العملاقة المهددة بالانقراض و 72 نوعًا من الإسفنج، وأربعة أنواع شائعة من Chaetognatha ، و 20 نوعًا من urochordates و 645 نوعًا من الرخويات.

النظام البيئي الأرضي محدود للغاية ويقتصر على منطقة الشاطئ التي تحيط بالمياه الساحلية. ومع ذلك فإن هذه المنطقة تحتوي على أنواع وموائل مختلفة خاصة بعد النظر إلى المناطق المحيطة بها. تقع المحمية المقترحة داخل منطقة النفوذ السوداني في الأردن، وهي جزء من النمط النباتي المعروف لشجر الطلح والمناطق الصخرية. يمكن ملاحظة العديد من أنواع النباتات والتي تقتصر على بعض الشجيرات والنباتات المالحة مثل نبات الرطريط (*Zygophyllum dumosum*) ونبات العجرم (*Anabasis*) ونبات الأثل (Juncus) ونبات شكاعة (*Fagonia* spp). على الرغم من تسجيل نوع واحد شائع من الثدييات البرية في المحمية المقترحة وهو الثعلب الأحمر (*Vulpes vulpes*) إلا أنه يمكن ملاحظة وجود الكلاب الضالة بشكل متكرر كما ويمكن العثور على سبعة أنواع أخرى من الثدييات بالقرب من منطقة المحمية المقترحة. بالإضافة إلى ذلك، تم إعلان المحمية المقترحة كمنطقة مهمة للطيور لأنها تقع ضمن أحد أهم مسارات الهجرة للطيور وهو حفرة الانهدام وتعتبر العقبة كمنطقة عنق زجاجة حيث يعبر 250 نوعًا مختلفًا وما يصل إلى 1.5 مليون طائر فوق منطقة المحمية المقترحة. أما بالنسبة للزواحف فمن المتوقع وجود ثمانية أنواع داخل حدود المحمية أو في المناطق المجاورة حيث يعتبر الضب وهو نوع مهدد بالانقراض أهمها.

تنحصر الخصائص الاجتماعية للمحمية المقترحة في مجموعات مجتمعية محلية محددة مثل الصيادين ومراكز الغوص وأصحاب القوارب الزجاجية. بالإضافة إلى ذلك، يعتبر الزوار والسياح من أصحاب العلاقة الرئيسيين في الموقع. تدعم المحمية المقترحة العديد من المواقع المغمورة تحت الماء وقد أصبحت مناطق هامة وحيود اصطناعية تضم العديد من الأنواع مثل حطام سفينة سيدار برايد، وتارماك فايف وهيركوليس سي -130. بالإضافة إلى ذلك فقد تم تخصيص حوالي 30 موقع غوص من قبل سلطة

منطقة العقبة الاقتصادية الخاصة لدعم رياضة الغوص في العقبة، ويُسمح بصيد الطعم داخل المحمية المقترحة في المياه السطحية كآلية دعم الصيادين.

تؤثر العديد من الضغوط على المحمية المقترحة إذا لم يتم تطبيق إدارة فعالة، حيث يعتبر النمو السكاني والزيادة المضطردة في عدد زوار العقبة من الضغوط الرئيسية على الموارد المحدودة. نتيجة لهذا الضغط، وجد أن بعض مناطق المتنزه هي الأعلى تأثراً بفعل أنشطة الغوص والسباحة باستخدام الانبوب (السنوركل). من المتوقع أيضًا أن تؤثر المشاريع السياحية القائمة والمخطط لها مثل شاطئ برانيس وتالا بيه ومرسى زايد على شواطئ العقبة وبالتالي ستؤدي إلى تركيز الزوار بشكل أكبر على تلك الشواطئ المدارة في إطار المحمية المقترحة، لكن وجود هذه المواقع يحمل فرص ايجابية يمكن البناء عليها. بالإضافة إلى ذلك، فإن وجود ميناء الركاب وميناء حاويات العقبة المجاور له قد يكون له آثار سلبية على المحمية خاصة مع النفايات المتولدة. ومع ذلك، يمكن استخدام مجموعة من الفرص الإيجابية لهذه الموانئ خاصة مع تطبيق أفضل الممارسات البيئية في ميناء حاويات العقبة، والاستفادة من برنامج المسؤولية الاجتماعية لها للمساعدة في إدارة المحمية المقترحة. من المتوقع أن يرتفع مستوى سطح البحر في خليج العقبة، الأمر الذي سيكون له عواقب عديدة إذا لم يتم اتخاذ تدابير مناسبة للتخطيط والتخفيف. وقد تمكنت سلطة منطقة العقبة الاقتصادية الخاصة من إنشاء 40 سداً لحماية المدينة من الفيضانات، لكن احتمالية حدوثها وحملها للرسوبيات للبحر لا تزال ممكنة في مساحة المحمية المقترحة.

من المتوقع أن تؤدي ظاهرة المد المنخفض الحاد إلى تعرض الشعاب المرجانية خلال ساعات النهار للشمس مما سيؤدي إلى جفاف أنسجتها وموتها. تعتبر جودة المياه من المعايير الحساسة للغاية والتي قد تتأثر بأي تسرب من نظام الصرف الصحي و / أو بسبب تصريف المياه العادمة الصناعية أو من أي مشروع قد يتم انشاءه مرتبط بمزارع الأسماك. تم تسجيل عدد قليل من حوادث الانسكاب النفطي في العقبة، وذلك بسبب سياسة عدم التصريف، ولكن هناك حاجة إلى مراقبة الموانئ وفرض عقوبات صارمة في حال عدم الالتزام. بالإضافة إلى ذلك، تم تطوير الإستراتيجية الوطنية لمياه الصابورة، وتفعيل اتفاقية مياه الصابورة مما يدعم تنفيذها بطريقة فعالة منع وصول الأنواع الغريبة الغازية. وتعتبر النفايات البحرية من الأسباب الرئيسية للتلوث ويؤدي إلى آثار خطيرة على النظام البيئي والأنواع. لذلك، هناك حاجة لبرامج التوعية المستمرة المرتبطة بالتطبيق الصارم وحملات التنظيف المبتكرة.

سيحمل إنشاء محمية العقبة البحرية عدة دلالات إيجابية على المستويات الوطنية والإقليمية والدولية. حيث سيدعم اعلان المحمية جهود الحكومة الأردنية ممثلة بوزارة البيئة للوفاء بمتطلباتها تجاه الاتفاقيات البيئية متعددة الأطراف وخاصة اتفاقية التنوع الحيوي واتفاقية الأمم المتحدة الإطارية بشأن تغير المناخ، كما ستساعد الحكومة الأردنية في تحقيق أهداف التنمية المستدامة، وعلى وجه التحديد الهدف رقم 14 بشأن الحياة تحت الماء. كما سيتم تحقيق العديد من الاتفاقيات ومذكرات التفاهم الأخرى مثل اتفاقية التجارة الدولية للأنواع المهددة بالانقراض من النباتات والحيوانات، واتفاقية الأنواع المهاجرة، واتفاقية جدة، واتفاقية التراث العالمي. علاوة على ذلك فإن إعلان المحمية سيحافظ على تكوين التنوع الحيوي وخدمات النظم البيئية. وأخيرًا، يمكن توفير فرص شراكة مختلفة على مستويات مختلفة مع القطاع الخاص والمجتمعات المحلية والحصول على اعتمادات وشهادات دولية تمكن المحمية من توفير فرص تمويل متنوعة.

يجب مراجعة الهيكل الحالي لمديرية إدارة الشاطئ وما يرتبط به من هيكلية خاصة بالمحمية المقترحة بعناية، ويجب تنفيذ برامج بناء القدرات لرفع المهارات والمعرفة والوعي لدى الموظفين تجاه إدارة المحميات البحرية.

Part One: Introduction

1.1 Overview

In 1997, the Aqaba Special Economic Zone Authority (ASEZA) established the Aqaba Marine Park (AMP). Its boundaries fall within the southern parts of the 27 km of existing Jordanian shoreline within the Gulf of Aqaba (GoA) which provides Jordan with the only access to the sea for activities such as ship transport, fishing (secondary importance), and industrial development. Across the Gulf (into Egypt) is a small but thriving tourism industry that is served by a number of hotels, an airport and ferry services to adjacent localities, which include the towns/resorts of Dahab, Taba and Nuweiba. Along this coastal stretch includes the presence of 13 km of a discontinuous series of fringing reefs, which contains unique marine and coastal ecosystems, habitats and rich biodiversity composition[1].

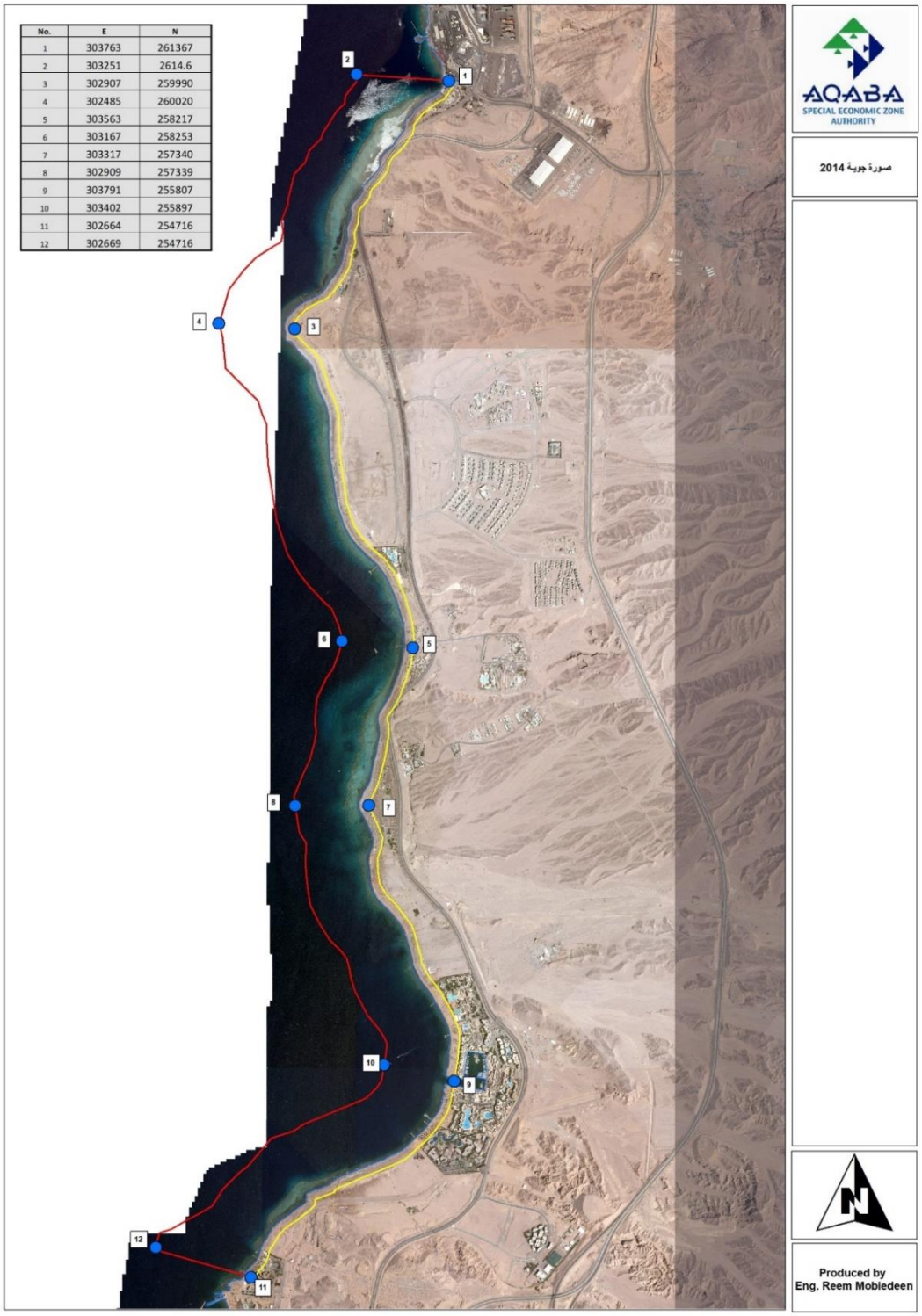
With a limited shoreline all coastal activities in Jordan are concentrated within a 27km stretch, which as a result is subjected to considerable and conflicting resource use pressures. Such competing activities includes tourist (hotels, resorts, and tourism related activities), a variety of port developments, an industrial complex, a marine park and a marine science station. This situation places all coastal habitats (including important coral reefs) under continuous direct and indirect pressures throughout the year because of the consistent monthly water temperatures that the Gulf experiences. In particular, the development of new port facilities and the expansion of existing ports are expected to extensively damage coral reef integrity within the vicinity. In addition, industrial related accidents/spillages coupled with illegal activities can impact significantly upon this sensitive marine environment especially in light of the ongoing and planned tourism and economic development proposals. Therefore, it was necessary to declare the AMP to support its ability to conserve and protect valuable marine ecosystems and the services they provide.

In June 3rd, 2020, His Majesty King Abdulla II gave his directive to declare the AMP as a national Marine Protected Area (MPA). Based on this, ASEZA has initiated the process to declare the site after a generous support from the United Nations Development Program (UNDP), and the process was conducted under the supervision from the Royal Hashemite Court, the Ministry of Environment (MoE) and a steering committee members. The process was started by an official decision made by the Board of Commissioners No. 38 for the year 2020 which declares the reserve boundaries following the original boundaries of the AMP. This was directly followed by a request sent to the MoE in June 10th 2020 to include the Aqaba Marine Reserve (AMR) within Jordan's Network of Protected Areas (JNPAs). Accordingly, a letter was forwarded by the MoE in June 17th 2020 to the cabinet based on the Protected Areas and National Parks Bylaw No. 29, for the year 2005 and the request was approved to add the MR in the JNPAs in August 18th 2020[2].

The boundaries of the proposed AMR follows the equivalent ones already set for the AMP, extending over 7km length from the Passenger Terminal in the north to the Royal Diving Club in the south. The park's terrestrial boundary currently lies 50 m east of the Mean High-Water Mark

[1] UNEP/IUCN 1988
[2] https://www.jordantimes.com/news/local/aqaba-marine-park-be-listed-first-marine-nature-reserve

and the marine boundary lying 350m west of the Mean High Water Mark (see Map 1 and Figure 1).



Map 1: Proposed Aqaba Marine Reserve Boundaries with coordinates, Aqaba/ Jordan[3]

[3] ASEZA, 2020

1.2 History and Reasons of Establishment

The AMP establishment dates back to 1977, when the first proposal was made to conserve the area, which is located between the Marine Science Station (MSS) as its northern border and the coast guard to the south[4]. The AMP contains three important and massive coral reef reserves, which were the key reasons behind proposing this site for conservation at this time. This proposal was further acknowledged by the recommendations of the International Union for the Conservation of Nature (IUCN) in 1992, and an earlier study, conducted by Mahasneh and Meinesz (1984), which highlights the necessity to follow the Aqaba Regional Authority (ARA) proposed boundaries after Ormond (1978). In 1997, an agreement was signed between the Global Environmental Facility (GEF) and the Government of Jordan (GoJ) to establish the AMP, under the umbrella of the ARA. In the same year, decision number 5 was issued in July 1997 by the Board of Directors of ARA to announce the declaration of the Aqaba Marine Park over 7Km shoreline length.

In 2000, ASEZA was established, and the Aqaba Marine Park By-Law No. 22 (2001) was issued. The first AMP Management Plan was developed in 2002 and subsequently updated in 2013 to cover the period of 2014-2018 under the UNDP project of marine biodiversity in Aqaba. This Management Plan was published taking all stakeholders' interests and challenges into consideration. The establishment of the proposed AMR is important in order to conserve the marine biodiversity resources of Aqaba. The proposed site includes representative portions of Jordan's known marine biogeographic zones and supporting physical environments including some of the world's most unique coral reefs that are critical as a genetic reservoir.

Figure 1: Arial photo for the proposed AMR

[4] Ormond, 1978

1.3 Governance and Legal Framework

ASEZA is the autonomous manager, regulator and developer of the Aqaba Special Economic Zone (ASEZ). It has both the rights and the responsibilities to oversee the conservation of Aqaba's coast and marine resources. ASEZA was established in 2000 equipped with Law No. 32 of 2000 and was mandated to transform Aqaba into a world class Red Sea business hub and leisure destination. In addition, it aims at enhancing the quality of life and prosperity of the Aqaba community through sustainable development. ASEZA was mandated with a series of regulatory, administrative, fiscal and economic responsibilities.

The Environment Commission was established within ASEZA with a mandate "***to evaluate the state of the environment in the zone, develop the necessary regulations and procedures to protect the environment and to establish cooperation with the local community, national and international environmental organizations in order to protect and contribute to the sustainable development through finding the balance between investment requirements and the protection of the natural resources for the next generations***". In order to achieve the mandates of the environmental commission, three main directorates were established which are the Environment Directorate, beaches management directorate and Ben Hayyan laboratory.

The Environment Directorate is working towards achieving a vision "***to lead in the field of environmental protection and resource efficiency and seeking of environmental excellence in ASEZ***" and a mission to "***well protected environment supporting local sustainable community and economy***". This is addressed by policies such as:

1. Preventing pollution of the environment and sound managing of its resources;
2. Zero discharge to the sea;
3. Enhancing the local environment and improving its environmental performance.

In addition, the Directorate is supported by the Environmental Protection By-Law No. 21 for the Year 2001 issued under Articles (52) and (56) of the Aqaba Special Economic Zone Law No (32) for the Year 2000, This law addresses issues such as sea water usage, solid waste disposal, dangerous materials, radioactive materials, wastewater, and cooling water disposal. According to the law, no permits are granted to any establishment that produce and dispose solid wastes, except after the Responsible authority is able to check that the establishment has complied with environmental requirements prescribed for this purpose. It also has articles that deal with Environmental Impact Assessment (EIA), environmental auditing, protection of air, and protection of marine environment.

The second Directorate, which was established at ASEZA, is the Beaches Management Directorate. This was originally named the AMP Directorate, but changes within ASEZA took place and subsequently, it was transformed into a "Section" (lower category) in 2015. A second change then occurred in 2017, where it was renamed the Beaches Management Directorate. In spite of these changes the Directorate remains governed by the Aqaba Marine Park bylaw No. 22 which was issued in 2001 which shall govern the proposed AMR and currently define the perimeters of the AMP and its aims. It also describes the formation and structure of the committee responsible for establishing the AMP's policies, requesting the preparation of annual

administration plans, defining financial allocations necessary for the Park, issuing administrative, financial and technical instructions, and any other functions required. It also stipulates a number of prohibited actions and activities, which may result in the destruction, damage or deterioration of the natural environment of its wild life or affect the aesthetics of the area. Several instructions have been issued to aid the implementation of this bylaw including the followings:

1. **Instruction No. 82 for the year 2005**: Regulating of Conducting Scientific Research in AMP: This instruction organize the research and monitoring attempts which will be conducted within the AMP boundaries and set the steps and regulations for.
2. **Instruction No. 83 for the year 2005**: Regulating Entrance into AMP: This instruction organize cars entry to the park, tourists and sports activities within the park. This instruction prohibit all forms of fishing, including fishing coloured coral reef fishes. It also prohibits the transferring or taking any organisms, sediments, or corals for any purpose except by a special permit from the chief commissioner.
3. **Instruction No. 84 for the year 2005**: Regulating the Boats Function in AMP: This instruction organize boat entry to the park, what is prohibited, and what diving boats should do when they enter the park.
4. **Instruction No. 85 for the year 2005**: Regulating Diving in AMP: This instruction organize the diving within the AMP where all regulations related to licensing registrations, entrance point and illegal fishing activities which might be used during the diving is provided.
5. **Instruction No. 86 for the year 2005**: Regulating the Underwater Cleanup Dive in AMP: This instruction set the cleanup campaigns rules and procedures and how to perform these without threatening the marine life.
6. **Instruction No. 161 for the year 2014**: this instructions provide the needed framework to organize the marine sports at Aqaba including licensing, safety and precautions.

In addition to the previously mentioned laws and bylaws, other legislative frameworks exists that contributed to govern the marine park area, such as:

- **Instructions Numbers (g/1) for the Year 2020**: Issued by the Minister of Agriculture under the Agriculture Law No (13) for the Year 2015 for the Regulation of Fishing in Aqaba: These are the latest and detailed instructions, and it was issued in order to organize fishing in Aqaba. It has provisions on fishing permits, net mesh size, trap mesh size, and define No fishing areas. The instructions prohibit the collection of ornamental fishes, and rare and endangered species such as marine turtles, dolphins, and sharks. It prohibit fishing by the extended and permanently fixed gill net construction (Local name: Hakoora) which were used before to catch target and non-target fish. Banning this damaging method is considered a success for the management of fishery resources in Aqaba. However, these instructions lack the list of organisms and fish species which should not be collected or fished. This list should be prepared in collaboration with the scientific community and should contain the season or months during which fishing is permitted. Provision on the necessity for monitoring of the fish catch should be included in the instructions in any future amendments. Finally, these instructions urged the formulation of a committee to provide on a yearly base a list of prohibited species for fishing and seasons.

The third Directorate is Ben Hayyan Laboratory, which is very specialized, working under a vision to "**become a world-class center of excellence, Promoting food safety and environment protection, contributing to better world by Improving the quality of life of people, and facilitating trade within ASEZ, Jordan and the wider region**". In order to achieve this vision, the laboratory has set their mission through the creation of a state-of-the-art laboratory that will provide cost effective, reliable, and accredited analytical services to regulatory agencies and commercial enterprises; create training and research opportunities and establish working ties with peer institutions involved in food safety and environmental conservation.

In summary and for the purposes of clarity, once the cabinet of Jordan declares the proposed AMR formally, it will be governed by the Protected Areas and National Parks Bylaw No. 29 for the year 2005, issued in reference to the environmental law No. 7 of 2016 that is implemented by the MoE. Therefore, the reserve management team should develop a management plan, which will be observed and supervised by the MoE. For that, a Memorandum of Understanding (MoU) may be required between ASEZA and the MoE in order to facilitate cooperation, ensure data sharing, track the management plan implementation and monitor the protected area effectiveness.

1.4 Marine Reserve Land Tenure

The proposed AMR's land tenure follows the ASEZA master plan; where all lands belong to ASEZA. A land use plan has been already developed for Aqaba (referred to as the "Gensler Plan"). Designed to promote and stimulate investments, the plan is a comprehensive vision that defines long-term development throughout the area with respect to land use, zoning, density, and design guidelines to simplify and streamline the planning approval process. The plan sets out a series of sub-areas (zones) as follows:

1. **Coral Coastal Zone**: It includes the proposed AMR, starting from the Marine Sciences Station (MSS) extending south to the Royal Diving Club.
2. **Coral Reserves**: The Coral Reserves protect the magnificent coral reefs within the above defined Coral Coastal Zone (as part of the established AMP). These reserves extend from a line 350 meters seaward from the Mean High Water Mark (MHWM) to a line 50 meters inland from MHWM.
3. **Beach Protection Zone**: The Beach Protection Zone (BPZ) limits development within an area 50 meters to 150 meters landward from the MHWM. Examples of restricted development include natural landscaping and certain recreational facilities. These limits protect the natural environment, water quality, and health of the coral reefs.

1.5 Vision and Objectives of Establishment

The vision set for the AMR is "***A marine reserve that supports the protection of health coral reefs and marine ecosystems whilst supporting the vibrant socio-economic development of Aqaba***"

The specific objectives are defined as follows:

1. Achieve a sustainable management of natural resources, ecosystems and biodiversity composition to maintain the reserve values;
2. Integrate and mainstream the conservation efforts within a healthy and sustainable socio-economic development;
3. Achieve international recognitions through setting models and best practices in nature conservation management;
4. Maintain effective and cooperative relations with the reserve stakeholders to facilitate the achievement of its vision and mission;
5. Encourage scientific research and foster scientifically based management, including citizen science.

Part Two: Environmental Characteristics

2.1 Overview

The Gulf of Aqaba (GoA) is a semi-enclosed basin (Figure 2) located in the sub-tropical arid zone (28–29◦30N; 34◦30–35◦E), and extends over a length of 180 km with a width between 5 and 25 km[5]. The hills on either side of the GoA also rise steeply from the coastline. The 500 m contour on the west side of the GoAis generally within 5 km of the coast, and the east side within 7 km. Hills and mountains rising to over 1,700 m bound the Gulf of Suez on both sides. The 500 m contour line is an average distance of 30 km from the coastline on the western side of the GoA, and within 25 km along the eastern coast. At some points where isolated hills rise more steeply the 500 m contour is within 4–5 km of the coast.

Figure 2: semi-enclosed Gulf of Aqaba of Jordan[6]

Within the GoA are some areas of relatively narrow beach, but in many parts the coastlines are rocky in nature. It consists of a series of embayment's that have in each a comparatively similar and wide range of communities; including rocky shore, reef flat, reef face, fore reef, sandy shore, sandy bottom, and sea grass ecosystems. The southern half of the Jordanian coastline consists of a series of arcuate bays created by valleys between mountain outcrops. There are also flat terraces

[5] UNDP, 2015

[6] Copyright: JREDS

extending out to fringing reefs, rock platforms, cobble beaches, or 1,000 m high vertical cliffs. The head of the GoA, however, is low lying; only rises 2 m above sea level.

2.2 Abiotic Characteristics

2.2.1 Geology of the Gulf and Reefs Formation

The GoA is part of the Wadi Araba – Dead Sea Rift Zone that in turn is a segment of the major geo-structure extending from East Africa to South Turkey with 6,000 km length. Accordingly, tectonics and evolution of this rift graben system have had an important bearing on the regional structure of the rocks exposed in the study area[7]. Faults are the main tectonic features in the area and are restricted to the basement complex. They vary in length from a few tens of meters to a few tens of km. Most of them strike N-S, NE-SW and E-W[8]which is the main cause for the presence of the majority of wadis trending east west, and bringing weathering products to the low-lying areas, where they then form alluvial fans[9]. The area of the proposed marine reserve is a Precambrian granitic rock that is partly covered by quaternary alluvial and shore deposits consisting of gravel sand and clay beds of up to 100 m thickness[10]. In addition, the alluvial and wadi sediments geological formation exists at AMR area[11] (Figure 3).

[7] Bender, 1968
[8] Ikhlas et al. 2016
[9] SOCER 2015
[10] Bender 1968; Farajat 2002
[11] Ikhlas et al. 2016

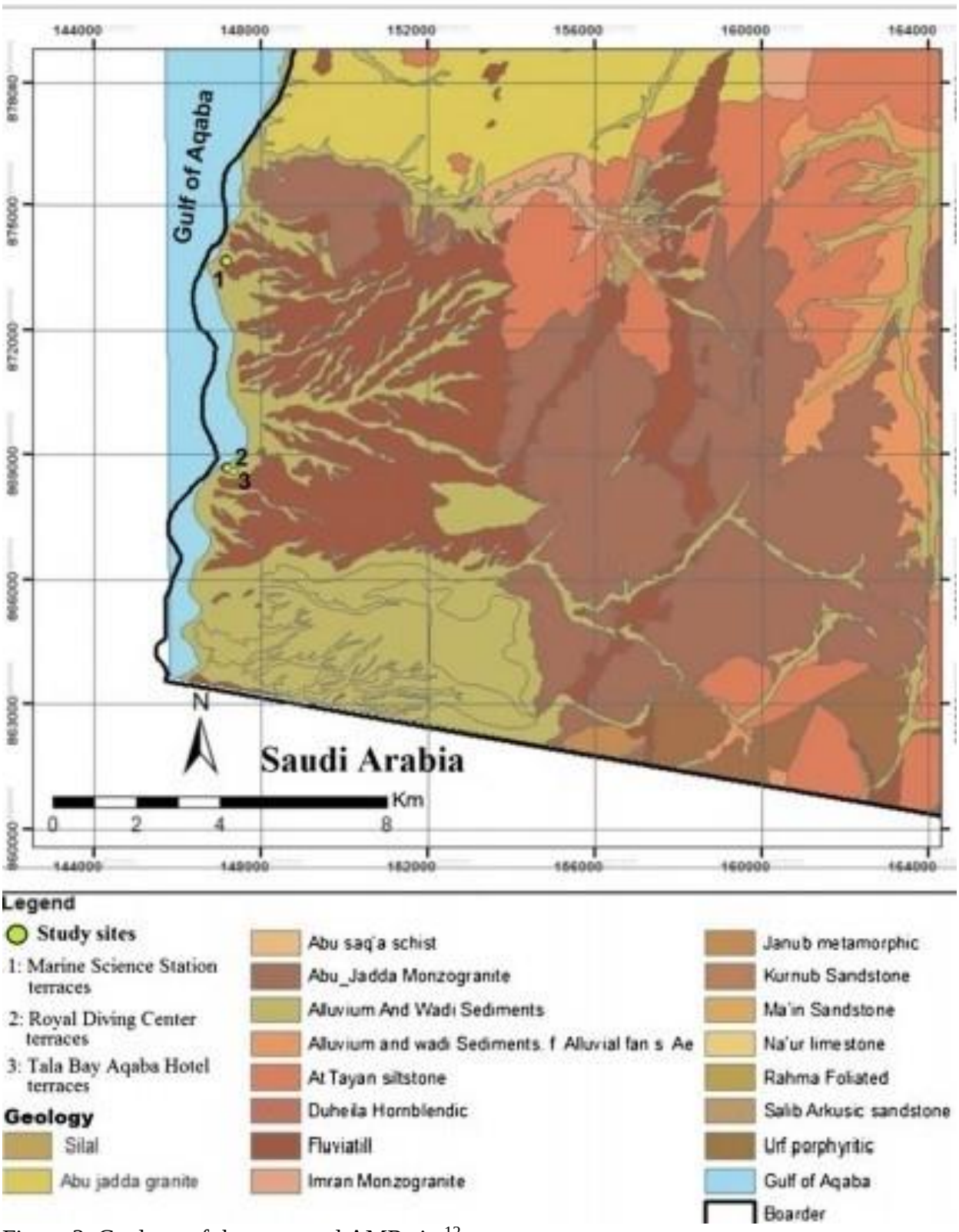


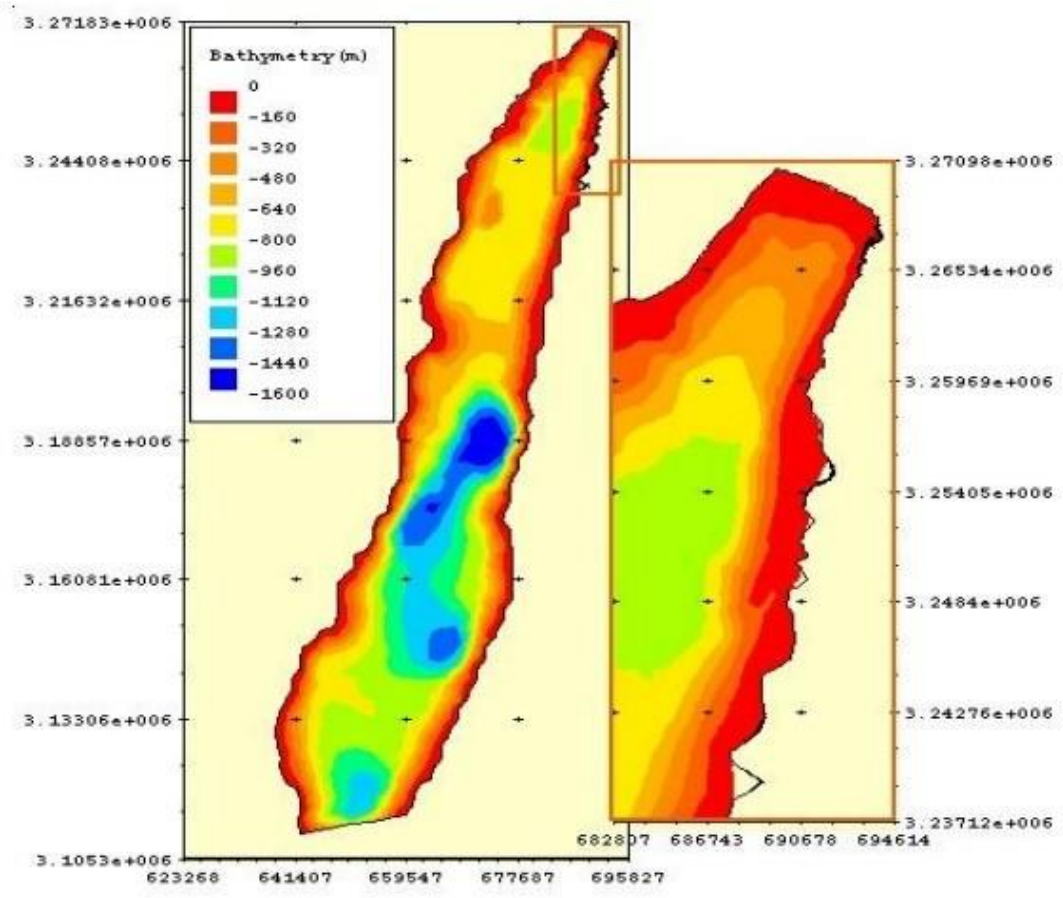
Figure 3: Geology of the proposed AMR site[12].

[12] Source: Ikhlas et al., 2016

Coral reefs have been formed within the Jordan GoA since the middle of the Pleistocene epoch (circa 781,000 to 126,000 years ago). Since then, reef-building organisms have repeatedly recolonized and built reefs during each subsequent sea level rise episode, which is subsequently marked by a thin and narrow biogenic pavement of less than 5 mm, on the reef flat or more frequently on the outer slope of an older reef uplifted during episodes of tectonic activity. The stability of the morphological characteristics of reefs at the GoA of Jordan, since the middle Pleistocene, suggests that their evolution is controlled by both geological and ecological factors. Moreover, the topography and the absence of a continental shelf coupled with the very steep inclination of submarine slopes, has played a major role in limiting the seaward extension of coral built formations[13].

2.2.2 Bathymetry

A unique feature of the GoA is its great depth in proportion to its width, where the deepest point reaches 1825 m with an average depth of 800 m. The continental slopes are also among the steepest in the world whilst the walls of the GoA are very steep, and the normal gradient ranging from 60 to 70 percent. The bathymetry is organized in three deep elongated basins separated from each other by relatively low sills[14]. Figure 4 below illustrates the bathymetry of the GoA.



[13] Bouchon et al. 1981
[14] UNDP, 2015

Figure 4: The bathymetry at the Gulf of Aqaba[15]

The bathymetric area at Aqaba is split into three sectors[16] and as follows:

1. The southern sector (Aqaba/Eilat) Deep, which is most relevant to this proposed AMR, and is characterized by steep slopes. These scarp-like features bound the almost at basin floor. Along these southern beaches (including the AMP), there is a narrow fringing reef area of circa 50m which then shelves off steeply to -20m depth.
2. The western slope which has a slope angle of 17.5º and is steeper than the eastern slope, with a slope angle of 14.0º. The western slope changes its slope angle abruptly and is inclined much more gently (5.7– 6.4º)
3. The eastern sector with two obvious dominant features, namely a linear ridge-like structure trends sub parallel to the strike of the Gulf, and, further north, a cone is well expressed by the bathymetric data.

2.2.3 Soils and Sediments

2.2.3.1 Sediment Characteristics

Sediments within the proposed AMR area are mainly black reflecting the mineralogy of the surrounding geology, (i.e. high calcium carbonate content give whiter sediment colours). No distinctive smell can be detected, indicating well-oxygenated sediments. Surface sediments have similar textural composition whilst the main grain size diameter ranges between 1.4 to 1.7 ø mm and are classified as medium sand. They are often moderately sorted with low mud contents ranging between 0.16 - 0.5 %[17]. Low calcium carbonate (CaCO3) and organic carbon concentrations are found within sediments in Aqaba, ranging from 3-10% and between 0.01-0.17 % for CaCO3 and O.C, respectively[18].

2.2.3.2 Alluvial Fans

Alluvial fans are divided into two zones; active and inactive. The active zones are those where recent floods flow. They are less elevated than the inactive zones, which are about one meter higher in elevation. About 18 alluvial fans exist clearly, their extent range from 30 km^2 to less than 1 km^2. The length of the vertical axes range from 0.6 to 5 km, while the widths range from less than 1 km to 7 km. Coastal wadis deposit terrestrial sediments on land forming alluvial fans, the rest flows to the sea to form small deltas. The minimal age of the alluvial fans that occur within the proposed AMR is more than 20,000 years ago[19].

Coarser rocks and gravel are deposited near the mouth of the canyon, often near the apex of these fans where coarser material can also be found in and along the main channel beds further down the fan from the apex. Intense fluvial erosion of the Aqaba granites has produced extensive alluvial fans, which fill the wadis and mantle the lower hill slopes. As the distance from the head of the fan increases, the size of the materials continues to decrease, from rocks and gravel, to small gravel

[15] Source: UNDP, 2015
[16] Ehrhardta et al. 2005
[17] ECO Consult 2006
[18] SOCER 2015
[19] Ikhlas et al., 2016

and sand, and finally to fine sands and silts where the active wadi deposits are found in the lowest part of the wadi profiles. Their sediments are mainly derived from the granite weathering products, especially in the southern part where Pleistocene gravels prevail[20].

2.2.3.3 Beach Composition and Classification

The sandy stretches along the southern coast are patchy, the major sources of sand for these beaches being the sediments carried from adjacent beaches by longshore currents, the sediments produced as a result of the scouring of waves at the base of the alluvial fans, and the sediments carried by flash floods during the rainy season. These southern areas are also made up of a series of capes and embayment. The wide bays are generally located at the mouth of a wadi outlet separated by narrow capes. A wide reef flat commonly protects the sandy beaches offshore, while beaches lined offshore by patch reefs are made up of pebble to cobble size lag sediments.

Beachrock is exposed along most of the shoreline of Aqaba's southern stretch, forming 1–3m wide strips along the shoreline (Figure 5). They are cemented by calcium carbonate and the clasts are similar to the present-day loose beach sediments varying in size from millimeter scale to a few centimeters. Numerous uplifted fossil reefs are also unique to this southern part of the GoA and are exposed close to the southern shores of the Gulf. These Pleistocene reef features formed during sea level high stands and reached their present position as a result of sea level fluctuations and tectonic uplift[21].

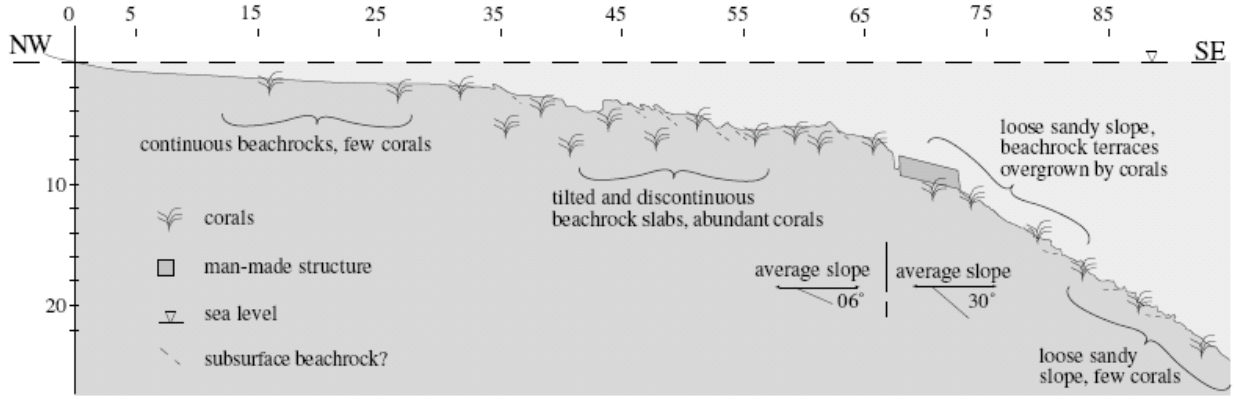


Figure 5: Indicative Aqaba cross section showing the transition from low angle slope of beach rock at shallow- depth to a high angle slope with outcropping beach rock slabs at greater depth[22].

With regard to beach, sediments found along the southern beaches in Aqaba are of two types:

1. Marine sediments ($CaCO_3$) derived from offshore;
2. Wadi or flood related siliciclastic (quartz) sediments derived from the hinterland.

Towards the northern boundary of the existing Aqaba Marine Park (South Beach area), the beach composition changes with finer grained materials being washed offshore, and larger stones and reef blocks making up a higher percentage of the beach intertidal area. The exposed beach-rocks

[20] UNDP, 2015
[21] Al-Rifaiy and Cherif, 1988
[22] Shaked et al 2002

that are seen along the southern beaches are found only where the overlying sediments have been removed by coastal erosion. It is clear that along southern beaches, there is a negligible sediment supply onto beaches, meaning that beach building sands are in small quantity and never likely to be in enough volume to enable attractive beaches for recreational purposes. Coupled with this, the lack of beach sand to cover the foreshore beach rock presents a serious safety and visitor hazard for bathers and swimmers.

2.2.4 Physical Oceanography

2.2.4.1 Sea Level

Sea level in the northern part of the GoA fluctuates during the year by up to one meter. The level is high from December through May through reduces during the period of July through October. The difference is reportedly due to the influence of monsoon winds in the Indian Ocean, which, in the winter results in a net flow of water from the Indian Ocean to the Red Sea and the GoA and vice versa in the summer months. Other factors that influence the tidal levels include real decrease of water volume due to intensive evaporation from the sea surface, and the variation of a positive component of water exchange through Bab el Mandeb and Suez Canal.

The maximum sea level range reference to global Mean Sea Level (MSL) during the year 2013 was 154.3 cm, where the highest value reported at 101.7 cm observed in December 12th, and the lowest value was -52.6 cm recorded on April 23rd. The sea level anomalies mostly depict a clear yearly cycle (Table 1), where the lowest monthly mean anomaly (5.0 cm) was in June. The highest monthly mean anomaly was 47.4 cm that occurred in November[23].

Table 1: Annual mean of the sea level (cm) at the northern GoA reference to Global Mean Sea Level (MSL) and to Multi-Annual Mean (MAM) for the years 2004-201324.

Annual mean of the sea Level (cm)			
year	Ref: Global MSL I	Ref: MAM2*	Differnece:1-2
2004	16.4	-10.4	26.8
2005	16.8	-10.1	26.9
2006	15.6	-14.4	29.0
2007	0.5	-27.9	28.4
2008	8.9	-19.8	28.7
2009	5.2	-23.3	28.5
2010	7.2	-21.5	28.7
2011	-11.7	-39.7	28.0
2012	4.1	-24.4	28.5
2013	16	-21.9	28.9

*: Multi - Annual mean (MAM) Was calculated for 10 years (2004 - 2013)

[23] National Monitoring Program 2013
[24] National Monitoring Program 2013

2.2.4.2 Exchange of Water

The GoA has a low rate exchange of water with the Red Sea due to the presence of narrow and shallow passage of Straits of Tiran[25]. Water residency time of water at the GoA can exceed two years in the upper depths of the Gulf and three years in the lower depths[26]. In terms of the southern shoreline section of Aqaba, longshore tidal currents are very small and occur in both easterly and westerly directions.

2.2.4.3 Waves

Waves are defined as the movement of water that occurs on the surface of water bodies, and they are usually created by winds which transfer energy to the water as they blow over. In the GoA, wind direction is the main driver of wave heights and directions in Aqaba, where the main winds are directed from north, and thus the predominant wave direction is from the north. In addition, the distance from the land upwind drives the heights of sea waves, or the fetch, generally increasing in height the further the wind blows from the land. During the winter months, wind generated waves and swell in the northern Red Sea, as far south as 20°N, are normally less than 2 m in height from the North-North-West, but occasionally reach heights of over 2 m. During the south-west monsoon period in the summer months, the situation within the proposed AMR area remains similar to these observations, with wind and swell waves from the north-north- west, generally less than 2 m in height[27].

2.2.4.4 Tides

Tides are defined as the rise and fall of water, or rather the difference between the crests and troughs, and is created as a result of gravitational attraction between the Earth, Moon and Sun and are often characterized by movements of water over extended periods of time. Very limited tides occurs at Aqaba with range of one meter or less occurs (locally known as “Azzyab”) [28][29], where semidiurnal tides occurs with two high and two low tides every 24 hours. Tides in the northern GoA showed a maximum sea level range of 1.42 m during 2004. The highest value reported was 0.94 m above MSL in November 2004 whereas the lowest was -0.48 m below MSL recorded in August 2004. Table 2 below illustrates the tidal characteristics at Aqaba ports.

Table 2: Tidal characteristics at the Aqaba Ports[30]

Datum	Elevation (LAT, Meters)
Highest Astronomical Tide (HAT)	1.5+
Mean high water springs	+1.10 (MHWS)
Mean low water springs	+.030 (MLWS)
Mean high water neaps (WHWN)	+0.90

[25] UNDP, 2015
[26] ISPAN, 1992
[27] UNDP 2015
[28] Al Tawaha et al. 2019
[29] UNDP, 2015
[30] ADC 2008/ National Imagery and Mapping Agency, 2002

Mean low water neaps (WHWN)	+0.50
Mean sea level (MSL)	+0.70
Lowest astronomical level tide (LAT)	+0.00

Of interest to this nomination file, low summer tides are noteworthy with respect to the thermal stress in inter-tidal/ shallow water corals. Extremely low tides occur in the upper GoA during which the reef flat and part of the shallow lagoon may be uncovered for up to 20 minutes each low tide over a maximum period of two days on rare occasions. Despite these extreme low tides, but most of the colonies are able to regenerate after exposure if parts of the living tissue remain intact on the skeleton[31].

2.2.4.5 Currents

Currents are defined as the large masses of water moving in a specific direction from one location to another, and they are usually measured in meters per second. The current at the northern GoA does have some consistent seasonal trends, although quite variable in direction. Southerly currents along the western coast are mostly observed throughout the year, with a short period (November-January) of northward flow and a reversal in early February, when the water column is vertically mixed, a clear onshore (westward) current is observed near the surface and a return (offshore) current over the bottom. This cross-shore pattern is consistent with a wind-driven Ekman circulation[32].

The currents within the proposed AMR area, are relatively weak (< 5 cms-1) and the dominant direction is southeast parallel to the predominant wind direction. Currents are stronger at the surface (average of 10.3 ± 9.0 cms-1 at 2 m depth) than at depth (at 4-26 m depth, the average speeds are 2.1 ± 1.4 cms-1). The average direction of the current recorded at 2 m and between 4-26 m depth is 246 ± 83°N and 153 ± 82°N, respectively. This indicates that the surface current is five times stronger than subsurface current and the current direction is generally parallel to the wind direction[33]. Due to the current directions, it makes the GoA vulnerable to the effects of pollution low rates of exchange, combined with high rate of evaporation mean that introduced pollutants can affect the Gulf for long periods of time[34].

2.2.5 Chemical Oceanography

2.2.5.1 Temperature

Sea surface temperatures in the GoA range from winter lows of 20.5°C (February) to highs in late summer (September) of over 27°C. During the summer months the Gulf is thermally stratified and a strong thermocline exists, with seawater temperatures below a depth of approximately 200 m remaining a constant 21.5°C. As sea surface temperatures fall in the winter, the thermocline collapses and mixing between the upper and lower layers of seawater occurs[35].

[31] Fishelson 1973
[32] Berman 2000; Genin & Paldor 1998
[33] UNDP 2015
[34] UNDP 2015
[35] UNDP 2015

2.2.5.2 Salinity

Salinity within the GoA ranges from 40.3 to 41.6 psu (practical salinity units) compared to an ocean's average salinity of 35 g/l. Vertical salinity differences are very small between 50-150 m. In general, the eastern side of the Gulf is less saline, most likely due to the influx of Red Sea[36]. The lack of regular freshwater input and the high evaporation rate contribute heavily to the particularly saline conditions within the Gulf.

At depths greater than 200 m within the deep basins, the salinity is remarkably homogeneous at 40.6‰, with the exception of the hot brines[37], which emerge from the sea floor in areas with an active seafloor rift and are characterized by very high salinity and high temperatures. It occurs at depths of more than 2,000 m where water temperatures can reach up to 60°C and salinity exceeds 300‰[38].

2.2.5.3 Dissolved Oxygen

Several factors affects the concentrations of dissolved oxygen (DO) in the Red Sea including the horizontal and vertical water circulation, water temperature, and salinity[39]. The dissolved oxygen levels are near saturation (i.e. 4.8–6.5 ml O2 L^{-1}) in surface waters in most of the Red Sea and Gulf of Aden[40]. DO is typically high in the northern Red Sea including the GoA, and its concentrations in surface waters are lower in summer than winter due to higher temperatures and salinity[41]. In the GoA there is a gradual decline with depth but never below 50% of oxygen saturation[42].

2.2.5.4 pH

pH is considered one of the most important parameters to measure seawater acidity. Records of pH appear to fluctuate around 8.3 with very minor variations, which is typical for all coral reef waters[43]. This is because these waters are always saturated with calcium carbonate, which acts as a buffer and resists any change in the pH.

2.2.5.5 Primary Productivity

The waters of the GoA are typical oceanic oligotrophic waters and are thus exceptionally clear. This high transparency is related in part to the absence of major rivers or streams flowing into the sea[44] meaning that the euphotic zone is deep, extending to 77–105 m in the GoA[45]. The input of terrigenous nutrients is therefore limited to sporadic dust events[46].

[36] ECO Consult 2006; UNDP, 2015
[37] Morcos 1970; Degens & Ross 1969
[38] SOCER 2015
[39] UNDP, 2015
[40] Sheppard et al. 1992; Quadfasel and Baudner 1993
[41] Poisson et al. 1984
[42] SOCER 2015
[43] MSS Data, 2010; Sorkin, 1995
[44] Al Tawaha et al. 2019
[45] Stambler 2005
[46] Sheppard et al. 1992

In winter season, nutrients concentrations in the whole water body of the GoA increased due to the mixing and stratification situations. At the beginning of summer conditions, light intensity increases, which enhances primary productivity and subsequently consumes the excess of nutrients which results from winter mixing condition. Therefore, during summer the concentrations of nutrients are generally very low. These recordings may be impacted upon by anthropogenic activities, which may increase nutrient concentration through either tourist or industrial interventions.

Primary productivity throughout the GoA is low, relative to other oceans, due to the thermocline preventing the recycling of nutrients from deeper water to the euphotic zone. Table 3 shows the seasonal spatial variation that is experienced throughout the GoA.

Table 3: Annual average primary productivity (g carbon m-2 d-1) in the Red Sea[47].

Location	Primary Productivity g carbon m-2 d-1
Gulf of Aqaba	0.2-0.9
Gulf of Suez	0.22
Northern Red Sea	0.21 - 0.50
Central Red Sea	0.39
Southern Red Sea	1.60
Gulf of Aqaba	1.60

Seasonal peaks of chlorophyll in the northern Gulf occur in spring over the period of February to May, when surface water concentrations reach 0.4 mg chlorophyll a m^{-3}. Significant primary production occurs at 200 m within the GoA due to high water transparency[48].

2.3 Biotic Characteristics

2.3.1 Biological Oceanography

2.3.1.1 Zooplankton

The distribution of zooplankton biomass within the GoA is fairly homogeneous. Generally, there are several environmental factors might disturb zooplankton production in the proposed AMR area directly and/or through other regions[49] such as;

1. Air pressure, which may affect zooplankton biomass as lower air;
2. Pressure, which can lead to a higher zooplankton biomass[50]. The disturbance of sea surface layer by low air pressure causes vertical mixing and subsequent nutrient enrichment;
3. Currents, which have different respective effects on zooplankton abundance and distributions within the proposed AMR area[51]. It is possible that the water is subject to a positive effect when it shifts northeastward.

[47] Sheppard et al. 1992
[48] Sheppard et al. 1992
[49] Aoki et al., 1999
[50] Tomosada and Odate, 1995
[51] ECO Consult, 2006

The zooplankton community > 150µm in the GoA holds the presence of 73 species included in 45 genera within 10 taxa namely; Tintinnidea, Foraminifera, Trachymedusea, Thecosomata, Cladocera, Ostracoda, Copepoda, Malacostraca, Chaetognatha and Urochordata. The most abundant zooplankton form is the holoplanktonic which constitutes 91.5%, and they are mainly Copepoda and Chaetognatha, which together comprise more than 90% of the total zooplankton. Copepods alone contribute numerically 87% of the total zooplankton abundance[52]. Most copepod species are epipelagic, with seven species found in the Gulf of Aqaba; which are *Paracalanus indicus, Calocalanus clausi, Phaenna spinifera, Clausocalanus ferrani, Calanua robstior, Euchirella messinensis, Candacia tenuimana,* and *Corycaeus subullatus*[53].

2.3.1.2 Chlorophyll

The concentration of chlorophyll is higher in winter season at the GoA, due to a number of reasons including deep water vertical mixing during winter in which deep water concentrations of different parameters in the offshore water come up to the surface. Increased nutrient concentrations in the euphotic zone enhance primary productivity resulting in higher phytoplankton abundance and increased chlorophyll a concentrations. In addition, water column stratification and high irradiance during summer result in a depletion of the inorganic nutrients in the upper waters by enhanced primary productivity at the subsurface level (50-75 m)[54].

The strong seasonal fluctuations in the waters of the GoA is associated with de-stratification cause a seasonal succession in the phytoplankton community that is more like temperate waters than tropical waters[55]. Chlorophyll a concentrations have been measured in water samples from 13 stations over the period of 2009-2013, where results showed Chlorophyll a concentration in green circles (Figure 6), and the difference in productivity between stations have been provided.

[52] Al-Najjar (2002)
[53] Al-Najjar (2002)
[54] Manasrah et al. 2004; Niemann et al. 2004; Badran et al. 2005; Rasheed et al. 2012
[55] Lindell & Post 1995; Post et al. 2002

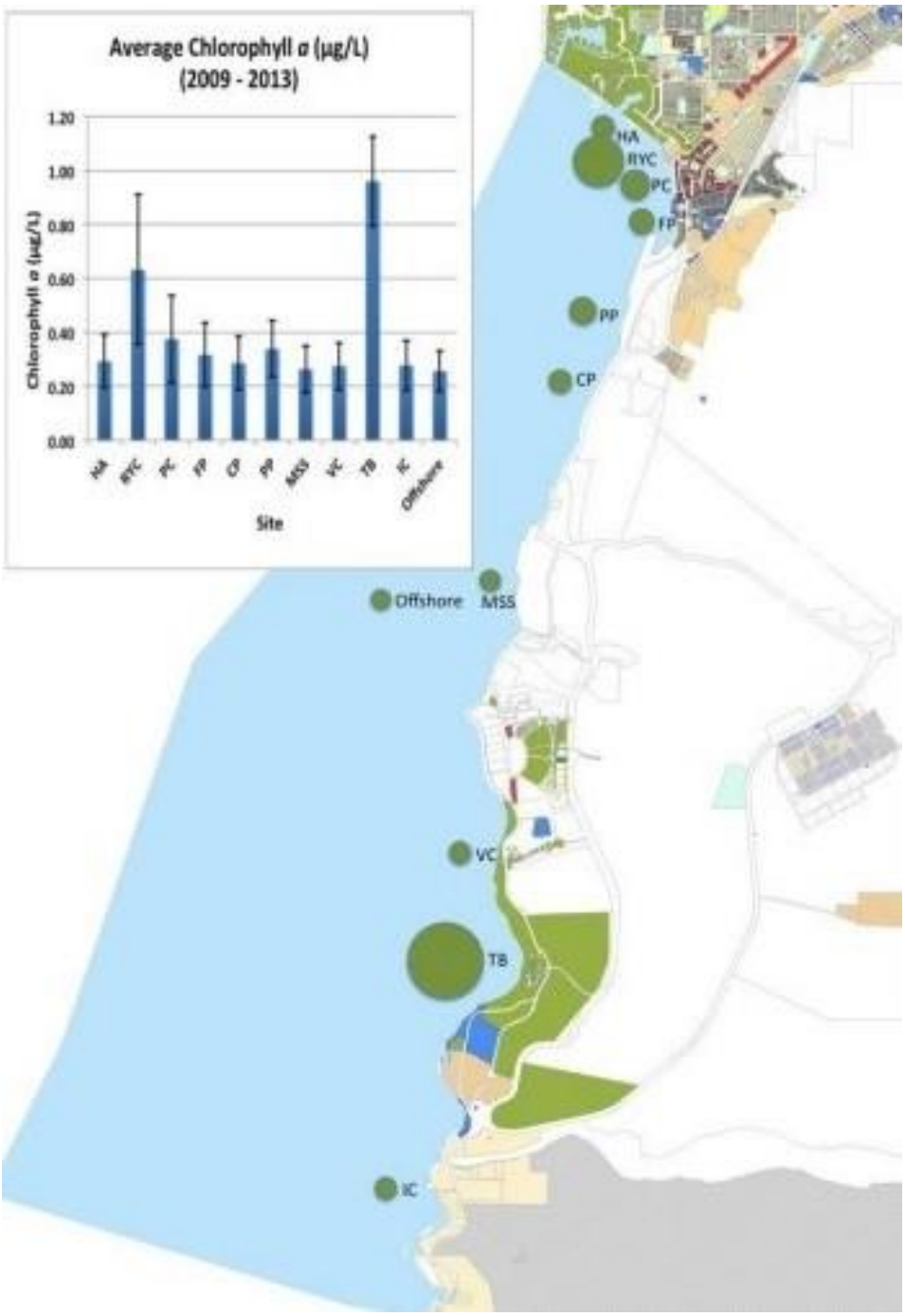


Figure 6: The average Chlorophyll a concentration (µg/L) over the years (2009-2013). It shows the range of Chlorophyll a between years. HA: Hotels area, RYC: Royal Yacht Centre, PC: Public Beach, FP: Fishers Port, CP: Clinker Port, PP: Passengers Port, MSS: Marine Science Station, VC: Visitor Centre, TB: Tala Bay, IC: Industrial Complex, Offshore: Offshore station (control station)[56].

[56] UNDP, 2015

2.3.1.3 Nutrients

Nutrients represented by nitrogen, phosphorous, and silica are utilized by phytoplankton for growth and reproduction. In the GoA, the nutrient is poor[57], due to the inflow of nutrient-rich waters. The concentrations of nitrogen in the GoA is low especially during summer with 1.0 µM[58]. The seasonal variations in silicate concentrations follow the variations in phosphate concentrations, where it is generally low during summer and high during the winter[59] (Figure 7). However, the concentrations of silicate at the MSS that represents the northern boundaries or the proposed AMR showed a high concentration during winter (~ 2.0 µM) and low values during summer (1.0 µM).

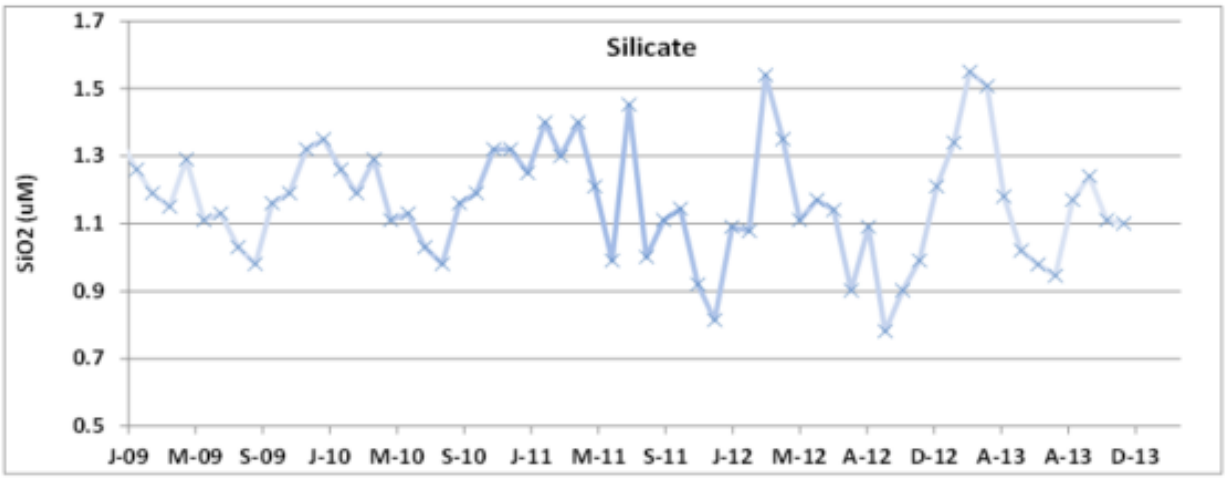


Figure 7: Time series of silicate concentrations (µM) from the coastal water in front of the Marine Science Station for the period January 2009- December 2013[60].

Loss of phosphate during shipments (transportation, storage, and loading along the GoA) has been a major concern since mid-1970s[61]. The lost phosphate particles tends to land around the storage areas, under the ship loader, near the berth, and to the sea, and is estimated between 0.05 and 0.1%[62]. The concentration of the dissolved inorganic phosphate range was between 0.02 to 0.2µM in the GoA[63]. Generally, the phosphate-phosphorous and other nutrients are generally higher in winter than in summer, since deep mixing dominates during winter[64]. The total phosphorous concentration in bottom sediments[65] is in the range between 87 to 460µg g^{-1}. The bottom sediments of the Jordanian coast waters contain 0.07% total phosphorous, 0.05% total nitrogen, and 0.35% organic matter as organic, and the phosphate concentration in the interstitial is about 50 times higher than those of the overlying waters[66].

[57] Sheppard et al. 1992
[58] Rasheed et al. 2002
[59] Rushdi 1996
[60] UNDP, 2015
[61] Rasheed et al. (2005)
[62] The Jordan Phosphate Mines Company
[63] Rasheed et al., 2002; Abu-Hilal et al., 2008
[64] Rasheed et al. (2003); Manasrah et al. (2006)
[65] MSS records, 1999
[66] Al-Rousan (1998)

The phosphate dust is leading to negative effects especially that increasing the suspended solid will decrease water clarity and light penetration, and will cause siltation on the coral reef and depression of coral growth[67]. In addition, phosphate particles will decrease the space available for new larval settlement, and enhance mucus production by coral which is an energy consuming process[68]. The raw phosphate (flouroapatite) does dissolve in the seawater and therefore it may contribute to the level of the inorganic phosphate nutrient in the ecosystem[69]. This is critical especially with having nearly three to four times higher phosphate level in the Phosphate Loading Berth area than that of the waters in the adjacent areas[70].

In order to solve the phosphate issue at the northern GoA, ASEZA has constructed, expanded, installed, tested, and operated a new phosphate terminal at the southern parts of the Jordan's GoA. The new Dry Bulk Jetty will be used for export and will be provided with Dust and Spillage Controls facilities[71].

2.3.2 Marine Ecosystems and Habitats

The following outlines the range of marine ecosystems and habitats that are associated with the proposed AMR area.

2.3.2.1 Sandy and Rocky Shores

The sand beaches along the southern coast of Aqaba are composed of coarse particles, originating from the disintegration and decomposition of terrestrial rocks, and varying amounts of calcareous, sand sized particles of biological origin[72]. The particles have been transported to the beach by water during flash floods in the wadis, where different amounts of calcareous, sand sized particles of biological origin, such as fragments of shells and coral, are also usually present [73]. In addition, the beach of the proposed AMR is characterized by the presence of rocky shores region on ancient coral reefs occurring now above the tidal limit (i.e. 'fossil reefs'), where coral sand has formed beach rock, and where coastal geological formations (e.g. lava flows) protrude into the sea[74]. The fossil reefs are derived from uplifting or they were formed during the early part of the Holocene when sea levels were up to 1 m higher than present[75].

2.3.2.2 Fossilized Reefs

The lower part of Aqaba's coral reef is divided into three steps, each representing a geological age millions of years old and includes fossilized animals that inhabited the marine area during the period. The upper part displays stone corals found in the reef today. Different types of shallow and deep corals are presented in this part. The somewhat well preserved "fossil" (or relic) coral reef present along the proposed AMRs southern shores is of great scientific importance. Therefore, the

[67] Abu-Hilal, 1999
[68] Te, 1992
[69] Abu-Hilal et al., 2008
[70] Abu-Hilal, 1985
[71] ADC 2014
[72] SOCER 2015
[73] UNDP, 2015
[74] UNDP, 2015
[75] Sheppard et al. 1992

protection of these features is of fundamental importance to protect Jordanian heritage because of the uniqueness of the area from a cultural point of view. Table 4 below lists the five distinct locations of fossilized reef in Aqaba.

Table 4: Locations of Relic Reef in Aqaba[76]

Locality A	**East of the Marine Science Station**
Locality B	600m from "Locality A", in the inner part of the wadi
Locality C	Opposite to the national campsite (1.5km from "locality A") characterized by morphological terraces due to the sea level fluctuations
Locality D	Opposite to the northern end of the big bay
Locality E	Opposite to the Royal Diving Center

2.3.2.3 Coral Reefs

The most significant feature of Jordan's marine environment is undoubtedly its coral reef ecosystems, and the associated corals species. These ecosystems cover a small area, estimated at four km^2 in total (including vertical and horizontal faces) though occur along about half of the country's short (27 km) coastline, and possess remarkably high diversity. Aqaba reefs also lie within this Red Sea biogeographic zone, which is designated as a World Wide Fund for Nature (WWF) "Global 200 Eco-Region" because of its unique marine biodiversity[77].

The Jordanian coastline is fringed by a discontinuous series of coral reefs over a length of 13 km, in which two morphological units can be distinguished: i) the reef flats and ii) the outer slopes[78]. The succession from the exclusively sedimentary head of a bay to the next headland as follows: i) scattered coral heads, ii) fragmented reef flat elements, iii) a continuous reef flat representing a narrow fringing reef and iv) a well-structured reef where a back reef channel develops[79]. The most remarkable characteristics of outer reef flats along the Jordanian coast is the vertical drop-off and the absence of spur and groove structures which are typical of most reef formations (Shinn, 1963; Stoddart, 1969). In addition, a continental shelf is absent in the GoA where the inclination of the outer slopes varies between 20-40 degrees and depths of several hundreds of meters are reached very rapidly. Generally, the fringing reef flat in the Jordanian part shows identical morphological characteristics represented by narrow reef flat and vertical drop-off.

With regard to the general distribution of corals along the coast, there is a trend of increasing hard coral cover from north to south towards the Saudi Arabian border. Also, the deeper water (>15m b.s.l) have more percent cover of healthy corals compared with the shallower water. This is attributed to the better protection from possible damaging factors, which affect the shallower reef corals. The rest of the items, for example sponge, clams, sea anemone, ascidians, algae and others, are less significant in terms of their distribution along the Jordanian coast of the GoA[80].

The GoA contains 157 identified hard coral species from which all have been confirmed within the boundaries of the proposed AMR. These species are composed of 153 scleractinian corals

[76] ECO Consult 2006
[77] Olson and Dinerstein. 2002
[78] Bouchon et al. 1981; Al Tawaha et al., 2019
[79] Bouchon et al. 1981
[80] Al Tawaha et al. 2019

(Anthozoa, Scleractinia), one organ pipe coral (Anthozoa, Alcyonacea), and 3 fire corals (Hydrozoa, Milleporidae). Scleractinian coral species found in this study belong to 15 families and 59 genera. Of the scleractinian corals, 147 are zooxanthellate (hosting the photosynthetic dinoflagellates of the family Symbiodinaceae) and six zooxanthellate. Fifteen scleractinian corals found and photographed during the field survey are currently known to occur exclusively in the Red Sea, and are hence considered Red Sea endemics[81].

In particular, 65% (No=15 species) of the 23 known Red Sea endemic coral species were found in Jordan (Table 5). Based on the collected data, 9.8% of the scleractinian corals recorded between 0 and 30m in Jordan in the present study are Red Sea endemics. It is noteworthy that 5 of the Red Sea endemics, namely *Pachyseris inattesa* Benzoni & Terraneo 2014, *Cyphastrea kausti* Bouwmeester & Benzoni 2015, *Cyphastrea magna* Benzoni & Arrigoni 2017, *Echinophyllia bulbosa Arrigoni*, Benzoni & Berumen 2016, and *Sclerophyllia margariticola* Klunzinger 1879 have been only recently described or resurrected thanks to the integrated systematics approach including morphological and genetic data coming from a reference collection assembled in Saudi Arabia[82].

Table 5: Red Sea endemic hard corals species recorded at GoA. IUCN international status as follows: VU: Vulnerable, NT: Near Threatened, LC: Least Concern, DD: Data Deficient, and NE: Not Evaluated

No.	Species name	Family name	IUCN Status	Exists at AMR	
				Yes	No
1	*Pachyseris inattesa*	Agariciidae	NE	√	
2	*Acropora maryae*	Acroporidae	DD	√	
3	*Acropora squarrosa*	Acroporidae	LC	√	
4	*Montipora hemispherica*	Acroporidae	DD	√	
5	*Cantharellus doederleini*	Fungiidae	LC	√	
6	*Echinophyllia bulbosa*	Lobophylliidae	NE	√	
7	*Oxypora convolute*	Lobophylliidae	DD	√	
8	*Sclerophyllia margariticola*	Lobophylliidae	NE	√	
9	*Cyphastrea hexasepta*	Merulinidae	VU	√	
10	*Cyphastrea kausti*	Merulinidae	NE	√	
11	*Cyphastrea magna*	Merulinidae	NE	√	
12	*Echinopora tiranensis*	Merulinidae	DD	√	
13	*Erythrastrea flabellate*	Merulinidae	NT	√	
14	*Merulina scheeri*	Merulinidae	LC	√	
15	*Stylophora mamillata*	Pocilloporidae	LC	√	

In addition, the proposed AMR holds the presence of 14 vulnerable species (threatened) according to the IUCN Red Lists, 30 Near Threatened (NT), five Data deficient (DD) and 41 Not Evaluated (NE) species. The remaining species, which constitutes 67 are Least Concern (LC) species. Table 6 below illustrates these species.

[81] Al Tawaha et al. 2019a
[82] Al Tawaha et al. 2019a

Table 6: Vulnerable and Near Threaded species recorded in the proposed AMR

No.	Species name	Family name	IUCN Status	
			VU	NT
1	*Turbinaria mesenterina*	Dendrophylliidae	√	
2	*Turbinaria reniformis*	Dendrophylliidae	√	
3	*Leptoseris incrustans*	Agariciidae	√	
4	*Leptoseris yabei*	Agariciidae	√	
5	*Pavona cactus*	Agariciidae	√	
6	*Pavona danai*	Agariciidae	√	
7	*Pavona decussata*	Agariciidae	√	
8	*Pavona venosa*	Agariciidae	√	
9	*Acropora anthocercis*	Acroporidae	√	
10	*Acropora pharaonis*	Acroporidae	√	
11	*Alveopora allingi*	Acroporidae	√	
12	*Montipora meandrina*	Acroporidae	√	
13	*Montipora stilosa*	Acroporidae	√	
14	*Cyphastrea hexasepta*	Merulinidae	√	
15	*Goniopora columna*	Poritidae		√
16	*Goniopora lobate*			√
17	*Goniopora minor*			√
18	*Acropora arabensis*	Acroporidae		√
19	*Acropora austere*			√
20	*Acropora digitifera*			√
21	*Acropora hyacinthus*			√
22	*Acropora nasuta*			√
23	*Acropora secale*			√
24	*Alveopora viridis*			√
25	*Montipora cryptus*			√
26	*Montipora efflorescens*			√
27	*Galaxea fascicularis*	Euphylliidae		√
28	*Fungia fungites*	Fungiidae		√
29	*Leptastrea bottae*	incertae sedis		√
30	*Leptastrea inaequalis*			√
31	*Plerogyra sinuosa*			√
32	*Cynarina lacrymalis*	Lobophylliidae		√
33	*Echinopora forskaliana*	Merulinidae		√
34	*Echinopora fruticulosa*			√
35	*Erythrastrea flabellata*			√
36	*Favites halicora*			√
37	*Favites vasta*			√
38	*Hydnophora exesa*			√
39	*Hydnophora microconos*			√
40	*Platygyra crosslandi*			√
41	*Platygyra lamellina*			√

42	*Trachyphyllia geoffroyi*			√
43	*Stylophora pistillata*	Pocilloporidae		√
44	*Tubipora musica*	Tubiporidae		√

Based on species diversity, coral coverage and rarity Index, the North First Bay, North Power Station, Marine Science Station, and King Abdullah Reef were found to contain the highest diversity of coral species[83]. From another point of view, Ras Al-Yamaniah (Eel gardens) showed the lowest species diversity (Figure 8).

[83] Al Tawaha et al. 2019a

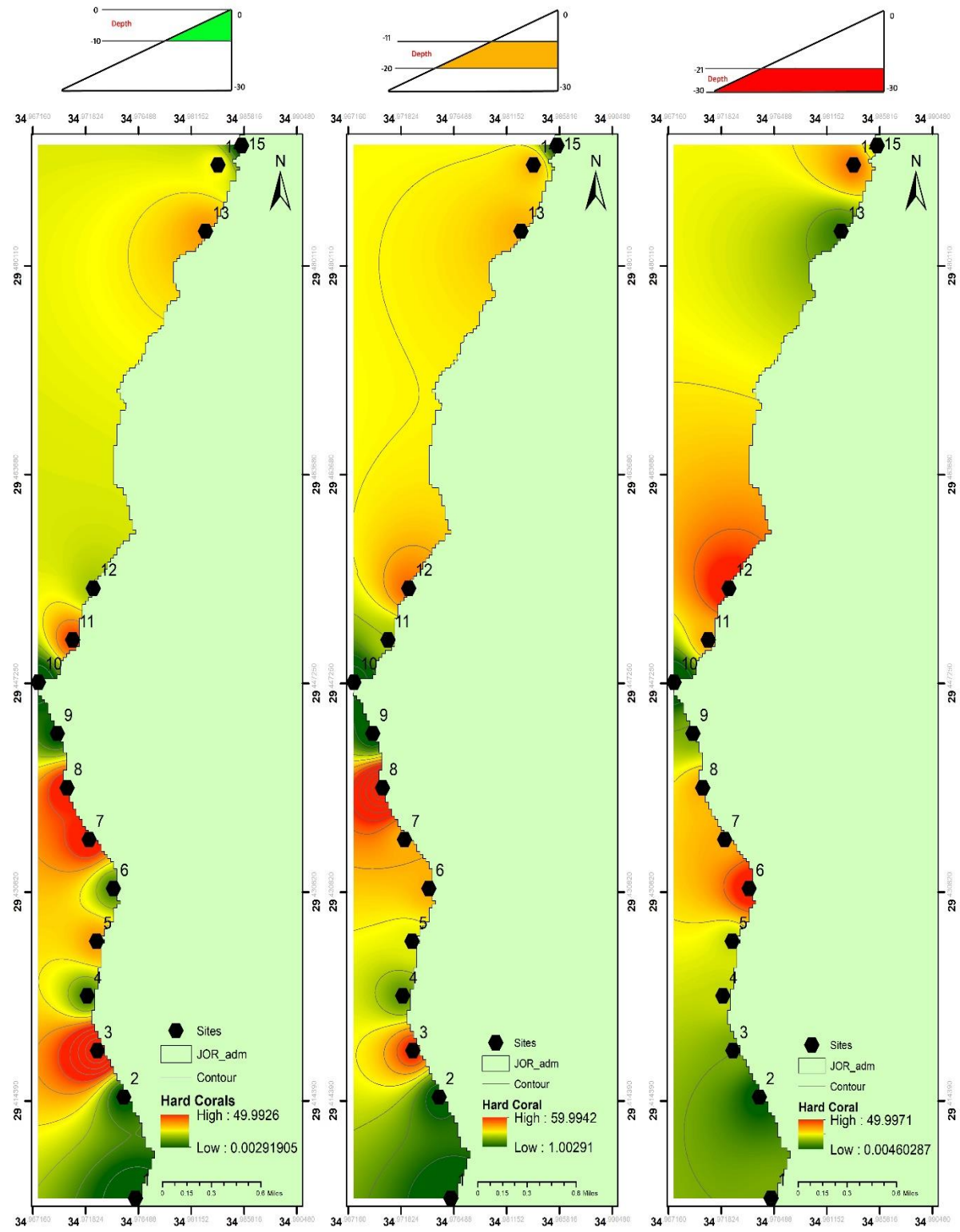


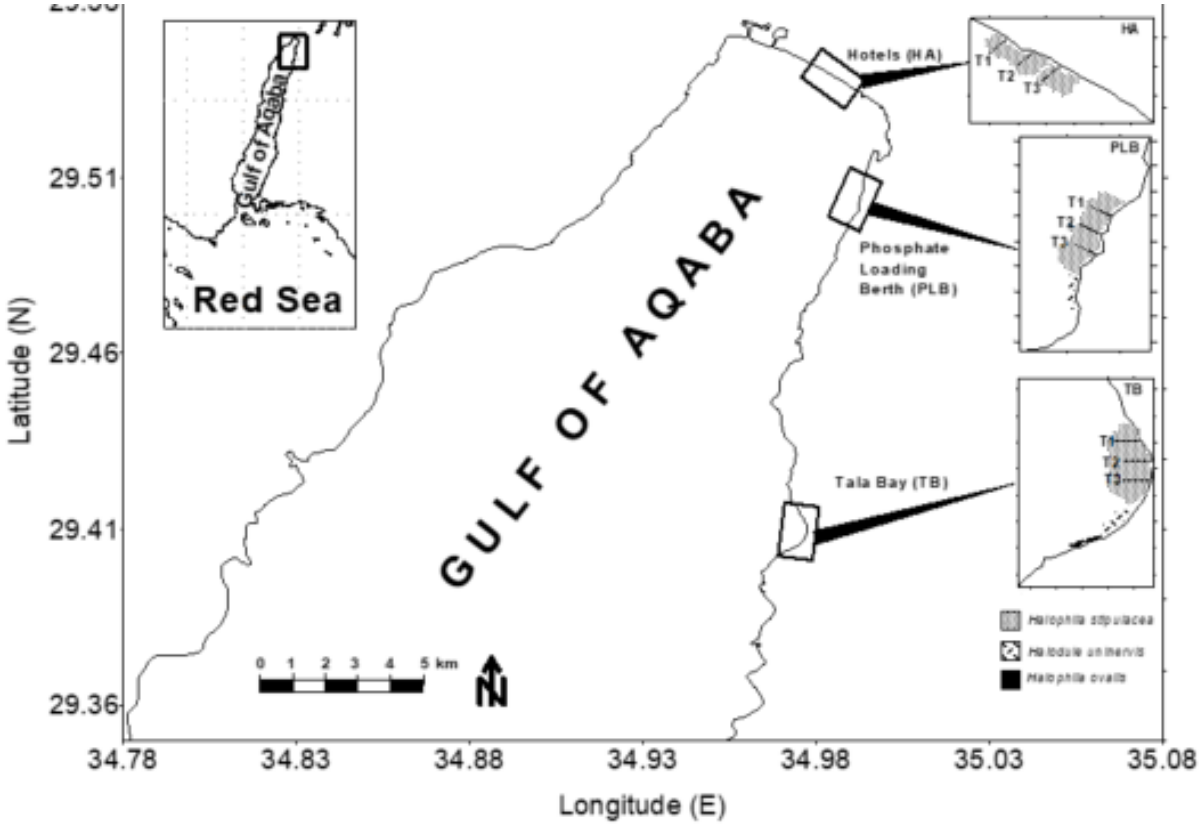
Figure 8: Hotspot areas for hard coral diversity (highest at sites 8: King Abdullah Reef, 11: North First Bay, 12: MSS, 15: North Power Station) and lowest at site No. 10: Ras Al-Yamaniah[84].

[84] Al Tawaha et al. 2019b

Despite the presence of a detailed survey on soft corals, but it is expected to have 120 species along the GoA of Jordan[85].

2.3.2.4 Seagrass Meadows

The seagrass stands along the proposed AMR are small in comparison with the magnitude of coral reef extent, and the greatest extent of seagrass beds are found at the Al-Mamlah Bay (Tala Bay) area (Map 2) which is located at the southern edges of the proposed AMR. The species richness and biodiversity nevertheless is very high with studies indicating the importance of conserving these meadows. The seagrass distributions increased with increasing depth up to 12 m, and thereafter decline.



Map 2: Location of occurrence of seagrass species and survey transects along the Jordanian coast[86]

Three species have been recorded in the proposed AMR, where the most common and distributed species is the *Halophila stipulacea*. The other two species *Halodule uninervis*, and *Halophila ovalis* are less abundant and only found at shallow depths within the vicinity of Tala Bay. Table 7 below illustrates the seagrass species recorded at the proposed AMR.

Table 7: seagrass species recorded at the proposed AMR[87]

Species name	Family name	IUCN Red List Status

[85] UNDP, 2015
[86] Al-Rousan et al., 2010
[87] Al-Rousan et al. 2005

Halophila stipulacea	Hydrocharitaceae	Least Concern
Halodule uninervis	Cymodoceaceae	
Halophila ovalis	Hydrocharitaceae	

Seagrass meadows provide appropriate habitats and shelter for many crustaceans and other invertebrates as well as providing a nursery and breeding ground for fish species. Fish assemblages and their relationship with sea grass meadows and coral reef habitats revealed a higher abundance of pisciverous fish in seagrass dominated areas over coral reefs[88].

The *Halophila stipulacea* is considered a prevalent species in the proposed AMR area, where its coverage varies and ranges from 35 to 55 percent coverage in more shallow waters between 0 and 10 m depth reducing to 20 to 40 percent in deeper waters from 11 to 30 m depth (Table 8).

Table 8: Seagrass species cover, distribution in two different depth within the proposed AMR[89]

Site	Seagrass cover %		Seagrass species
	Shallow (0-10 m)	Deep (11-30 m)	
1	45	35	*Halophila stipulacea*
2	50	40	*Halophila stipulacea*
3	45	35	*Halophila stipulacea*
6	35	20	*Halophila stipulacea*
9	50	35	*Halophila stipulacea*
10	55	40	*Halophila stipulacea*
11	55		*Halophila stipulacea, Halodule uninervis*

2.3.3 Marine Biodiversity

2.3.3.1 Macroalgae

The GoA holds the presence of eighteen genera of benthic macroalgae including seven chlorophytes, eleven Rhodophytes, and ten Phaeophytes[90]. The brown algae (Phaeophyceae) has the highest biomass and Mean Absolute Cover (MAC) within the proposed AMR area. Coastal waters adjacent to the industrial complex (further to the north of the proposed area) have the highest brown algae coverage and associate biomass, which is significantly different from those recordings observed close to the Phosphate loading port. The highest coverage appears to be evident during spring months. Occasionally, local Aqaba fishermen mix algae with fish pieces and flour to make a paste which is used as bait in fish traps. Table 9 shows the common macroalgae species recorded within the proposed AMR area.

Table 9: Common macroalgae species recorded in the AMR area.

Species name	**Family name**	**IUCN Red List Status**
Coulerpa serrulata	Caulerpaceae	Least Concern
Padina pavonia	Dictyotaceae	
Laurancia papillosa	Rhodomelaceae	
Ulva lactuca	Ulvaceae	

[88] UNDP, 2015
[89] Al Tawaha et al 2019b
[90] UNDP, 2015

Hydroclathrus clathrus	Scytosiphonaceae	
Centroceras clavulatum	Ceramiaceae	

2.3.3.2 Coral Turf Algae

The turf algae along the GoA coastline exhibits higher coverage within shallower depths (circa 8 m). Sites where turf algae and low living coral reef coverage occur within close proximity to heavy industrial developments, whereas the area adjacent to the public beach (inside the existing AMP, which prohibits fishing) is the site where least turf algae and live reef cover occurs[91]. Average turf algae coverage, in relation to the total reef area for all water depths is 28%, whilst bare dead coral to total reef proportion constitutes greater percentage (40%)[92]. This may indicate that the potential phase-shift from coral reef to turf algae is not yet incurable; but with intervention and suitable management action, its prevalence could be slowed, halted, or even reversed specially at sites in close proximity to anthropogenic influences such as construction activities and nutrient (i.e. Phosphorus and Nitrogen) over-enrichment[93].

2.3.3.4 Marine Fauna

2.3.3.4.1 Fish communities

The endemism in the Red Sea is high, with an estimated 25 species of fish that occur only in the Red Sea. This has reflected on the diversity of fish at the GoA, where a total of 507 in total belonging to 109 families were recorded so far, which constitutes 40% of the known, 280 fish species of the Red Sea. Eight families represented more than 41% of the recorded fish species at the gulf including Wrasse labridae (51 species), Pomacentridae (29 species), Serranidae (25 species), Apogonidae and Blenniidae (24 species for each), Gobbiidae (21 species), Carangidae (17 species) and Syngnanthidae (16 species). Seven species are recognized as endemic, and several are considered to be commercially important varieties. More than 50% of the species recorded in Jordan are coral reef dwelling species, which provides the richness at the proposed AMR area, due to its healthy coral reefs[94]. A first record for an extremely rare species was confirmed from 2 m depth at the seagrass meadow in Al-Mamlah Bay in the proposed AMR belongs to Sea Grass Wrasse *Novaculichthys macrolepidotus*, which was recorded for the first time in 2004[95]. Three introduced species to the GoA have been also recorded including *Sparus auratus, Dicentrarchus labrax*, and *Tilapia* sp. from the fish farm project which was established before in Eilat[96]. Table 10 shows the endemic fish species recorded in the AMR area.

Table 10: Endemic fish species recorded in the AMR[97]

Species name	Family name	IUCN Red List Status
Rhinobatos punctifer	Rhinobatidae	Near Threatened
Heteronarce bentuviai	Narcinidae	Data Deficient
Torpedo panthera	Torpenidae	Data Deficient

[91] UNDP, 2015
[92] SOCER 2015
[93] SOCER 2015
[94] Khalaf, 2004
[95] Khalaf, 2004
[96] Khalaf, 2004
[97] Khalaf, 2004

Pseudanthias heemstrai	Muraenidae	Not Evaluated
Chlidichthys rubiceps	Pseudochromidae	Least Concern
Pseudochromis dixurus	Pseudochromidae	Least Concern
Pseudochromis flavivertex	Pseudochromidae	Least Concern
Pseudochromis fridmani	Pseudochromidae	Least Concern
Pseudochromis olivaceus	Pseudochromidae	Least Concern
Pseudochromis springeri	Pseudochromidae	Least Concern
Cheilodipterus lachneri	Apogonidae	Not Evaluated
Gorgasia silneri	Congridae	Not Evaluated
Ophichthus echeloides	Ophichthidae	Not Evaluated
Physiculus marisrubri	Moridae	Not Evaluated
Caesio suevica	Caesionidae	Least Concern
Diplodus noct	Sparidae	Least Concern
Atrobucca geniae	Sciaenidae	Data Deficient
Parupeneus forsskali	Mullidae	Least Concern
Chaetodon fasciatus	Chaetodontidae	Least Concern
Chaetodon paucifasciatus	Chaetodontidae	Least Concern
Chaetodon semilarvatus	Chaetodontidae	Least Concern
Heniochus intermedus	Chaetodontidae	Not Evaluated
Amblyglyphidodon flavilatus	Pomacentridae	Least Concern
Amphiprion bicinctus	Pomacentridae	Least Concern
Chromis pelloura	Pomacentridae	Not Evaluated
Chromis trialpha	Pomacentridae	Not Evaluated
Pomacentrus albicaudatus	Pomacentridae	Not Evaluated
Cheilinus trilobatus	Labridae	Least Concern
Cirrhilabrus blatteus	Labridae	Least Concern
Cirrhilabrus rubriventralis	Labridae	Least Concern
Gomphosus caeruleus	Labridae	Least Concern
Larabicus quadrilineatus	Labridae	Data Deficient
Paracheilinus octotaenia	Labridae	Least Concern
Thalassoma rueppellii	Labridae	Least Concern
Calotomus viridescens	Scaridae	Least Concern
Chlorurus genazonatus	Scaridae	Least Concern
Scarus collana	Scaridae	Least Concern
Trichonotus nikii	Trichonotidae	Not Evaluated
Uranoscopus marisrubri	Uranoscopidae	Not Evaluated
Belenniella flaviumbrinus	Blenniidae	Not Evaluated
Ecsenius aroni	Blenniidae	Least Concern
Ecsenius frontalis	Blenniidae	Least Concern
Ecsenius gravieri	Blenniidae	Least Concern
Meiacanthus nigrolineatus	Blenniidae	Least Concern
Enneapterygius destai	Tripterygiidae	Least Concern
Ctenogobiops maculosus	Gobiidae	Least Concern
Acanthurus nigricans	Acanthuridae	Least Concern
Acanthurus sohal	Acanthuridae	Least Concern

Thyrsitoides marleyi	Gempylidae	Not Evaluated
Sufflamen albicaudatum	Balistidae	Not Evaluated
Arothron diadematus	Tetraodontidae	Least Concern
Canthigaster margaritata	Tetraodontidae	Least Concern

Three flagship species have been identified for the GoA including the the whale shark (*Rhincodon typus*), Reef stingray (*Taeniura lymma*), and the masked butterfly fish (*Chaetodon semilarvatus*)[98].

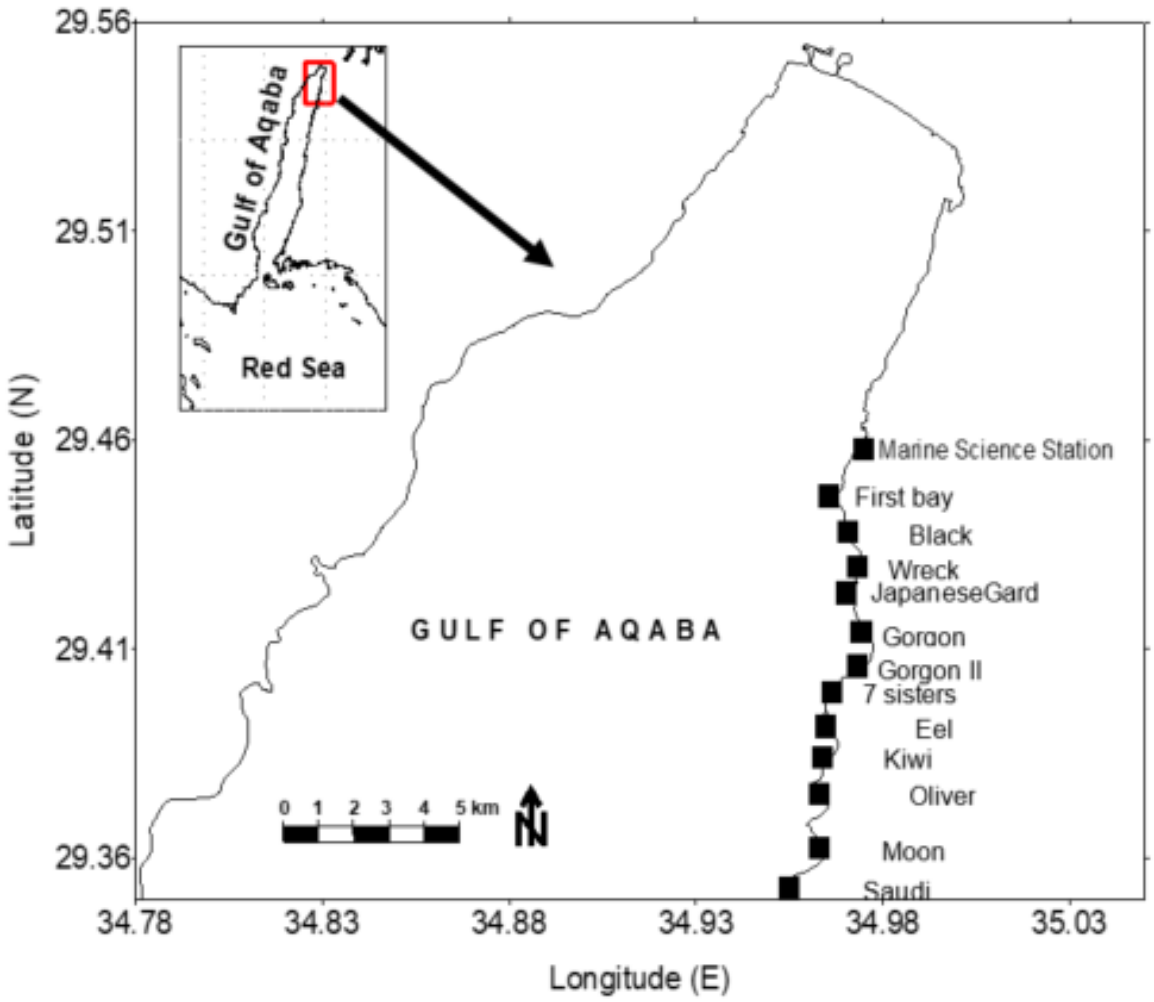
Around 70% of the Jordanian marine fish catch are species belong to the Scombridae family, which is considered of great importance commercially to Aqaba. Main species fished include migratory species such as *Katsuwonus pelamis* and *Euthynnus affinis*. Other important commercial fish species are *Decapterus macarellus, Decapterus macrosoma, Caesio lunaris, Caesio suevica* and *Caesio varilineata*[99].

Finally, the most abundant shallow water pelagic species are the silver side fish *Atherinomorous lacunosus*, and the clued fish, *Spratelloides gracias*. The most common inhabitant of deep sea fishes are *Ago amanuensis, Rhinobatos punctifer, Mureanesox cereus, Carangoides equal, Paracaesio sordid, Polysteganus coeruleopunctatus, Argyrops spicier, Upends davidaromi, Trichiurus lectures* and *Thyrsitoides marley*.

2.3.3.5 Sea Turtles

Three turtle species have been recorded at the Gulf of Aqaba, and a fourth is expected to be encountered which is the Endangered green turtle *Chelonia mydas*[100]. The loggerhead turtle *Caretta caretta* is a vulnerable species according to the IUCN Red List, and it has been recorded at Aqaba but this record is probably a migrant through the Suez Canal[101]. Although uncommon with few recorded, but the vulnerable leatherback turtle *Dermochelys coriacea* has been confirmed from the GoA water[102]. The most abundant and widely distributed species along the GoA and the proposed AMR is the hawksbill turtle *Eretmochelys coriacea*. The Black Rock location (towards Tala Bay) demonstrates the highest turtle population within the proposed Aqaba Marine Reserve area[103]. Map 3 below shows the eye-sighting records of the hawksbill turtle in the proposed AMR.

[98] Khalaf, 2004
[99] Khalaf, 2004
[100] Disi et al, 2001
[101] Disi et al, 2001
[102] Disi et al, 2001; Eid and Al Tawaha. Pers. Observation (2018)
[103] UNDP, 2015



Map 3: Turtle study sites (most popular recorded) in Jordanian waters[104].

Despite some reports which states that urban and industrial development affected the nesting of the hawksbill turtle at the GoA[105]. However, other reports indicated that no nesting have been reported from the Jordanian parts.

2.3.3.6 Marine Invertebrates

The coastal waters of the Jordanian GoA and its coral reef ecosystem hosts a plethora of marine fauna including hundreds of species of marine invertebrate (Table 11). Major groups of invertebrates occupying this zone include gastropod molluscs, rock oysters, barnacles, and chitons. Twenty percent of molluscs and Echinodermata as well as several species of algae occurring in the Gulf may be endemic.

Table 11: Total number of species and genera of invertebrate phyla recorded from the Jordanian side of the GoA[106].

[104] UNDP, 2015
[105] ECO Consult 2006
[106] UNDP, 2015

Group	Number of species	Number of genera
1. Sarcodina	58	54
2. Porifera	72	44
3. Cnidaria	237	101
a. Hydrozoa	24	21
b. Scyphozoa	3	3
c. Total Anthozoa	219	77
C1. Hard corals	158	51
c2 . Others	52	26
4. Nomatoda	242	129
5.Mollusca	645	300
a. gastropoda	479	207
b. polyplacophora	17	8
c. Bivalvia	162	82
d. Cephalopoda	2	2
e. Scaphopoda	2	1
6. Annelida	37	34
7.Crustacea	1202	131
8. Echinodermata	125	82
a. Asteroidea	21	17
d.Ophiuoidea	29	16
c.Echinoidea	29	25
d. Holothuroidea	32	11
e. Crinoidea	14	13

2.3.3.6.1 Giant Clams

Giant clams support a wide variety of reef dwelling vertebrates and invertebrates, and it is considered a significant species in the overall production of a healthy reef as it contributes in the foundation for reef growth and development. The preservation of both species of giant clam is therefore a necessity in sustaining marine biodiversity along the proposed AMR area.

A study on the distribution of the Giant lams *Tridacna maxima and T.squamosa* within Jordanian waters suggests that both species of clam are considered keystone species within a coral reef fulfilling a niche role within the community. Due to lack of abundance in Giant clams they can be considered endangered in Jordanian waters and require protection[107]. In addition, both species are considered of Lower Risk/conservation dependent species according to the IUCN Red List assessment.

2.3.3.6.2 Sponges

[107] UNDP 2015

Sponges of the phylum Porifera, are the most primitive of the multicellular animals. All members of the phylum are sessile and exhibit little detectable movement. Many sponges, like corals, contain symbiotic algal cells and are at least partly autotrophic. The number of Porifera species and genera reported from the Jordanian coasts of the GoA. There are 72 species of sponges known from the Jordanian coast of the GoA[108].

Several sponge species e.g. *Sigmosceptrella* and *Prianos* produce compounds that show great promise as a drug to combat malaria, tuberculosis and other infectious diseases. Many compounds extracted from sponges have also anti-viral, anti-neoplastic and anti-cancer properties. There are no reports, from Jordan, on the use of any species of sponges in any type of industries, production of chemical compounds, or for medicinal applications.

2.3.3.6.3 Cnidarians

These species represent limited areas of the Gulf of Aqaba, and the taxonomic validity of some species must be revised. The phylum includes three classes:

1. **Hydrozoa**: Hydrozoans display either the polypoid or the medusoid structure, and some species pass through both forms in their life cycle. Twenty-four hydrozoan species belonging to 21 genera were recorded from the Jordanian side of the Gulf of Aqaba. The most famous hydroid species is the fire coral or stinging coral (*Millepora exesa*).
2. **Scyphozoa**: Most frequently referred to as Jellyfish. In this class the medusa is the dominant and conspicuous individual in the life cycle; the polypoid form is restricted to a small larval stage. Only three species belonging to three genera were recorded from the Jordanian side of the Gulf of Aqaba.
3. **Anthozoa**: Anthozoans are either solitary or colonial polypoid cnidarians in which the medusoid stage is completely absent. This class includes the major constructors of tropical reefs, the scleractinian corals. Scleractinian corals live in symbiotic association with brown coloured dinoflagellates known as "zooxanthellae".

2.3.3.6.3 Gastropods

Out of 950 species of molluscs occurring in the whole Red Sea basin, 645 species are recorded from the GoA inhabiting fringing reefs (reef flats, Millepora fringing reefs, fringing reefs with massive corals) and fore-reef hard substrata (coral patches, coral carpets and small patch reefs). The phylum mollusca is represented by five classes in the Jordanian coastlines of the GoA, including[109]:

1. **Gastropoda** is represented by 462 species, which equals about 71 % of the phylum;
2. **Bivalvia** or **Lamellibranchia** is represented by 162 species, which equals about 25% of the phylum;
3. **Polyplachophora** is represented by 17 species, which equals about 2.6% of the phylum;
4. **Cephalopoda** is represented by 2 species only, which equals about 0.3% of the phylum;
5. **Scaphopoda** is represented by 2 species only, which equals about 0.3% of the phylum.

[108] Al-Sabi', 2000
[109] SOCER 2015

The most important molluscs in the assemblage were the parasitic gastropod *Coralliophila neritoidea*, the encrusting gastropod *Dendropoma maxima* and the coral-associated bivalve *Pedum spondyloideum*[110].

2.3.3.6.4 Chaetognatha

Four common species of Chaetognatha (arrow worms) representing two genera were recorded in the Jordanian side of GoA including *Sagitta enflata*, *Sagitta hexaptera*, *Sagitta pacifica* and *Spadella* sp.

2.3.3.6.5 Urochordata

Adult urochordates are commonly known as tunicates and a total of 20 species have been recorded from the Jordanian side of the GoA divided into three classes which are: Ascidiacea (6 species), Larvacea (8 species), and Thaliacea (6 species)[111].

2.3.3.6.7 Macro, Micro and Meiofauna

The animals living in the intertidal sand are divided into three groups based on size; the largest includes the macro fauna, which displace the sand surrounding them by digging and burrowing; the meiofauna, or interstitial fauna, generally occupy the interstitial spaces between the grains; and the micro fauna, which are usually one-celled animals.

Table 12 shows the occurrence of the major species of molluscs and crustaceans in the supra-littoral fringe and mid-littoral zones of the rocky intertidal along the proposed AMR area. The table shows the type of substratum on which the species occur in greatest abundance. To be noted (within the table) is the range of three species, *Acanthopleura gemmata*, *Cellana radiata* and *Nerita sanguinolenta*, in middle and lower midlittoral. Among the fauna of the rocky intertidal zone are those that are sedentary or permanently attached to the substratum, and those that are free and mobile. In the former group are those that cement themselves substratum and include the giant barnacle *Tetraclita squamosa rufotincta*, the smaller barnacle *Tetrachthamalus oblitteratus* and the oyster *Ostrea forskali*. The mussel *Brachidontes variabilis* and the clam *Isognomon cf. recognittis* attach themselves to the substratum by byssus threads. The mussel occurs in cracks and depressions on slab, while the clam can be found in crevices and on the underside of pebbles.

Table 12: Vertical zonation and the most abundant substrate occurrence of the dominant rocky intertidal molluscs and crustaceans in the Jordan GoA. Abbreviations in parentheses refer to substrate: S = slab; B = boulders; P = pebbles[112].

Supralittoral Fringe
Nodilittorina subnodosa (Philippi, 1847) (S) *Nodilittorina millegrana* (Philippi, 1848) (B) *Ligia exotica* Roux, 1828 (P)
Supralittoral Fringe-Midlittoral (Upper)

[110] Zuschin and Stachowitsch 2007
[111] SOCER 2015
[112] After Hulings and Wahbeh 1988

Littorina scabra scabra (Linnaeus, 1758) (B)		
Midlittoral		
Upper	Middle	Lower
Celiana radiata (Born, 1778) (B, S) *Clypeomorus moniliferum* (Kiener, 1841) (P) *Monodonta dama* (Philippi, 1848) (P, B, S) *Nerita polka orbignyana* (Recluz, 1842) (P) *Nerita quadricolor* (Gmelin, 1791) (B) *Planaxis sulcatus* (Bom, 1780) (P, S)	*Acanthopleura gemmata* (Blainville, 1825) (S) *Brachidontes variabilis* (Krauss, 1848) (S) *Cerithium caeruleum* (Sowerby, 1855) (S) *Clibanarius signatus* (Heller, 1861) (S) *Clypeomorus tuberculatum* (Linnaeus, 1758) (S) *Grapsus albolineatus* (Lamarck, 1818) (B) *Grapsus granulosus* (H. Milne Edwards, 1853) (S) *Grapsus tenuicrustatus* (Herbst, 1783) (B) *Isognomon cf. recognitus* (Mabille, 1895) (S, P) *Nerita sanguinolenta* (Menke, 1829) (P, S) *Ostrea forskali* (Chemnitz, 1795) (S, B) *Peasiella cf. isseli* (Semper, 1867) (S) *Plagusia tuberculata* (Lamarck, 1818) (B) *Siphonaria laciniosa* (Linnaeus, 1758) (S) *Tetrachthamalus oblitteratus* (Newman, 1967) (S, P) *Tetraclita squamosa rufotincta* (Pilsbry, 1916) (S, B) *Thais hippocastanum* (Linnaeus, 1758) (S)	*Acanthopleura gemmata* (S) *Cellana radiata* (S) *Nerita sanguinolenta* (S)

The mobile forms are represented by the chiton *Acanthopleura gemmata*, the patellid limpet *Cellana radiata* and the pulmonate limpet *Siphonaria laciniosa*. Other mobile gastropods include the nerites, *Nerita sanguinolenta*, and *N. polita orbignyana*; the littorinids *Nodilittorina* sub-*nodosa*; and *N. millegrana*; the ceriths *Cerithium caeruleum*, *Clypeornorus moniliferum* and *C. tuberculatum*; the trochid *Monodonta dama*; the smallest gastropod *Peasiella cf. isseli*; the black *Planaxis sulcatus*; and the rock shell *Thais hippocastanum* gastropods, *Nerita quadricolor* and *Littorina scabra scabra*, are very rare along the coast of Jordan and are, and unlikely to be

observed. The mobile crustaceans occurring in the rocky intertidal include the isopode *Ligia exotica* and the amphibious grapsoid crabs *Grapsus granulosus, G. albolineatus, G. tenuicrustatus* and *Plagusia tuberculata*. *G. granulosus* is the most abundant, inhabiting in the upper and mid midlittoral on slab where refuges are available. The other grapsoids are characteristic of the mid midlittoral boulder habitats, with *G. albolineatus* being the most common.

The sympatric species of gastropods living in the rocky intertidal zone include the supralittoral fringe *Nodilittorina subnodosa* and *N. millegrana*, the midlittoral *Nerita sanguinolenta, N. polita orbignyana* and *N. quadricolor*; and *Clypeamoms moniliferum* and *C. tuberculatum*. Among the rocky intertidal crustaceans, sympatric species include those of the crab Grapsus, *G. albolineatus*, *G. granulosus* and *G. tenuicrustatus*. There are varying degrees of spatial and reproductive isolation within the sympatric species that prevent interbreeding. The occurrence of so many sympatric species in the rocky and sand beach (*Hippa celaeno* and *H. picta*) intertidal zone of Jordan is unusual when compared with other geographic areas.

Other components of the rocky intertidal fauna that can be seen at low tide are groups of shells in various positions. Throughout the cooler part of the year, these are commonly seen on top of slab whereas, during the warmer period, they are under stones. Ten represents fishes in the rocky intertidal zone or so species along the coast of Jordan, some of which are amphibious. An example of the latter is the comical, leaping blenny *Alticus kirkii magnusi*[113] which can be seen on boulders. Though it is well adapted for life out of water, it remains close proximity to the water level or sprays from breaking waves and follows the flooding and ebbing tide levels. Another common intertidal species is *Antennablennius hypenetes* (Klunzinger, 1871) which can be seen on submerged slab. Unlike the previous species, it does' not leave the aqueous medium. Both species feed on algae.

Components of the flora that can be seen in the rocky intertidal zone include large or macroalgae. Particularly notable are the green algae, including the leafy *Ulva lactuca* (Linnaeus) Le Jolis and the thread-like or filamentous *Enteroinorpha cornpressa* (Linnaeus) Grev. Brown algae, such the sac-like *Colpornenia sinuosa* (Mert.) *Derbes et solier*, and the fan-shaped *Padina pavonia* (Linnaeus) Gaillon, can also be seen. Common red algae include *Galaxura Iapidescens* (Sol.) Lamour, and the filamentous *Erythrotrichia* sp.

The meiofauna includes representatives of most of the major animal groups, as well as some groups that are restricted entirely to the interstitial habitat. Hulings (1975) characterized the sand beach meiofaunal community in Jordan as dominated by harpacticoid copepods with turbellarians, nematodes, archiannelids, polychaetes and ostracods as being significant component. Other taxa reported included cnidarians, gastrotrichs, oligochaetes, mollusks, halacarids and tardigrades. The major groups of meiofauna include threadworms called nematodes and shrimp-like benthic copepods called harpacticoids.

The microfauna possess numerous hair-like cilia and, for one-celled organisms, have evolved into an extremely diverse group in terms of shape and structure. There is also a wide variety of feeding habits among the ciliates including those that are herbivorous, carnivorous, bactivorous and omnivorous.

[113] Klausewitz, 1964

2.3.4 Terrestrial Ecosystems, Habitats and Biodiversity

2.3.4.1 Biogeographical Affinity

Jordan contains four bio-geographical zones, namely the Mediterranean, Irano- Turanian, Sudanian and Saharo-Arabian zones. The Aqaba Marine Park is located within Jordan's Sudanian Penetration Zone, which is characterized by having warm winters and very hot summers, where the temperature ranges from 15-45°C. It is also unique in having the lowest point on earth where it reaches about -400 m at the Dead Sea level. The rainfall ranges from 50-100 mm/year and the soil is mostly alluvial, saline, sandy (or sand dunes), hammada, some granite fragments and Lisan marls (Al Eisawi, 1996).

2.3.4.2 Vegetation types

Acacia and Sudanian rocky vegetation type is located at the western parts of Jordan extending from Al Karamah in the north until Aqaba in the south and constitutes 2,621.44Km^2. The marine reserve terrestrial side is situated within, where it is characterized by hilly ground covered with hammada soil type; the leading plant species are *Acacia raddiana* and *Acacia tortilis*, which can be found at the eastern parts that are adjacent to the marine reserve (Al Eisawi, 1996).

2.3.4.3 Habitats

The proposed AMR contains several habitats, that formulate the terrestrial section and as follows:

2.3.4.3.1 Alluvial Fans

The mainly lie east west, where several shallow wadi systems flow in the fans, and represent good examples of specific terrestrial ecosystems. These are important for acacia trees and other Afro-Subtropical flora and fauna. These fans can be subdivided into the following sub-habitats:

1. **Wadi systems**: Several wadis flow east west, but their water flow is seasonal. Flora and fauna species have adapted themselves to such conditions and are very specific to these habitats. True subtropical trees growing in such habitats are the *Acacia*, *Tamarix*, *Ziziphus* and *Haloxylon*. Typical fauna associated with wadis include desert rodents such as the gerboa, spiny mouse, jerds, as well as common reptiles such as agamas and lizards, the wild cat, and foxes. These wadis exist to the east of Aqaba town and are not found at the property site.
2. **Fringing Granite Mountains**: Whilst not directly within the proposed AMR, the geology of such mountains has created a special soil and edaphic condition, which could be classified as a unique habitat for Jordan. The pristine Granite Mountains of Aqaba still maintain important flora and fauna. These mountains are breeding sites for many resident and migratory globally, regionally and locally threatened birds, particularly for raptors.

2.3.4.4 Terrestrial Flora

The terrestrial part of the proposed AMR is weakly covered with vegetation; however, the flora that can be observed is confined to some shrubs and saline plants such as *Zygophyllum dumosum*, *Anabasis articulate*, *Juncus mariümus* and *Fagonia* spp. However, a detailed study is required to confirm and produce a list of flora species that exist in the existing AMP and its adjacent areas. The following (Table 13) represents the flora species that are common at the Acacia and Sudanian rocky vegetation that contains the adjacent areas of the proposed AMR.

Table 13: terrestrial flora species survive within the proposed AMR and its adjacent areas

Species name	Family name	IUCN Red List Status	Present at AMR	
			Within	Adjacent
Acacia raddiana	Fabaceae	Not Evaluated		√
Acacia tortilis	Fabaceae	Least Concern		√
Anabasis articulata	Amaranthaceae	Not Evaluated	√	√
Hammada scoparia	Amaranthaceae	Not Evaluated	√	√
Cassia italica	Fabaceae	Not Evaluated	√	√
Zygophyllum dumosum	Zygophyllaceae	Not Evaluated	√	√
Caralluma spp.	Apocynaceae	Not Evaluated	√	√
Fagonia spp.	Zygophyllaceae	Not Evaluated	√	√
Reaumuria hirtella	Tamaricaceae	Not Evaluated	√	√
Gymnocarpos decandrus	Caryophyllaceae	Not Evaluated	√	√
Helianthemum lippii	Cistaceae	Not Evaluated	√	√
Asteriscus graveolens	Asteraceae	Not Evaluated	√	√
Sclerocephalus arabicus	Caryophyllaceae	Not Evaluated	√	√
Anastatica hierochuntica	Brassicaceae	Not Evaluated	√	√
Capparis spinosa	Capparaceae	Least Concern	√	√

2.3.4.5 Terrestrial Fauna

2.3.4.5.1 Mammals

A single common species to Jordan has been recorded in the proposed AMR which is the red fox; *Vulpes vulpes*. In addition, the feral dogs *Canis familiaris* can be encountered frequently in the area. However, the areas adjacent to the AMR area hold the presence of eight mammalian species that belongs to three families and according to Table 14 below:

Table 14: Mammalian species survive within the proposed AMR and its adjacent areas

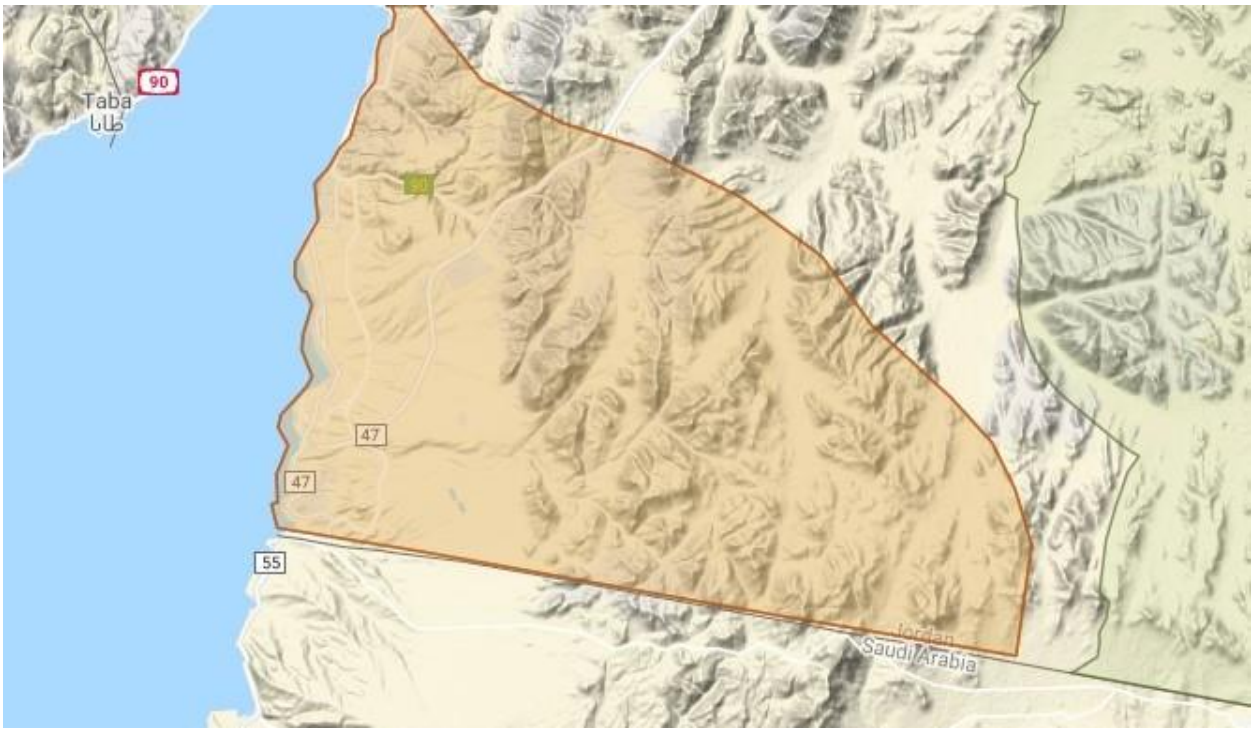
Species name	Family name	IUCN Red List Status[114]	Present at AMR	
			Within	Adjacent
Rousettus aegyptiacus	Pteropodidae	Near Threatened		√
Tadarida teniotis	Molossidae	Least Concern	√	√
Pipistrellus kuhli	Vespertilionidae	Least Concern	√	√
Acomys dimidiatus	Muridae	Least Concern	√	√
Dipodillus dasyurus	Gerbillinae	Least Concern	√	√
Gerbillus gerbillus	Gerbillinae	Least Concern		√

[114] Eid et al. 2020

Meriones crassus	Gerbillinae	Least Concern		√
Vulpes vulpes	Canidae	Least Concern	√	√

2.3.4.5.2 Birds

The GoA is considered a major bird migration route that connects Europe and Asia with the African continent (Eid and Qaneer, 2013). This route hosts around 250 different species, and up to 1.5 million birds flying over it. Therefore, Aqaba coast and surrounding mountains have been declared as an Important Bird Area (IBA), where the area of the proposed AMR is situated within (Map 4).



Map 4: Aqaba coast and surrounding mountains IBAs

This declaration as an IBA provides that the site contains a migratory bottleneck site also holding a breeding bird community representative of the Rift Valley. The enormous spring passage of raptors such as *Buteo buteo* and *Accipiter brevipes* has added a value to consider this site as an IBA. Generally raptors cross the Rift Valley into Jordan further north up Wadi Araba, but spring passage at Aqaba undoubtedly exceeds 50,000 raptors per season. Other spring migrants occurring in good numbers include *Nycticorax nycticorax, Ardea cinerea, Sterna hirundo, Chlidonias leucopterus, Sylvia curruca, S. atricapilla, Passer hispaniolensis* and *Emberiza hortulana*. *Falco pelegrinoides* and *Corvus rhipidurus* are resident and the town has a small population of *Corvus splendens*[115].

The important bird's species which could be observed in the proposed AMR is the endemic White-eyed Gull *Ichthyaetus leucophthalmus* to the Red Sea and is a resident in the region. Another

[115] Available at http://datazone.birdlife.org/site/factsheet/8202

species that they might consider especially if any rehabilitation program is planned for the coastline is the Western Reef Heron *Egretta gularis* which was known to breed before. In addition, some tern species can be observed such as the Common Tern *Sterna hirundo* and Little Tern *Sternula albifrons*.

2.3.4.5.3 Reptiles

Very low diversity of reptiles exist in Jordan, with eight recorded animals from which three have been observed in the proposed AMR area. Table 15 illustrates the reptilian species that survive within the proposed AMR area and its adjacent localities.

Table 15: Reptilian species survive within the proposed AMR and its adjacent areas

Species name	**Family name**	**IUCN Red List Status**[116]	**Present at the proposed AMR**	
			Within	**Adjacent**
Cyrtopodion scabrum	Gekkonidae	Least Concern	√	√
Hemidactylus turcicus	Gekkonidae	Least Concern	√	√
Ptyodactylus guttatus	Gekkonidae	Least Concern		√
Ptyodactylus hasselquistii	Gekkonidae	Least Concern		√
Laudakia stellio	Agamidae	Least Concern		√
Uromastyx aegyptia	Agamidae	Vulnerable		√
Spalerosophis diadema	Colubridae	Least Concern	√	√
Echis coloratus	Viperidae	Least Concern		√

[116] Eid et al. 2020

Part Three: Social Characteristics

3.1 Population Data

3.1.1 Demographics

The city of Aqaba contains a traditional, conservative society with a comparatively small population. The population of Aqaba's was around 208,000 persons by the end of 2019 which represents 2% of the total population. This represents a population density of 30.1 based on the 6,905km^2 recorded for the Governorate. Males consist around (117,600) of this number whilst females are around (90,400). Youth numbers (between the ages 15-65) of both gender represent more than 60% of this total[117].

The population of Aqaba ranges mainly from age 15 to age 65+ with 63% of those who are below thirty years old. A small percentage of 14% are older than 45 years or older. Since the majority of the Aqaba population is young, more employment opportunities will be required in the near future. Poverty rates in Aqaba are amongst the lowest in the country with around (11%)[118].

3.1.2 Employment and Unemployment at Aqaba

Aqaba's employment rate was recorded as being 6.9 percent in 2018. The main employment activities in Aqaba revolve around business associated with the ports, shipping and the associated land transportation, power generation, manufacturing, fertilizer production, tourism, and commercial fishing. Although industrial employment in Aqaba has fluctuated substantially in recent years, it has tended to increase between 2009 and 2018 ending at 4.9 percent in 2018. Aqaba female economic activity rate was recorded at 12.4 % in 2018, down from 14.6 % previous year. In 2018, the female employment rate was at level of 93.1 percent, down from 100 percent previous year. Aqabas' male economic activity rate was at level of 66.9 % in 2017, down from 71.4 % previous year. In 2017, male employment rate was at level of 10 percent in 2018, unchanged from the previous year.

In 2018, employment in services for Aqaba was -25.3 percent. Though Aqaba employment in services fluctuated substantially in recent years, it tended to decrease through 2009 - 2018 period ending at -25.3 percent in 2018. In 2017, public sector jobs for Aqaba was 528.4 number of vacancies. Public sector jobs of Aqaba increased from -163.6 number of vacancies in 2010 to 528.4 number of vacancies in 2017 growing at an average annual rate of 39.09%. Aqaba private sector jobs was at level of 284 number of vacancies in 2017, down from 682 number of vacancies in 2015, this is a change of 58.35%.

The unemployment rate for the second quarter of 2020 has reached (23.0%) during the second quarter of 2020; representing an increase by 3.8 percentage points of the second quarter 2019. Unemployment in Aqaba Governorate (for 2019) is 6,129 persons, where unemployment amongst women is 1,536 and amongst men is 4,592[119].

[117] Department of Statistics, 2019
[118] Aqaba Ecotourism Development Plan 2014
[119] Department of Statistics, 2019

3.1.3 Women's Participation in the Local Economy

Similar to many parts of Jordan, the cultural norms and traditions as well as the early exit of women from labour force to start a family, led women to have a low to very low participation rate in income earning activities in the ASEZ region in general. The lack of suitable job opportunities for women and the discrimination against female job applicants are other important factors contributing to the comparatively high unemployment rate of women. As a result, many young women stay at home without any professional occupation despite a frequently high level of education and the desire to work. However, women are working in the following sectors at the Aqaba region:

1. **Touristic Sector**: in the sector women are working in areas where they have no or only indirect contact with tourists such as in handicraft or jewellery production.
2. **Public service sector**: within this sector, the jobs managed by the women include working in the governmental agencies and the educational sector as teachers and administrative staff at the female's schools.

3.2 Culture and Community

3.2.1 Cultural and History

Owing to Aqaba's location on a major trading route, Aqabawis are a unique mixture of Bedouin, Hijazi (of Arabian Peninsula), Egyptian and Levantine origins. They hold dearly to the customs for which Arabs are known; pride and hospitality.

The early days of the Islamic era saw the construction of the city of Ayla. The ruins of Ayla, unearthed in the mid-1980s by an American-Jordanian archaeological team, are a few minutes' walk north along the main waterfront road. By 1170, Salahuddin conquered Aqaba. The Mamluks took over in 1250, but by the beginning of the sixth century, it had been overtaken by the Ottoman Empire. The city then declined in status and for 400 years or so it remained a simple fishing village (Aqaba Ecotourism Development Plan 2014).

Until the 1960s, the GoA was relatively undeveloped, with sparsely populated coastline mostly by Jordanians in search for better job opportunities. More recently, in 1965, King Hussein traded 6000 Km^2 of Jordanian desert with Saudi Arabia for another 12 kilometers of prime coastline to the south of Aqaba.

3.2.2 Archaeological Resources

Archaeologists who have worked extensively in Aqaba believe that civilizations were built or established in safe and secure areas. Hence, there is little potential of having surface archaeological sites on flood plains and alluvial fan of Wadi Araba or the proposed development area. Such a location renders them at risk of being directly in the way of flash floods. This fact is very evident in the existing discoveries of archaeological sites and their concentration around the

classic and Islamic Ayla. These sites are located along the coast that has formed an attractive site for the settlement of the various civilizations that inhabited the region[120].

Aqaba contains sites reflecting human habitation back to 4000 BC during the Iron Ages, resulting from the city's strategic location at the junction of trading routes between Asia, Africa and Europe. Some Biblical sources suggest that Aqaba was referred to as (Ezion-Geber), where King Solomon built ships to export copper from Araba Valley area to the known world that time, as trading routes developed connecting Aqaba with southern Arabia and Yemen, while the town grew into a thriving city[121]. The Nabateans populated the region extensively, drawn by the strategic trading location of Aqaba. In Roman times, the great Via Nova Triana came down from Damascus passing through Amman to Aqaba, where it connected with a west road leading to Palestine and Egypt.

3.2.3 Submerged Structures

Of relevance to the proposed AMR, sites of special importance include a number of wrecks that are now supporting marine biodiversity by acting as artificial reefs.

3.2.3.1 Cedar Pride Shipwreck

The site is accessible by boat or shores, and is considered the most popular diving sites at Aqaba. The history of this wreck is dated back to 1985 when His Majesty King Abdullah II bin Al-Hussein "Prince Abdulla that time" supervised the deliberate sinking of this ship at Aqaba. Recently, the site holds an extraordinary fish assemblage surviving within this important artificial reef. Night dives are very popular at the site.

3.2.3.2 Tarmac Five

The site is accessible by boat or shore, and is considered an artificial wreck scuttled in 1996 after Alcatel had finished laying the electrical cables to Egypt. The wreck is situated close to the Cedar Pride, and hosts a variety of marine life, including Blue spotted stingrays, frogfish and coral shrimps.

3.2.3.3 The Tank

The site is accessible by boat and easily reachable from the shore, where an M40 anti-aircraft tracked vehicle ("The Tank") scuttled in September 1999 to create an artificial reef.

3.2.3.4 Hercules C-130

The wreck of Hercules C-130 is easily accessible from the shore and by a boat. Located not far from the wreckage of the Cedar Pride, and only a few metres from the M42 'Duster' anti-aircraft tracked vehicle, more commonly known as 'the Tank' makes an excellent dive for all levels of training. The aircraft is standing upright at a flat bottom, almost level, at an average maximum

[120] ECO Consult 2006
[121] Aqaba Ecotourism Development Plan 2014

depth of around 16m. The wreck with a length of 30m and a wingspan of about 40m is almost always visible from the surface

3.2.3.5 Al Shorouq "Shipwreck"

Al Shorouk, a large, well-preserved wreck lies on her starboard across two reefs to the west of Kirk's Forest Reef - named after Kirk Green, a pioneer of diving in Aqaba back in the '80s. It is a deep and technical wreck as her bow is at 38m and her stern at about 60m. At these depths, the coral growth is slower than in the sun-soaked waters above – remarkably free from encrustation and corrosion; she almost looks like could have sunk yesterday. The existing AMP scuttled the ship on the 18th of June 2008 and although intended for shallower water drifted away and could have easily ended up in over 100m of water.

3.2.3.6 The Military Museum

The dive site is located just off the coast of Aqaba, South Beach in an area popular with divers. The objects - decommissioned vehicles donated by the Royal Jordanian Army. The museum is currently made up of 21 military relics and is expected to grow as more equipment becomes available. All hazardous materials have been removed from the vehicles, which will slowly turn into reefs to benefit the environment. The location of the museum was specifically chosen for its lack of coral and other marine life. The new attraction already brings more species to the site and scuba divers seeking new thrills to Aqaba. It is hoped the museum will also help alleviate the burden of increased tourism on local, healthy coral reefs.

3.2.3.7 Taiyong

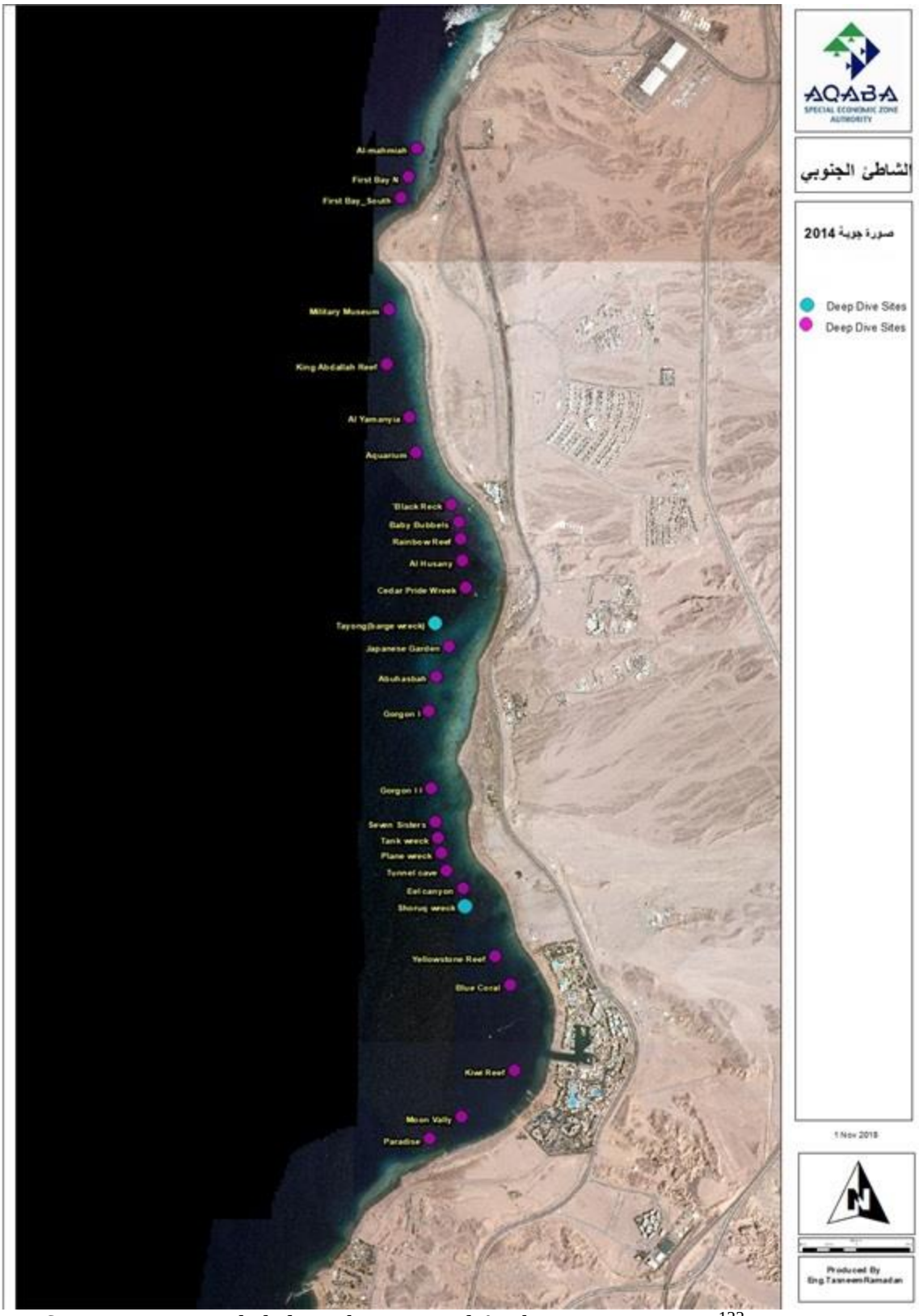
The wreck was re-discovered in 2004, lying on her starboard side not too far the dive site known as the Japanese Gardens. At its shallowest point, it reaches 35m and dropping to about 58m at its deepest, making it a great technical dive. The vessel was purchased by the Aqaba Port Authority in 1974 and used for offloading ships coming into Aqaba. An accident led to the jib of the loading crane dropping and causing damage to the ship's hold. Although this repaired with a concrete plug, subsequent leaking deemed uneconomical to service, and the authorities decided to scuttle the ship in the late '90s

3.2.4 Aquarium

A single aquarium is located at the Marine Science Station at Aqaba southern beach. Despite its importance as a tourism attraction, substantial harvesting of live corals and fish specimens occurs directly from the sea for exhibition purposes.

3.2.5 Dive Sites

A number of dive sites have been identified and located by ASEZA within the current AMP. Map 6 outlines those dive sites that are located within the proposed AMR.



Map 6: Dive sites recorded along the proposed Aqaba Marine Reserve[122]

[122] ASEZA GIS unit, 2020

Along the marine park, there are 30 diving sites (mentioned above) of various features and depths, and all of these sites are equipped with mooring buoys to avoid the use of moorings. Most of these sites are entered from the shore through specific corridors, and for most of them, there are beach sites and special umbrellas to equip divers. Table 16 describes the observations, and locations of each dive site.

Table 16: Dive Sites within the proposed Aqaba Marine Reserve[123]

No.	Name	Coordinates	Description of Dive Site
1	Marine Science Station/ Al Mahmiyeh	Latitude 29°27'8.56" Longitude 34°58'10.23"	The site is accessible through beach and boat but only for scientific researches and after obtaining the necessary permission. The site is protected since mid-1970 when the Marine Science Station (MSS) was founded, and where only research activities are allowed. However, corals and fish species are collected to be displayed at the MSS public aquarium
2	First Bay (North)	Latitude 29°27'1.30" Longitude 34°58'8.50"	The site is accessible by boat or shore, and represents the first diving site within the AMP, and is characterized by the presence of fringing reef located between 2 – 5 m depth and has a wide sandy plain at 9 m depth with intermittent coral clusters. There is a pinnacle with a banana shape to the west of the mooring at 15 m. This is a good reference point if diving deeper on this site as it is opposite the shore entrance through the fringing reef
3	First Bay (South)	Latitude 29°26'57.10" Longitude 34°58'8.70"	The site is accessible through boat and easily reachable from shore. It contains many black coral trees and usually has a large number of coronet fish hunting smaller glassfish. The site also has a large number of colourful Parrotfish.
4	Military museum	Latitude 29°26'42.03" Longitude 34°58'1.77"	Diving enthusiasts can explore one of Aqaba's unique sites here! The Military Museum, scuttled in 2019, offers 21 fascinating relics of battle placed along the seabed to mimic a tactical battle formation, creating an exciting underwater experience intriguing divers and snorkelers alike. Military hardware here, donated by the Jordan Armed Forces-Arab Army, includes tanks of different sizes, an ambulance, a military crane, a troop carrier, and a combat helicopter. The site complies with best environmental practices and its location was specifically chosen for its lack of coral and other marine life. Don't forget to take your camera on this dive
5	King Abdulla Reef (North)	Latitude 29° 26.536' N Longitude 34° 58.166' E	The site is accessible through boat or shore, and is considered one of the most popular diving sites, where reefs have some very beautiful fan colours and large shoals of pennant fish. Torpedo rays and Hawksbill turtles

[123] Al Tawaha et al. 2019

			are also a common sight. The site has very high densities of coral coverage and is ideal for underwater photography
6	King Abdulla Reef (South)	Latitude 29°26'31.00" Longitude 34°58'7.40"	The site is accessible by boat or shore, and holds the presence of an extraordinary ecosystems and species diversity, and the AMP has installed mooring at the site.
7	Al Yamaniyah	Latitude 29°26'24.20" Longitude 34°58'8.30"	Refer to King Abdulla Reef south-
8	Aquarium	Latitude 29°26'12.00" Longitude 34°58'11.40"	Refer to King Abdulla Reef south-
9	Black Rock	Latitude 29°26'3.70" Longitude 34°58'19.00"	The site is accessible by boat or shore, and is ideal for snorkelers, as a coral garden starts just below the surface and extends outwards for approximately 30m when it drops away steeply. The reef has a prolific number of fish and turtles could be observed. A new highlight of this dive is the area beneath the new jetty at Club Berenice where shoals of small fish gather providing food for many predators such as lionfish and barracuda. The sea grass area to the south holds the presence of several species including grey morays and seahorse
10	Baby bubbles	Latitude 29°25'58.10" Longitude 34°58'23.80"	This site provides an excellent training area for divers with standing depth down to 5m on a flat sandy bottom – here you can practice without any danger of damaging corals
11	Rainbow Reef (Cable Area)	Latitude 29° 29°25'55.10" Longitude 34°58'24.50"	The site is accessible by boat and shore, and is named after the reef shape, which resembles the rainbow. The alternative name “cable area” is named after the telecommunication cable that connects Egypt and Jordan, which is visible at the site. It is considered ideal for night dives, where several species could be observed including large Spanish Dancers, lobsters, Feathered Starfish, moray eels and Lionfish. In addition, divers could easily reach the Cedar Pride Shipwreck if diving started from the shore
12	Alhusany	Latitude 29°25'52.00" Longitude 34°58'23.03"	Refer to Rainbow site above
13	Cedar Pride Shipwreck	Latitude 29°25'49.60" Longitude 34°58'22.80"	One of Aqaba’s most iconic dive sites, the Cedar Pride is a former Lebanese freighter that sustained extensive damage during a fire. It was scuttled for divers in 1985 approximately 150m offshore on its port side at a

			maximum depth of 26m across two reefs. Since then, the wreck has been colonized by numerous hard and soft corals. The site is marked by a surface buoy and can be accessed from the shore or by boat. Experienced divers can explore the ship's interiors, and the site is highly recommended for underwater photographers and night divers
14	Tayoung	Latitude 29°25'43.10" Longitude 34°58'17.50"	The wreck of the crane barge Tayoung is a technical diver's dream. Sunk on its starboard side not too far from the Japanese Garden, Tayoung is covered with multi-colored corals from bow to stern and offers a great opportunity to swim through the ship's wheelhouse and explore its machinery.
15	Tarmac Five	Latitude 29°25'51.2"N Longitude 34°58'24.6"E	Divers enjoy a joint dive between Tarmac and the Cedar Pride especially when boat diving is performed. Also a great deep technical dive can be done here down a gulley starting at 40m dropping to 75m plus, this site is known as Kleta's Wall (named after a German dive master who explored it in 1996). There are many large gorgonian fan corals here and some fantastic gullies to explore. Large tuna fish and other pelagic species are often spotted at depth here. See above section on submerged wrecks.
16	Japanese Gardens	Latitude 29° 29°25'39.20" Longitude 34° 34°58'18.70"	The site is accessible by boat or shore, and is located to the south of the Shipwreck. One of the best dive sites worldwide with very good conditions for diving and snorkeling. The reef begins in shallow water and then gently slopes to the magnificent colourful reef bed where very large schools of Anthias (Gold fish) play with the golden sunbeams while getting their snack of plankton around the pinnacles. Lyre Tail Groupers, Royal Angelfish, Moray Eels, big Clam Shells are also very common here. In 2013 many corals were placed here from the Saudi Border to save them from destruction due to development of a new port facility there.
17	Abu Hasbah	Latitude 29°25'234.60" Longitude 34°58'13.30"	Refer above to the Japanese Gardens
18	Gorgone I	Latitude 29°25'28.00" Longitude 34°58'15.60"	The site is accessible by boat or shore, and it was named after a large Gorgonia fan coral located at 16m depth. Maximum depth of the site is 18m and is excellent for newly certified divers. It has an entry access from shore of 3m wide and 4m deep, after passing through this wonderful passage the diver is met with a vast cabbage coral. This dive provides examples of a fantastic array of the different varieties of the coral of the Red Sea. The site

			has three large pinnacles extending from the bottom to near the sea surface, inhabited by unique soft and hard corals forming a safe and wealthy home for many kinds of beautiful invertebrates and fish. The boulder, fan and table corals complete the coral packed tour.
19	Gorgone II	Latitude 29°25'16.90" Longitude 34°58'15.90"	The site is accessible by boat or shore, and resemble the Gorgone I in species diversity and richness, especially for corals. The site is named after Gorgonia fan-coral that used to sit at 22m depth and is sadly no longer there. Several species could be observed such as Moray Eels, Lionfish, Blue Tangs and other surgeonfish. Multiple coral clumps create a small maze giving the diver something to wander leisurely through on their safety stop.
20	Seven Sisters	Latitude 29°25’11.9”N Longitude 34°58’19.4”E	Easily accessed from shore over grass, the Seven Sisters reef begins at 3m and extends down to 16m. The site has two sets of pinnacles bustling with sea life and vibrant colours. From blennies and damsels to butterflies and barracuda, fish life here is plentiful as these pinnacles make a great nursery. Larger species are somewhat rare at this shallow level but that means the corals and sponges are just crawling with life. The Seven Sisters is a great location for an underwater photo-shoot
21	Tank	Latitude 29°25'9.20" Longitude 34°58'18.60"	Here you can find a submerged M42 Duster in all its military glory. Scuttled in 1999, the tank is a great location for learners and beginner divers, or an interesting safety stop on a dive of the nearby canyons. This site is also highly recommended for snorkelling and free-diving as it sits on a sandy bottom under just 6m of water. Soft corals and sponges have taken hold of her hull, and the first things you’ll notice are swirling schools of colourful fish that now call her home. Moving in for a closer look, the tank’s little crevices and nooks house dozens of invertebrate species, including starfish, shrimp, crab, and more
22	C-130	Latitude 29°25'6.60" Longitude 34°58'17.80"	Scuttled in 2017 and already an Aqaba favourite, this C-130 military aircraft is easily accessible from shore or by boat. The Hercules is an impressive sight with a length of 30m and a wingspan of 40m, and it is almost always visible from the surface. This majestic wreck is in close proximity to the Cedar Pride and the Tank. The aircraft lies flat on its belly on a sand bed at an average maximum depth of 16m. This site is ideal for divers of all experience levels, and it is highly recommended to combine the C-130 with other wrecks in the vicinity for advanced tech divers

23	Artificial Tunnel (the Cave)	Latitude 29°25'2.60" Longitude 34°58'23.50"	This site is accessible by boat or shore, within the Aqaba Marine Park. It was established after port relocation to the south of Aqaba beach, and transplantation efforts of corals at AMP. The Cave is one of the newly created diving locations; the local experts planted coral reefs at the site four years ago and protected the site until the reefs regenerated. It is located south of tank dive site.
24	Eel Canyon	Latitude 29°24'59.40" Longitude 34°58'25.60"	The site was named after garden eel that protrude from the sand at the bottom of the canyon.
25	Shorouq	Latitude 29°24'55.50" Longitude 34°58'22.30"	A large, well-preserved wreck that lies on her starboard across two reefs to the west of Kirk's Forest Reef - named after Kirk Green, a pioneer of diving in Aqaba back in the '80s. Al Shorouq is a deep and technical wreck as her bow is at 38m and her stern at about 60m. At these depths, the coral growth is slower than in the sun-soaked waters above – remarkably free from encrustation and corrosion. The ship was scuttled in 2008 and although intended for shallower water, it drifted away and could have easily ended up under over 100m of water
26	Yellowstone Reef	Latitude 29°24'52.30" Longitude 34°58'27.30"	This site is accessible by boat or shore, and was named for a large coral boulder, which looks yellowish when viewed from the surface. The site lies just north of the Tala Bay hotel development. With the deeper depths of this reef at over 30 m, deep divers may experience some of the larger sea life we have here such as stingrays and Napoleon Fish.
27	Blue Corals	Latitude 29°24'43.60" Longitude 34°58'33.60"	Known for its blue corals, this site is open-ended in terms of size and depth. The reef begins at 10m and contains 3 massive coral shelves and a number of pinnacles poking out of a sandy bottom and seagrass bed. In the shallows, you'll see turtles, morays, reef fish, and an invertebrate galore, especially nudibranchs. Venture deeper and you'll start to see schools of larger fish feeding over the reef, larger sponges and even more impressive soft and hard corals
28	Kiwi Reef	Latitude 29°24'24.00" Longitude 34°58'29.40"	This site is accessible by boat or shore, and was named for a diver from New Zealand who discovered this dive site. The site consists primarily of dense sea-grass beds along a steep slope. At a depth of 12-20 m, a series of small coral pinnacles litter the bottom creating small clusters of self-contained ecosystems.
29	Moon Valley	Latitude 34°58'21.63"	Named after a valley in Wadi Rum, this site drops of steeply but offers a nice dive in the medium depth range 10-25m. Large pelagic creatures can be spotted here,

		Longitude 29°24'18.66"	especially the occasional shark, lots of Unicorn Fish and some large Napoleon Wrasses.
30	Paradise	Latitude 29°24'16.20" Longitude 34°58'14.80"	Named after the red soft coral growing in the area which catches the current. This site is accessible by boat only, where a gentle slope with patch corals leads to a pinnacle and cave at the edge of a wall at greater than 40 m can be found. In addition, a soft coral garden at 10-15 m exists, where several species can be encountered such as Stingrays and Eagle Rays.

3.2.3.10 Other sites of Great importance

Along the southern shore and within the boundaries of the proposed AMR (from the MSS to the northern boundary of Tala Bay) there are six public beaches equipped with all the main services such as umbrellas, seats, toilets, parking lots, sales kiosks, barbecue stoves, ambulance and rescue units, camping areas, playgrounds, etc (Map 7).

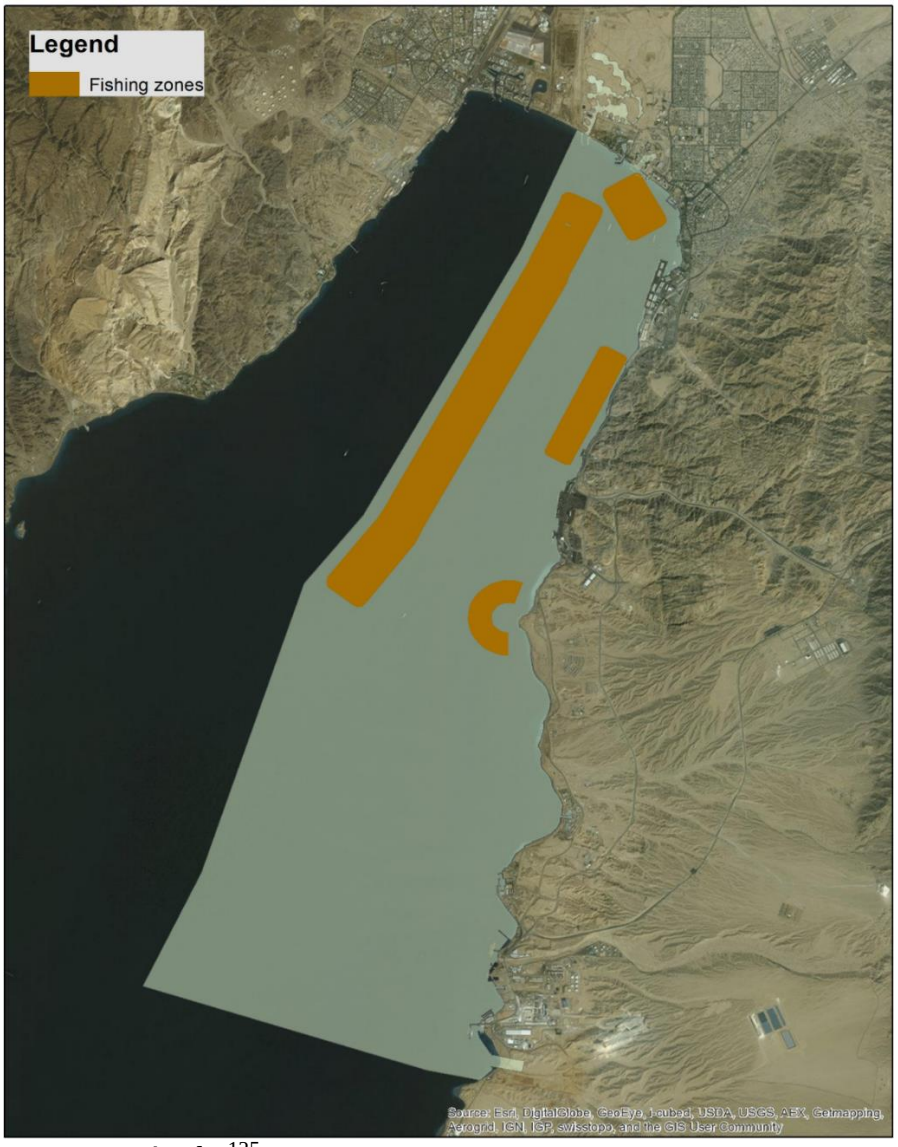
On the shores of the AMP, there are jetties and special sites used for the loading and unloading of passengers by glass-bottom boats. On these beaches there are areas designated for different categories of swimmers, marked with special signs. In addition to the marine park visitor center, which includes administration offices, galleries, halls of various purposes, and a restaurant.

Map 7: Public beaches available within the proposed AMR boundaries[124]

[124] ASEZA, 2020

3.2.3.11 Fisheries or “bait” Areas

As for the services provided to fishermen within the AMP, fishing is permitted within the boundaries of the proposed AMR for the purposes of collecting live bait only in the early morning hours until nine o'clock as a supporting mechanism from ASEZA to the fishermen in response to the limited areas they have. Moreover, fishing is allowed in the pelagic water outside the boundaries of the marine park and 100m before the territorial water. Fishing in the northern parts of Aqaba is also allowed under conditions of keeping a distance from ship anchors, swimming and marine sports areas as well as security sensitive sites. Fishing is permitted near ports, docks, industrial and border areas (Map 8).



Map 8: Fisheries sites at Aqaba[125]

[125] ASEZA, 2020

Part Four: Pressures Affecting the Aqaba Marine Reserve

This section provides the natural and anthropogenic pressures that might affect the proposed AMR area.

4.1 Population Growth, and the Associated Recreational and Tourism Growth

The resident population is growing rapidly in Jordan generally and at Aqaba city specifically, and is associated with an exponential increase in number of visitors to Aqaba where a total of 423,000 locals have visited Aqaba out of 931,000 tourist recorded in 2019. The population increase will be associated with various factors including but not limited to the increasing demands over the limited resources available, increase solid waste creation, increase infrastructure along the limited coastline and the demands for more job creation. In addition, Aqaba is considered the only maritime in Jordan, and a major touristic destination, which resemble intense visitation rates which will overburden the limited resources.

Visitors to Aqaba enjoys the water sports activities such as diving, which is considered a major industry at Aqaba with the presence of around 30 diving centers established so far. More than 80% of the diving sites are located within the boundaries of the proposed AMR. Snorkeling/swimming and diving are considered the cause the most damage to marine biodiversity (Table 17) within the proposed AMR. The North King Abdullah Reef is found to be the site that is most affected by these activities (Figure 9)[126]. Therefore, careful considerations to the proposed AMR carrying capacity is required.

Table 17: Social Threats and pressure levels recorded within the proposed AMR[127]

Site Number and name	Diving	Snorkeling & Swimming (Visitor numbers)	Fishing	Trash/Solid waste	Coral damage (partial mortality)
Blue Coral (Tala Bay South)	Moderate	High	Very Low	Very Low	Very Low
Eel Canyon	Low	Moderate	Very High	Moderate	Low
Gorgon 1 & 2	Very High	High	Very Low	Very Low	Low
Seven Sisters and The Tank	High	Very High	Very Low	Very Low	Very Low
Japanese Garden	Very High	Very High	Very Low	Very Low	Very Low
Rainbow Reef	Very High	Moderate	Very Low	Very Low	Very Low
Black Rock	High	High	Very Low	Very Low	Low
King Abdullah Reef	Very High	Very High	Very Low	Very Low	Very Low
King Abdullah Reef North	Very High	Very High	Very High	Very High	Moderate
Ras Al-Yamaniah (Eel gardens)	High	Very High	Very High	Low	Very Low
First Bay North	High	Very High	Very Low	Very Low	Very Low
Marine Science Station	Very Low	Very Low	Very Low	Very Low	Very Low
Power Station South	Moderate	Very Low	Very Low	Very Low	Very Low
Power Station Center	Moderate	Very Low	Moderate	High	Moderate
Power Station North	Moderate	Very Low	Moderate	Moderate	Low

[126] Al Tawaha et al. 2019b
[127] Al Tawaha et al. 2019b

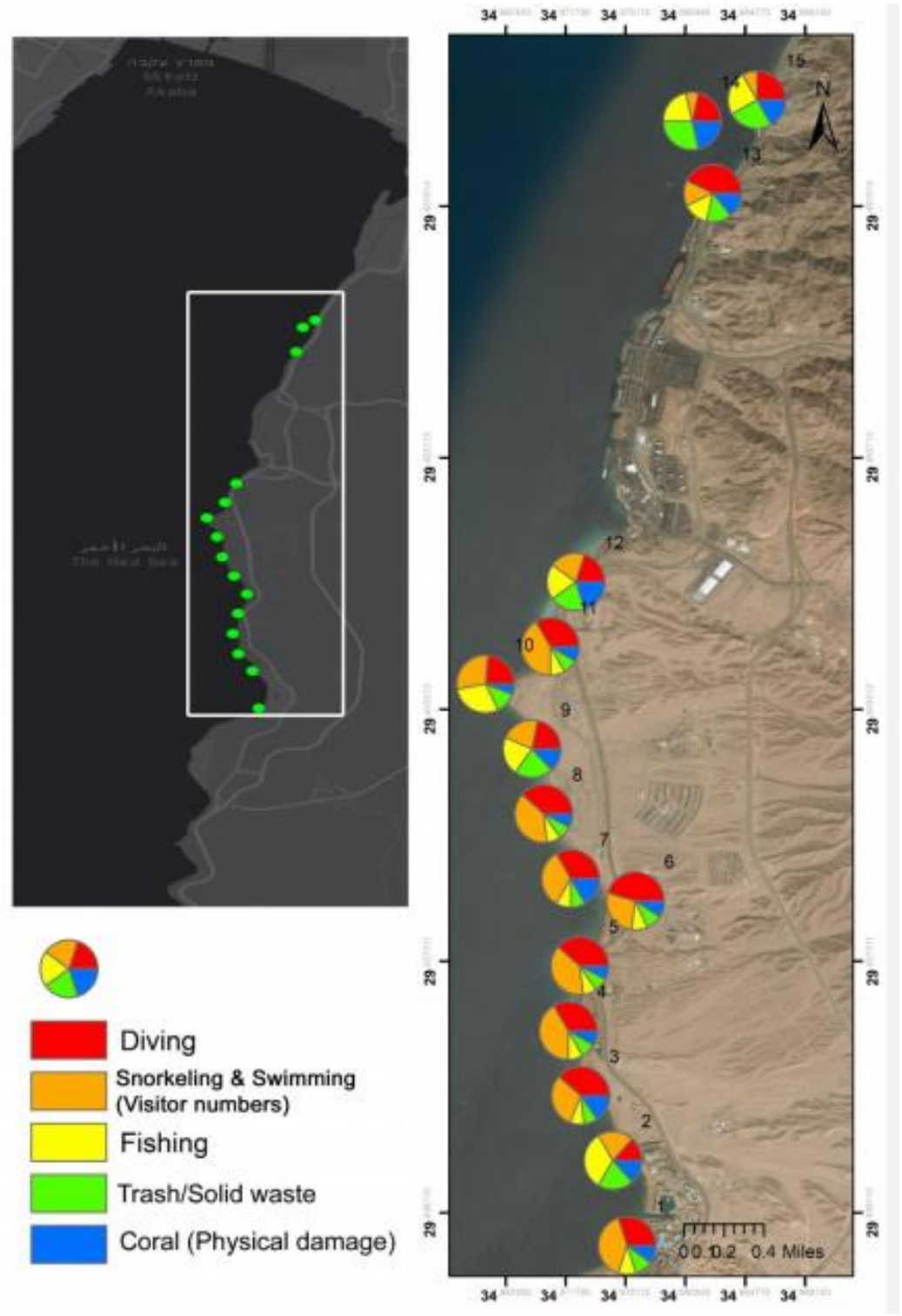
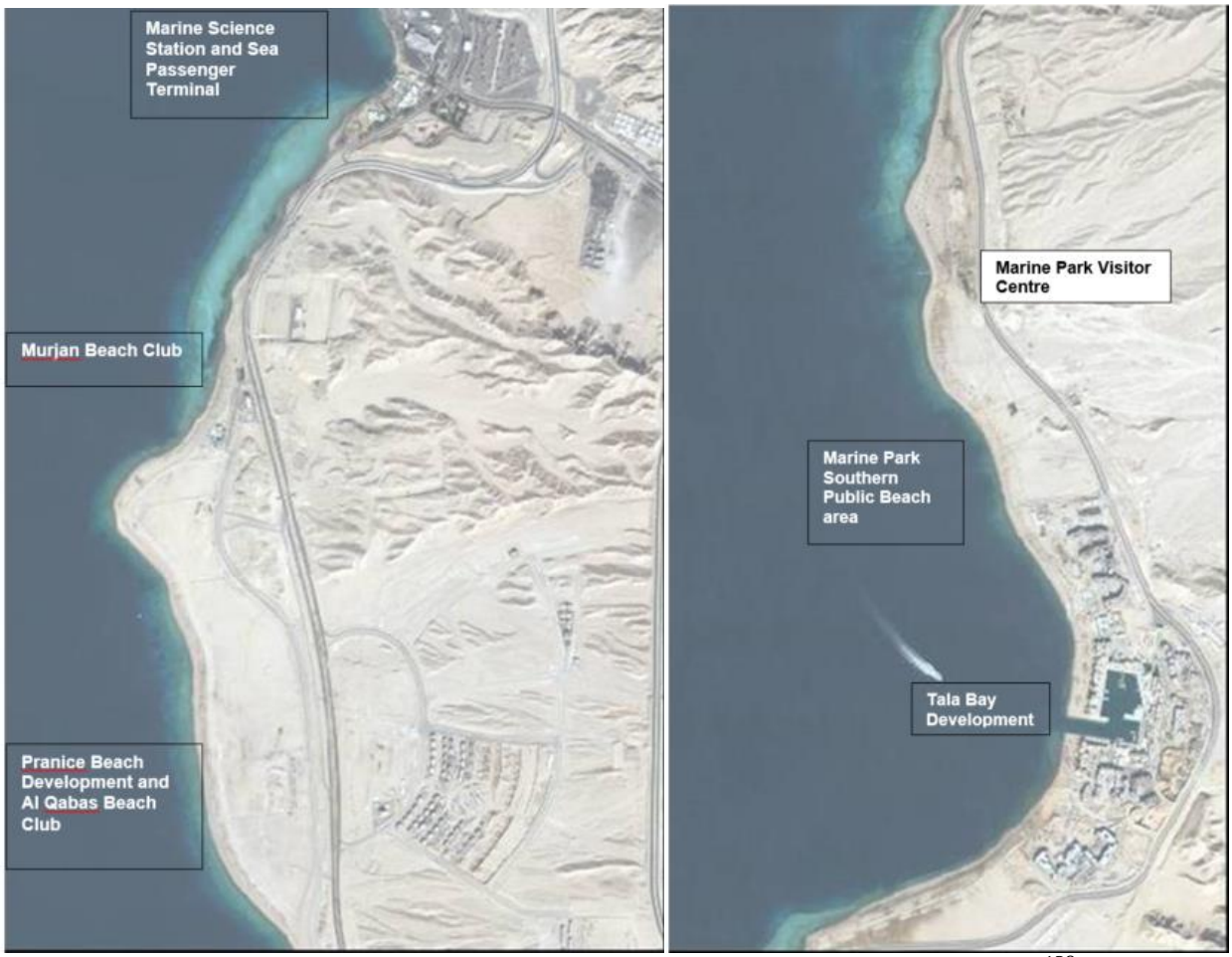


Figure 9: Percentage and ratios of social threats facing the proposed AMR (sites number is available in Table 17 above)[128]

[128] Al Tawaha et al. 2019b

In addition, the increasing user demands within the limited coastal area of Aqaba will result in the request for more tourist and housing related projects (to increase accommodation and leisure). The established (and future planned projects) are expected to reduce the area of available beach and therefore re-direct visitors more on those beaches that are currently managed by the AMP. Two touristic destinations exist within the proposed AMR boundaries which include the Pranice beach and diving center and Tala Bay (Map 9). Environmental friendly practices are being implemented at Tala Bay especially as a result of the resort recently obtaining both Green key and Blue Flag international eco-certifications. However, pressures associated with waste management remains a potential pressure facing the proposed AMR area.



Map 9: Ongoing, completed or proposed developments within the proposed AMR[129].

A mega project (Marsa Zayed) is planned at the northern parts of the proposed AMR. This project is the largest real estate project in the history of Jordan, covering an area of 3.2 km^2 and 2 km of waterfront, and a total cost estimated at 10 billion USD. Its potential scale runs the risk of it completely changing the social characteristics and character of Aqaba. The project requires the relocation of the existing main port and includes high-rise buildings, a marina, a cruise ship terminal, hotels and approximately 21,000 units of housing - apartments, villas and townhouses.

[129] ADC 2014

This would almost double the existing housing stock of Aqaba and accommodate 50,000 people, mostly expatiates and residents of Amman.

As a consequence, visitor pressure on the coastline, in particular, is expected to increase in targeted areas which is likely to require additional management, enforcement and resources for public areas, and proactive engagement through voluntary incentives with the private sector managing privatized beaches. This will demand the need to strengthen the concepts of environmental eco-certifications for the touristic facilities, whilst also applying best practices in environmental-friendly development.

4.2 Ports Development

The estimated area of hard corals affected by direct impact based on ports relocation to the southern beach of Aqaba near the Saudi border[130] is 32,509 m^2[131]. In spite of this extensive damage, coral transplantation efforts have been conducted since 2012 where corals from the southern region of the coast were transplanted onto damaged reefs in tandem with a range of artificial structures (cave site) using a range of cement and metal structural units was constructed at the proposed AMR area. In addition, it is expected that the damages anticipated from the southern ports on the AMR area will be minimal due to the distance as well as the measures applied at port management level.

Two ports are still located close to the proposed AMR boundaries where the passenger port is located at the northern edges of the proposed AMR, and the Aqaba Container Terminal (ACT) is situated northern of it. This may create negative environmental effects especially as a result of waste created and disposed in the GoA receiving waters. Positive indicators exist including a suite of environmental rewards that ACT have obtained. Also, the proposed AMR management team should be able to build upon the Social Corporate Responsibilities program to help support the AMRs budget to help provide mitigatation strategies to negate any potential environmental impacts.

4.3 Sea Level Rise

The relationship between global mean sea level rise and local sea level rise depends on a combination of factors, including changes in ocean circulation, variations in oceanic levels due to thermal expansion and relative sea-level change associated with land movements[132]. The GoA is an extension of the Levantine or Dead Sea Fault, and part of the Red Sea Rift that are tectonically active leaving the possibility of sea level increase. Therefore, it is expected to witness a sea level rise at the GoA, which will have several consequences including infrastructure loss and other serious economic and social losses. The consequences of sea level rise will have serious effects on the limited shorelines that naturally occur plus the impact that unplanned infrastructure development can have on shoreline extent. In 2019, strong tidal currents led to major effects on the submerged artificial diving sites. For that, the existence of healthy coral reefs will certainly aid to protect diving industry, and the infrastructure in the proposed AMR.

[130] ADC, 2014
[131] Al Tawaha et al. 2019a
[132] Nicholls and Klein, 2005; Harvey, 2006

4.4 Flood Risk

Several wadis flow east west, though water flow remains seasonal, flowing in a seaward direction. Despite low annual average rainfalls, flooding is a significant problem in the northern parts of Aqaba are the most vulnerable regions for flash flood hazards. These areas contain all the town residential expansion area, the Aqaba International Industrial Estate, the King Hussein International Airport, and all the northern light industries and logistics areas. Forty six (46) catchment areas have been identified which input into the Aqaba basin from the Jordanian side. There are seven main catchments draining to the coastline.

Within the proposed AMR area, runoff from Wadi 9 (Al-Mamlah) passes through the tourist area of the "Coral Coast" and Tala Bay within the proposed AMR[133]. A significant sediment load is also carried by runoff from this catchment where a key source of pollutants occurs. Runoff with extreme flooding is caused when rainfall occur in adjacent regions of Aqaba, which will have negative consequences on the marine life at the GoA, where it will change water salinity, turbidity, temperature and also disruption of microbiological activity and life cycles of flora and fauna. The northern parts of Aqaba are the most vulnerable regions for flashflood hazards since they are located downstream from areas of major wadis. Climate prediction showed a decrease of rainfall by 2050 reaching less than 50% of current rainfall in the North of Aqaba[134]. In order to mitigate the negative effects of flooding on Aqaba generally and the proposed AMR specifically, ASEZA has established 40 dams at the eastern wadis flowing to Aqaba.

4.5 Extreme Low Tide

A major characteristic of the proposed AMR are the healthy coral reefs, which will be affected by the extreme low tide. Low tide events cause corals to be exposed during daylight hours, which subsequently lead to the overheating and drying out of coral tissues. In addition, some irresponsible activities might happen in the event of extreme low tides, where people may be more able to walk onto reefs to collect souvenirs and cause serious damage to individual corals[135].

4.6 Water Quality Issues

The GoA is highly vulnerable to pollution, where both water stratification and intense dust storms are the major contributing factors to the observed seawater chemistry. In order to identify water quality deterioration, several parameters should be investigated including pH, total dissolved solids (TDS), total alkalinity (TA), Cl^{-}, $NO3^{-}$, SO_4^{2-}, PO_4^{3-}, NH^{4+}, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Sr, Cd, Co, Cr, Cu, Fe, Mn, Pb, and Zn.

Generally, the mean value of pH at Aqaba is 8.26, with no clear trend due to the calcium carbonate buffering capacity of water[136]. The average value of TA recorded at 146 mg/L, while the TDS average value is 41.95 g/L. The high TDS values are linked to water stratification and poor water circulation during the sampling period, which in consequence created a unique environmental conditions of higher temperature, evaporation, and salinity rates compared to other oceans. In

[133] ADC 2008
[134] TNC, 2014
[135] Al Tawaha et al. 2019
[136] Al-Taani et al. 2020

addition, the lack of input of freshwater into the coastal water contributes to high salinity water, and the negligible supply of sediments into the water results in clear water conditions with high transparency.

Inorganic nutrients such as nitrate, ammonium, and phosphate are minor constituents of seawater, but are essential for marine ecosystem productivity and growth. Relatively low levels of inorganic nutrients such as $NO3^{-}$, PO_4^{3-}, and NH^{4+} have been observed in surface water layer. The coastal waters of Aqaba are extremely oligotrophic, with very limited nutrients supplied to Gulf's water through terrestrial runoff. Any high NH^{4+} levels could be associated with leaks from sewer system and/or because of water discharged from fish farm or fertilizer plume[137].

4.7 Oil Spills

Jordan imports oil and liquefied natural gas (LNG) from adjacent countries, which pose threats of oil or liquid spills, which as a consequence will have detrimental effects on its coastal waters and its associated ecosystems, the impacts of which is exacerbated noting the small width and semi-enclosed nature of the GoA. Several steps have been established by ASEZA such as the zero-discharge policy, cooperation at regional level through the Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), and the improvements made by the International Maritime Organization (IMO). Although few incidents of oil spills have been recorded in Aqaba, careful monitoring, preparedness and regulation enforcement shall all be required[138].

4.8 Ballast Water

Invasive species (contained within ship/tanker ballast waters) are considered to be the third greatest threats to the world's oceans with at least 7,000 different species being transported in ships "ballast tanks" around the world (Globallast/IMO 2014; IMO 2012). Ballast water on container ships, bulk carriers, and tankers, visiting the ports in Jordan and the neighboring countries in the GoA, remains a potential source of pollution that can carry and seriously pollute the marine environment of the GoA with invasive species. Therefore, port`s managers and other official responsible authorities in the region need to embrace all possible measures to address and mitigate the threat that ballast waters can present. Jordan has participated over ten years in an international project with UNDP and IMO GloBallast, and as a result has established a vast array of experience and knowledge. In addition, a Ballast Water National Strategy has recently been developed in line with the Ballast Water Convention which is effective towards supporting and providing advisories on implementation and control[139].

4.9 Marine Debris

Most of the litter reported in coastal waters of the GoA results from recreational and shipping activities. Many items come from the Aqaba passengers' port just north of the MSS beach whilst it is was estimated that 19 million items are reaching the marine environment from ferryboat each

[137] Al-Taani et al. 2020
[138] Al Tawaha et al. 2019
[139] https://www.imo.org/en/MediaCentre/HotTopics/Pages/Implementing-the-BWM-Convention.aspx

year[140]. Shipping and port activities contribute 30% of marine litter whilst the fishing industry represents only 3%[141]. The most significant accumulated debris in Aqaba's seas is plastic[142]. Micro plastic is considered another serious factor that is threatening the status scleractinian (reef-building) corals[143]. The positioning of Aqaba as a major touristic destination, quantities of waste generated with an estimated 120 tons per day of waste is collected and transported to the dumpsite located in Wadi Al- Yutum, 8 km northeast of Aqaba town and the attitude of visitors is causing serious problem to the marine life. Physical pollution generated from solid waste poses a serious threat both to biodiversity at hand and to the achievement of tourism ambitions in Aqaba from another hand.

Marine litter reported in the proposed AMR include plastics (fragments, sheets, bags, containers); polystyrene (cups, packaging, buoys); rubber (gloves, boots, tyres); wood (construction timbers, pallets, fragments of both); metals (drink cans, oil drums, aerosol containers, scrap); paper and cardboard; cloth (clothing, furnishings, shoes); glass (bottles, light bulbs); fishing gear (nets, abandoned/lost fishing gear); and plastic pellets. In almost all reports, plastics were by far the most abundant. Large quantities of plastic materials and in part the result of dropping other items such as soft drinks cans, match boxes, plastic straws, sanitary napkins, disposable diapers and garment pieces such as shoes, boots, sandals shirts and small blankets which were found on the southern beaches and on the bottom of the sea in the passengers port area. Thousands of cigarette butts and filters, cigarette boxes and spent disposable lighters are commonly observed on this beach.

It is also observed that the proposed AMR area receives litter from several wadis and small valleys. Debris from several wadis and small valleys is transported to sea by occasional but very strong floods caused by rainstorms common to the region. Debris of foreign origin as indicated by inscription or imprinting were also found. Many of these were from Eilat on the west side of the GoA as indicated from the imprinting language (Hebrew). They include cardboards, canned food in tins, non-carbonated natural water plastic bottles, plastic oil containers and plastic cover and caps, and many other debris items were originated from Egypt and Saudi Arabia[144].

The seasonal distribution of the litter clearly indicates a relationship between passengers' port activities during the late spring and the whole summer. These periods coincided with high peaks of passengers' movement from the Arabian Gulf States and Saudi Arabia to Egypt via Aqaba port in Jordan and Nuwaibi port in Egypt. Lost or abandoned gear contributes to the marine debris and litter[145]. This causes a phenomenon known as 'ghost fishing', which significantly affects coral health and abundance[146].

4.10 Living Marine Resource Extraction

The marine fishing industry is insignificant in meeting Jordan's current fisheries requirements (protein), the vast majority of which is imported[147]. Because of the small size of the marine fishing

[140] Abu Hilal and Al Najjar 2004
[141] PERSGA 2006
[142] Abu Hilal and Al-Najjar 2004; JREDS, 2016
[143] Hall, et al., 2014
[144] Abu Hilal and Al Najjar 2004
[145] Gall and Thompson, 2015; Kühn et al. 2015; de Carvalho-Souza et al. 2018; Naranjo-Elizondo and Cortés, 2018
[146] Al Tawaha et al. 2019
[147] De Young (2006)

industry in Jordan, fisheries management is not undertaken to a scale that delivers national needs. To this end, it is important to develop a sustainable fisheries management plan that is based on scientific research outputs and developed in in consultation with the local scientific community.

Another major impact that is affecting sustainable fisheries management is associated with the gear being currently used which consists of non-biodegradable materials that can damage hard corals[148]. Living marine extraction is also happening as corals are collected and dried as part of the ornamental trade business for souvenirs and jewellery at Aqaba and even as far as Amman city. In addition, substantial harvesting of live corals and fish specimens occurs directly from the sea for exhibition purposes at the marine aquarium[149].

4.11 Natural Predators and Coral Disease

There is a general agreement among scientists and researchers that predators such as corallivorous gastropods, including *Drupella cornus* and the crown-of-thorns (*Acanthaster planci*) as well as coral diseases represent common threats to coral populations in many countries around the world[150]. Coral predation and diseases are threatening the coral reefs in Jordan[151].

Natural predators, which could cause serious effects to reef building corals, is *Drupella cornus*, which is found in the Red Sea and along the Jordan coast of theGoA[152]. *D. cornus* prey almost exclusively on living coral tissues[153] and display outbreaks similar to the outbreaks of *Acanthaster planci*[154]. The field observations along the Jordanian coast reveals that this snail is mostly infects branching corals such as *Acropora* spp. and *Stylophora* spp., with an average of about 14 and 10 snails per colony for the *Acropora* and *Stylophora*, respectively, while only 4 snails per colony on the massive coral Porites[155]. Along the Jordanian coast of the GoA, the Crown of Thorns (CoT) did not form serious problems in the past, although sometimes, individuals of CoT are encountered in some places, but no actual outbreaks have been recorded[156].

The Skeleton Eroding Band (SEB) coral disease was studied along the Jordanian coast in the GoA[157]. Although the infection rate was relatively low, this disease was frequently encountered with *Acropora* spp. and *Stylophora* sp., coral species while relative infection-rates were highest among *Seriatopora* sp. (75%), as well as *Stylophora* sp., *Hydnophora* sp., and *Galaxea* sp. (50% each). The SEB was found to a depth of 30 m, but may occur even deeper.

[148] Dameron et al. 2007; Abu-Hilal and Al-Najjar, 2009; Gilardi et al. 2010; Niaounakis, 2017; Sheehan et al. 2017; Lamb et al. 2018
[149] Al Tawaha et al. 2019
[150] Birkeland 1989; Schumacher 1992
[151] Al-Moghrabi 1996 and 2001; Al-Horani et al. 2006
[152] Johnson and Cumming 1995
[153] Turner 1994
[154] Turner 1994a; Black and Johnson 1994; McClanahan 1997
[155] Al-Horani et al., 2011
[156] Antonius and Riegl, 1997; Loya and Gur, 1996; AlMoghrabi, 1997
[157] Winkler et al. 2004

Part Five: Potential Impacts Associated with Establishing the Marine Reserve

The importance of establishing the AMR cannot be overemphasized. The proposed area (embracing the existing AMP boundaries within it) is not only aesthetically spectacular (Figure 10), with its un-spoilt coastal landscapes and diverse seascapes, but it also supports high levels of biodiversity, including many endemic and threatened species. The proposed AMR contains an array of habitat types, including extensive coral reef complexes, seagrass beds and intertidal areas, which all enable the survival (breeding, feeding and resting) of significant populations of several endemic and threatened species, not to mention numerous other fish and invertebrate species of great importance to maintain ecological balance.

Of importance regarding the significance and integrity of the marine ecosystems in Aqaba is the high resilience demonstrated by the coral reefs, which- to date - have been unaffected by bleaching and other effects of global warming. The Jordanian reefs are thus a vitally important potential reservoir of reef species, and a natural laboratory for the study of climate change impacts on coral communities. More specifically, this coastline supports small but important coral reef communities comprised of a discontinuous belt of fringing coral reefs with two different morphological reef units; the coral reef flat and the outer reef slope. This coral habitat is one of the most diverse high-latitude reef systems in the world.

The following section illustrates the impact expected from establishing the AMR at national and international levels, following three main headers, namely the environmental, social and economic perspectives. It is important to highlight that the proposed AMR represents an extension of years of experience and management derived from the AMP team. This will help to facilitate the engagement of local communities and relevant stakeholders towards the effective implementation of the anticipated activities assigned to the AMR. Any potential impacts, illustrating positive and negative impacts, are also listed below.

Figure 10: Majestic underwater images from the proposed AMR

5.1 A National and International Exemplar for marine conservation

The cabinet has approved a network of protected areas to be established in Jordan, with an aim to conserve critical ecosystems and habitats and ensure the sustainability of their associated species. Marine Protected Areas however have not been covered with this network, even though the AMP was declared by ASEZA, which serves as a biodiversity 'hotspot' lying close to the centre of marine biodiversity in the Red Sea and boasting hard and soft coral fauna that is amongst the richest in the Region. Thriving on this rich reef ecosystem, over 250 fish species (including pelagic) inhabit the proposed AMR and hosts significant populations of globally important, endemic and threatened species. The proposed AMR also acts as an important spawning ground for key fishery species as well as a larvae export area. Therefore, declaring AMR will support the government of Jordan represented by the MoE to fulfil its requirements toward Multilateral Environmental Conventions (MEAs) and the Sustainable Development Goals (SDGs).

The GoJ has ratified the Convention on Biological Diversity (CBD) in 1993, which implies its commitments to the convention provisions. The CBD urged parties to establish a network of Protected Areas (PAs) in its specific conservation objectives highlighted in "**Article 8**" which require:

1. Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;
2. Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity;
3. Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use;
4. Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas;
5. Cooperate in providing financial and other support for in-situ conservation, particularly to developing countries.

In addition, The Conference of Parties (CoPs) of the CBD agreed in 2004 (Decision VII/5) that marine and coastal protected areas are an essential tool for the conservation and sustainable use of marine and coastal biodiversity. The CoP also agreed that a national framework of marine and coastal protected areas should include a range of levels of protection, encompassing both areas that allow sustainable uses and those that prohibit extractive uses (i.e., "no-take" areas). Therefore, declaring the proposed AMR is a requirement for the GoJ. Moreover, the establishment of AMR will also supports the MoE to effectively implement the Nagoya Protocol, especially that a complete setup has been developed for this protocol in Jordan, including a bylaw, which is currently under ratification according to the legal mechanism in Jordan.

By declaring the AMR, the MoE will be capable to report to the CBD through the National Biodiversity Strategy and Action Plan (NBSAP), which aimed to define the status of biodiversity, the threats leading to its degradation and the strategies and priority actions to ensure its conservation and sustainable use within the framework of the socio-economic development of the country. In addition, it aims to mobilize the adequate financial resources for the management and

conservation of biodiversity, developing the human resource base and strengthen institutional capacity for biodiversity conservation and management and improving public awareness and education.

Also, Aichi targets[158] will be achieved especially that the proposed AMR declaration will be mainstreamed into the five strategic goals. However, the AMR will directly be linked to[159]:

1. **Target 9**: By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.
2. **Target 10**: By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, to maintain their integrity and functioning.
3. **Target 11**: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

In addition, through the establishment of the proposed AMR, the GoJ will be capable to comply with its requirements set in United Nations Framework Convention on Climate Change (UNFCCC), which Jordan is party with since 1994. The proposed AMR will offer nature-based solution to support global efforts towards climate change adaptation and mitigation, and it will be a critical tool to maintain climate change resilience and rebuilding ecological and social resilience. In addition, the reserve will increase species survival by allowing them to move around and escape certain pressures. The sea is considered a major sink of carbon, which in consequence will help Jordan's government in carbon sequestration, carbon trade and to achieve the National Adaptation Plan (NAP) as well as the National Detrimental Contributions (NDCs).

Jordan is committed to achieve the Sustainable Development Goals (SDGs) where the establishment of the proposed AMR will support SDG14 on Life Underwater. This SDGs aims to "conserve and sustainably use the oceans, seas and marine resources for sustainable development". This is extremely required especially that the United Nation (UN) stated that Jordan has achieved 0% of SDG14 until now[160]. In addition, the AMR will support Jordan's government to achieve SDG13 on Climate Change, which aims to "take urgent action to combat climate change and its impacts". Moreover, the AMR will indirectly aid to achieve SDG3 (Good Health and Well-Being), SDG5 (Gender Equality) SDG8 (Decent Work and Economic Growth), SDG10 (Reduce Inequality), SDG15 (Life on Land) and SDG17 (Partnership for the Goals).

Additional conventions and Memorandum of Understandings (MOUs) will be achieved through the declaration of the AMR including the effective implementation of the following:

1. Convention on International Trade in Endangered Species of Plants and Animals (CITES);

[158] https://www.cbd.int/sp/targets/
[159] Al Tawaha et al. 2019a
[160] https://sustainabledevelopment.un.org/memberstates/jordan

2. World Heritage Convention (WHC) - United Nations Educational, Scientific and Cultural Organization (UNESCO);
3. Jeddah Convention/ Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment;
4. Convention on Migratory Species;
5. International Convention for the Prevention of Pollution from Ships (MARPOL);
6. The London Convention;
7. The Reef Check Initiative in Jordan, where the MOE is the focal point.

5.2 Protection of Biodiversity, and Increase Resilient of Ecosystem Services

Biodiversity protection will have several consequences on the ecosystem balance, aesthetic protection, and economic returns. An increase in the abundance of previously fished species can have a positive flow-on effect, through rebalancing predator-prey relationships, and overall the food web. Corals as a foundation species will also ensure having a balanced water characteristics which will sustain the associated species. A well-designed marine protected areas can help to promote healthy ecosystems which are resilient, and able to adapt to stresses, because they are complex systems with inbuilt buffers. Resilience enables marine communities to better withstand pressures whilst still retaining their basic function, including the delivery of the ecosystem services upon which we all rely. Critical services include climate regulation, oxygen production, nutrient recycling and production of protein for human consumption. This will in return provide further economic opportunities through enhancing tourism and recreational activities, which in consequence will support local communities with better job opportunities and a new source of income.

5.3 Partnership establishment

The AMR declaration, and management as a formal marine reserve, will increase the scope for partnerships to develop at the national, regional and international levels. These partnerships will facilitate research growth, environmental conservation and socio-economic development. Table 18 illustrates potential partnership that can be established.

Table 18: Positive potential impact from declaring the AMR in Aqaba

Partnership Modalities	Commentary
Private Sector Engagement	Several opportunities exist such as: 1. Linkages with ACT and passenger port through their Corporate Social Responsibility (CSR) program. This can support the reserve management to mitigate the negative effects which might be caused from the daily ports activities especially waste creation. 2. Linkages with diving industry: this can support the reserve management in various means including the engagement of local communities in the reserve management, maintain cleanup campaigns, awareness raise and capacity building programs. 3. Linkages with touristic infrastructure: this can aid in prompting environmental- best practices such as international eco-certification. Also, it can help to engage this private sector in maintaining the site and to prevent violations 4. Investment opportunities: attracts investment in eco-tourism which will generate jobs and it will create new source of income. An example of such investment is the establishment of marine aquarium following international standards, eco-tourism trails that adjoin sea and land, and a multi-purpose room for capacity building and natural history museum.
Local community engagement	Several opportunities exist such as: 1. Engage fishermen and glass-boats owners in the conservation actions such as protecting species, and reporting violations. A program based on incentives can be established to ensure the effectiveness of this approach. 2. Engage beach visitors in awareness and educational programs toward the marine life conservation.

	3. Tourism attraction building on the transparent water, rich biodiversity and unique services provided by the AMR management. 4. Develop initiatives for Small and Medium Enterprise (SMEs) for tourism and marine biodiversity linked products and services
International Accreditation Opportunities	Several international accreditation is possible to the proposed AMR including 1. UNESCO world heritage landscape area; 2. UNESCO Man and Biosphere Reserve (MAB); 3. IUCN Green List of protected areas; 4. Key Biodiversity Areas; 5. Ramsar sites.
Marine Research Hub	The Jordanian coast contains rich biodiversity, and high levels of endemism. Therefore, several opportunities can be achieved: 1. Develop a comprehensive scientific research hub, especially for the unique and outstanding coral reef 2. Enhance coral farms role in restoring degraded ecosystems. 3. Develop pharmaceutical research at Aqaba capitalizing only on artificial reef or opportunistic corals (corals that broke and it can be recovered with care) to avoid any exploitation of the natural ecosystems and species. 4. Re-design the existing National Monitoring Program (NMP) to effectively contribute to the objectives of the AMR
Corporation opportunities	Several partnerships can be established at the national, regional and international levels including 1. Partnership with line governmental institutors for management, promotion and development such as the MOE, Ministry of Tourism and Antiquities (MOTA), and the Ministry of Agriculture (MOA) 2. Partnership with the academic sector especially departments of science, pharmacy and tourism. 3. Strengthen partnership with PERSGA[161] in means of research, enforcement and collaborative work. 4. Develop partnership with the Global Coral Reef Monitoring Network[162]. 5. Develop partnership with the International Coral Reef Initiative[163]. 6. Develop partnership with the CoralWatch[164]. 7. Register AMR once declared as a Verified Conservation Area (VCAs) or as a network of VCAs[165] to ensure that the site is managed as an integrated network of conservation areas. 8. Strengthen collaboration between the environmental commission in managing the reserve in a synergetic manner.
Fundraising opportunities	The AMR can attract various funding opportunities from different funding organizations including but not limited the followings 1. National budget of Jordan 2. Financial costs arising from violation on the marine environment 3. Coral endowment fund 4. Green Climate Fund (GCF) (projects up to >250 million US$ can be approached) 5. USAID 6. EU Delegation to the Hashemite Kingdome of Jordan 7. EU ENI CBCMED program In addition, establishing the reserve will help to develop a business plan, which will ensure the sustainability of the reserve financially

Part Six: Protection and Management of the Aqaba Marine Reserve

6.1 Current and Proposed Management Structure and Activity

6.1.1 Current Details

As ASEZA is the autonomous manager, regulator and developer of the Aqaba Special Economic Zone, it has both the rights and the responsibilities to oversee the conservation of Aqaba's coast and marine resources. Most importantly, the vision and mission of ASEZA has puts in place the institutional framework for marine conservation. ASEZA has also established an Environment Commission, which contains a specialized Department for Beaches Management where part of their tasks is to manage, enforce and develop the proposed AMR (Figure 11).

[161] available at http://www.persga.org/inner.php?id=91
[162] Available at https://www.icriforum.org/gcrmn
[163] Available at https://www.icriforum.org/
[164] Available at https://coralwatch.org/
[165] available at https://earthmind.org/vca/registry

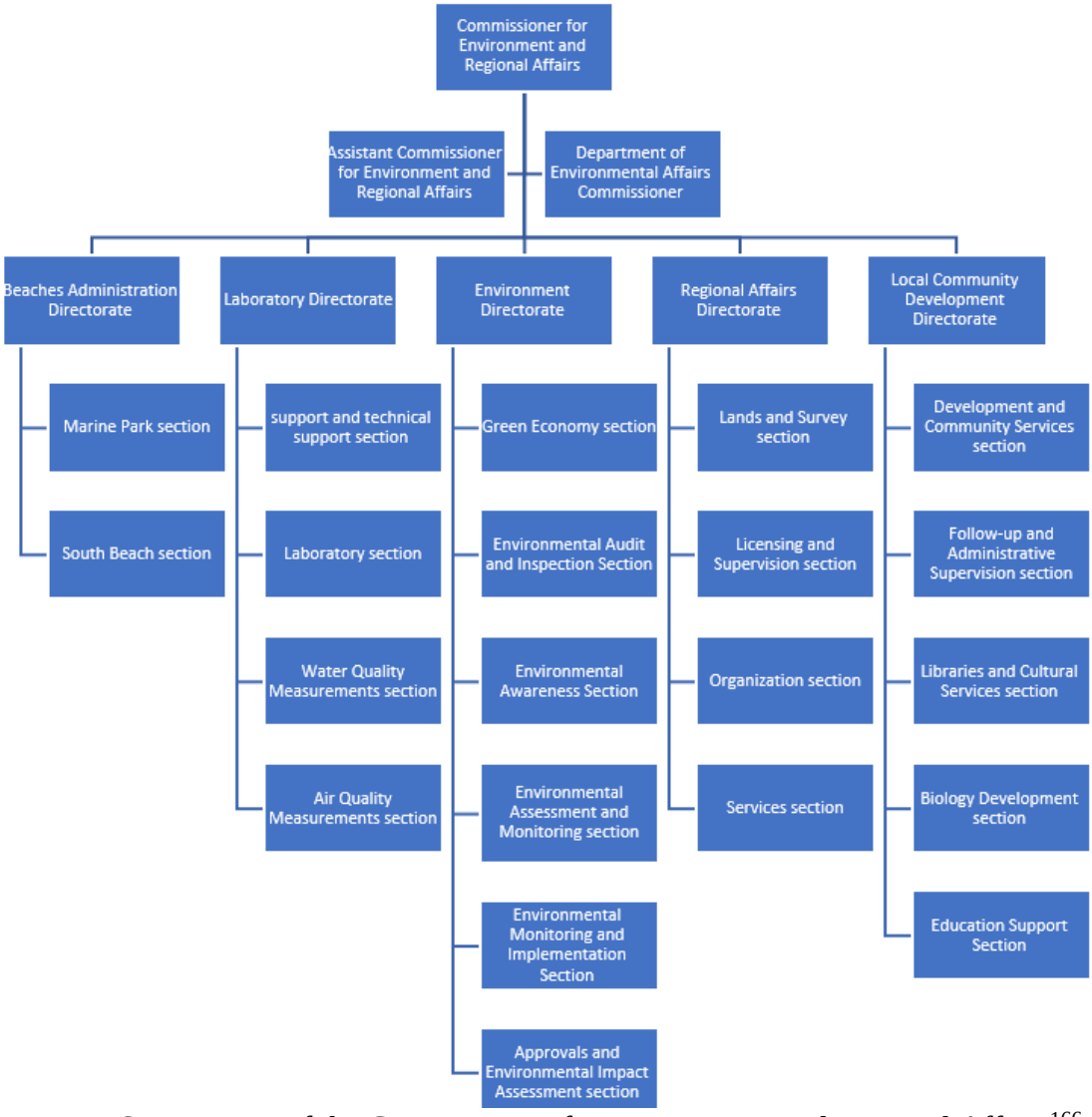


Figure 11: Organogram of the Commissioner for Environment and Regional Affairs[166].

Once the AMR is declared by the cabinet of Jordan, the reserve management should develop, starting with an update to the existing AMP Management Plan. This should then be sent to the MoE for approval and subsequent monitoring. Creating a mutually acceptable MOU will help both parties to join efforts and exchange knowledge to effectively manage the site.

6.1.2 Staffing Levels

Currently, a total of 26 staff members are recruited for the AMP, divided into the following management categories:

1. Management (1);
2. Administration (4);
3. Rangers (10);

[166] ASEZA, 2020

4. Gardening and maintenance (8);
5. Technical staff (1);
6. Drivers (2).

The staff of the AMP are responsible for a range of tasks including the following key functions:

1. Issuance of annual permits and monitoring of the activities of Glass-boats;
2. Issuance annual permits and monitoring of the activities of recreational boats;
3. Issuance annual permits and monitoring of the activities of dive centers;
4. Issuance annual permits and monitoring of the activities of fishing, (bait collection and commercial fishing licenses);
5. Routine clean up dives for the collection of trash underwater around the Park;
6. Acting as life guards in light of the considerable needs to ensure minimum safety measures within the public beach;
7. Surveillance of the public beach especially with regards to compliance of visitors to trash collection and management of the Park's facilities.

These prevailing conditions have accordingly driven the AMP management team to work in a reactive mode, to respond to constantly rising pressures that the Park's resources are facing, as opposed to being able to set strategic and adaptive approaches that better are aligned towards targeting the threats that the Park is facing. This has also incurred an extensive pressure on the human resources of the Park and resulted in heavy turn-over of the staff, due to hardship conditions and lack of needed incentives at the administrative level to respond to extensive workload.

Although some of the Park's responsibilities have been out-sourced (such as cleanup campaigns and some maintenance activities), this extensive workload on the Park's staff (from every day duties) is preventing it from responding to the conservation mandates entrusted to the Park, including key mandates within its regulation such as "Implementing, updating and monitoring scientific research programs to rehabilitate coral reefs and other natural resources... and facilitating and participating to scientific research programs...". This gap in AMP operations has prevented it from gathering, analyzing and disseminating information to the public and to the decision makers who need scientific information to help raise the concerns regarding the impact of the different threats on the marine biodiversity and thus the founding principles of ASEZA as a whole.

The Park's regulation also calls upon a special committee known as the "Aqaba Marine Park Committee" to administer the Park, under the Chairmanship of the Commissioner and the membership of the Park's Manager, the Vice Chairman and three Members appointed by the Chief Commissioner upon the Commissioner's recommendation. However, this function is not being implemented and prevents the Park from fulfilling its role and adopting the necessary decision making process for strategic management of the Park. Accordingly, the combination of a lack of a strategic management approach in responding to the threats on the Park coupled with a lack of information to document the negative impacts of these threats on the Park's resources, is preventing the AMP from building a strong case for strengthening its role and its activities in the management of this important natural asset of Aqaba.

Several other unusual factors confront the AMP ability to function effectively. These include:

1. Around half of the total coastal stretch of the AMP remains accessible to the public and will have to absorb the extensive pressure of visitors and activities, which will generate a significant source of pressure on the AMP staff in peak seasons such as week-ends and holidays and impose an adaptive approach in the management of the human and physical resources of the AMP;
2. The disconnection between the different stretches of the public beaches which remain under the authority of the AMP prevents it from adopting an ecosystem approach in its management of the AMP and also calls upon innovative management approaches of the AMP aligned with the current situation,

The leisure activities practiced on the public beaches (including snorkeling, diving, glass boaters and beach visitors) all constitute an extensive pressure on the fragile ecosystem of the Park, which are not reflected in the absorption capacity of AMP's resource capabilities. For example, the increasing litter issue, which results from the increasing beach visitor numbers being experienced, is a significant threat facing the AMPs marine biodiversity. This needs urgent attention which demands the adoption of preventive measures to avoid further escalation of the current conditions Ad hoc cleanup activities, which is the current approach, is not strategic enough as a sustainable option for the future.

Fishing (commercial and recreational) constitutes another important threat to marine biodiversity and this needs to be more effectively monitored and controlled. Given the AMP's mandate and resources in enforcing fishing regulation, the AMP's role in the managing and regulating any activity that is jeopardizing marine biodiversity remains very important.

6.1.3 Proposed Activities

The revised AMP Management Plan (2020-2025) should be designed to focus on providing the framework to deliver effective future management, regulation and enforcement requirements for the proposed AMR[167]. This shall embrace the agreed activities that shall be allowed to take place within its administrative boundaries, where these should be taking place and who is responsible for managing and monitoring these activities. In addition, a new zoning plan will need to be developed based on the existing information, and updating the original plan. Once the AMR is established, a strong emphasis will be placed on scientific research, marine biodiversity protection (via strong monitoring, regulation and enforcement) to enable more sustainable eco-tourism, and visitor management to take place.

The AMP rangers will need to be better supported with enforcement powers as they can also play an important role in visitor's management on site if their numbers can be increased and if they receive the proper skills and knowledge through special training and capacity development. This actually should create better moral and financial incentives for them to undertake their difficult enforcement tasks. Rangers will also take on increased tasks whereby they can share their knowledge and experience with others in tandem with them protecting and managing the proposed AMR.

[167] The current specific management plan for the AMP is being systematically revisited and updated based on recent and especially discussed in detail with local stakeholders to examine which recommendations will be practical and accepted to implement.

Targeted communication and outreach efforts (internationally, nationally and within the proposed AMR) shall therefore need to be strengthened. Strengths can be shared and weaknesses can be examined for possible ways in which they may be improved based on exchange of information and knowledge. The example of the Sanganeb Atoll MPA (Sudan) is proposed here as a possible exchange partner to better engage with.

Local communities and stakeholder in Aqaba should also be assisted to define standards for environmental quality. These standards should be required to a) protect those ecosystem services that support human need and well-being in Aqaba, b) provide tangible benefits to local stakeholders and c) maintain environmental quality so that such benefits are sustained over time.

Both social and economic monitoring should be developed to determine the nature and distribution of benefits tied to marine resources coming from the proposed AMR. Routine follow-up monitoring from selected trainings (i.e. through a revised AMP Annual Training Programme) should be performed immediately following the training program, to examine how the skills learned are being used within Aqaba

6.1.4 Financial Responses

At present, all ASEZA's regulatory activities are funded from its own budget, that is, from funds received from economic activity in the Zone. This includes the operation of the AMP. However, ASEZA operates a polluter-pays policy, which requires those responsible for damage to the environment - including both accidental damages, and ongoing routine impacts, even if within legal limits -to contribute to its environmental management costs. The ASEZA Finance Directorate is responsible for the accounting of all revenues collected. However, for a financial stability and sustainability, ASEZA through its reserve management should diversify the income resources from different funding mechanism.

Annex I: Stakeholders Consultation

Several stakeholders' consultation efforts have been accomplished by ASEZA to inform decision makers, local communities and various other stakeholders about the anticipated plan to declare the AMP into the AMR. The consultation included five major consultations processes which are "sorted out according to the timeframe":

1. Steering committee meeting
2. Technical and local community meeting.
3. Board of Commissioners at ASEZA
4. Stakeholders Meeting
5. Specific stakeholder's events.

The following summarize these events, noting that the annex contains the list of attendees and their affiliations

- **Steering Committee meeting**

A steering committee was created and composed of representatives from the Royal Hashemite Court (RHC), Ministry of Environment, Ministry of Tourism and Antiquities, Jordan's Federation for Environmental NGOs (FENGOs), International Union for the Conservation of Nature/ West Asia Office (IUCN ROWA), The Royal Marine Conservation Society of Jordan (JREDS), The Marine Science Station, the Royal Society for the Conservation of Nature (RSCN) and an independent expert in biodiversity conservation and protected areas management. The committee was led by the ASEZA represented by the Commission of Environment.

A meeting was held at Aqaba in June 22nd 2020, where the roadmap for deceleration, plan and the boundaries were discussed and a decision was made to recommend the boundaries following the AMP original boundaries. This recommendation was provided to the Environmental Commissioner to discuss it with the board of commissioners at ASEZA on a later stage.

قائمة الحضور لاجتماع اللجنة التوجيهية تضمنت التالية اسمائهم

الاسم	الجهة
عطوفة سليمان النجادات	مفوض البيئة والاقليم/ سلطة منطقة العقبة الاقتصادية الخاصة
مها ابو رمان	الديوان الملكي الهاشمي
محمد سالم الطواها	الجمعية الملكية لحماية البيئة البحرية
د. هاني الشاعر	مكتب الاتحاد الدولي لحماية الطبيعة/ مكتب غرب آسيا
السيد بلال قطيشات	مدير حماية الطبيعة/ وزارة البيئة
السيد محمد الشوشان	رئيس مجلس إدارة اتحاد الجمعيات البيئية/ اتحاد نوعى
د. علي المناصير	وزارة السياحة والآثار
د. نشأت حميدان	الجمعية الملكية لحماية الطبيعة
السيد عبدالله ابو عوالي	سلطة منطقة العقبة الاقتصادية الخاصة
ايمان السعودي	سلطة منطقة العقبة الاقتصادية الخاصة
السيد إيهاب عيد	مستشار / مختص بالتنوع الحيوي والمحميات الطبيعية
اعتذر عن الحضور الدكتور نضال العوران من برنامج الامم المتحدة للبيئة	

- **Technical and Local Communities meeting**

18 participants representing 15 organization attended this meeting, which was held in 23rd of June 2020. Representatives from the security departments, local communities, NGOs, governmental entities, research and academic organizations attended this meeting. It worth to note that ASEZA has committed to number of participants which should not exceed 20 people according to the governmental instructions for COVID-19. This meeting aimed to:

1. Illustrates the mission objectives, and its ultimate aim represented by declaring the marine reserve
2. Describe the anticipated boundaries of the proposed reserve, and discuss this with the various stakeholders
3. Provide details on the marine protected areas, and their importance for sustainable development
4. Collect feedback, any objection and consensus on the establishment of the AMR

There was a general consensus and agreement between all participants on the necessity to proceed in the declaration, especially that the site is managed and conserved since years before.

قائمة الحضور لاجتماع اللجنة الفنية والمجتمع المحلي تضمنت التالية اسمائهم

اجتماع فريق العمل

الخاصة بانشاء المحمية البحرية

الثلاثاء ٢٠٢٠/٦/٢٣

متنزه العقبة البحري – العقبة

	الاسم	الجهة	البريد الالكتروني	التوقيع
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- **Boards of Commissioners at ASEZA**

The Board of Commissioners meeting aimed to discuss the proposed reserve boundaries and the way-forward. This meeting was ended by a decision No. 38 for the year 2020 issued in 30th of June 2020. The key decisions made are:

1. Approve the boundaries as declared for the AMP and following the notes highlighted from the steering and technical committee meetings described above
2. Re-evaluate the current zoning plan once the reserve is declared, and during the development of its management plan
3. To manage the remaining shoreline areas according to the Integrated Coastal Zone Plan (ICZM) guidelines

- **Stakeholders Meeting**

A call for a meeting was announced by the RHC, aiming to present the efforts made so far in the declaration process, discuss uniqueness of Aqaba and why the reserve should be established and

to discuss potential eco-tourism development opportunities. This meeting was held under the patronage of H.E. the Minister of Environment. The meeting was led by EDAMA chairperson Dr. Duried Mahasneh and various decision makers attended this meeting including former prime ministers, advisers at the RHC, ministers, RHC representatives, donor entities, NGOs, governmental entities, local communities, security department's representatives, academic and research institutions and independent experts.

The UNDP head of the environmental portfolio represented by Dr. Nedal provided a description about the UNDP efforts at Aqaba followed by a presentation by Mr. Ehab Eid, the national consultant for the marine reserve establishment on the progress made so far including the proposed boundaries. In addition, several other presentations were provided by different entities especially the MSS and ASEZA.

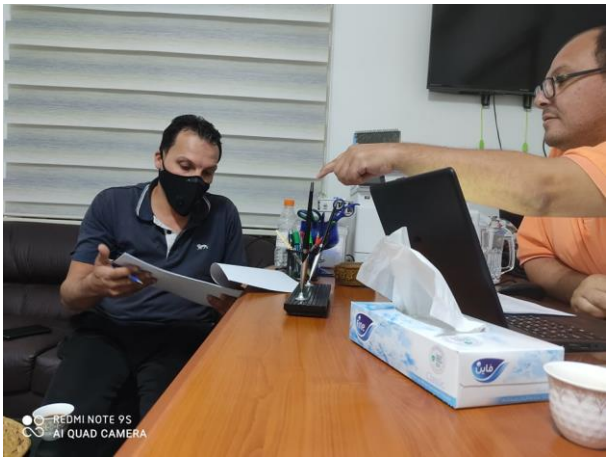
Specific Stakeholder's Events

ASEZA supported by JREDS conducted one-to-one meetings with specific stakeholders either from those who could not attended the previously mentioned events or to re-assure that the mission is clear. The following illustrates the stakeholders visited:

1. Aqaba Diving Association;
2. Hamza Abu Mahfouz & Partners Company / Aqaba Sharks Bay Divers;
3. Aqaba special economic zone authority – Environment Directorate;
4. Ministry of Agriculture;
5. Jordan fishermen cooperative;
6. Directorate of Education for Aqaba Governorate;
7. Tala Bay resort;
8. Aqaba International Laboratories – Ben Hayyan;
9. Deep Blue Dive Center – Tala Bay;
10. Aqaba company for port operation and Management;
11. The Royal Department for Environment Protection and Tourism;
12. Marine Science Station;
13. Aqaba Cooperative for Glass Boats Owners;
14. Aqaba Navy;
15. Aqaba Container Terminal Company.

In this meeting, a description about the marine reserve mission, and boundaries was presented. In addition, information about the skills and capacities were collected to develop a training need assessment report.


REDMI NOTE 9S
AI QUAD CAMERA



Photos obtained from some of the stakeholders consultation process