

# RAMON CRATER INTERNATIONAL STARLIGHT RESERVE

## INTERNATIONAL DARK SKY PARK DESIGNATION NOMINATION PACKAGE



February 2017



## **Ramon Crater International Starlight Reserve: International Dark-Sky Park Designation Nomination Package**

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Cover photos:

An INPA Reserve Ranger enjoys the starry night in Ramon Crater. Photo credit: Gal Bismuth, INPA

Proposed logo for the Ramon Crater International Starlight Reserve featuring the Nubian Ibex, an endangered species native to the Ramon Crater, which serves as the symbol of the Israel Nature & Parks Authority. Design by Sas Falco, INPA and Gitam BBDO.

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*I don't know anything with certainty, but seeing the stars makes me dream."*

—*Vincent Van Gogh (1853 – 1890)*

## **Introductory Statement**

Ramon Crater Nature Reserve (RCNR), in the Negev highlands, represents one of Israel's most isolated wilderness areas, and is Israel's largest nature reserve (1,100 square kilometers). This public land is protected by law and managed by the Israel Nature & Parks Authority (INPA). The Ramon Crater Nature Reserve is designed to protect the Ramon Crater, the largest of the three erosion craters (geologically termed Maktesh), uniquely formed in the Negev desert of Israel. The Ramon Crater is 40 kilometers long and 2 to 10 kilometers wide, shaped like an elongated heart. It contains geological formations unparalleled elsewhere in the world. Together with magnificent panoramic views, it presents a fascinating story and an important natural laboratory of geomorphologic evolution. Its remoteness and Genesis-like landscape attracts numerous visitors, who can enjoy a variety of geological phenomenon and archaeologists sites. Its location far from big cities offers not only an exceptional daytime visiting experience, but also a unique night time experience, when the extraordinarily clear night skies can be enjoyed at their fullest.

The Ramon Crater is an "open reserve", open year-round, and attracts a diversified audience consisting of many domestic and international travelers alike, with more than 300,000 visitors a year. Visitors take part in a variety of different activities including family tours, hiking, cycling, horseback riding, and touring by motor vehicle (both on-road and off-road). Also, while there are visitors who come for a brief tour, there are many who come for full day hiking, with others who camp for a single or several nights.

A great emphasis is given to the preservation of the night skies, as it is recognized as an important natural resource, having its own intrinsic value and due to its importance to the natural ecosystem as a whole. The rare qualities of the Ramon Crater were highlighted by the Tel Aviv University, which owns and operates the Wise Astronomical Observatory, located on the edge of the Ramon Crater. This observatory is the only professional astronomical observatory in Israel. And so, throughout the years, star gazing activities have become an inherent part of the experience of thousands of visitors, who visit, hike, and camp for the night and enjoy the undisturbed night sky views available to them in the Ramon Crater Nature Reserve.

The Israel Nature & Parks Authority is requesting International Dark Sky Park designation from the International Dark-Sky Association for the Ramon Crater Nature Reserve, to be named as the "*Ramon Crater International Starlight Reserve*". We seek to establish, maintain and defend a high level of protection and recognition for the park's outstanding dark sky resources. We believe this will signal a milestone in the local awareness on the topic of night sky preservation, and inspire park staff and the INPA as a whole to continue to refine and improve lighting management policy



and practice. The Ramon Crater already serves as an important educational center, and this will enable to introduce new goals to enrich public awareness to the topic of night sky conservation. Securing a designation for the park may encourage the further development of this pioneering approach in other sites in Israel.

Multiple park objectives are engaged within our effort to attain Dark Sky Park status. A strict light management policy will help achieve our goals of protecting the park's fauna and flora, including endemic species, and the nighttime ecosystem as a whole. It will also contribute to our educational goals, putting the Ramon Crater in the forefront of environmental policy in Israel. Lastly, such a designation is in direct agreement with the vision, goals and policy of the INPA, stating that the splendor of nature, together with the wonders of our galaxy and beyond is to be treasured and shared with all, and should be experienced by everyone.

This application represents the joint effort of many people in the INPA and other individuals and organizations, to which we are grateful for their contribution and enthusiasm. Throughout this process we have learned not only about the scientific and conservation challenges of night sky preservation, but also much about ourselves and the unique experiences we have the privilege to witness in our lifetime and our responsibility to preserve them for future generations to come.

For many of us, the Ramon Crater is and will forever be "the place where darkness comes to light".

On behalf of the Israel Nature & Parks Authority,

A handwritten signature in black ink, appearing to read "Noam Leader".

Noam Leader, PhD

Head of the Ecology Department, Science Division,  
Israel Nature & Parks Authority



**Figure 1:** Acacia under a starry night in the Ramon Crater. Credit: Astrophotography by Tzukran Michael All Rights Reserved 2012 <http://www.michaelastro.com/>



## Nomination Letter

Ido Bareket, Bareket observatory - Israel IDA section



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November 20, 2016

IDA board of directors  
International Dark-Sky Association  
3223 North First Ave.  
Tucson, AZ 85719

Dear IDA Board of Directors

Please accept this nomination packet of Israel's nature and parks authority for Ramon Crater International Starlight Reserve.

The designation as a dark sky park is an encouraged step towards recognizing and promoting value of dark sky communities through Israel and the Middle East.

This nomination packet seeks to demonstrate that Ramon Crater is one of the last Dark Sky resorts of its kind in Israel, while providing both science and educational opportunities among the local population. With characteristics closely associated with "Silver Tier Designation".

Please feel free to contact me directly as you carefully consider the acceptance of this nomination packet seeking the Dark Sky Park Designation of Ramon Crater.

Best Regards,

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Sunday - Friday from 8:00am till 5:00pm (GMT+03:00), holidays excluded.

## Section 1 – General Reserve Information Relevant to Night Skies and Stargazing Activities

### General Location and Description of the Nature Reserve

Ramon Crater Nature Reserve is located in the Negev highlands, in southern Israel (Figure 2), and is Israel's largest nature reserve (1,100 square kilometers, about 425 square miles). This public land is protected by law and managed by the Israel Nature & Parks Authority. Ramon Crater Nature Reserve includes parts of two statutory reserves, Har Hanegev Nature Reserve to the west, and the Matsuk HaTsinim Nature Reserve to the east, and is designed to protect the Ramon Crater (Figure 3). There are no privately owned lands within the area of the designated Dark Sky Park, which is entirely within the the Nature Reserve, under the jurisdiction of the INPA.

The Ramon crater is the largest erosion crater to be found on earth, making it a true rarity. Correctly termed *Makhtesh* emanating from the Hebrew word for a mortar grinder, this geological landform was given this name, because of its similarity to a grinding bowl (Figure 4). The Ramon Crater is 40 kilometers long and up to ten kilometers across at its widest point. Mt. Ramon, the highest peak in the Negev (1,037 meters above sea level), towers over the southwestern corner of the crater. Ramon Crater is cut into the Ramon Ridge, a large anticline. The makhtesh is the result of a series of geological processes, beginning about 110 million years ago, which included the deposition of sandstone in a continental environment, the creation of an ancient sea followed by marine sediments, folding, rising, the retreat of the sea and destruction of the anticline peak, the development of rivers, eventually causing mass erosion and the formation of the Ramon Crater (c.f. Krasnov & Mazor 2001).

The town of Mitzpe Ramon (population of ~5,000) is located on its northern edge, outside of the crater itself (Figure 3). The reserve attracts a diversified audience of domestic and international travelers alike, with more than 300,000 visitors a year, who engage in a wide range of recreational activities. The Reserve is accessible freely to the public year-round and provides for public nighttime access without supervision. The majority of the visits are to the crater's eastern parts, and near Highway 40, which crosses the crater from North to South, as the attractions are easily accessible by car or on foot. The crater's western parts are designated as a "core area" for the conservation of this unique ecosystem, warranting minimum human impact (Figure 5). Accordingly, this area receives a significantly smaller number of visitations, due to its remoteness and absence of paved roads.

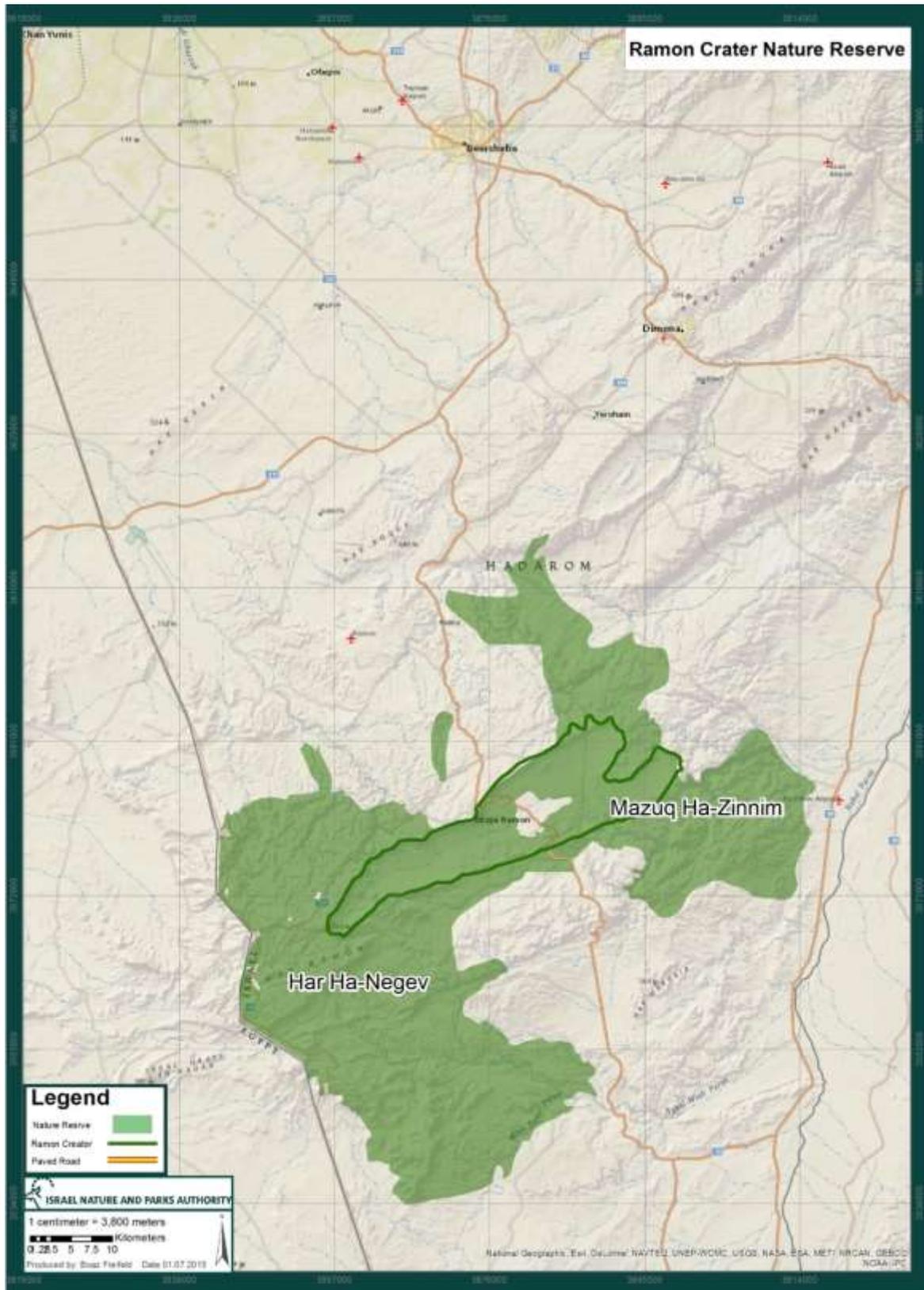
park provide for "public nighttime access, with or without supervision" (item C, page 3). The answer is probably that the entirety of the property is accessible to the public, 24 hours a day. On both sides, Ramon Crater enables visitors to enjoy undisturbed wild nature, with its unique quietness and isolation, appropriate to desert environments. Long and narrow in shape, the Ramon Crater conceals within its borders countless unique geological phenomenon (volcanic and magmatic phenomena, fossils, and ancient rock formations, created 220 million years ago),



archaeological sites and paths for hiking, cycling, and off-road vehicles. It is a home to a diverse range of animals and plants, and has a rich human heritage.



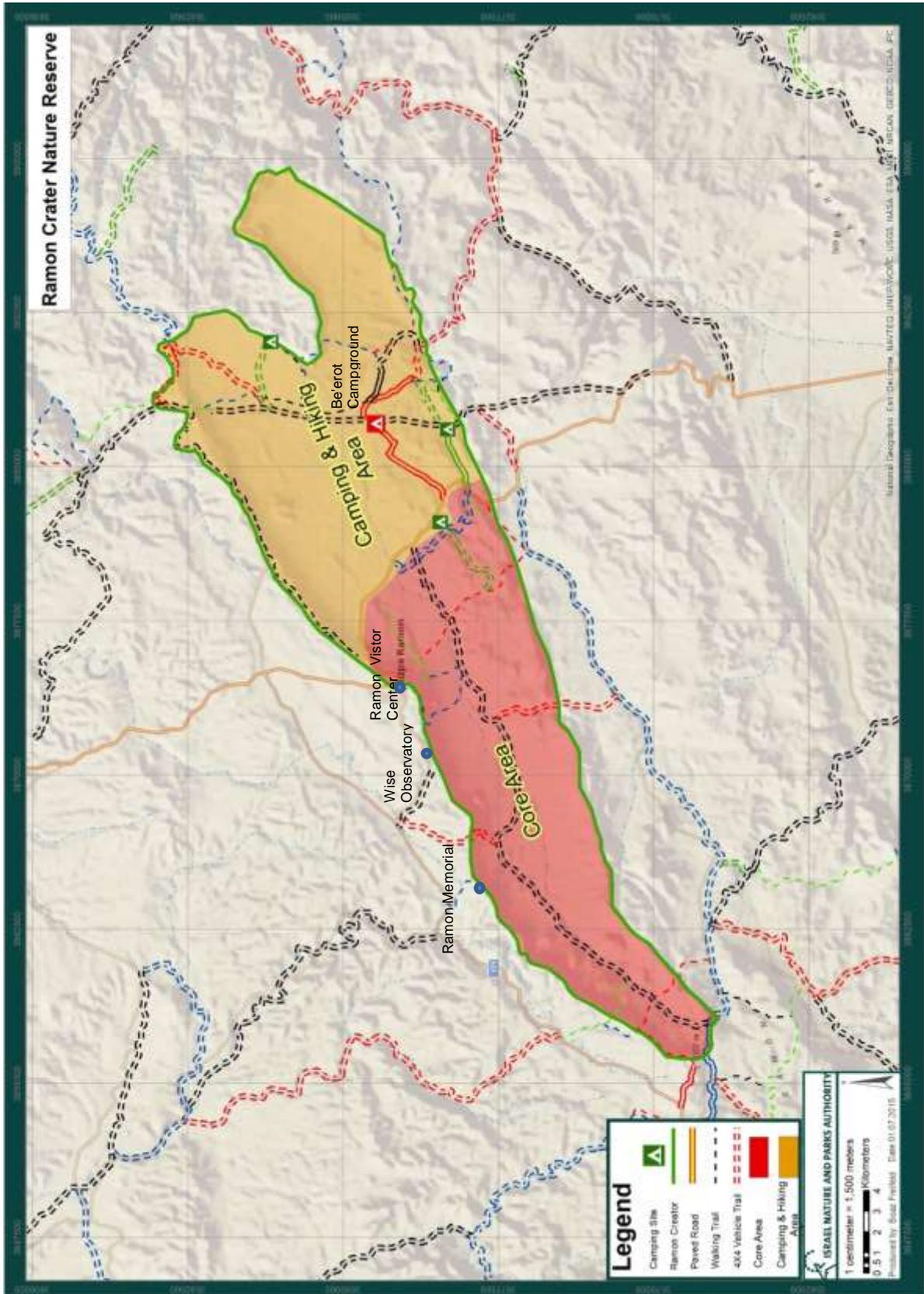
Figure 2: Map of Israel and the relative position of the Ramon Crater Nature Reserve.



**Figure 3:** Map showing the RCNR, located in the southern part of Israel, with the two statutory nature reserves, Har Ha-Negev and Mazuq Ha-Zinnim in the background.



**Figure 4:** Views of the Ramon Crater. Photo credit: Doron Nissim, INPA.



**Figure 5** : Map of RCNR, including paved roads, 4X4 vehicle trails, walking trails and overnight camping sites.

## Fauna and flora

The geography of the Ramon region exerts a strong influence on the fauna and flora. First, as it lies on a crossroad between Africa, Asia and Europe, with animals originated from regions with different climates. Therefore, animals and plants representative of several bioclimatic regions can be observed in the area. These include the Irano-Turanian (cold in the winter), Saharo-Arabia (hot, dry weather), and Mediterranean (warm, wet winter, hot summer) regions. Secondly, varied altitude and topography, lead to the proximity of different habitats - Negev highlands, cliffs, erosion plains, Wadi (dry riverbeds), and springs. As a result, a diversity of fauna and flora species inhabit the crater and its surroundings.

As a result of its remoteness and the large open space within it, Ramon Crater was chosen by the INPA as a site for reintroduction of Onagers (*Equus hemionus*). This rare mammal (Figure 6) was over-hunted to extinction in the early 20<sup>th</sup> century. In 1968, a group of 11 individuals was brought from Iran, and captive-bred. In 1982, 14 pairs were released near Saharonim Spring. More individuals were released with time, and their reintroduction is considered today a success story, with over 200 individuals now living in the wild in this region.

Additionally, a group of Arabian Oryx (*Oryx leucoryx*) was reintroduced by the INPA into the Arava, few dozen kilometers to the east. The Arabian Oryx (Figure 7) was also extinct in the wild in Israel because of hunting in the early 20<sup>th</sup> century, and nearly reached a global status of "Extinct in the Wild". International conservation steps were introduced, and a captive-breeding program was start in 1962 at the Phoenix Zoo. In 1978, four pairs were brought to Israel, to be captive-bred at the Hai-Bar Nature Reserve. Following reintroduction, their population is now estimated at 100-150 individuals in the wild.

Both reintroduction projects have proved successful, helping to preserve critically endangered species. Ramon Crater with its vastness and remoteness proved an important element in these efforts. Consequently, Onagers and Oryx can once again be seen roaming within the Crater.



**Figure 6:** Onager breeding herd at the Hai-Bar Nature Reserve. Photo Credit: Doron Nissim, INPA.



**Figure 7:** Arabian Oryx breeding herd at the Hai-Bar Nature Reserve. Photo Credit: Doron Nissim, INPA.

The following animal species (Figure 8) inhabiting the crater are representatives of the savannahs of East Africa:

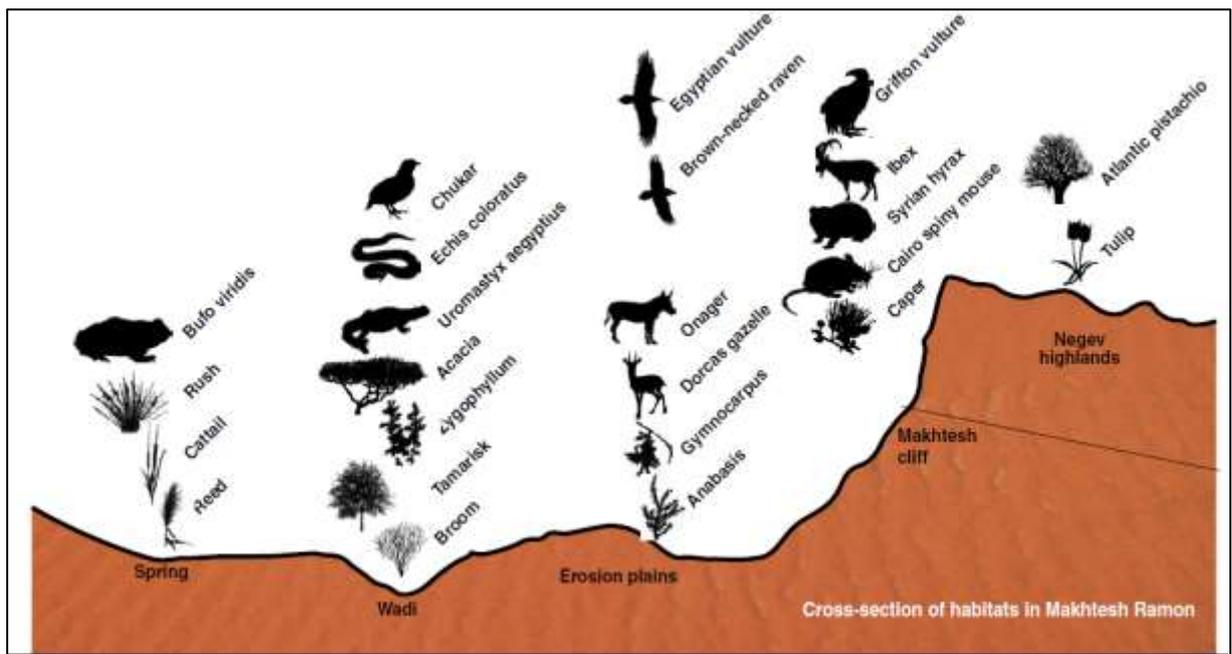
- **Leopard** (*Panthera pardus nimr*) – The Negev highlands are one of the only places in Israel with a small yet vital population of this critically endangered nocturnal feline.
- **Striped hyena** (*Hyaena hyaena*) – The striped hyena is a large nocturnal canine scavenger.
- **Caracal** (*Caracal caracal*) – Recognizable by the large tufts of hair at the tips of its ears, the caracal is a medium-sized nocturnal feline.
- **Syrian Hyrax** (*Procavia capensis syriaca*) – A small brown-furred diurnal herbivore, and distant relative of the elephant, the Syrian Hyrax lives in large groups among the rocks.

The following animal species inhabiting the crater are representatives of Arabian deserts:

- **Dorcas gazelle** (*Gazella dorcas*) - The Dorcas gazelle is smaller than the Mountain gazelle (*Gazella gazelle*) found elsewhere in Israel. This population was endangered in the 1960's, but was saved thanks to the Wild Animals Protection Law.
- **Sand fox** (*Vulpes rueppelli*) – The diet of this small endangered nocturnal fox is varied: bugs, small rodents, fruits, and vegetables.
- **Fat desert rat** (*Psammomys obesus*) – The saltbush is the mainstay of the diet of this large diurnal rodent. If fed sugar-rich food, the fat desert rat will develop diabetes.
- **Egyptian mastigure** (*Uromastyx aegyptius*) – This herbivorous diurnal agama lizard can grow to be up to 75 centimeters long.
- **Cairo spiny mouse** (*Acomys cahirinus*) – The body of this mouse-sized diurnal rodent is covered with sharp bristles.
- **Sand partridge** (*Ammoperdix heyi*) – A characteristic desert bird, ground nesting with low flying capabilities.

The following animal species inhabiting the crater are representatives of the Mediterranean region of Israel:

- **Red fox** (*Vulpes vulpes*) – Larger than the sand fox and Afghan fox, this nocturnal animal is seen all over Israel. Its varied diet includes meat, insects and plants.
- **Gray wolf** (*Canis lupus*) – The wolves living in the Negev highlands are smaller than those found in northern Israel. The average male of this nocturnal predator weighs only 20 kilograms.
- **Griffon vulture** (*Gyps fulvus*) – Griffon vultures nest on high, isolated cliffs overlooking the crater.



**Figure 8:** Wildlife and habitats in the Ramon Crater.

A large community of bats inhabit the crater's diverse habitats. All bats in the crater are insectivorous bats feeding on a wide range of insects, from flying moths to beetles and even scorpions. A bats survey conducted in Wadi Ramon in 2014 found 7 different species of bats, and in a single night 6 different species were documented passing in the wadi. An analysis of species richness predicts that within the Ramon crater there are about 10 different species of bats, representing a third of Israel's bat fauna.

The above list of fauna is only partial, and yet as can be seen, many of the species are nocturnal. Maintaining their nocturnal habitat undisturbed and protecting the region's natural darkness, is therefore a high priority for the INPA, and is complementary to the general directive of the INPA of protecting wildlife and natural habitats. Therefore, movement after sunset inside the Nature Reserve is prohibited (except for road traffic on Highway No. 40), and camping is allowed only within designated campgrounds.

Of all of Israel's desert regions, the Ramon area has the most varied and luxuriant flora. This can be attributed to the variety of habitats found here and the difference between the climatic conditions on the Ramon Ridge and those on the crater floor. Many different types of plants grow on the Ramon Ridge, with those of Irano-Turanian (central Asian) origin predominating. The bitter winter cold delays the main flowering season to late winter and spring, when the flowers bloom with amazing beauty. The crater floor is drier and hotter than the ridge. Saharo-Sindian flora (originating in the Sahara Desert and the deserts of the Arabian Peninsula) are most commonly seen here.

## Remnants of the Past

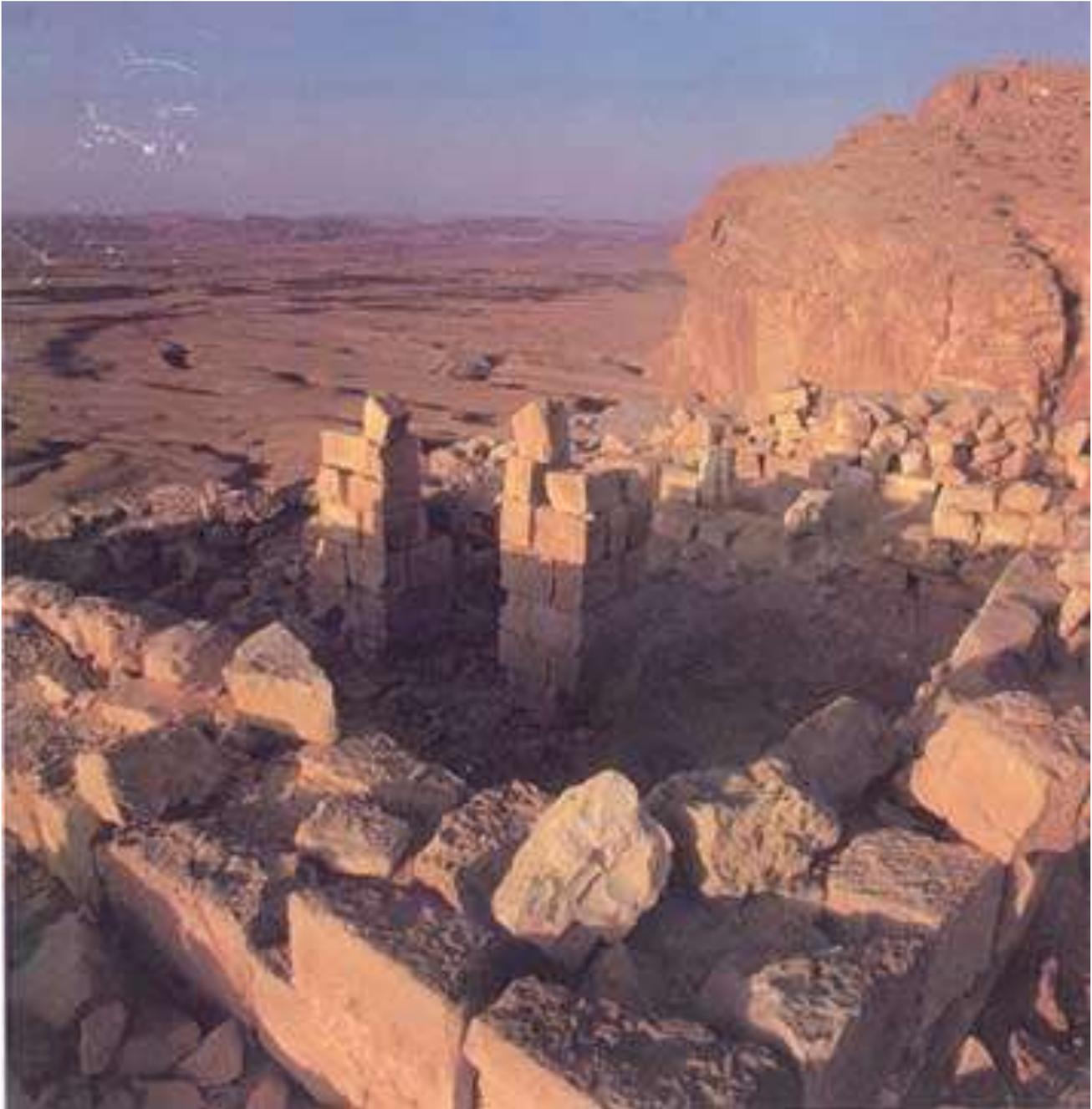
Human beings "discovered" the Negev highlands at the dawn of history. Finds from the Negev highlands provide a great deal of information about the ways in which people adapted to the environment. During some prehistoric periods, the Negev highlands had more rainfall than today, and its weather resembled that which we now see on Israel's coastal plain. Large expanses were covered by a Mediterranean scrub forest, with its typical flora and fauna. These climatic conditions attracted groups of people who lived as hunters and gatherers. Remnants of hunters' camps from over 50,000 years ago, including flint tools, were discovered near Kibbutz Sde Boker. Remains of human settlement from 20,000 years ago were found on two mountains near Ramon Crater. This area was eventually deserted because of climatic changes.

In the early and middle Bronze Ages (fourth to third centuries BCE), people returned to the Negev. This is evidenced by the remains of oval houses, clustered like villages, discovered in and around Ramon Crater. It is possible that the open shrines and large rock piles found on the Saharonim Plateau were left by these people, and contain clues to their religion and rituals. The tribe of Simon inhabited the Negev during the settlement period (13th to 11th centuries BCE). Israelite rule of the Negev became more firmly established during the period of King David. During King Solomon's reign, a string of fortresses lined the Negev roads, marking the southern border of the Solomonic kingdom. The most impressive ruins from the Israelite period are the water-collection systems, which can be seen at the Lotz Cisterns, the Hemet Cisterns, and elsewhere. These sites border RCNR, and others are to be found in it.

The fall of the kingdom of Judea gave rise to a new age in the Negev, the Nabatean period. Beginning in the fourth century BCE, the Nabatean traders and guides lead great caravans from southern Arabia and the Dead Sea area to the Mediterranean ports. Within Ramon Crater lies part of the ancient Incense Route, a famous trade route used by the Nabatean 2,000 years ago. The Incense route was recognized by UNESCO as a World Heritage site in 2010. Along this route, great camel caravans brought costly spices perfumes out of Arabia via Petra, through the Negev and on to Mediterranean ports. The ruins of the cities the Nabateans left behind attest to a flourishing culture and great wealth as can be seen in the remnant forts and guard towers that were built along the portion of the Incense Route that crosses Ramon Crater. Among them is Khan Saharonim (Figure 9), the ancient remains of a *caravanserai*, or roadside inn, located within the crater, an important stopover for caravans traversing this route. Another site located in the crater is the Makhmal Fortress (Figure 10). It is a lookout and guard spot, dated to the first century CE. Six milestones are still to be found along the route in Ramon Crater. Successful protection of this significant cultural resource and heritage sites depends not only on our ability to preserve the archaeological sites themselves, but also on the preservation of the ancient tradition of star-based navigation, developed and mastered by these ancient people.



**Figure 9:** Khan Saharonim, an important caravanserai on the ancient Incense Route.  
Credit: Dr. Tsvika Tsuk and Michal Levi, INPA.



**Figure 10:** Makhmal Fortress, one of the lookout and guard spots along the ancient Incense Route. Credit: Dr. Tsvika Tsuk and Michal Levi, INPA.

## Conservation and Protection of Nature

In the first years after the establishment of the State of Israel, awareness for the importance of conservation and the protection of nature and ecosystems was near-absent. In addition, back in those early years the new State of Israel was in a great need for natural resources. Thus, in the first decade after independence (the 1950s), many geological surveys have been designed to provide an inventory of minerals, etc. with the aim to examine the possibility to make use of all available natural resources. Therefore, in these years Ramon Crater was looked upon only as a site for the production of natural resources.

The Israel Nature and Parks Authority (INPA) was established as two separate entities (which were merged in 1998), by a law passed by the Israeli parliament, the Knesset, in 1963, to meet the goals of the National Parks, Nature Reserves and Commemoration Sites Law and the Law for the Protection of Wild Animals. The INPA's goals translate into obligations to protect nature and heritage sites and care for them for the benefit of the public, and to educate the public in keeping with them. The INPA is a government authority held in trust for the public. Its assets, nature reserves and national parks belong to all, and the INPA views them as a trust to be protected for the generations to come. The following professional considerations guide the INPA in the management of its national parks and nature reserves:

- Protecting nature (conservation of species and ecosystems)
- Making sites accessible to the public
- Preservation of human heritage sites
- Conservation planning and development

In order to enable the Authority to fulfill its mission, a process began where many areas were declared as nature reserves. Indeed, already in a 1965 regional planning documentation, large parts of Ramon Crater appear as nature reserves, alongside the existing quarries and mining sites. Since then, a series of declarations, the result of long-term planning, have led to the expansion of the protected areas. At the same time, the first tourist infrastructures were built, and a regional master plan was written. A Park station and Tourist Information Center were built, as well as Be'erot Overnight Campground, and easy-access points of interest were developed.

In 1994 a government resolution (No. 3497) was published with a declaration of "Craters Land", to be further developed and announced officially in 1996. The resolution recognizes the craters in Israel as natural monuments with local and global importance. Therefore, special care should be taken to preserve their natural state; to mitigate any potential damage; and to plan and develop them as nature and tourist sites. At the same time, all mining and quarrying activities were halted. Indeed, since 1998 a vast restoration program was introduced, and many of the abandoned quarries were restored. One of them was converted to serve as a campground, while others were turned into visitor attractions (with a geological orientation in mind) or were fully restored.

## Ilan Ramon Memorial

On 1 February 2003, the seven crew members of the Space Shuttle Columbia perished aboard their craft during re-entry into the Earth's atmosphere as their mission drew toward its conclusion. Among the fallen astronauts was Col. Ilan Ramon, age 48, the first Israeli citizen to travel in space. He served as a fighter pilot in the Israel Air Force and was chosen as Israel's first astronaut in 1997. Col. Ramon was selected as a Payload Specialist for the Columbia shuttle mission, representing the Israel Space Agency. He was designated to train as prime crew member for the Mediterranean Israeli Dust Experiment (MEIDEX), a multispectral camera intended to measure small dust particles (dust aerosols) in the atmosphere over the Mediterranean and the Saharan coast of the Atlantic. The responsibilities of Col. Ramon aboard the space shuttle also included conducting many important scientific research experiments in the fields of physics, chemistry and biology.

The memorial in honor of Columbia crew members Rick D. Husband (mission commander), William C. McCool (pilot), Michael P. Anderson (payload commander), David M. Brown (mission specialist), Kalpana Chawla (mission specialist), Laurel Blair Salton Clark (mission specialist) and Ilan Ramon (payload specialist), is located at a viewpoint on Mt. Ramon, the highest peak in the area. This commemorative view point overlooks "Karni Ramon" (Ramon horns); a series of seven basalt hills inside the crater, each named in memory of one the fallen Columbia crew members (Figures 11-12).

In addition to the memorial, the Ramon Crater Visitor Center was re-opened in 2013 after major renovation took place, to incorporate Col. Ramon's legacy at the visitor center. It is designed to bring together space and earth, his personal story and the story of the crater. Preservation of the splendor of the naturally occurring night skies and stars as part of the memorial is of course an essential intrinsic part of both of these powerful stories.



**Figure 11:** The view from Karnei Ramon. Photo credit: Mark Catz, INPA.



## Wise Observatory

The Wise Observatory (Figure 13) is a professional astronomical research facility owned and operated by the Tel-Aviv University. The observatory is located 5 km west of the town of Mitzpe Ramon in the Negev desert near the edge of the Ramon Crater, and it is the only professional astronomical observatory in Israel. It hosts the main 1-m diameter telescope, a number of smaller automated telescopes, as well as instrumentation for geological and atmospherical research. For over 40 years, Wise Observatory has been steadily outputting cutting-edge astronomical research, much of it taking advantage of the clear desert skies and the favorable geographic longitude. These allow tracking transient and time-variable phenomena when it is daytime at most other observatories on earth.

The number of clear nights (zero cloudiness) at the Wise Observatory site is about 170 a year. The number of useful nights, with part of the night cloud-free, is about 240. The best season, when practically no clouds are observed, is June to August, while the highest chance for clouds are in the period January to April (Table 1). Winds are usually moderate mainly from North-East and North. Storm wind velocities (greater than 40 km/h) occur, but rarely. The wind speed tends to decrease during the night. Temperature gradients are small and fairly moderate. The average relative humidity is quite high with a tendency to decline during the night from April to August.

**Table 1: Clear nights 1972 to 1983 as recorded at the Wise Observatory. The standard deviation of the mean is given in square brackets (Brosch 1992).**

Month	Percent clear
January	52 [10]
February	56 [17]
March	55 [12]
April	51 [10]
May	77 [10]
June	89 [10]
July	92 [06]
August	90 [05]
September	76 [16]
October	67 [19]
November	60 [12]
December	64 [13]
Yearly mean	69 [15]

**Table 2: Sky brightness in mag/square arcsec as recorded at the Wise Observatory (Brosch 1992).**

Period/Band	U	B	V	R	I	Notes
<b>Nov-Dec 1976</b>	23.0	22.7	21.6	-	-	From Vidal <i>et al.</i> (1978)
<b>July 1979</b>	21.7	22.2	21.6	-	-	Bi-li tube
<b>Mar 1989</b>	21.5	22.2	21.7	21.2	20.4	Ga-As tube

Based on sky brightness data (Table 2), Wise Observatory has a similar sky brightness as other professional observatories (Brosch 1992 p. 29). The average seeing is about 2-3 seconds of arc. Rare nights exhibit 1" seeing or less; these are only a few per year and occur mainly in winter, after the passage of a storm front.

An important advantage of the Wise Observatory at its location of  $\sim 35^\circ\text{E}$  in the Northern Hemisphere, is the possibility of cooperating with observatories at other longitudes for time-series studies. Such projects involve searches for stellar oscillations within the Whole Earth Telescope project, monitoring gravitational microlensing events, combined ground and space observing campaigns, etc.



**Figure 13:** The Wise Observatory operated by Tel-Aviv University, located near the edge of the Ramon Crater, Israel. Photo credit: Etan J. Tal (<https://commons.wikimedia.org/wiki/File:WiseObservatory.jpg#filelinks>)

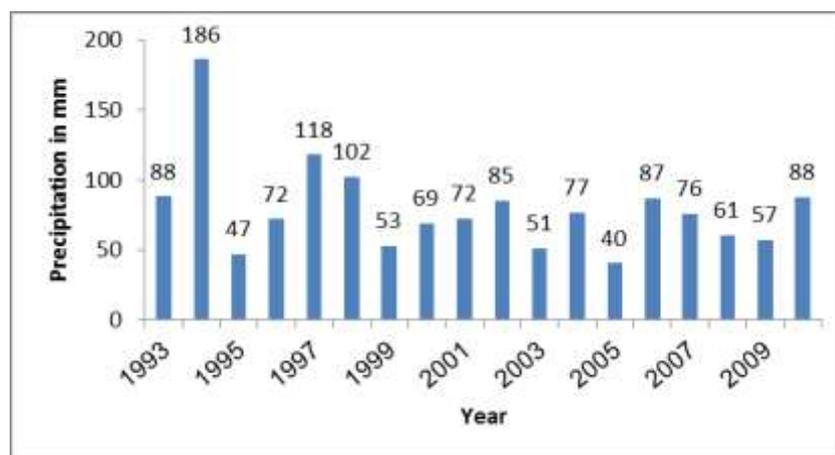
## Section 2 – Description of Ramon Crater’s Night Sky Resources

### Weather, Climate, and Visibility

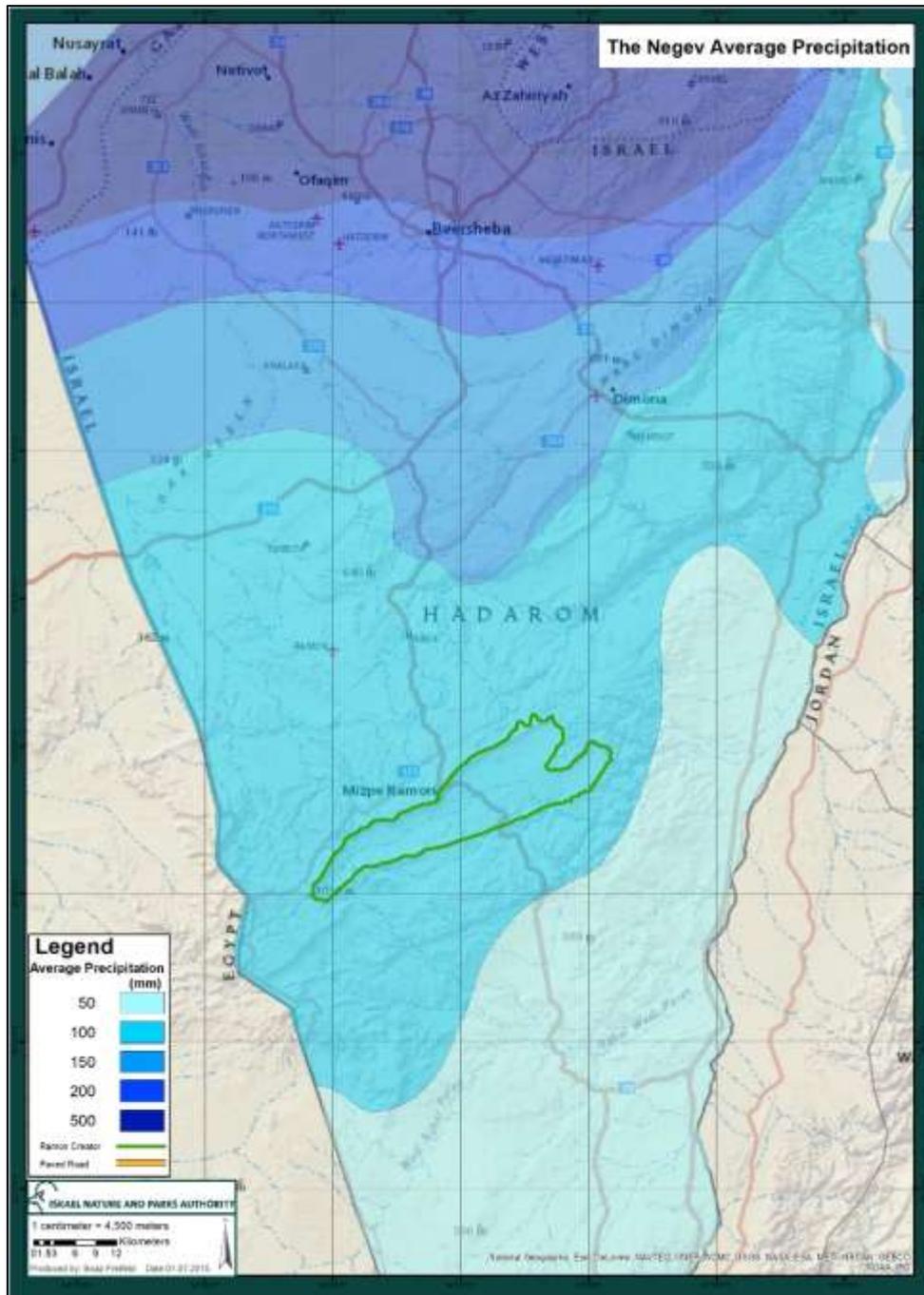
RCNR has an arid climate with precipitation averaging as little as 68 mm annually (Figures 14-15). The region's climate is affected by several main factors: (a) proximity to the Mediterranean Sea, (b) location on the northern edge of the Global Desert Belt (30 North), and (c) topographical altitude above sea level. Traveling south, the moderating effect of the Mediterranean wanes, which is the reason that the Negev desert is characterized by high day temperatures, low night temperatures and very low precipitation. Precipitation varies greatly from year to year, and is characterized with short, strong, localized rain events (Goldreich 2003). Floods are not uncommon in the main dry riverbeds.

Local conditions also contribute to the aridity, as there is a significant altitude drop between (mainly, but not only) the northern ridge of the crater and the crater itself. The highest peak is Mount Ramon, 1,037 meters (3,402 ft.) above sea level, located on the north-west side of the ridge surrounding the crater. The bottom of the crater measures about 570 meters above sea level. This drop relates to the rising of air, cooling down and condensation which take place outside of the crater, in a process which prevents precipitation within the crater.

The average summer day temperature is 34° Celsius (93° Fahrenheit), with winter day temperature average of 12° Celsius (54° Fahrenheit). The differences from day to night temperature can often reach 10° Celsius and more (Figures 16-17).



**Figure 14:** Yearly precipitation in mm in Mitzpe Ramon.



**Figure 15:** Average annual precipitation map of southern Israel, RCNR included.

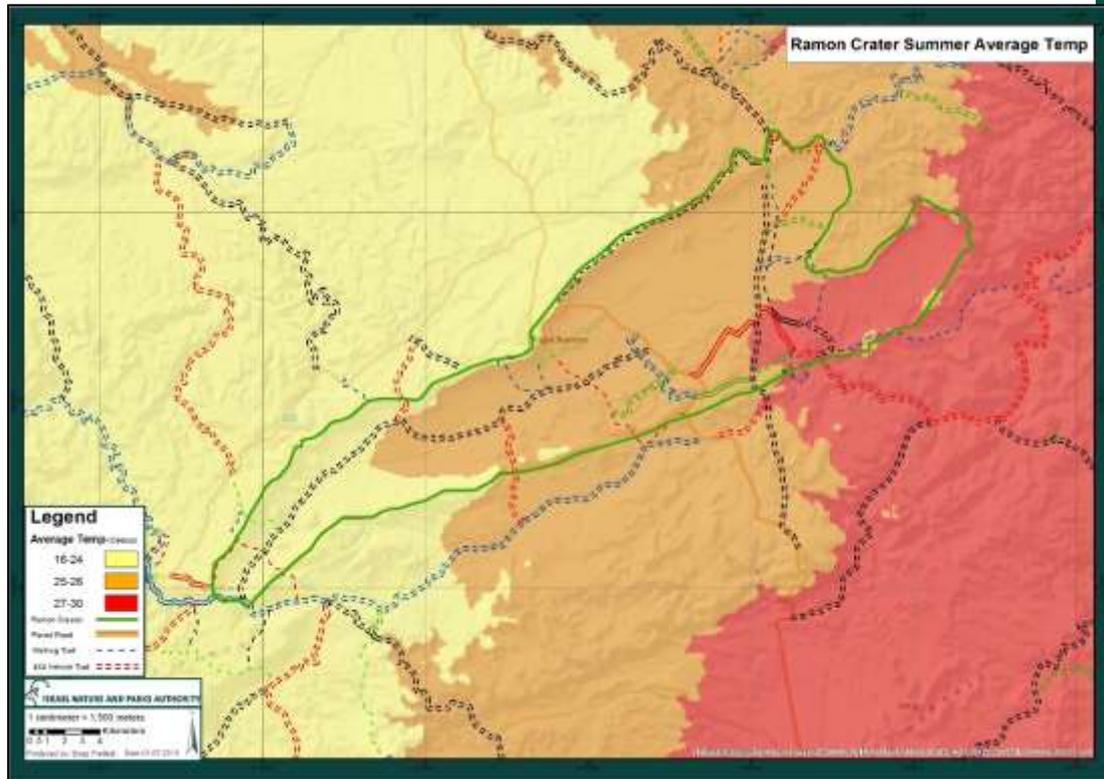


Figure 16: Ramon Crater summer (August) average temperature in Celsius.

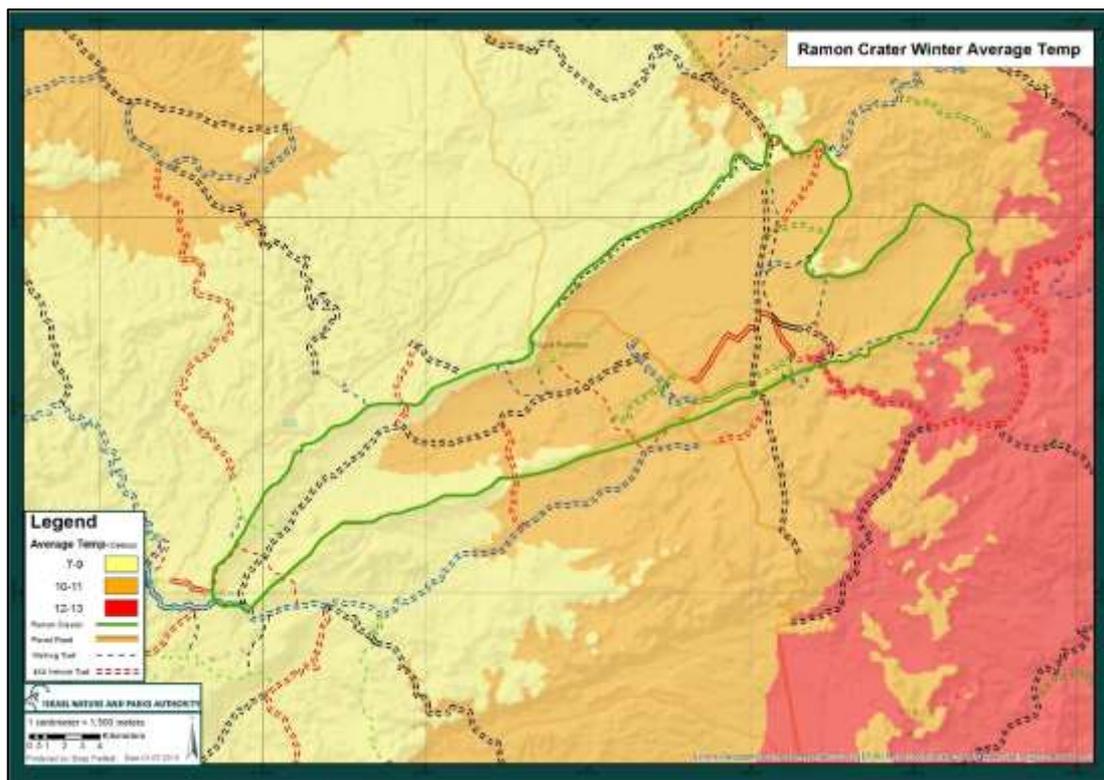


Figure 17: Ramon Crater winter (January) average temperature in Celsius.



RCNR is located outside the area monitored by the Israel Ministry of Environmental Protection for air quality. The nearest monitoring station is in Yeruham, a town with a population of about 10,000 residents, located approximately 43 km (27 miles) away. The levels of Ozone, Sulfur dioxide, and Nitrogen oxide are all on the lowest side of the measurement scale (Kordova 2014).

The region is subject to long-range transport of desert-dust aerosols from the deserts of North Africa and the Near East, with mineral dust being a major component of aerosol mass (Levin & Lindberg 1979; Ganor & Mamane 1982; Ganor et al. 1991). Dust storms occur occasionally, mainly in winter and spring. As a result, on average, for more than 5% of the time there are visibility limitations (Kutiel & Furman 2003). Consequently, March, April and May average with the highest levels of dust particles in the air, and July, August and October average with the highest levels of related pollution (Derimian et al. 2006). Nonetheless, visibility limitations are more likely to occur during day time, while the nights are usually clear and with no visibility disturbance.

Regarding clouds, the number of clear nights (zero cloudiness) at the Wise Observatory site is about 170 a year. The number of useful nights, with part of the night cloud-free, is about 240. The best season, when practically no clouds are observed, is June to August, while the highest chance of clouds are in the period January to April (for details, see above on Wise Observatory, Table 1).

## Isolation from Light Pollution

Ramon Crater Nature Reserve is located in Israel's Southern District. With a total area of 14,185 km<sup>2</sup> (5,477 mi<sup>2</sup>), and a population of 1,168,600 (CBS 2014), the district population density is the lowest in Israel with about 77 per km<sup>2</sup>. But, in the area around RCNR the population density ranges from 1.4 to 3 per km<sup>2</sup>. It is isolated from cities and towns of substantial size (Table 3). The Nature Reserve itself produces nearly no light pollution of its own, with only minimal measurable amounts from specific locations within the reserve (Figures 18-21).

Taking into account that the whole land area of Israel is 20,770 km<sup>2</sup>, RCNR is located at a significant distance from potential anthropogenic light pollution sources (source for distance is [merchak.org](http://merchak.org); sources for residents is [cbs.gov.il](http://cbs.gov.il)):

**Table 3: Cities and other settlements in the area, with their distance from RCNR and their population size**

CITY	POPULATION	DISTANCE FROM RCNR (AIR KM)
EILAT	47,800	118 km
BEER SHEVA	196,913	72 km
KMEHIN	145	49 km
SAPIR	357	37 km
SDE BOKER	398	29 km
MIDRESHET BEN-GURION	1,637	27 km
SHADAMA	~200	13 km
MITZPE RAMON	5,000	1 km

North of the reserve is the small town of Mitzpe Ramon. The town is located on the crater's northern edge, outside the crater itself. Resulting from its small size and its location above the crater, the town contributes only limited anthropogenic light pollution into the crater. Further north there are several small rural settlements, too small and too far to cause much anthropogenic light pollution. There are several military bases which are located north of the reserve, which also contribute relatively mild anthropogenic light pollution. INPA currently works both with the local council of Mitzpe Ramon and with the military authorities, to introduce and implement a lighting policy aiming to reduce anthropogenic light pollution in the region.

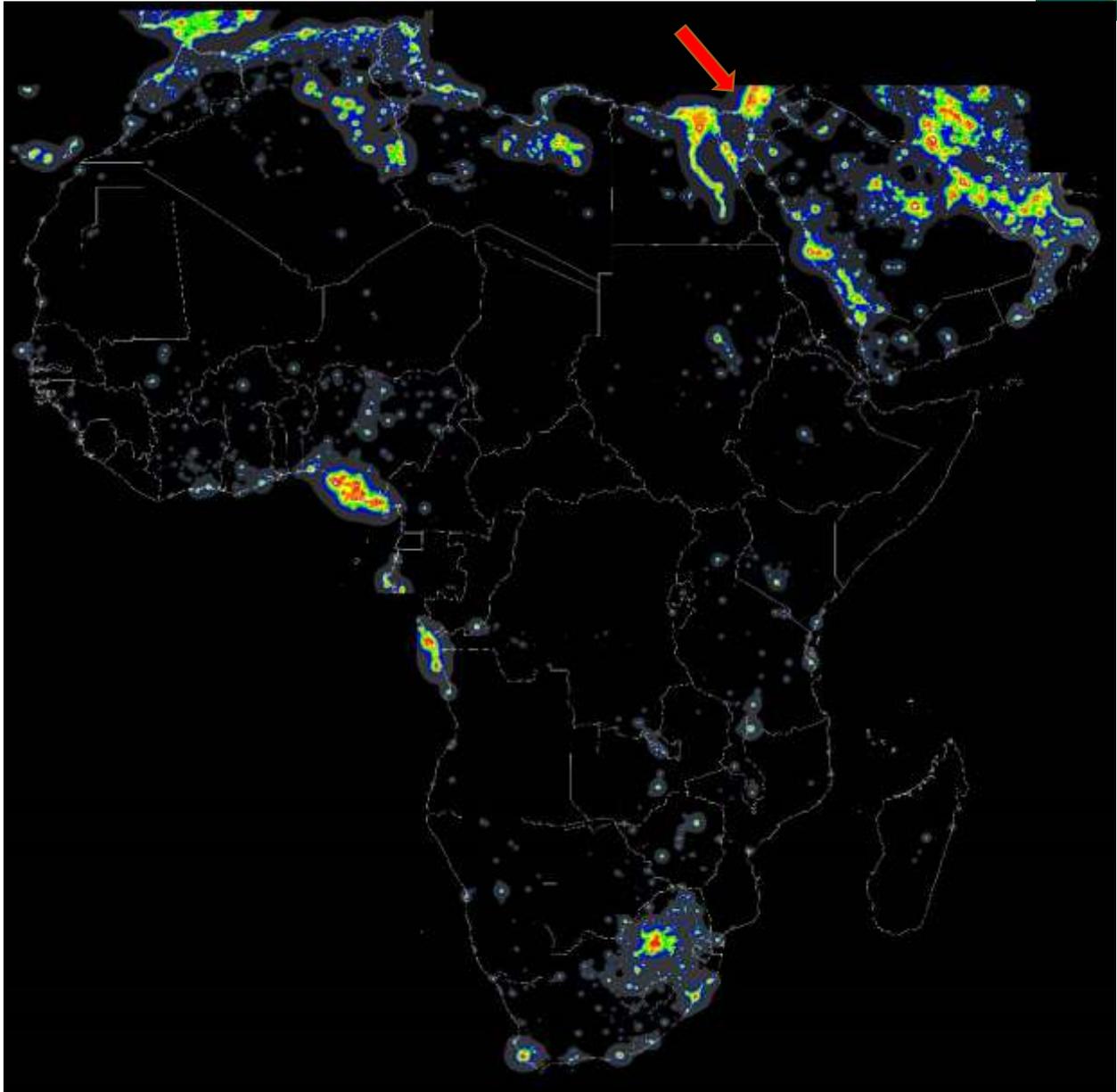
East, south and west of the reserve there is open wilderness, with only a handful of small rural settlements. A small military base (Shadama) is located about 13 km south to the reserve, and it is estimated that no more than 200 people are stationed there. Therefore, there are nearly no anthropogenic light pollution sources to the east, to the south, and to the west of the reserve.



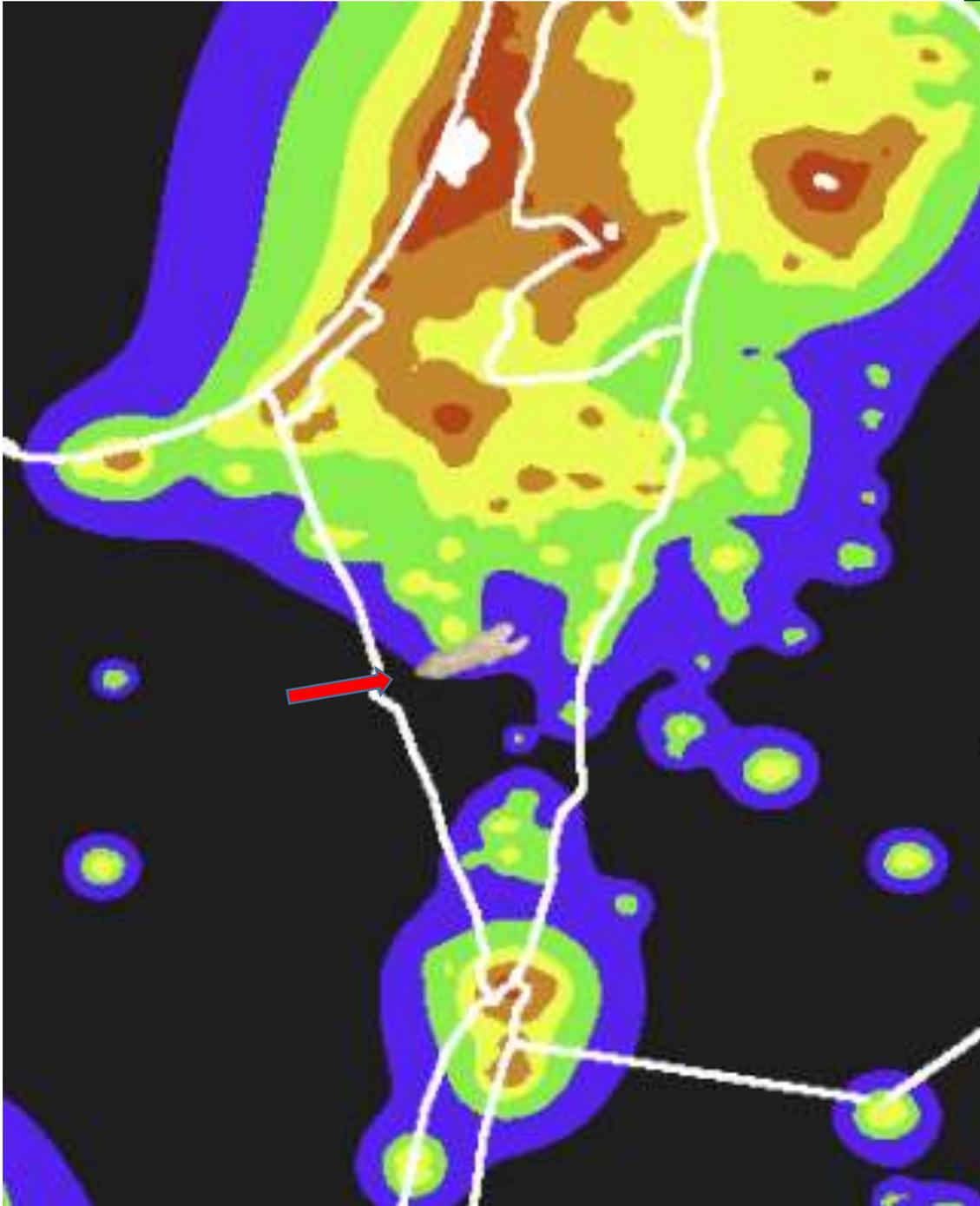
Road lighting is sparse in the area. A short section is installed at the southern outskirts of Mitzpe Ramon, in a dangerous curve along the road going down to the crater. INPA initiated a dialogue with Netivei Israel - National Transport Infrastructure Company Ltd, to work together to mitigate its effects.

A number of citable measures are used to indicate the lack of light pollution. Cinzano et al. (2001) developed a night sky brightness model, which may graphically portray the condition of Ramon Crater's night skies (Figures 18-19). They summarize their First World Atlas of Artificial Night Sky Brightness with the following words:

“We present the first World Atlas of the zenith artificial night sky brightness at sea level. Based on radiance-calibrated high-resolution DMSP satellite data and on accurate modeling of light propagation in the atmosphere, it provides a nearly global picture of how mankind is proceeding to envelop itself in a luminous fog. Comparing the Atlas with the United States Department of Energy (DOE) population density data base, we determined the fraction of population who are living under a sky of given brightness. About two-thirds of the World population and 99 per cent of the population in the United States (excluding Alaska and Hawaii) and European Union live in areas where the night sky is above the threshold set for polluted status. Assuming average eye functionality, about one-fifth of the World population, more than two-thirds of the United States population and more than one half of the European Union population have already lost naked eye visibility of the Milky Way. Finally, about one-tenth of the World population, more than 40 per cent of the United States population and one sixth of the European Union population no longer view the heavens with the eye adapted to night vision, because of the sky brightness.”

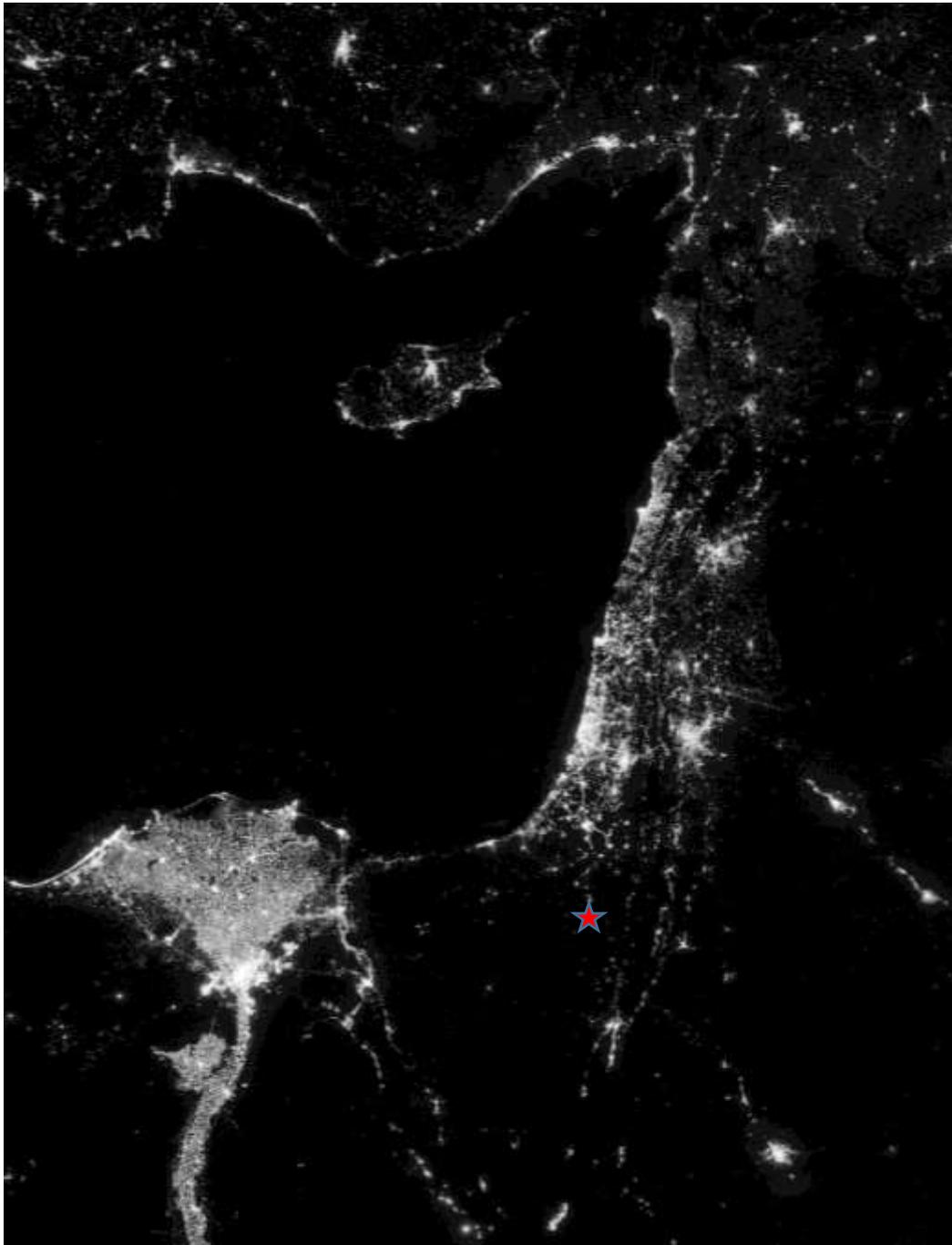


**Figure 18:** False color image of light pollution in Africa. Israel is indicated by the red arrow. Credit: P. Cinzano, F. Falchi (University of Padova), C. D. Elvidge (NOAA National Geophysical Data Center, Boulder). Copyright Royal Astronomical Society. Reproduced from the Monthly Notices of the RAS by permission of Blackwell Science.

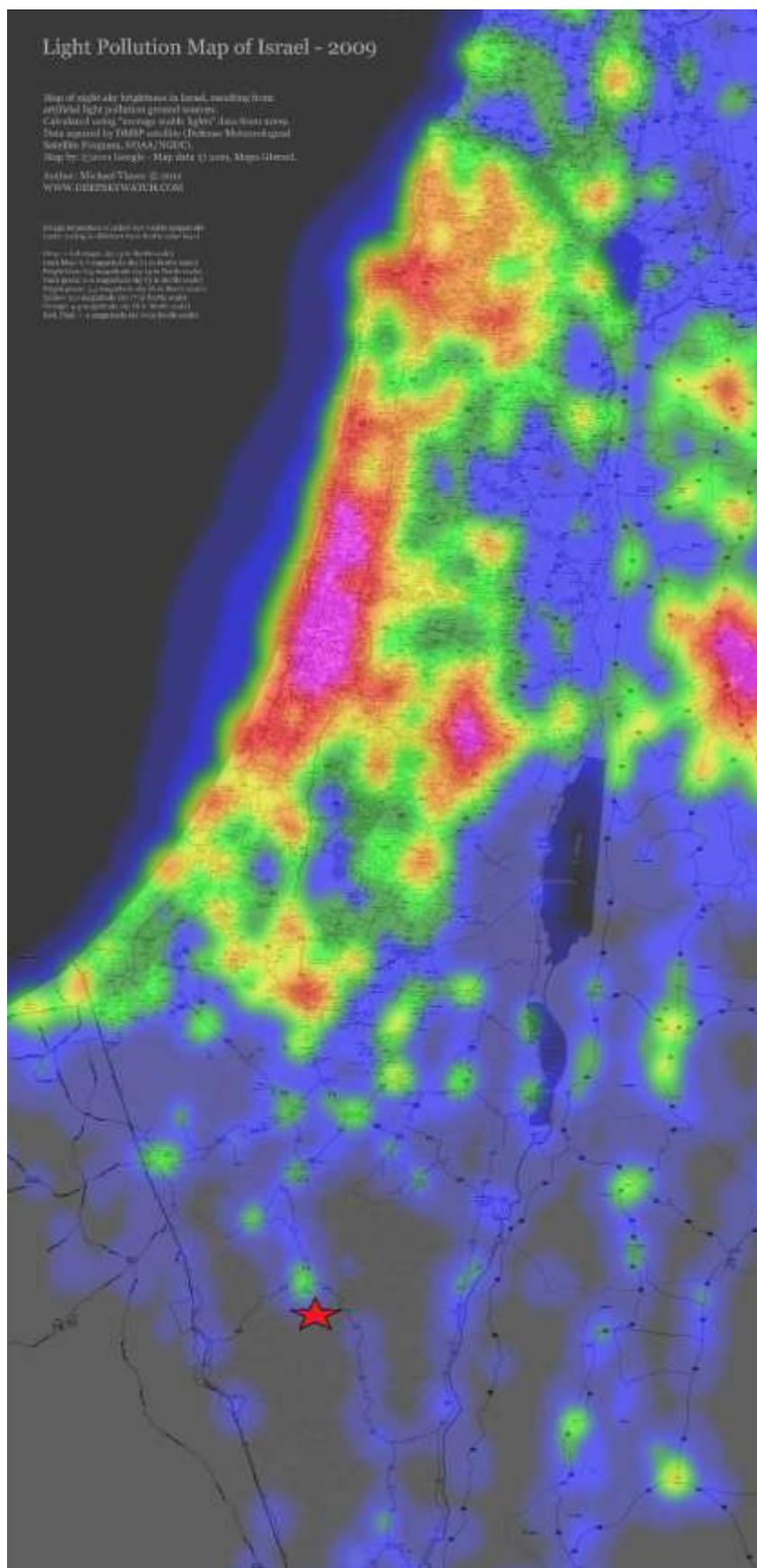


**Figure 19:** False color image of light pollution in Israel. Ramon Crater is the oval figure indicated by the red arrow. Colors correspond to ratios between the artificial sky brightness and the natural sky brightness of:  $<0.01$  (black),  $0.01-0.11$  (dark-gray),  $0.11-0.33$  (purple),  $0.33-1$  (green),  $1-3$  (yellow),  $3-9$  (orange),  $9-27$  (red),  $>27$  (white). Credit: P. Cinzano, F. Falchi (University of Padova), C. D. Elvidge (NOAA National Geophysical Data Center, Boulder). Copyright Royal Astronomical Society. Reproduced from the Monthly Notices of the RAS by permission of Blackwell Science.

NASA's Earth at Night, a section of the larger Earth Observatory program, enables a unique perspective of lights at night. Figure 20 shows the eastern part of the Mediterranean and the Nile River Valley and Delta (the mass lights on the center-left). RCNR is marked. It can be seen that the whole region surrounding Ramon Crater is characterized by very limited light pollution, with nearly no human settlement of any kind, both west, towards Egypt, and east, towards Jordan.



**Figure 20:** Nighttime view of the Nile River Valley and Delta. Credit: NASA Earth Observatory/Suomi NPP.



**Figure 21:** Light pollution map of Israel, 2009. Light data acquired by DMSP satellite. Credit: Michael Vlasov [www.deepskywatch.com](http://www.deepskywatch.com)

## Sky Quality at Ramon Crater Nature Reserve

### Existing Night Sky Conditions

Based on reviewing the above mentioned information, Ramon Crater has relatively low levels of light pollution. Following Cinzano et al. (2001), the ratios between the artificial sky brightness and the natural sky brightness is 0.11-0.33 (Figure 20). Data acquired by DMSP satellite was used for a rough estimation of naked-eye visible magnitude (Figure 21). The area of the Ramon Crater ranges between < 6.8 magnitude sky (3 in Bortle scale) to 6.7 magnitude sky (4 in Bortle scale).

### International Dark Sky Park Silver Tier Eligibility

With respect to the three night sky quality tiers (*gold*, *silver* and *bronze*) utilized by the IDA for International Dark Sky Park designations, RCNR meets all of the requirements for becoming an International Dark Sky Park at the Silver Tier Level. The reserve has some of the darkest night sky conditions in Israel, a relatively small and densely populated state, and meets this set of standards (Table 4).

**Table 4: IDA standards for International Dark Sky Park Silver Tier status and RCNP eligibility.**

Sky Quality Measurement	Silver Tier Eligibility	RCNR Existing Conditions
<b>Artificial Light And Skyglow</b>	Point light sources and glary lights do not dominate nighttime scene. Light domes present around horizon but do not stretch to zenith.	Light domes restricted to horizon and blocked by the crater walls; effects of light pollution on viewing conditions in the crater are minor.
<b>Observable Sky Phenomena</b>	Brighter sky phenomena can be regularly viewed, with fainter ones sometimes visible. Milky way is visible in summer and winter.	Natural sky phenomenon dominate the night sky. Brighter sky phenomena can be viewed regularly. Milky way is visible regularly.
<b>Nocturnal Environment</b>	Areas that have minor to moderate ground illumination from artificial skyglow. Lights that may cause disorientation to wildlife are distant. Disruption of ecological processes is minor with no impairment to plants or wildlife.	Disruption of ecological processes is minor with no impairment to plants or wildlife.
<b>Visual Limiting Magnitude</b>	6.0 to 6.7 under clear skies and good conditions	6.7-6.8 (derived from DMSP satellite); 6.5 (derived from SQM measurements)
<b>Bortle Sky Class</b>	3-5	3-4 (derived from SQM measurements)
<b>Unihedron Sky Quality Meter</b>	21.74-21.00	Avg. SQM = 21.30 mags/arc-sec <sup>2</sup> . Darkest recorded SQM = 21.70 mags/arc-sec <sup>2</sup> .

## Sky Quality Survey Data

### Data collection protocol

INPA rangers collected data on light levels in the Ramon Crater during 2013-2015 at more than 200 different locations (measurements points) within the crater. Data was collected on dark nights without moon or cloud cover. Measurements were taken after astronomic sunset and before astronomic sunrise (defined as when the sun is positioned at 18 degrees and lower below the horizon). A Sky Quality Meter handset (Unihedron model SQM-L) was used for data collection. At each location, three straight reading were taken. A mean of the two latter readings was calculated and was then used as the SQM value for that location. The coordinates of each location were recorded together with SQM values using a GIS-based field-data recording system (Cybertracker).

### Data analyzing protocol

Based on the data collection protocol, light levels data was collected in 207 locations. The locations are spatially spreads (Table 5, Figure 22) and the measured values range between 20.42-21.70 SQM.

This database enabled us to generate an interpolation between the locations sampled, and to create a 'smooth' or a 'continuous' surface of light level of the whole area of the Ramon Crater Nature Reserve. This was done in a similar method to an interpolation between elevations points which are spatially spread, which enables to calculate the total surface elevation. Instead of creating a total surface elevation, we created a 'continuous' surface of light level of the area of Ramon Crater.

The interpolation was done using ARCVIEW-GIS software by ESRI, using the 'Topo To Raster' tool, which receives elevations points as input and then generates a 'smooth' surface of the requested area. Based on mathematical calculations, the tool transform a set of individual's points into a 'continuous' surface. The "elevation" values were replaced with the average SQM readings, to create a 'smooth' or a 'continuous' surface of light level of the whole area of the Ramon Crater Nature Reserve (Figures 23-25).

**Table 5: Full night survey data collected at Ramon Crater between 2013-2015.**

<b>Date mm-dd- yyyy</b>	<b>Location: Latitude - North</b>	<b>Location: Longitude – East</b>	<b>Average SQM Reading</b>	<b>Notes</b>
11-3-2013	30.49473	34.64554	21.42	Cloudless night with no visible moon
11-3-2013	30.49477	34.65152	21.44	Cloudless night with no visible moon
11-3-2013	30.49423	34.65544	21.38	Cloudless night with no visible moon
11-3-2013	30.50715	34.65805	21.43	Cloudless night with no visible moon
11-3-2013	30.50998	34.6616	21.33	Cloudless night with no visible moon
11-3-2013	30.51358	34.66466	21.37	Cloudless night with no visible moon
11-3-2013	30.51656	34.66854	21.35	Cloudless night with no visible moon
11-3-2013	30.52287	34.67302	21.32	Cloudless night with no visible moon
11-3-2013	30.52519	34.67731	21.34	Cloudless night with no visible moon
11-3-2013	30.53839	34.68628	21.36	Cloudless night with no visible moon
11-3-2013	30.54099	34.68959	21.38	Cloudless night with no visible moon
11-3-2013	30.54831	34.69577	21.30	Cloudless night with no visible moon
11-3-2013	30.55139	34.69875	21.38	Cloudless night with no visible moon
11-3-2013	30.55326	34.70415	21.33	Cloudless night with no visible moon
11-3-2013	30.55607	34.70791	21.31	Cloudless night with no visible moon
11-3-2013	30.55884	34.71125	21.34	Cloudless night with no visible moon
11-3-2013	30.56092	34.71586	21.29	Cloudless night with no visible moon
11-3-2013	30.56364	34.72015	21.28	Cloudless night with no visible moon
11-3-2013	30.57277	34.73061	21.27	Cloudless night with no visible moon
11-3-2013	30.57209	34.7397	21.33	Cloudless night with no visible moon
11-3-2013	30.56865	34.74198	21.31	Cloudless night with no visible moon
11-4-2013	30.56671	34.74734	21.27	Cloudless night with no visible moon
11-4-2013	30.56725	34.76702	21.23	Cloudless night with no visible moon
11-4-2013	30.56903	34.77222	21.25	Cloudless night with no visible moon
11-4-2013	30.56953	34.77746	21.14	Cloudless night with no visible moon
11-4-2013	30.57128	34.78233	21.19	Cloudless night with no visible moon

Date mm-dd- yyyy	Location: Latitude - North	Location: Longitude - East	Average SQM Reading	Notes
11-4-2013	30.56753	34.79337	21.24	Cloudless night with no visible moon
11-4-2013	30.55433	34.79547	21.22	Cloudless night with no visible moon
11-4-2013	30.58192	34.80201	21.05	Cloudless night with no visible moon
11-4-2013	30.58477	34.80571	21.00	Cloudless night with no visible moon
11-4-2013	30.58726	34.80813	21.03	Cloudless night with no visible moon
11-4-2013	30.58932	34.81936	21.07	Cloudless night with no visible moon
11-4-2013	30.59284	34.83325	20.99	Cloudless night with no visible moon
11-4-2013	30.59561	34.83775	21.12	Cloudless night with no visible moon
11-4-2013	30.5984	34.84166	21.08	Cloudless night with no visible moon
11-4-2013	30.59477	34.84383	21.07	Cloudless night with no visible moon
11-4-2013	30.60196	34.85072	21.12	Cloudless night with no visible moon
11-4-2013	30.60441	34.86085	21.08	Cloudless night with no visible moon
11-4-2013	30.59637	34.87782	21.20	Cloudless night with no visible moon
11-4-2013	30.59642	34.8758	21.21	Cloudless night with no visible moon, Taken inside a small campground (Geves)
11-4-2013	30.59459	34.87514	21.20	Cloudless night with no visible moon, Taken inside a small campground (Geves)
11-4-2013	30.59262	34.87279	21.27	Cloudless night with no visible moon
11-4-2013	30.59169	34.86724	21.18	Cloudless night with no visible moon
11-4-2013	30.57924	34.85446	21.16	Cloudless night with no visible moon
11-4-2013	30.58652	34.84499	21.08	Cloudless night with no visible moon
11-4-2013	30.59158	34.83636	21.07	Cloudless night with no visible moon
11-4-2013	30.6104	34.85484	21.12	Cloudless night with no visible moon
11-4-2013	30.6091	34.85346	21.03	Cloudless night with no visible moon
11-4-2013	30.60593	34.85715	21.07	Cloudless night with no visible moon
11-4-2013	30.60251	34.85931	21.06	Cloudless night with no visible moon
11-4-2013	30.59658	34.86698	21.17	Cloudless night with no visible moon

Date mm-dd- yyyy	Location: Latitude - North	Location: Longitude – East	Average SQM Reading	Notes
11-4-2013	30.59345	34.87026	21.08	Cloudless night with no visible moon
11-4-2013	30.58936	34.87245	21.23	Cloudless night with no visible moon
11-4-2013	30.58795	34.87405	21.15	Cloudless night with no visible moon
11-4-2013	30.58606	34.88369	21.13	Cloudless night with no visible moon
11-4-2013	30.58464	34.87594	21.06	Cloudless night with no visible moon
11-4-2013	30.58461	34.88146	21.20	Cloudless night with no visible moon
11-4-2013	30.58629	34.88585	21.20	Cloudless night with no visible moon
11-4-2013	30.58361	34.88743	21.19	Cloudless night with no visible moon
11-4-2013	30.58772	34.88243	21.10	Cloudless night with no visible moon
11-4-2013	30.58942	34.88821	21.20	Cloudless night with no visible moon
1-21-2015	30.6189	34.81357	21.00	Cloudless night with no visible moon
1-21-2015	30.62392	34.83611	21.10	Cloudless night with no visible moon
1-21-2015	30.62074	34.84257	21.08	Cloudless night with no visible moon
1-21-2015	30.61683	34.83934	21.14	Cloudless night with no visible moon
1-21-2015	30.61362	34.83934	21.14	Cloudless night with no visible moon
1-21-2015	30.61269	34.85544	21.17	Cloudless night with no visible moon
1-21-2015	30.60604	34.86371	21.19	Cloudless night with no visible moon
1-21-2015	30.60099	34.87054	21.22	Cloudless night with no visible moon
1-21-2015	30.59396	34.88577	21.23	Cloudless night with no visible moon
1-21-2015	30.59154	34.88947	21.26	Cloudless night with no visible moon
1-21-2015	30.58515	34.89082	21.34	Cloudless night with no visible moon
1-21-2015	30.59282	34.87196	21.33	Cloudless night with no visible moon
1-21-2015	30.5888	34.86453	21.22	Cloudless night with no visible moon
1-21-2015	30.58719	34.86287	21.31	Cloudless night with no visible moon
1-21-2015	30.58484	34.85883	21.35	Cloudless night with no visible moon
1-21-2015	30.58185	34.85509	21.30	Cloudless night with no visible moon
1-21-2015	30.57766	34.85464	21.23	Cloudless night with no visible moon

Date mm-dd- yyyy	Location: Latitude - North	Location: Longitude – East	Average SQM Reading	Notes
1-21-2015	30.57639	34.84998	21.38	Cloudless night with no visible moon
1-21-2015	30.57896	34.84532	21.44	Cloudless night with no visible moon
1-21-2015	30.58275	34.84319	21.42	Cloudless night with no visible moon
1-21-2015	30.58646	34.84112	21.41	Cloudless night with no visible moon
1-21-2015	30.58902	34.83704	21.37	Cloudless night with no visible moon
1-21-2015	30.59138	34.83286	21.32	Cloudless night with no visible moon
1-21-2015	30.59442	34.83642	21.20	Cloudless night with no visible moon
1-21-2015	30.59592	34.84087	21.18	Cloudless night with no visible moon
1-21-2015	30.59902	34.84443	21.16	Cloudless night with no visible moon
1-21-2015	30.6013	34.84876	21.21	Cloudless night with no visible moon
1-21-2015	30.60234	34.85349	21.20	Cloudless night with no visible moon
1-21-2015	30.60407	34.85879	21.22	Cloudless night with no visible moon
1-22-2015	30.59011	34.82767	21.23	Cloudless night with no visible moon
1-22-2015	30.58958	34.82318	21.24	Cloudless night with no visible moon
1-22-2015	30.58849	34.81778	21.14	Cloudless night with no visible moon
1-22-2015	30.58797	34.81304	21.19	Cloudless night with no visible moon
1-22-2015	30.5792	34.79667	21.26	Cloudless night with no visible moon
1-22-2015	30.58005	34.79173	21.29	Cloudless night with no visible moon
1-22-2015	30.57719	34.78832	21.26	Cloudless night with no visible moon
1-22-2015	30.55445	34.79548	21.42	Cloudless night with no visible moon
1-22-2015	30.55829	34.79376	21.36	Cloudless night with no visible moon
1-22-2015	30.5623	34.79186	21.42	Cloudless night with no visible moon
1-22-2015	30.57214	34.79118	21.41	Cloudless night with no visible moon
1-22-2015	30.57405	34.78879	21.38	Cloudless night with no visible moon
1-22-2015	30.57332	34.78588	21.39	Cloudless night with no visible moon
1-22-2015	30.56736	34.76701	21.46	Cloudless night with no visible moon
1-22-2015	30.56648	34.76222	21.49	Cloudless night with no visible moon

<b>Date mm-dd- yyyy</b>	<b>Location: Latitude - North</b>	<b>Location: Longitude – East</b>	<b>Average SQM Reading</b>	<b>Notes</b>
1-22-2015	30.56611	34.75728	21.48	Cloudless night with no visible moon
1-22-2015	30.56677	34.75252	21.49	Cloudless night with no visible moon
1-22-2015	30.57431	34.73703	21.50	Cloudless night with no visible moon
1-22-2015	30.57324	34.73179	21.54	Cloudless night with no visible moon
1-22-2015	30.57183	34.72729	21.50	Cloudless night with no visible moon
1-22-2015	30.56834	34.72376	21.32	Cloudless night with no visible moon
1-22-2015	30.55693	34.70936	21.53	Cloudless night with no visible moon
1-22-2015	30.55365	34.7055	21.54	Cloudless night with no visible moon
1-22-2015	30.55165	34.70121	21.60	Cloudless night with no visible moon
1-22-2015	30.54972	34.69705	21.60	Cloudless night with no visible moon
1-22-2015	30.54666	34.69382	21.60	Cloudless night with no visible moon
1-22-2015	30.53291	34.68207	21.45	Cloudless night with no visible moon
1-22-2015	30.529	34.67922	21.49	Cloudless night with no visible moon
1-22-2015	30.5259	34.67551	21.58	Cloudless night with no visible moon
1-22-2015	30.52273	34.67244	21.56	Cloudless night with no visible moon
1-22-2015	30.51942	34.67002	21.43	Cloudless night with no visible moon
1-22-2015	30.50572	34.65785	21.40	Cloudless night with no visible moon
1-22-2015	30.50298	34.65716	21.43	Cloudless night with no visible moon
1-22-2015	30.49982	34.65542	21.45	Cloudless night with no visible moon
1-22-2015	30.49773	34.65605	21.41	Cloudless night with no visible moon
1-22-2015	30.49484	34.65558	21.64	Cloudless night with no visible moon
1-22-2015	30.49467	34.65222	21.70	Cloudless night with no visible moon
1-22-2015	30.49496	34.64916	21.68	Cloudless night with no visible moon
1-22-2015	30.49441	34.64616	21.70	Cloudless night with no visible moon
1-22-2015	30.49604	34.64714	21.66	Cloudless night with no visible moon
6-15-2015	30.5862	34.89658	21.41	Cloudless night with no visible moon
6-15-2015	30.58853	34.90116	21.52	Cloudless night with no visible moon

Date mm-dd- yyyy	Location: Latitude - North	Location: Longitude – East	Average SQM Reading	Notes
6-15-2015	30.59073	34.90583	21.52	Cloudless night with no visible moon
6-15-2015	30.592	34.9105	21.51	Cloudless night with no visible moon
6-15-2015	30.59261	34.91555	21.47	Cloudless night with no visible moon
6-15-2015	30.58892	34.91827	21.49	Cloudless night with no visible moon
6-15-2015	30.59714	34.91757	21.47	Cloudless night with no visible moon
6-15-2015	30.60173	34.91826	20.98	Cloudless night with no visible moon
6-15-2015	30.60859	34.91942	20.49	Cloudless night with no visible moon
6-15-2015	30.61323	34.91979	20.74	Cloudless night with no visible moon
6-15-2015	30.61781	34.91944	21.30	Cloudless night with no visible moon
6-15-2015	30.62214	34.92041	21.27	Cloudless night with no visible moon
6-15-2015	30.6268	34.92013	20.42	Cloudless night with no visible moon
6-15-2015	30.63135	34.91987	21.48	Cloudless night with no visible moon
6-15-2015	30.63605	34.91974	21.28	Cloudless night with no visible moon
6-15-2015	30.6405	34.9203	21.20	Cloudless night with no visible moon
6-15-2015	30.6436	34.92378	20.92	Cloudless night with no visible moon
6-15-2015	30.64461	34.92839	20.85	Cloudless night with no visible moon
6-15-2015	30.64473	34.93294	21.47	Cloudless night with no visible moon
6-15-2015	30.64523	34.93803	21.13	Cloudless night with no visible moon
6-15-2015	30.61987	34.91579	21.43	Cloudless night with no visible moon
6-15-2015	30.6235	34.91361	21.48	Cloudless night with no visible moon
6-15-2015	30.62063	34.90966	21.44	Cloudless night with no visible moon
6-15-2015	30.61909	34.90557	21.43	Cloudless night with no visible moon
6-15-2015	30.61744	34.89922	21.47	Cloudless night with no visible moon
6-15-2015	30.61682	34.89365	21.44	Cloudless night with no visible moon
6-15-2015	30.61671	34.88942	21.46	Cloudless night with no visible moon
6-15-2015	30.61425	34.88473	21.43	Cloudless night with no visible moon
6-15-2015	30.61168	34.8807	21.41	Cloudless night with no visible moon

Date mm-dd- yyyy	Location: Latitude - North	Location: Longitude – East	Average SQM Reading	Notes
6-15-2015	30.61007	34.87435	21.47	Cloudless night with no visible moon
6-15-2015	30.60571	34.87347	21.45	Cloudless night with no visible moon
6-18-2015	30.59471	34.88932	21.16	Cloudless night with no visible moon
6-18-2015	30.59843	34.89221	21.39	Cloudless night with no visible moon
6-18-2015	30.60177	34.89542	21.41	Cloudless night with no visible moon
6-18-2015	30.60609	34.89758	21.31	Cloudless night with no visible moon
6-18-2015	30.60985	34.90056	21.23	Cloudless night with no visible moon
6-18-2015	30.61347	34.90344	21.26	Cloudless night with no visible moon
6-18-2015	30.61264	34.90813	21.22	Cloudless night with no visible moon
6-18-2015	30.61443	34.91205	21.32	Cloudless night with no visible moon
6-18-2015	30.61792	34.91561	21.20	Cloudless night with no visible moon
6-18-2015	30.6242	34.92149	21.23	Cloudless night with no visible moon
6-18-2015	30.62309	34.92663	21.21	Cloudless night with no visible moon
6-18-2015	30.61986	34.92903	21.23	Cloudless night with no visible moon
6-18-2015	30.61542	34.93073	21.22	Cloudless night with no visible moon
6-18-2015	30.61169	34.93354	21.22	Cloudless night with no visible moon
6-18-2015	30.60811	34.93631	21.23	Cloudless night with no visible moon
6-18-2015	30.60507	34.93762	21.28	Cloudless night with no visible moon
6-18-2015	30.6028	34.93486	21.25	Cloudless night with no visible moon
6-18-2015	30.60123	34.93024	21.30	Cloudless night with no visible moon
6-18-2015	30.5992	34.92673	21.23	Cloudless night with no visible moon
6-18-2015	30.5976	34.92259	21.21	Cloudless night with no visible moon
6-18-2015	30.5976	34.92259	21.24	Cloudless night with no visible moon
6-18-2015	30.60467	34.93878	21.23	Cloudless night with no visible moon
6-18-2015	30.60369	34.94331	21.23	Cloudless night with no visible moon
6-18-2015	30.60447	34.94686	21.24	Cloudless night with no visible moon
6-18-2015	30.6036	34.95093	21.24	Cloudless night with no visible moon

Date mm-dd- yyyy	Location: Latitude - North	Location: Longitude – East	Average SQM Reading	Notes
6-18-2015	30.60017	34.95327	21.23	Cloudless night with no visible moon
6-18-2015	30.60363	34.95217	21.22	Cloudless night with no visible moon
6-18-2015	30.60138	34.94877	21.22	Cloudless night with no visible moon
6-18-2015	30.59996	34.94681	21.30	Cloudless night with no visible moon
6-18-2015	30.60507	34.95615	21.23	Cloudless night with no visible moon
6-18-2015	30.60834	34.95747	21.25	Cloudless night with no visible moon
6-18-2015	30.61214	34.95617	21.25	Cloudless night with no visible moon
6-18-2015	30.61405	34.95266	21.23	Cloudless night with no visible moon
6-18-2015	30.6156	34.94801	21.22	Cloudless night with no visible moon
6-18-2015	30.61869	34.94473	21.22	Cloudless night with no visible moon
6-18-2015	30.61723	34.94087	21.21	Cloudless night with no visible moon
6-18-2015	30.61853	34.93632	21.16	Cloudless night with no visible moon
6-18-2015	30.61924	34.93174	21.22	Cloudless night with no visible moon
6-18-2015	30.62165	34.92848	21.20	Cloudless night with no visible moon
6-18-2015	30.64481	34.92079	21.19	Cloudless night with no visible moon
6-18-2015	30.64937	34.92203	21.21	Cloudless night with no visible moon
6-18-2015	30.65324	34.92294	21.22	Cloudless night with no visible moon
6-18-2015	30.66212	34.92495	21.20	Cloudless night with no visible moon
6-18-2015	30.66653	34.92481	21.21	Cloudless night with no visible moon
6-18-2015	30.67079	34.92464	21.19	Cloudless night with no visible moon
6-18-2015	30.67487	34.92386	21.21	Cloudless night with no visible moon
6-18-2015	30.67937	34.92392	21.26	Cloudless night with no visible moon
6-18-2015	30.6832	34.9234	21.21	Cloudless night with no visible moon
7-12-2015	30.65871	34.92534	21.48	Cloudless night with no visible moon
7-12-2015	30.66024	34.9278	21.43	Cloudless night with no visible moon
7-12-2015	30.66361	34.93053	21.45	Cloudless night with no visible moon
7-12-2015	30.6661	34.93383	21.40	Cloudless night with no visible moon

Date mm-dd- yyyy	Location: Latitude - North	Location: Longitude – East	Average SQM Reading	Notes
7-12-2015	30.66961	34.9357	21.47	Cloudless night with no visible moon
7-12-2015	30.67293	34.93757	21.47	Cloudless night with no visible moon
7-12-2015	30.67627	34.93903	21.47	Cloudless night with no visible moon
7-12-2015	30.67982	34.9411	21.51	Cloudless night with no visible moon
7-12-2015	30.68268	34.94393	21.51	Cloudless night with no visible moon
7-12-2015	30.68516	34.94722	21.48	Cloudless night with no visible moon
7-12-2015	30.68797	34.94976	21.48	Cloudless night with no visible moon
7-12-2015	30.69176	34.94986	21.48	Cloudless night with no visible moon
7-12-2015	30.69335	34.95083	21.41	Cloudless night with no visible moon
7-12-2015	30.69512	34.95293	21.46	Cloudless night with no visible moon
7-12-2015	30.66171	34.93215	21.42	Cloudless night with no visible moon
7-12-2015	30.66251	34.93647	21.48	Cloudless night with no visible moon
7-12-2015	30.66326	34.941	21.42	Cloudless night with no visible moon
7-12-2015	30.66288	34.94519	21.49	Cloudless night with no visible moon
7-12-2015	30.66141	34.94939	21.46	Cloudless night with no visible moon
7-12-2015	30.66028	34.95318	21.48	Cloudless night with no visible moon
7-12-2015	30.65931	34.9548	21.50	Cloudless night with no visible moon
7-12-2015	30.62962	34.91595	21.47	Cloudless night with no visible moon
7-12-2015	30.63137	34.91346	21.49	Cloudless night with no visible moon
7-12-2015	30.6323	34.91034	21.40	Cloudless night with no visible moon
7-12-2015	30.63353	34.90674	21.37	Cloudless night with no visible moon
7-13-2015	30.63389	34.90304	21.47	Cloudless night with no visible moon
7-13-2015	30.63421	34.89951	21.35	Cloudless night with no visible moon
7-13-2015	30.63643	34.89674	21.41	Cloudless night with no visible moon
7-13-2015	30.63842	34.89302	21.34	Cloudless night with no visible moon
7-13-2015	30.63917	34.8896	21.34	Cloudless night with no visible moon
7-13-2015	30.64111	34.88691	21.35	Cloudless night with no visible moon

Date mm-dd- yyyy	Location: Latitude - North	Location: Longitude – East	Average SQM Reading	Notes
7-13-2015	30.64252	34.88337	21.32	Cloudless night with no visible moon
7-13-2015	30.64388	34.88001	21.27	Cloudless night with no visible moon
7-13-2015	30.6469	34.8799	21.29	Cloudless night with no visible moon
7-13-2015	30.64962	34.87703	21.26	Cloudless night with no visible moon
7-14-2015	30.64824	35.02401	21.41	Cloudless night with no visible moon
7-14-2015	30.64804	35.01847	21.43	Cloudless night with no visible moon
7-14-2015	30.64912	35.0141	21.49	Cloudless night with no visible moon
7-14-2015	30.6492	35.00929	21.48	Cloudless night with no visible moon
7-15-2015	30.64566	35.00642	21.45	Cloudless night with no visible moon
7-15-2015	30.64265	35.00257	21.44	Cloudless night with no visible moon
7-15-2015	30.63942	34.99898	21.29	Cloudless night with no visible moon
7-15-2015	30.63618	34.99573	21.27	Cloudless night with no visible moon
7-15-2015	30.63268	34.99281	21.32	Cloudless night with no visible moon
7-15-2015	30.62947	34.989	21.36	Cloudless night with no visible moon
7-15-2015	30.62682	34.98591	21.39	Cloudless night with no visible moon
7-15-2015	30.62426	34.98274	21.29	Cloudless night with no visible moon
7-15-2015	30.62426	34.98274	21.37	Cloudless night with no visible moon
7-15-2015	30.62426	34.98274	21.46	Cloudless night with no visible moon
7-15-2015	30.62263	34.9782	21.30	Cloudless night with no visible moon
7-15-2015	30.61923	34.97602	21.29	Cloudless night with no visible moon
7-15-2015	30.61605	34.97269	21.30	Cloudless night with no visible moon
7-15-2015	30.61362	34.96875	21.28	Cloudless night with no visible moon
7-15-2015	30.61157	34.96447	21.32	Cloudless night with no visible moon
7-15-2015	30.60761	34.96118	21.30	Cloudless night with no visible moon
7-15-2015	30.61651	34.84683	21.28	Cloudless night with no visible moon
7-15-2015	30.61983	34.84213	21.16	Cloudless night with no visible moon
7-15-2015	30.61759	34.84144	21.18	Cloudless night with no visible moon

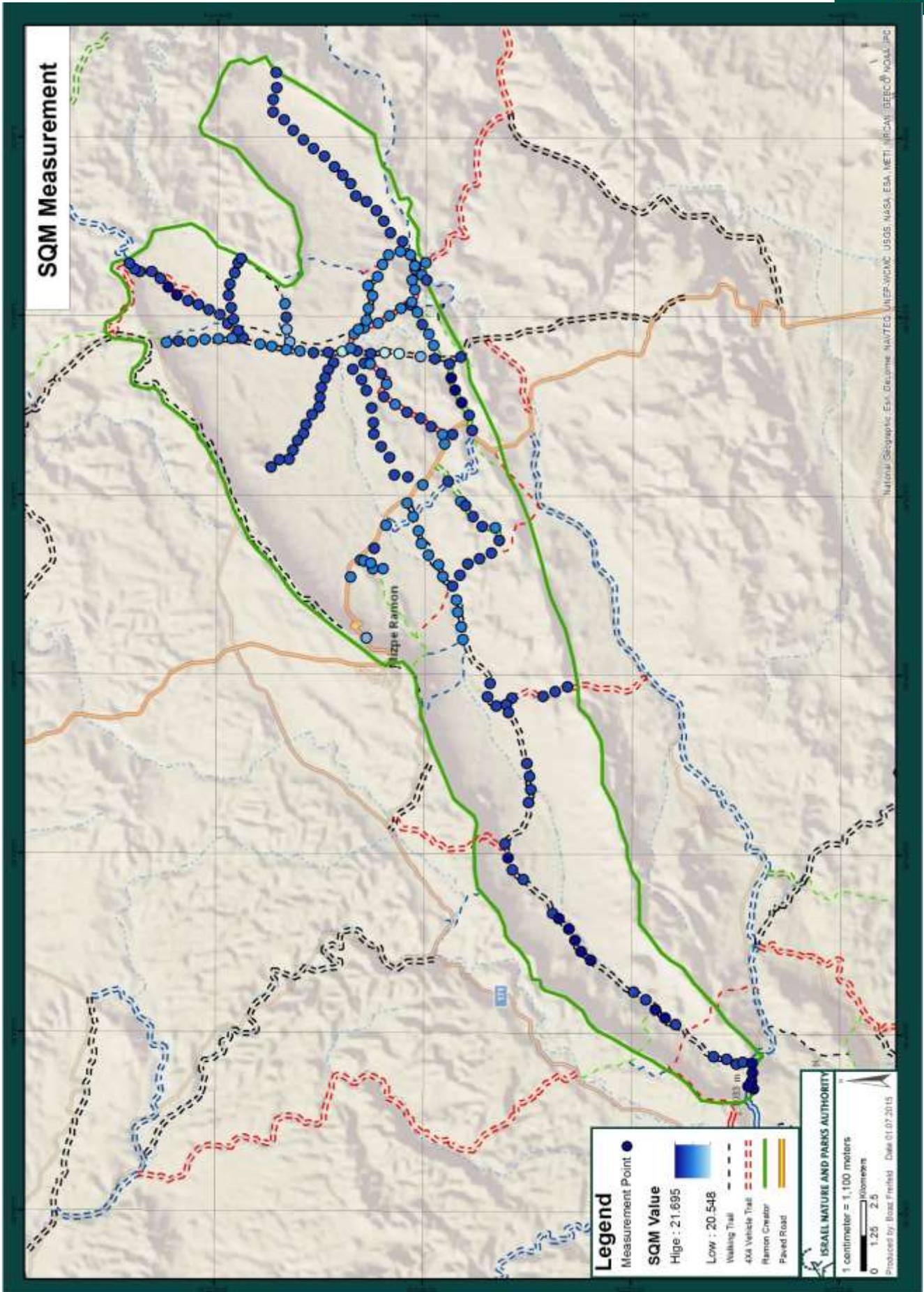


Figure 22: SQM Measurement points in the Ramon Crater.

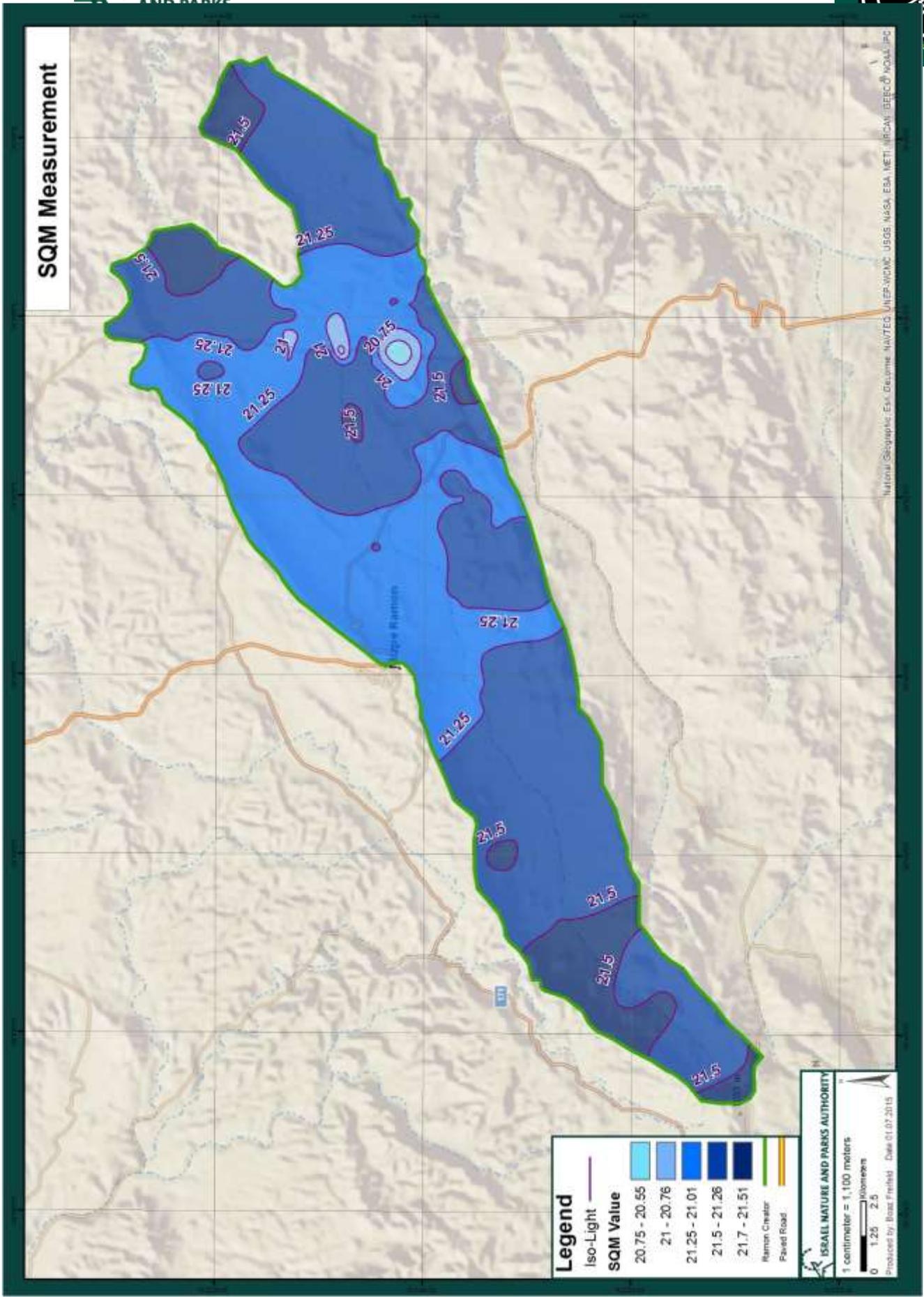


Figure 23: Categorical SQM levels in the Ramon Crater.

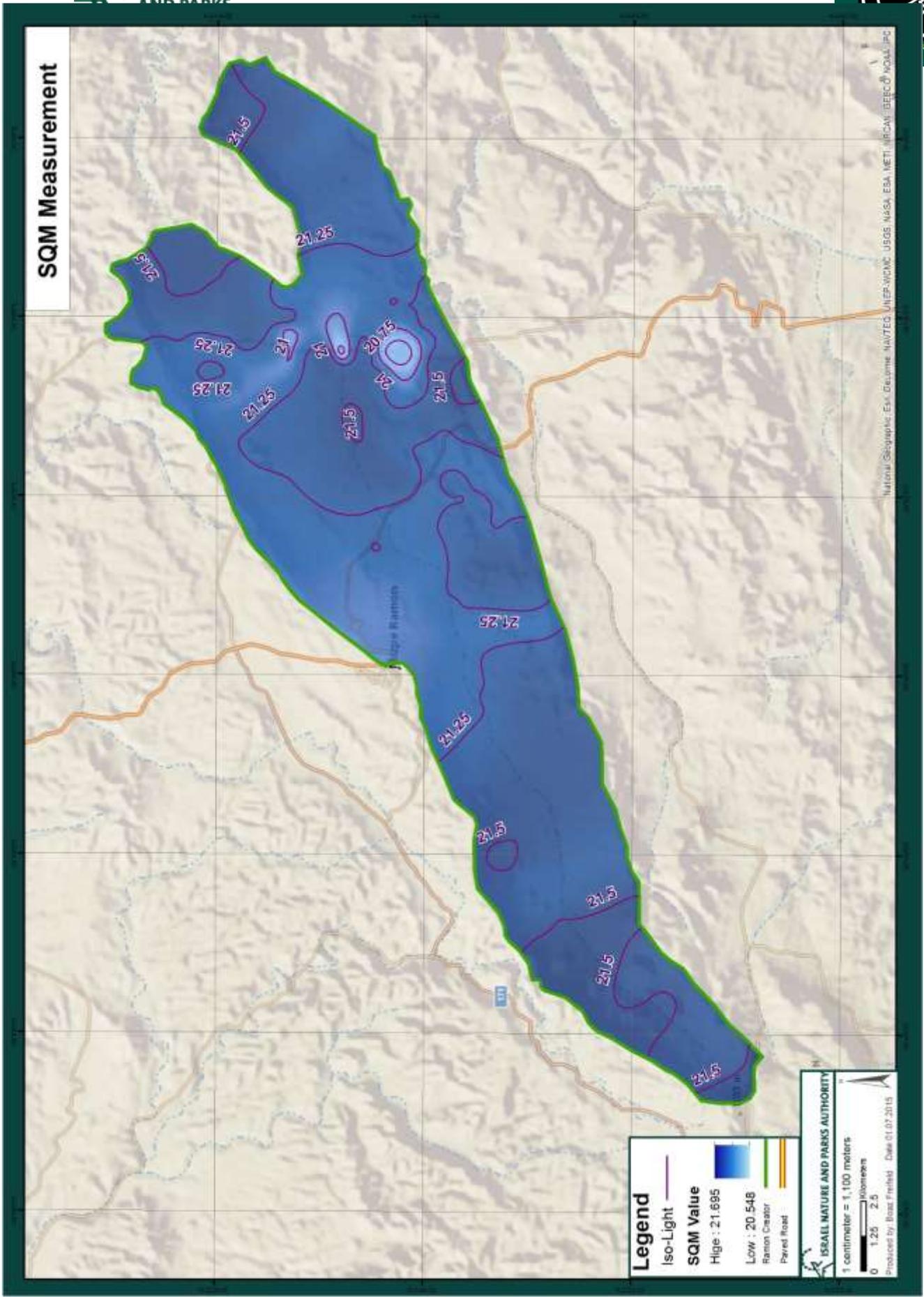


Figure 24: Continuous SQM levels plus contours in the Ramon Crater.

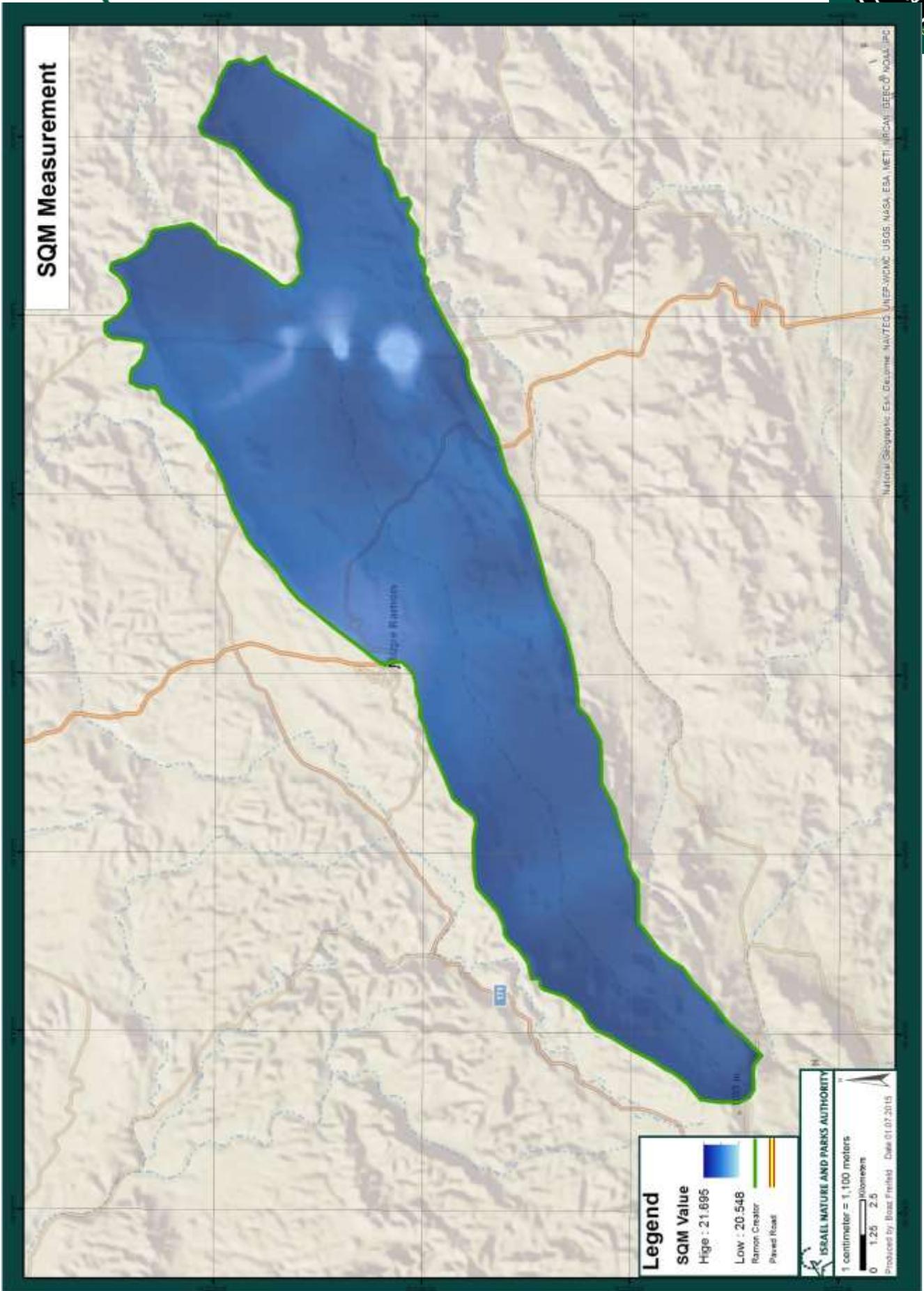


Figure 25: Continuous SQM levels in the Ramon Crater.

## Long Term Monitoring

The Israel Nature & Parks Authority and Ramon Crater Nature Reserve staff are committed to the conservation of dark skies and to collecting long-term sky quality measurements and documentation.

INPA Ramon Crater staff will implement yearly measurements throughout the crater to track the stability of night skies within the park and monitor any improvement or degradation at 12 locations, located along the main axes (north-south / east-west) and roads within the crater (Table 6, Figure 26).

Measurements will be taken using handheld Unihedron Sky Quality Meters (model SQM-L). A GIS based collection system was developed to enable easy data collection and long-term analysis of night sky quality at the determined sampling locations. Additionally, a continuous monitoring unit (Unihedron model SQM-LU) will be installed at the Be'erot Overnight Campground, to monitor the effects of artificial lighting on night sky quality and the campgrounds compliance with the parks lighting guidelines.

These measurements will be submitted as part of Dark Sky Places Program Annual Report submitted to the IDA.

**Table 6: Locations and latest SQM measurement of the 12 locations for long term monitoring in Ramon Crater**

ID	Location: Longitude – East	Location: Latitude - North	Last Measured	Average SQM Reading	Notes
1	34.81357	30.6189	01-21-15	21	Near Mizpe Ramon
2	34.87196	30.59282	01-21-15	21.33	Near Campground
3	34.83286	30.59138	01-21-15	21.315	In The Core Area
4	34.78879	30.57405	01-22-15	21.375	In The Core Area
5	34.7055	30.55365	01-22-15	21.535	In The Core Area
6	34.65222	30.49467	01-22-15	21.695	Darkest Point
7	34.91555	30.59261	06-15-15	21.47	Near Campground
8	34.91979	30.61323	06-15-15	20.735	Minimal Lighting Area
9	34.94722	30.68516	07-12-15	21.475	Minimal Lighting Area
10	34.9548	30.65931	07-12-15	21.5	Near Campground
11	34.99281	30.63268	07-15-15	21.315	Minimal Lighting Area
12	34.84144	30.61759	07-15-15	21.18	Near The Road

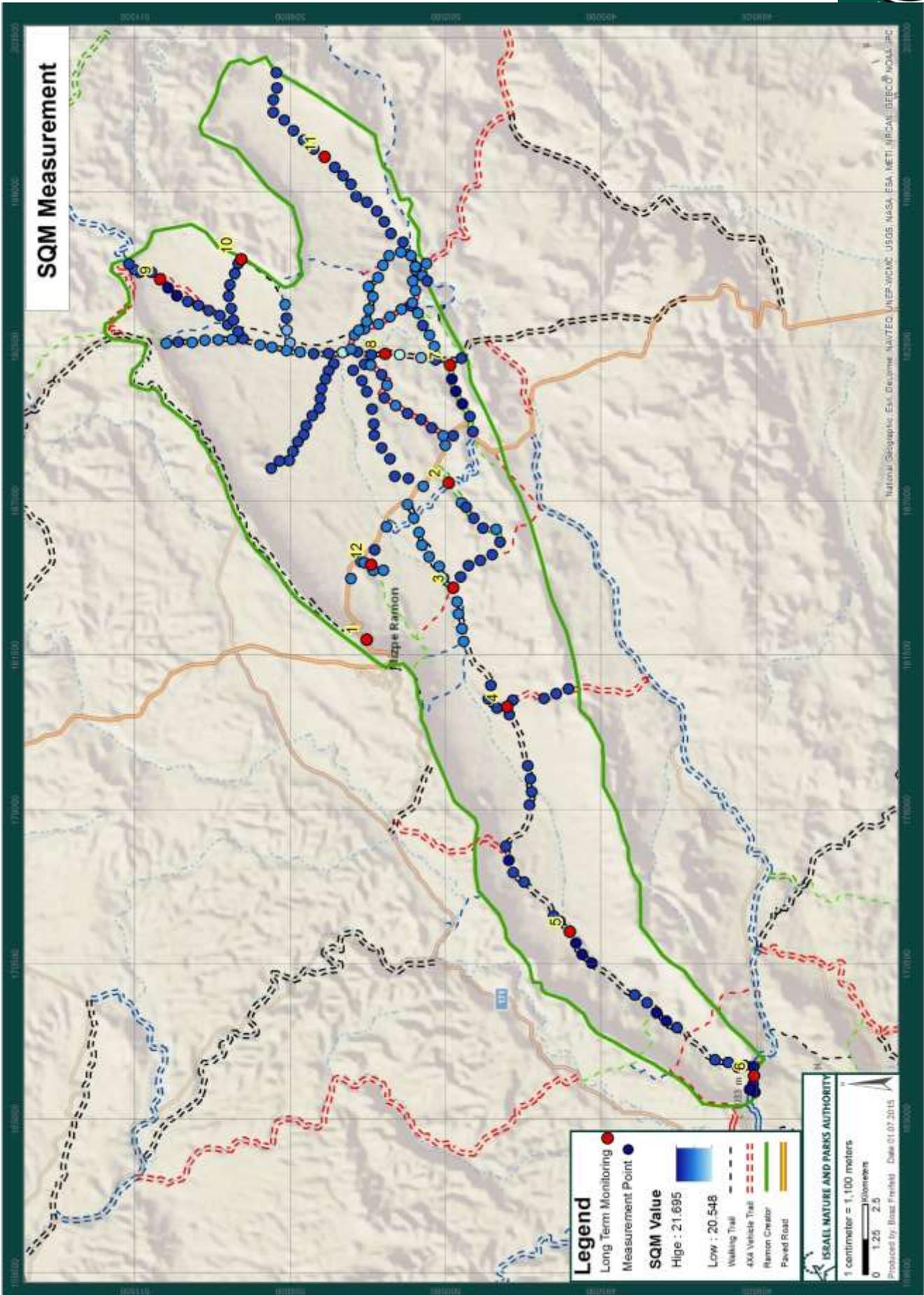


Figure 26: Locations for long term monitoring of SQM level.

## Visitor Experience

The Ramon Crater Nature Reserve is already publically associated with its world class quality of night skies. Every year the undisturbed night skies of Ramon Crater attract many visitors who come to enjoy the darkness, and the countless stars above them. Many come to engage in astronomical activities, some even bringing with them their own telescopes, or simply to view one of the many meteorite showers. The yearly Perseid meteor shower in August attracts up to 50,000 people to the Negev desert, many of them engage in instructed meteorite viewing near or in the crater. The Be'erot campground hosts up to 1,000 visitors during this time (full-capacity), in a spectacular setting optimized for star-gazing, equipped with telescopes and guided viewing by professional astronomers.

To further engage the public in night time activities, with the educational goal of raising the public awareness to the topic of night skies and darkness and its importance, several activities are designed. These will be carried out by park staff throughout the year, with special attention on holiday times, when visiting season is at its peak.

Several of the educational programs are listed below:

**Starry night:** The activity will focus on the starry night skies typical of the Ramon Crater. Different observation instruments will be used during the guidance (telescopes, smartphone apps, laser pointers, star maps). An overview on the development of astronomy as a field of science will be presented. Guided star gazing will be conducted, and the term 'light pollution' will be explained and discussed, as well as the importance of open spaces for the conservation of darkness, together with ways to reduce light pollution.

**Glowing scorpions:** The activity will focus on nocturnal animals, and specifically on scorpions as they glow under UV light. This will lead the activity to discuss nocturnal life and the various forms of biological adaptations. Observation on scorpions will take place in the area of the campground, using a UV flashlight. During the guidance, special attention will be given to scorpions in different cultural traditions, their life cycle, venom, mating dance, offspring, unique body construction and the assumptions for the glow produced by UV light. Habitat as a term will be explained, with a focus on the reduction of available habitats and on landscape restoration acts.

**Walking in the dark:** The activity will deal with the visible and invisible light spectrum. Topics such as what different colors are made of, how different animals see, including examples of the different adaptations for different types of sight. Light measurement devices will be used, as well as different types of binoculars and other instruments for the illustration of the light

spectrum and the night light on earth. Lights of different colors will be introduced and played with. The importance of the protection of wildlife nocturnal activity will be explained, as well as the methods used at the RCISR to mitigate light pollution.

**Animals in the desert:** The activity will focus on the senses, and is designed primarily for families with young children. Our different senses will be explored, and a comparison between the senses human use and the senses that animals use during night time will be made, by short games and illustrations. Unique body types, designed to sharpen specific senses, will be discussed, together with potential man-made disturbances.



**Figure 29:** A Scorpion glows under UV light. Photo credit: Asaf Tsoar, INPA

Based on positive experience from the last three years, instructed star-gazing events are scheduled at least five times a year at the Be'erot campground (Figure 30, 31):

1. Annual INPA Nature Conservation Week – yearly on the second week of March.
2. Passover holiday – yearly in late Spring (March-April).
3. Annual Perseid meteor shower – yearly in the middle of August.
4. Sucot (Pentacost) holiday – yearly in the fall (September-October).
5. Hanuka holiday – yearly in December.



**Figure 30:** Full occupancy (~800 people) at the Bee'rot campground on the eve of the Annual Perseid Shower, August 2016. Photo credit: Nadav Taube, INPA.



**Figure 31:** Visitors to the Bee'rot campground engaged in guided star-gazing activity. . Photo credit: Noam Leader, INPA.

### **Ramon Crater Visitor Center**

Re-opened in 2013, the renovated Ramon Crater Visitor Center is set on the northern cliffs of the Ramon Crater at the edge of the town of Mitzpe Ramon. The Visitor Center offers interactive exhibits explaining the natural processes which led to the creation of the crater, together with information about the plant and animal life of the region. It also serves as a museum and memorial for Ilan Ramon, Israel's first astronaut who perished together with the crew members of the Space shuttle Columbia in 2003 when the Shuttle disintegrated while re-entering the earth's atmosphere. The visitor center offers regular star gazing tours using professional guides and telescope viewing. A new film dealing with astronomy, light pollution and dark sky conservation is currently in the making and is scheduled to be shown at the visitor center in 2017.

In addition, INPA plans the installations of road signs, to inform visitors on the importance of darkness, and to provide instructions according to the guiding principles of the Ramon Crater Nature Reserve Lightscape Management Plan. They will be installed along Highway 40, from the Visitor Center along the highway down to the crater, and upon leaving the highway to the main dirt roads.

### **Public Outreach**

INPA policy encourages integration of the public in nature conservation. The INPA cooperates with the Directing Light Group (<http://www.ormekuvan.co.il/>), an Israeli NGO specializing in light pollution and its mitigation. There is an ongoing work with the local council of Mitzpe Ramon and the military authorities, to work side-by-side for the mitigation of light pollution.

"Losing the Dark" – a short planetarium show and video on light pollution produced by the IDA and Loch Ness Productions was translated to Hebrew. The movie is planned to be exhibited at the Ramon Visitor Center and as part of night awareness activity at the Bee'rot Campground.

English version: <http://darksky.org/resources/losing-the-dark/>

Hebrew version: <https://www.youtube.com/watch?v=tqJ5HyZBCKE&feature=youtu.be>

(Translated by Dr. Noam Leader, INPA Science Division, dubbing: Zohar Leader).

## Public support



**Figure 33:** "Every Person has a Star in the Sky" Campaign: During the 2015 Perseid shower viewing event at the Be'erot Campground in the Ramon Crater, visitors were asked to support the declaration of the Ramon Crater as an IDA Dark Sky Park. After listening to a talk by an INPA guide, the visitors pasted a star on the banner with their signature. More than 500 stars and signatures were collected. Photo credit: Tom Amit, INPA.



**Figure 34:** Dr. Noam Leader from the INPA Science Division explains to visitors about the plans to declare the Ramon Crater as an IDA Dark Sky Park. Photo credit: Tom Amit, INPA.



**Figure 35:** A bright "future astronomer" lights up one of the first stars. Photo credit: Tom Amit, INPA.

## Media Coverage

Television article on Israel Channel 2 news. Broadcast on 10/1/2015 (in Hebrew):

### ***To darken the crater: A voyage among the stars in the Negev.***

Video on: [http://www.mako.co.il/news-channel2/Channel-2-Newscast-q4\\_2015/Article-92813fa64052051004.htm](http://www.mako.co.il/news-channel2/Channel-2-Newscast-q4_2015/Article-92813fa64052051004.htm)



Online | החדשות 2

מכתש רמון

חדשות סלבס תרבות makoTV תכניות אוכל בריאות אוטו כסף עוד

ראשי | פוליטי | פילימ | בארץ | צרכנות | בעולם | מזג אוויר | התכנית | ידאופדיה | המיל האדום

חדשות < התכנית < המחזור החודשית

## מחשיכים את המכתש: מסע בין כוכבים בנגב

מכתש רמון נחשב למכתש הגדול בעולם - וברשות הטבע והגנים מקווים להוסיף לו בקרוב תואר נוסף: שמורת אור כוכבים - הכוונה למקום שבו, במרבית ימי השנה, תנאי הצפייה בכוכבים הם קרובים לאידיאלים

אילנד הורז, תומי חדשות 2 | חדשות 2 | פורסם 23:35 01/10/15

מחשיכים את המכתש: מסע בין כוכבים בנגב

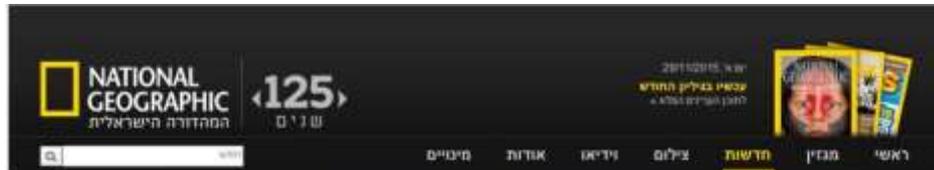
2

Figure 36: Television article on Israel Channel 2 news.

Article in National Geographic Magazine (Israeli Edition) 5/5/2013 (in Hebrew):

**A Crater of Stars**

<http://www.nrg.co.il/online/20/ART2/466/832.html>



הלילה יתקיים סטיבל מטאורים במצפה רמון. צילום: אילוסטרציה: GETTY IMAGES

20 מאי 2013

**מכתש של כוכבים**

הלילה יתקיים סטיבל מטאורים במצפה רמון. המכתש לקבלת הכוכבים במכתש רמון ישיא המטאורים האופייניים של כוכבים

11:28 05/05/2013

מד' שמונה בלילה הארץ תהיה דרוך בשל האבק של שבועי הלילה ומתי המטאורים אנו-אקטיוויזם מביא את שמי הלילה בקצב של 70-80 מטאורים בשעה. במכתש רמון נצפים לשיא המטאורים הלילה: 6-8 בואו. ואשקע השוכב באזור המכתש תהיה בין 1:00 ל-2:00 בקירוב

לרוב המטאורים יגיעו במכתש רמון סטיבל מטאורים בשיתוף בית ספר ועוד הרבה מהמכתש להגעת המטאורים כדי לאפשר תצפית אסטרונומית טובה. תחילת הצופות תהיה רחוק את המכתש הרחוק ביותר בין השעה 1:00 ל-5:00 לפנות בוקר. המטאורים הם חלק מפעילות מטאורית לקדם את ההגדרה על מכתש רמון שמורת או סוכים.

ד"ר טום לידר, אקולוג הראשי של רשות הטבע והגנים, מסביר שהמכתש "שמורת או סוכים" הוא חלק מהמכתש של הרמון הבינלאומי לשמירת הטבע. המטאורים יורד עם אופק. הוא חובב כוכבים ומטאורים אלה ברובי השקע. מכתש המכתש הוא לשמור אחרים כמעט ערים יתרים בתחום האסטרונומיה או מקומות שבהם יש ליהנות או הפולחן על בריאות המכתש האקולוגי.

"לפי אנו ידועים לשמור על החי והצומח ביום. אך עד הנה לא הקדשנו מחשבה רבה לשמירת השמורה בלילה. זאת בעוד מקומות רבים מאופקים מרחיקים או, מסביר לידר, "על המכתש על אודות המכתש לרוב השמורה המכתש - אורך היום המכתש על ידי חובב לרוב הארץ מכתש השמורה מכתש המכתש ביום, אשר מכתש המכתש מאפיין על גדות שמורת. מכתש חיי צומח המכתש של צב"ט."

הוא מנה מספר סיבות לחישוב של מכתש רמון רואי הכוכבים המכתש או כוכבים "קטנים כל המכתש רמון הוא שמורת טבע ארץ עירן אוקולוגי הדג על עירי המכתש במקום גם באשקע הלילה "הוא מחיר את העסקי, הלילה בשמורת הלילה, "שלישי מכתש המכתש בישראל הם עשירים, מכתש הלילה במכתש המכתש. אם לא מכתש לשמור על הלילה, לא מכתש עליו."

לילה מכתש רמון יש גם המכתש היסטורית "דרוך הבאשקע, אשר לשמורה המכתש המכתש את שמורת מכתש אסטרונומיה לרשות. עבודת ורין מכתש רמון, מספר לידר: "לרבות, המכתש ישו כמכתש המכתש, ועוד מכתש גם להמכתש המכתש המכתש."

מטאורים האסטרונומיה הבאים למכתש המכתש המכתש על שמורת המכתש ישבא מכתש המכתש. מכתש רמון עמי לוחית מכתש הרמון הישראלית בשמורת הלילה מספר יום או, ועוד לידר, כי "אחת" עד בארץ אפשר לישות במכתש המכתש."

Figure 37: Article in National Geographic Magazine.

Article in Globes Newspaper 2/16/2013 (in Hebrew):

**Fascinating and exciting: A tour of the new Ilan Ramon Visitor Center**

<http://www.globes.co.il/news/article.aspx?did=1000822010>



The screenshot shows the article's header with the title "מרתק ומרגש: סיור במרכז המבקרים החדש על-שם אילן רמון" (Fascinating and exciting: A tour of the new visitor center named Ilan Ramon). Below the title is a sub-headline: "מרכז המבקרים החדש במכתש רמון משלב בין הדרמה האנושית של האסטרונאוט הישראלי הראשון לדרמה הנוכחית והגיאולוגית של הטבע". The article text begins with: "ברגע שמסתים הסרט על חייו ועל מותו הטרגי של אילן רמון, מוסס באחת הוולות שמאחורי המסך, ומבעד לקיר הזכוכית הענק נפער מבט על אחד המופים הכי עוצמתיים שישי: מכתש רמון במלוא הדרו וקדמוניותו. זהו אולי אחד הרגעים המרגשים והמפתיעים בביקור במרכז המבקרים המחודש במכתש רמון. הוא מדגים את החיבור הכלל לא מזבן מאליו בין הדרמה הטפית והגיאולוגית היוצאת דופן של הסבך כאן, לבין הדרמה האנושית של האסטרונאוט הישראלי הראשון, שכזכור נהרג באסון מעבורת החלל קולומביה, בפברואר 2003." The article continues to describe the 15-story tower and the museum, mentioning that the tower is 15 stories high and the museum is located in a 17-story building. The article is dated 16/02/2013.

Figure 38: Article in Globes Newspaper.

"Seeing Stars" - Special issue on Night Sky Conservation: in ""Bishvil Haaretz" (in the path of the land) – The Israel Nature & Parks Authority bi-monthly journal Aug. – Sept.2016 (in Hebrew):



**Figure 39:** Special issue on Night Sky Conservation: in ""Bishvil Haaretz" (in the path of the land) – The Israel Nature & Parks Authority bi-monthly journal

### Section 3 – Management Documents

Conservation of night sky resources presents a relatively new challenge for conservation in Israel. Therefore, in terms of local significance, the current application for International Dark Sky Park status is groundbreaking. In past decades the Ramon Crater Nature Reserve stood at the frontline of the Israeli nature conservation efforts and land management practices. Grounded in a need-based approach, Reserve rangers led to the development of proper management practices relating to off-road vehicles, and to the inherent tension between allowing public access and nature protection. These management practices have since been upscaled and adopted by the Israel Nature & Parks Authority at the national level. Hereby, we seek to do the same, with the management of night sky resources.

During the present application process, INPA established for the first time a clear policy and appropriate management practices on the subject of light pollution and the protection of natural nocturnal habitats and the right of humans for dark night skies.



**Figure 40:** Astronomers enjoying the views of the Milky Way at a night with good visibility, 5° above horizon. Credit: Directing Light Group [www.ormekuvan.co.il](http://www.ormekuvan.co.il)

## Management Documents Relating to Night Sky Conservation at the Ramon Crater Nature Reserve

### Israel Nature & Parks Authority Policy

At the national level, there are very little official documents concerning night sky preservation. While the problem of light pollution received only little attention from Israeli policy makers, the awareness to the subject is slowly growing among the local ecological experts and scientists at the Israel Nature & Parks Authority.

In recent years, the Science Department of the Israel Nature & Parks Authority has published two documents which have been translated into policy. The first deals with the ecological consequences of road lighting, and the second provides an expert opinion on LED lighting. Consequently, the INPA has accepted a new and comprehensive policy and guidelines for the preservation and management of night sky resources within all Nature Reserves and National Parks.

#### **Ecological consequences of roadside lighting in Israel and solutions to the problem (Leader 2008):**

“Light pollution is the sum of all negative effects of artificial lighting. There is a need to distinguish between astronomical light pollution that prevents from seeing stars in the night skies, to ecological light pollution, that changes natural light regimes in terrestrial and aquatic habitats.” P. 5

“Road areas should be categorized to four environmental zones:

1. Areas that are essentially dark, such as nature reserves and other ecologically vulnerable areas.
2. Areas with low light levels, such as around small rural settlements and the outskirts of suburb.
3. Areas with medium light levels, such as small town centers etc.
4. Areas with high light levels, such as the centers of big cities etc.

Based on those categories, areas with no lighting can be declared (except where lighting is a safety necessity). It is also possible to prevent light from escaping upward, towards the sky. Upward Light Ratio of the Installation (ULR) expresses the percent of light directed toward the sky, out of the total lamp lighting capability. According to the British Institution of Lighting Professionals, the ULR values should not exceed: 0%, 2.5%, 5.0%, and 15.0%, for the four environmental zones, respectively.” P. 11

“Where roadside lighting must be used, full-cutoff luminaires should be used together with high pressure sodium lamps. These should be directed in 90 degrees to the road, to prevent light escaping upwards to the sky.” P. 11

**Expert opinion on LED lighting (Leader 2010):**

“This expert opinion will discuss the impact of the increased spectral emission in blue-rich white lighting (BRWL), such as LED lights, and their environmental significance. This spectral field has a strong negative impact on the ability to see stars in the night sky and a remarkable contribution to increase sky glow. Exposure to blue light at night also has known negative effects on ecological systems by affecting circadian rhythms of living organisms, and is thought to cause certain kinds of chronic disease in humans. Therefore, extensive use of blue-rich white lighting may be problematic not only in terms of aesthetic light pollution, hence, astronomical light pollution, but also an environmental contaminant and a human health risk. This expert opinion is based on the International Dark Skies Association study (2010) - Visibility, Environmental, and Astronomical Issues Associated with Blue-Rich White Outdoor Lighting.” P. 1

“Based on this information on the potential negative effect of LED lighting of BRWL type, this type of lighting should be avoided in adjacent to open spaces and in areas managed by INPA. If used, it should not exceed 3000 K.” P. 5

**INPA management policy on the preservation of natural lightscapes (INPA 2016):**

In July 2016, the INPA has accepted a new and comprehensive management policy and guidelines for the preservation and management of night sky resources within all Nature Reserves and National Parks. The policy represents the outcome of collaboration in recent years by INPA scientists together with local and international experts, which has led to creation of new knowledge with conservation priorities and guidelines for preserving the nighttime environment in protected areas. For example the Statement of the EU-COST Action ES 1204 LoNNe (Loss of the Night Network) - Protected Areas in Europe: Essential for safeguarding the nighttime environment (COST LoNNe 2016).

***The Israel Nature & parks Authority will act to preserve, to the greatest extent possible, the natural lightscapes of nature reserves and national parks, which are natural resources and values that exist in the absence of human-caused light.***

*The natural darkness of night together with the light of the stars, planets, and earth's moon that are visible during clear nights influence biological processes of many species of animals, such as bats foraging for prey, migrating birds navigating by star light and hatchling sea turtles, which use the light of the stars and the moon to orient from their beach nests towards the sea, where they will live out the rest of their lives. Improper outdoor lighting may interfere with important natural biological processes and may also impede the view and visitor enjoyment of a natural dark night sky, an important scenic resource which has accompanied man from the dawn of history, and is now in danger of disappearing as a result of excessive lighting.*

*Recognizing the important role of natural light regimes in natural biological processes and in the evolution of species, the INPA will protect and preserve natural dark regimes and other components of natural lightscapes in its sites:*

- The INPA will reduce the amount of artificial light in parks and reserves to the minimum required to prevent the loss of natural nighttime lighting conditions and views of the natural night sky.*
- The INPA will not use artificial lighting in areas where the presence of lighting may harm natural resources that are intended to be preserved within the site.*
- The INPA will limit the use of artificial lighting only to those locations where it is required for security and public safety as well as the specific needs of visual illumination of cultural resources.*
- The INPA as an environmental organization will strive to set an example of proper public use of outdoor lighting, which is environmentally friendly and energetically efficient.*
- The INPA, assisted by the public, neighboring communities, local government and infrastructure factors will work together to prevent or reduce artificial light penetration into the nocturnal ecosystems of INPA managed sites and natural sites in general.*
- In those places that require the use of defined lighting, the INPA will use outdoor lighting methods having a minimal impact to prevent damage to the observed quality of the night sky, physiological processes of living organisms and other natural processes.*
- The decision to use artificial lighting in INPA managed areas will be based on a precise planning process which will include detailed definitions of illumination requirements and resulting ecological, aesthetic and operational consequences. Planning will include references to light color spectrum, lighting fixtures structure and positioning as well as operational regimes.*
- The INPA will work with government and infrastructure development officials throughout Israel, towards the prevention and reduction of artificial night lighting penetrating into the night scenery and sensitive ecosystems.*

## **Ramon Crater Nature Reserve Management Actions**

The commitment of the INPA regarding the protection of nature is well documented in Nature Reserve Management Plans (all source materials are in Hebrew):

### **Har Hanegev Nature Reserve & Matsuk HaTsinim Nature Reserve Management Plans (1980):**

(Together, the two reserves comprise the Ramon Crater Nature Reserve).

The objectives of the reserve are:

1. "To preserve native wildlife and plants, and to reach full actualization of its natural potential as a functional ecosystem." P.1
2. "To encourage public visitation within the nature reserve, and to provide them with suitable infrastructure and safety measures." P.1

### **Ramon Crater Nature Reserve Management Plan (2012):**

"The objectives of the reserve are:

1. To protect geological and geomorphological phenomena which are unique on a global scale.
2. To protect its unique biodiversity.
3. To protect its unique range of natural habitats.
4. To protect rare species, typical to the reserve area.
5. To allow public access, while not compromising nature protection.
6. To educate visitors, according to INPA guidelines." P. 4

"Campgrounds inside the reserves are designed to serve visitors and hikers, and in doing so to mitigate disturbance to nocturnal animals." P. 24

The only staffed campground, which provides visitors with full service, is Be'erot Overnight Campground:

"The campground's location in the heart of the crater produces potential disturbances of different types, including lighting, sewage, noise, vehicle movement after dark and litter. To face some of those issues, the lighting in the campground is being transformed with new lighting according to the INPA instructions on this subject (Leader 2008)." P. 24

### **Ramon Crater Nature Reserve Lightscape Management Plan (2015):**

In spring-summer 2015, Ramon Crater Nature Reserve staff in cooperation with the Science Division of the Israel Nature & Parks Authority, composed the reserve's Lightscape Management Plan. The objective is to introduce the topic of night skies as a valuable and a primary essence to all, while providing guidance on the topic to the reserve, the entire INPA park system and the general public. A set of guidelines to reduce light pollution and to promote conservation practices were identified. In addition, programs were designed to involve the general public in on-site educational activities, to raise awareness on the topic. One of the objective goals is the pursuit of Dark Sky Park designation through the IDA. Together, our aim is to place the cornerstone of a night sky policy in Israel, providing a blueprint for others to follow.

In conformance with newly approved INPA lighting policy the installation and use of artificial lighting within the Dark Sky Park shall be reduced to the bare minimum, and be used only when and where it is dictated for safety, security or operational reasons. When lighting is needed, it should follow INPA policy and expert advice (see Leader 2008, 2010) to mitigate light pollution. The Lightscape Management Plan (LMP) strives therefore to care for the safety and needs of the reserve visitors and staff, and while so doing to reduce any impact on the night skies of RCNR to the bare minimum. Designing night sky friendly lighting will thus serve to preserve the natural darkness, while raising awareness of its importance.

### **Light pollution**

With the growing use of artificial lighting, so does the level of light pollution. Light pollution is the sum of all negative effects of artificial lighting, and should be distinguish to two, as suggested by Longcore and Rich (2004):

“Astronomical light pollution” occurs where stars and other celestial bodies are washed out by light that is either directed or reflected upward. This is a broad-scale phenomenon, with hundreds of thousands of light sources cumulatively contributing to increased nighttime illumination of the sky; the light reflected back from the sky is called "sky glow". We describe artificial light that alters the natural patterns of light and dark in ecosystems as "ecological light pollution".” P. 191

Light pollution carries grave effects on nocturnal animals of different species, and can alter entire ecosystems. Moreover, since ancient time, night skies had an important role in man's life, as a pathfinder (literally and mentally) and a source of spiritual guidance. Encompassed in it is a unique sensation one can only gain from gazing at stars. Therefore, the natural night sky is one of the physical resources under which natural ecosystems and humanity alike have evolved.

Currently, the objectives of the reserve are:

1. To protect geological and geomorphological phenomena's which are unique in a global scale.
2. To protect its unique biodiversity.
3. To protect its unique range of natural habitats.
4. To protect rare species, typical to the reserve area.
5. To allow public access, while not compromising nature protection.
6. To educate visitors, according to INPA guidelines.

To fulfill these purposes in full, the issue of light pollution needs to be addressed. Our obligation to protect the land entrusted to us is not restricted to the daytime only; preservation of natural nocturnal lightscapes should be addressed as well.

Moreover, keeping our skies dark is important for mankind, as a central cultural resource. For thousands of years people lived and traveled under those stars. The

Incense route, a famous trade route used by the Nabatean people, was recognized by UNESCO as a World Heritage site. Along this route great camel caravans brought costly spices and perfumes out of Arabia via Petra, through the Negev and on to Mediterranean ports. Successful protection of this significant cultural resource and heritage site depends on our ability to also preserve with it the ancient tradition of star-based navigation, developed and mastered by these ancient people.

Dark night skies also have a strong recreational value for campers and hikers, allowing the experience of enjoying the night sky or sleeping under the stars. Thus, night sky quality is an important wilderness value.

As such, the preservation of natural lightscapes and the protection of dark night skies should be added to the stated objectives of the Ramon Crater Nature Reserve.

### Guiding Principles

**Visitor and staff safety.** This should be achieved while protecting the natural environment from light pollution.

**"Good light is natural light" policy.** Within the Ramon Crater Nature Reserve, no lighting should be installed or used outside of eligible lighting zones except in places where road safety demands road lighting by national regulations. Driving off-road is forbidden at night<sup>1</sup>, as well as night hikes. Visitors seeking to spend the night in the reserve must do so in one of the designated campgrounds. Residential or development areas are prohibited within the reserve.

**Sustainable and eco-friendly lighting.** Where lighting is required, it should be as energy efficient as possible, to lessen the reserve carbon footprint. Nevertheless, this comes with exceptions. Newer technologies, such as LED technology, has been found to be less night-friendly light due to its high spectral output of blue-rich white light (International Dark-Sky Association 2010; Leader 2010). Therefore, it should not be used, where possible. The correlated color temperature (CCT) of all lamps (including LED) installed in the Park shall not exceed 3000 K. The equipment used should be robust and easy to use, contributing to its long term sustainability in operation and maintenance.

**Wildlife friendly lighting.** Darkness is important for the protection of nocturnal animals and their habitat. Parameters of direct light intensity, scattered light intensity, light color, light timing and duration are all important considerations for wildlife.

**Night skies as a cultural heritage.** Dark night skies are part of our cultural heritage, and should be understood and protected as a resource.

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<sup>1</sup> The two exceptions are Highway 40 (that crosses the crater) and a dirt road few miles long that leads to Be'erot Overnight Campground. INPA plans to install road signs informing drivers that they enter a Dark-Sky Park, and instructing them to drive with low lights.

## Leadership in the restoration of dark skies

The Ramon Crater Nature Reserve has set several leadership examples in the restoration of dark skies by implementing the following:

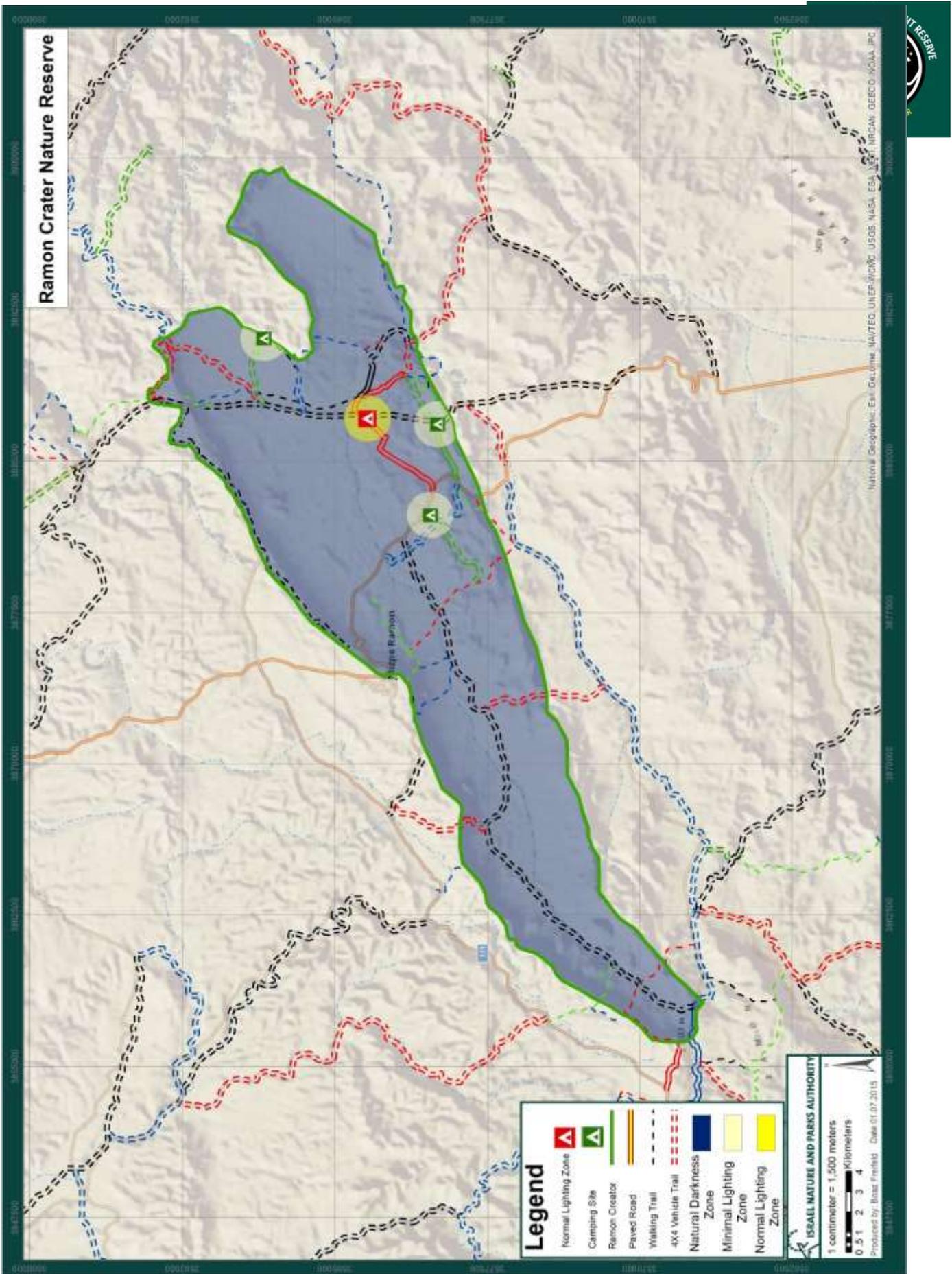
1. Involving the following external partners in dark sky restoration efforts (on-going):
  - a. The Society for the Protection of Nature – cooperation on guidelines for correct lighting of military bases and infrastructure in the Negev desert area.
  - b. Israeli Astronomical Association – development of star-gazing friendly camp sites in the Ramon Crater area.
  - c. The Israel Society of Ecology & Environmental Sciences – expert workshops on light pollution.
  - d. The "Guiding Light Group" volunteer organization – cooperation in advising the National Transport Infrastructure Company on road lighting in sensitive areas around the Ramon Crater.
2. Cooperation with the following nearby municipalities that results in adoption of lighting codes that improve sky conditions in the Park:
  - a. Mitzpe Ramon Local Council – the municipality has adopted strict outdoor lighting regulations and is planning major renovation of all outdoor lights to shielded warm color (3000K) LED lights, dimming and zoning restrictions to limit light pollution in the town.
  - b. Ramat Negev Regional Council – the Council's Environmental Committee is planning implementation of lighting codes to protect the areas dark skies and enhance the regions star-gazing tourism appeal.

## Outdoor lighting zones

In accordance with the above Guiding Principles, INPA has assigned all reserve areas to one of three designated lighting management zones. The vast majority of the reserve – over 99% - has been included in the reserve's Natural Darkness Zone (NDZ), with the Standard Lighting Zone and Minimal Lighting Zone comprising less than one percent of the reserve (Figure 41).

The only Standard Lighting Zone within Ramon Crater is Be'erot Overnight Campground. It is the only manned campground in the reserve, as well as being the only campground with electrical infrastructure. The four unmanned overnight campgrounds fall within the Minimal Lighting Zone. A lighting protocol follows.

All campgrounds are located in the eastern part of the crater, which receives the majority of visitors. This is in contrast to the crater's western part that is designated as a "core area", set aside for the conservation of its unique ecosystem and night skies, warranting minimum human impact. Accordingly, this area receives a significantly smaller number of visitors, due to its remoteness and absence of paved roads.



**Figure 41:** INPA Outdoor lighting zones. The vast majority of the reserve – over 99% - has been included in the reserve’s Natural Darkness Zone.

## Lighting Management Plan

All exterior lighting should be designed to eliminate light trespass, minimize glare, and use an intensity, color, and mode of operation that will preserve the natural darkness as much as possible. Any installation of permanent artificial light within the reserve requires prior authorization from the park's managers, and full compliance with INPA and IDA guidelines.

Following the "good light is natural light" policy, artificial light should be used only as needed, and to minimize environmental impact whenever possible.

When installed, lighting should follow these guidelines:

1. Upward Light Ratio of the Installation values should not exceed 0% within the entire reserve area.
2. Fully-shielded luminaires should be used in any outdoor lighting installation.
3. The correlated color temperature (CCT) of all luminaires (including LED) installed within the Park shall not exceed 3000 Kelvin.

As there is currently no policy either at the local or national scale concerning lighting and dark sky protection or other applicable guidance and laws, The LMP surpasses the current norms, and is compatible with INPA policy for Nature Reserves and Parks.

## Lighting protocol for overnight campgrounds at Ramon Crater

The Ramon Crater receives a great number of visitors. Every year, about 45,000 visitors spend a night camping in one of four overnight campgrounds scattered within the crater. The visitors can be categorized into two broad groups: individual visitors (families, small groups of friends, etc.) and organized groups (school trips, youth movements such as the Israeli Scouts.)

This protocol is designed to both provide clear lighting guidelines which comply with the IDSP standards, yet still enable a pleasant visitor experience and the maintenance of safety procedures.

The overnight campgrounds can be divided into two categories, manned and unmanned. While the former provides basic services such as electricity and running water, the latter does not, and is simply an empty area where camping is permitted within the area of a reserve. The vast majority of the overnight campgrounds at Ramon Crater fall in the latter category, with Be'erot Overnight Campground being the single manned campground. To accommodate the differences between those categories, two sets of guidelines are needed, and are hereby presented.

### Unmanned Overnight Campgrounds

1. Lighting is allowed only between sunset and up to three hours after sunset.

2. Lighting is allowed only by using camping strip lights.
3. Other types of lighting (such as spotlights, vehicle lamps, etc.) are forbidden.
4. When using strip lights, the CCT in use should be warm-white and shall not exceed 3,000 K.

#### Manned Overnight Campground – Be'erot Overnight Campground

1. Lighting is allowed throughout the night, from sunset to sunrise. However, three hours past sunset, all lighting should be dimmed and minimized, based on need.
2. Indoor lighting in the reception area, kitchen, and refrigerator room and at the service area should be switched off or dimmed at 24:00.
3. The correlated color temperature (CCT) of all lighting in the overnight campground should be warm-white in color and should not exceed 3,000 K.
4. All outdoor lighting as well as the ones within the tents should be fully shielded, to mitigate light leakage upwards.
5. The use of floodlights is restricted for use only in emergency or when temporary security or safety situations may dictate this, at the decision of the campground manager. All floodlights should be shielded, directed downward and under 3000K in color.
6. Camp staff is responsible for managing the lighting regime within the campground based on current occupancy and specific visitor needs.
7. Camp staff is required to routinely examine the lighting within the campground and provide the necessary maintenance to ensure proper function.
8. Addition of any lighting requires planning, compatibility with IDA and INPA guidelines, and approval of the Park's manager.

## Section 4 – Reserve Lighting Inventory

### Summary

Ramon Crater is nearly a “artificial light free zone”, with no fixed lighting outside of Be’erot Overnight Campground. In 2013 the lighting in the campground was partially transformed by replacing all existing light sources to "warm-white" lights (<3000K) according to new INPA lighting guidelines. RCNR conducted a lighting inventory in the campground in spring 2015 and is in the process of adjusting all current lighting in the campground to conform to the IDA Dark Sky Park Lightscape Management Plan (LMP) by 2017. Consequently we plan to exceed the minimum requirements for an approved Dark Sky Park (to bring 90% of outdoor lighting into compliance with the IDA---DSP---GOL within five years).

### Mitigations

Already in the reserve 2012 management plan, mitigation of light pollution was considered as a central management target. Consequently, the lighting in Be’erot Overnight Campground was replaced according to INPA instructions, which included replacing all existing light sources in the campground to energy saving "warm-white" lights (<3000K). The operating mode and timing of existing flood lights in the campground was changed to only that necessary for visitation of large youth groups, when extra lighting is required during the early evening hours. The entire lighting plan for the campground has been renovated to conform to IDA Dark Sky Park Lightscape Management Plan (LMP). All external light sources within the campground will be fully-shielded, and any future lighting changes will be prohibited without prior professional consultation and authorization of the Park manager.

Vehicle movement after dark inside the reserve is forbidden off Highway 40 and the designated campgrounds. There is currently no fixed artificial light sources outside Be’erot Overnight Campground.

### Consultation with International Experts

In March 2016, the Ramon Crater Nature Reserve was visited by a group of international scientists and experts within the European COST funded project “Lost of the Night Network” (LoNNe). The following report submitted by Dr. Andreas Hänel of Dark Sky Germany, focuses on the potential of the Ramon Crater to achieve an IDA Dark Sky Park Designation, and outlines the necessary actions to be fulfilled. As can be seen in this proposal, the major issues have been addressed, including a complete renovation of the lights at Be’erot Campground (See Lighting Inventory and Figures 43-46, documenting the changes in lighting).

## Report by Dr. Andreas Hänel of Dark Sky Germany

### National Park Makhtesh Ramon Crater as Star Park

From Noam Leader, National Parks Israel, we learned that the National Park Makhtesh Ramon Crater wants to apply as an International Dark Sky Park.

On March 3 – 4, 2016, the place was visited during an excursion within the European COST funded project “Lost of the Night Network” (LoNNe). Noam showed us the place and explained the project.

A film in the visitor’s center at Mitzpe Ramon demonstrated illustratively that many desert animals living in the crater are night active. Therefore the conservation of a dark night in this protected area would also be very important to protect a dark nocturnal environment for these animals.



Fig. 1: Bright illumination within the campground

Fig. 2: The undirected lighting illuminates the surrounding landscape

Then we arrived at the campground, which had glaring lighting: badly oriented extremely bright floodlights, many unshielded glaring lights, often with high blue content. Noam explained that these about 100 light sources will be replaced by shielded luminaires, lower intensities, warm white and amber lamps. Rocks, which were dangerous as they were hard to discern when walking around due to the glaring light, shall be marked with fluorescent painting that will be better visible.

We went to an observing place some 100 m away from the campground where direct lights were no longer visible. Even from here the light dome over the campground and the over large areas lit landscape were disturbing (fig. 2). Unfortunately the sky was also not totally

clear with changing cloudiness. The sky brightness was measured with the SQM-LU (#2536) at 21.35 – 21.4 mag/arcsec<sup>2</sup>. The Milky Way and even the zodiacal light were visible.

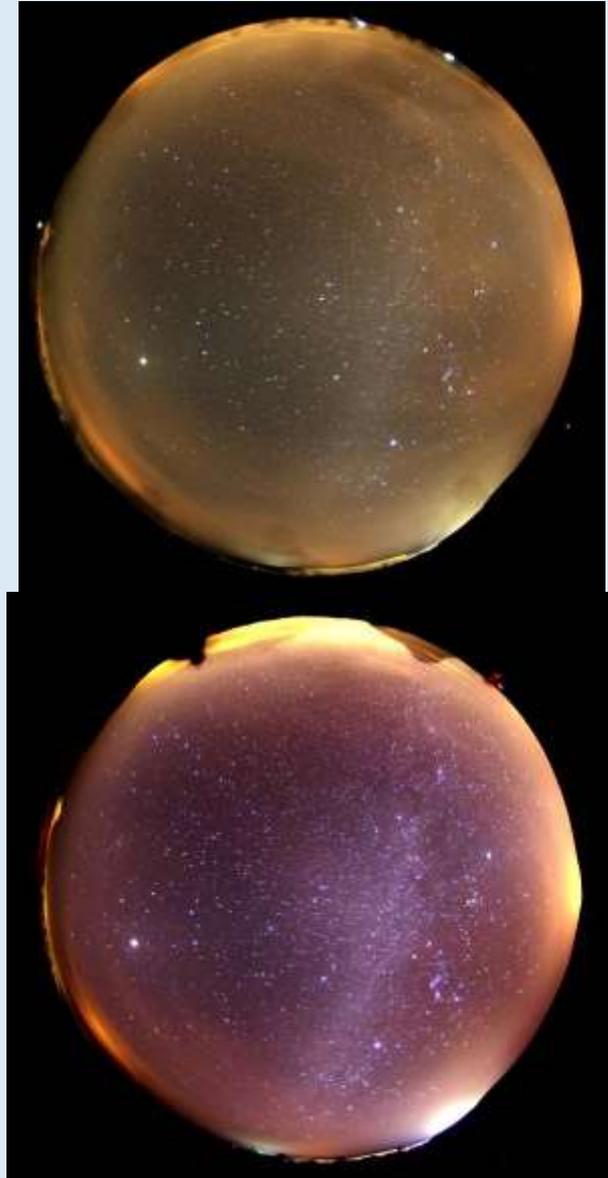


Fig. 3: All sky picture in the early evening

Fig. 4: All sky picture with a camera with enhanced H $\alpha$ -sensitivity and enhanced contrast, that fainter details become visible.

Many light domes in the surrounding could be recognized:

1. towards the West the dome from the city of Mitzpe Ramon (5 000 inhabitants, 11 km away)
2. to the North the light dome combined from Be'er Sheba, Yeroham and other cities (>250 000 inhabitants, 50-70 km)
3. to the East the direct lights from cities of Jordan, lying at higher altitudes (eg. Wadi Musa/Petra, 24 000 inh., 60 km). These seem to be very brightly illuminated referred to their population.

4. to the South the lights from Aqaba and Eilat, which are not directly visible (ca. 150 000 inh., 120 km)
5. another bright white light source is from a military installation at the southern border of Ramon Crater (13 km).

These light sources were identified using the VIIRS satellite data from 2015 (fig. 5, from [www.lightpollutionmaps.org](http://www.lightpollutionmaps.org).) and they can be distinguished better from the height of the crater rim at Mitzpe Ramon (fig. 7, 10, 11).

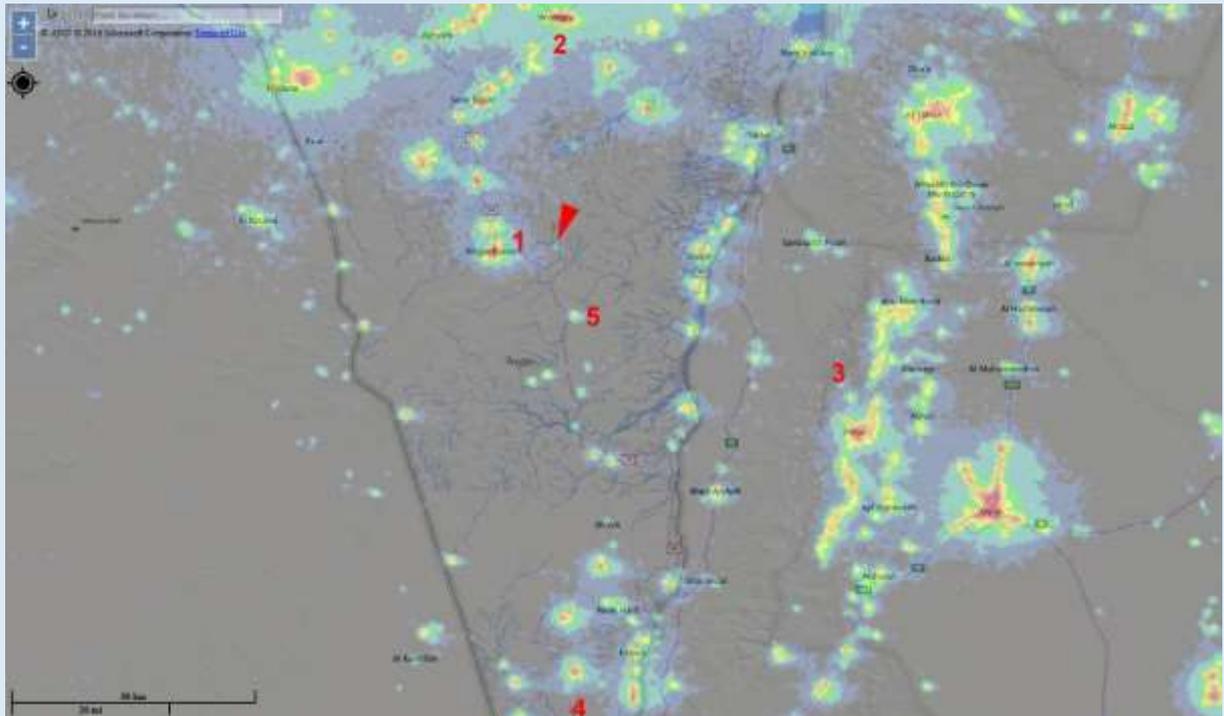


Fig. 5: The VIIRS 2015 map of the region ([www.lightpollutionmap.org](http://www.lightpollutionmap.org)), the arrow points to the lights from the campground, the numbers to some light sources of the list.

During our observations we were joined by some young people from Sweden, Canada and Simbabwe, who stayed for a workshop in the campground and were very interested in taking photos of the night sky. This demonstrates the potential for astronomical experiences in the area.

Later from the crater rim at Mitzpe Ramon the light sources could be better identified. From there even the campground is clearly visible (fig. 7 and 8). later in the night the globular cluster Omega Cen and the northern stars of the Southern Cross were visible (fig. 11). On the other hand one could recognize that the city of Mitzpe Ramon emits so much light that even the ground of the crater is illuminated by the light dome (fig. 7), though this dome shows a steep brightness gradient at the rim (fig. 6).

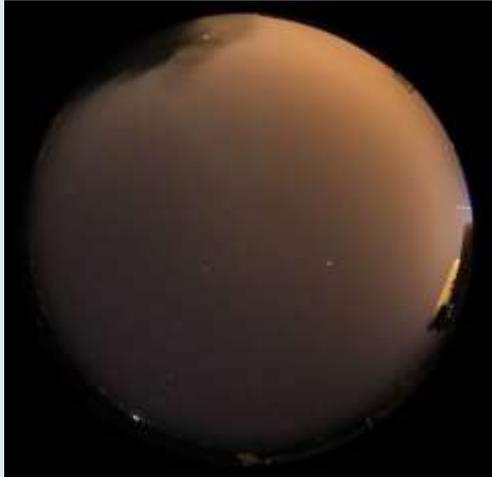


Fig. 6: All sky picture at the crater rim in Mitzpe Ramon, where the steep brightness gradient from the bright city towards the dark crater can be seen.

Fig. 7: View towards the East from the rim lookout: the foreground of the crater bottom is still illuminated from the city, the bright spot is the campground, in the background the light domes of villages in the Jordan valley and in the background on the heights in Jordan



Fig. 8: Though the street lighting is well shielded, it must be questioned, if it is with such high intensity necessary at this place. The bright light on the left above the rocks are due to the campground. The lights to the right are the headlights of cars driving through the crater.



Fig. 10: Bright lighting of a nearby military installation and settlements in the highlands of Jordan in the background.

Fig. 11: Light domes of Eilat and Aqaba identified and some interesting astronomical objects

I think Ramon Crater would be appropriate for an International Dark Sky Park, **when the planned replacement of the lighting in the campground really has taken place.** I estimate that the sky brightness will be reduced by about  $0.1 \text{ mag/arcsec}^2$ , but the impression of darkness in the landscape will be restored. The aim should be that it is no longer visible from the crater rim. As many visitors come during summer to the region, especially for the Perseid meteor shower, reduced light pollution would enable them to experience a natural night. Even German travel guides (Dumont, Michael Müller) mention the star gazing in the crater as a tourist attraction!

A night friendly lighting in Ramon crater will also be a good example of best practice for the lighting in the other national parks in Israel, as Noam explained. Hopefully this will also become exemplary for more environmental friendly lighting in the city of Mitzpe Ramon (fig. 12, 13, 14) and others whose light domes are visible from the crater. In addition that would also protect the sky quality of the nearby national astronomical Wise observatory (fig. 15).



Fig. 12: An overview of Mitzpe Ramon from the visitor's center.

Fig. 13: An unshielded and very brightly lit road near the lookout point in Mitzpe RamonFig.

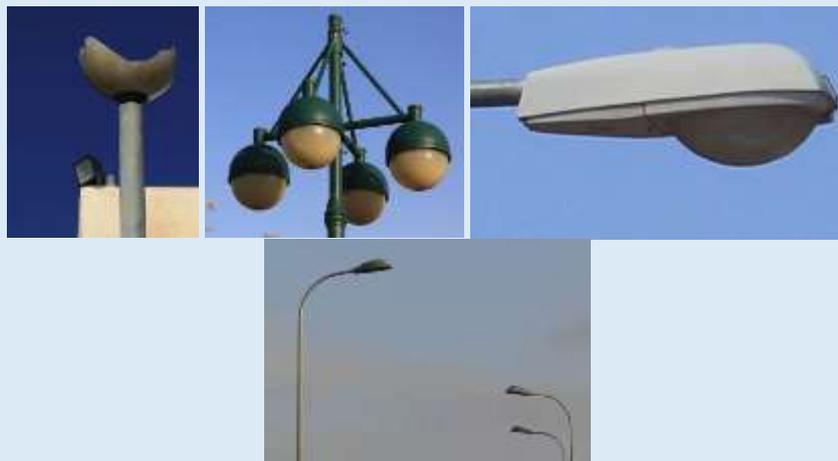
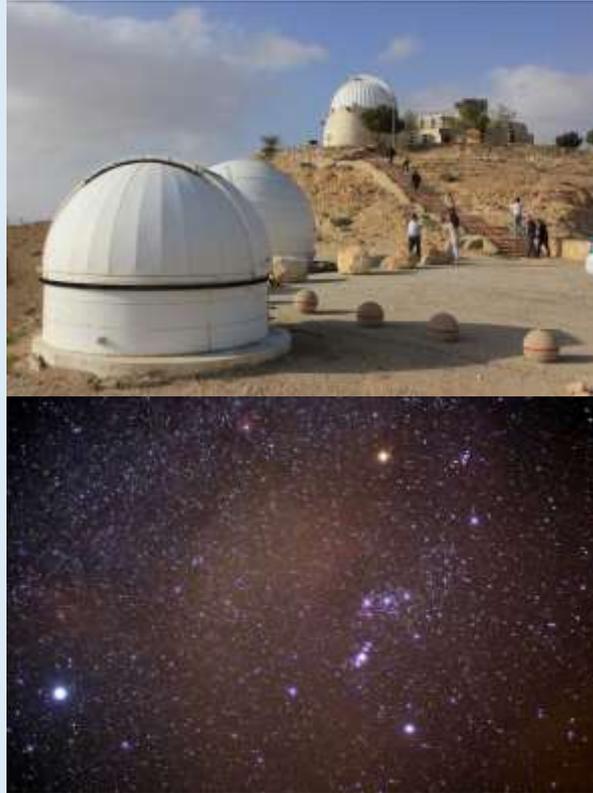


Fig 14: Bad and good (only the right!) oriented luminaires in Mitzpe Ramon



15: The Wise astronomical observatory

Fig. 16: The constellation of Orion with Barnard's Loop disturbed by clouds, camera with enhanced  $H\alpha$ -sensitivity

Dr. Andreas Hänel, Dark Sky Germany, Museum am Schölerberg, ahaenel@uos.de, 3/2016

## Be'erot Overnight Campground Light Inventory

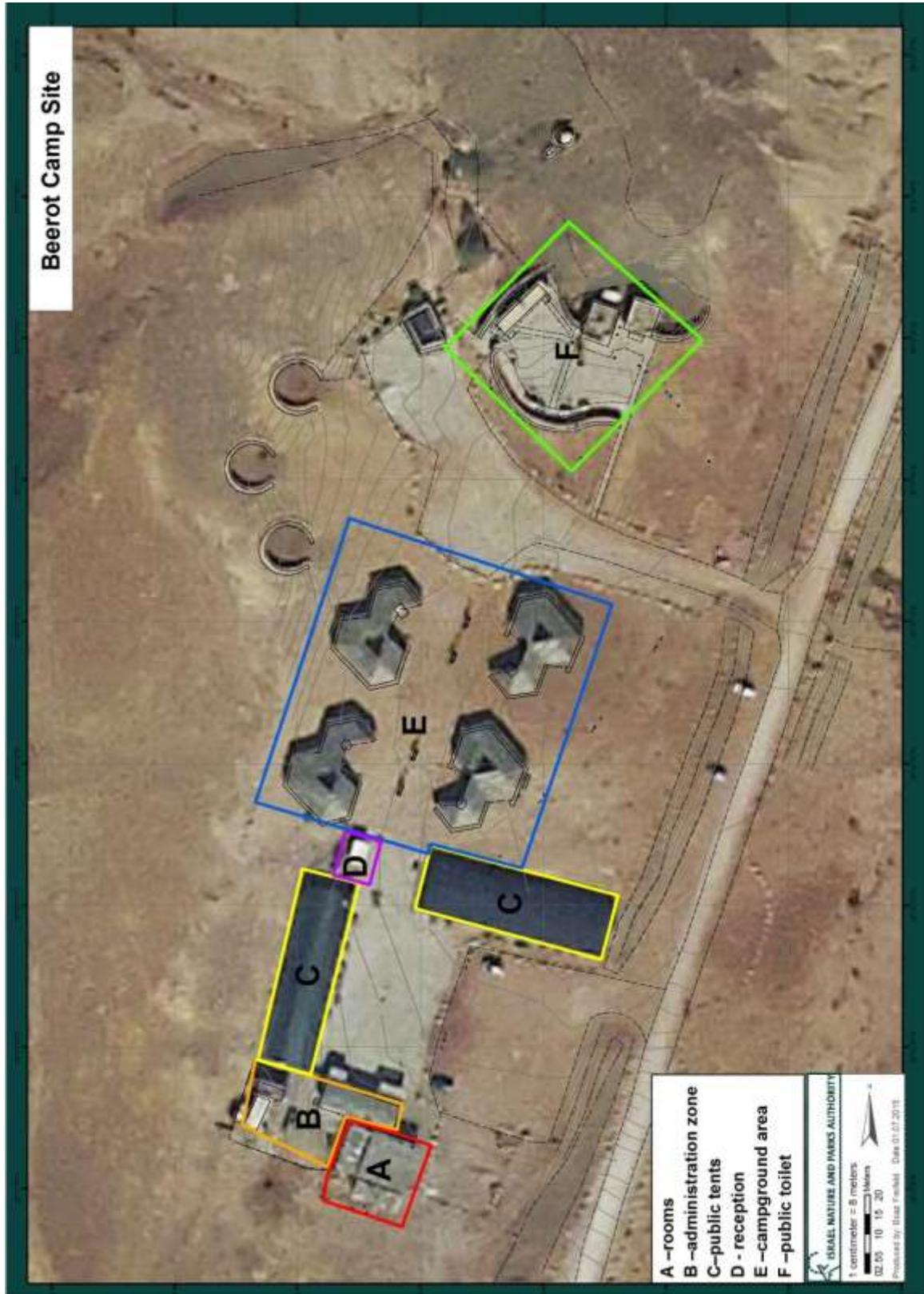


Figure 42: Map of Be'erot Overnight Campground with its different type infrastructure.

### Lighting Inventory – Be'erot Overnight Campground

Total lights: 89

Total in compliance: 83

Total not in compliance: 6

Area	No.	Photo	Fixture	Application	Fully-shielded	Special purpose < 500 lumens	Conformity with Lighting Guidelines
A (rooms)	1		5 fixtures CFL 9W 3000K	Building Egress 1 above each room door (5 in total)	NO Under roof	NO	NO (to be retrofitted with C7 fixtures)

A (rooms)	2		1 fixture fluorescent 14W	Terrace outside rooms	NO Under roof	NO	NO  (shielding will be added)
A (rooms)	3	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><b>Before</b></p>  </div> <div style="text-align: center;"> <p><b>After</b></p>  </div> </div>	1 fixture Metal-Halide 150W 3000K	Courtyard outside rooms	YES	NO	YES  Cancelled for standard operation. Only for emergency or special purposes
B (Administration zone)	4	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><b>Before</b></p>  </div> <div style="text-align: center;"> <p><b>After</b></p>  </div> </div>	1 fixture Metal-Halide 150W 3000K	Courtyard in service area	YES	NO	YES  Cancelled for standard operation. Only for emergency or special purposes

<b>B</b> (Administration zone)	5	<b>Before</b> 	<b>After</b> 	1 fixture Metal-Halide 150W 3000K	Courtyard outside kitchen	YES	NO	YES Cancelled for standard operation. Only for emergency or special purposes
<b>C (Public tents)</b>	6	<b>Before</b> 	<b>After</b> 	4 fixtures Metal-Halide 150W 3000K	Courtyard outside tent area	YES	NO	YES Cancelled for standard operation. Only for emergency or special purposes
<b>C (Public tents)</b>	7			16 fixtures CFL 14W 2700K	Tent entrances	YES	NO	YES

D Reception	8		3 fixtures CFL 14W 2700K	Service center lighting	YES Under roof	NO	YES
E (Campground area)	9		47 fixtures CFL 14W 2700K	Entrance to camping huts	YES	NO	YES
F (Public toilets/shower area)	10		6 fixtures CFL 23W 2700K	Outside the restroom/shower area	NO	NO	NO (Cancelled) Replaced by solar pavement (see below)

F (Public toilets/shower area)	11		8 fixtures CFL 23W 2700K	Outside the restroom/shower area	NO	NO	NO (Replaced with F12)
F (Public toilets/shower area)	12		8 fixtures CFL 14W 2700K	Outside the restroom/shower area	YES	NO	YES (Replaced F11)
F (Public toilets/shower area)	13		2 fixtures Metal-Halide 150W 3000K	Outside the restroom/shower area	YES	NO	Cancelled

<b>F (Public toilets/shower area)</b>	14	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">Before</div> <div style="border: 1px solid black; padding: 2px;">After</div> </div> 	2 fixtures Fluorescent 14W 2700K	Above shower doors	YES Shielded by wooden panels	NO	YES
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**Before-** campground tent area is flooded with light from undirected spotlights causing light pollution, glare and discomfort to visitors. Photo Credit: Andreas Hänel, Dark Sky Germany.



**Changes made-** Spotlights were cancelled. Tent awnings were equipped with small full cut-off lighting fixtures (14W CFL, 2700K). Photo Credit: Nadav Taube, INPA.



**After** – Light is directed downwards. Allows suitable use by visitors, without affecting the night sky. Photo Credit: Noam Leader, INPA.



**Figure 43:** Photographic documentation of changes to light in Bee'rot Campground

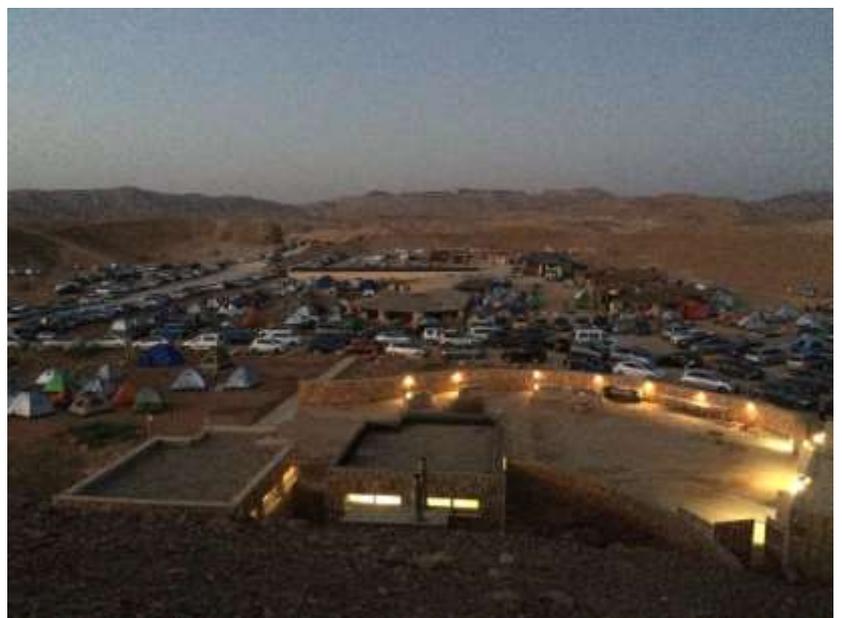
**Before-** Public toilets/shower area was flooded with light from unshielded cool white lights causing light pollution, glare and discomfort to visitors. Photo Credit: Nadav Taube, INPA.



**Changes made-** Area was equipped with small full cut-off lighting fixtures (14W CFL, 2700K). Photo Credit: Nadav Taube, INPA.



**After** – Lighting in Public toilets/shower area is directed downwards. View from a hill during full occupancy at the annual Perseid Shower. Photo Credit: Nadav Taube, INPA.



**Figure 44:** Photographic documentation of changes to light in Bee'rot Campground



**Before-** Foot path between the tent area and public toilets/shower area was poorly lit by glaring undirected wall mounted lights. Photo Credit: Nadav Taube, INPA



**After-** New concrete Foot path with embedded solar-charged resin-based glow stones lights up the way between the tent area and public toilets/shower area. No additional lights are required. Photo Credit: Avi Morag. Courtesy of Y.A.G.

**Figure 45:** Photographic documentation of changes to light in Bee'rot Campground 90



**Figure 46:** Panoramic views of Bee'rot Campground at night after changes to the lighting plan. Photo Credit: Noam Leader, INPA.

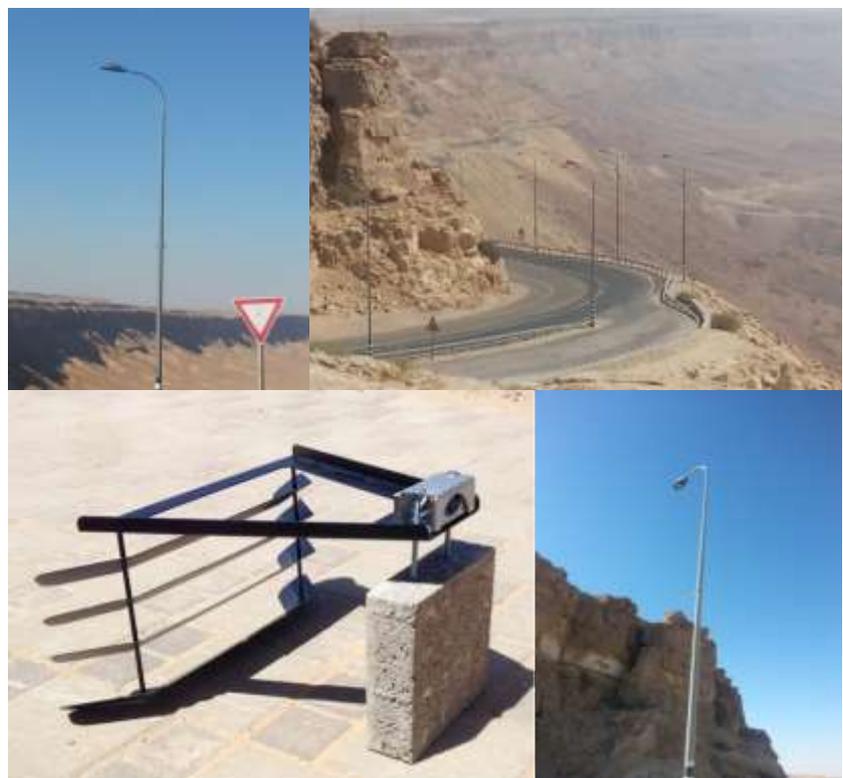
## Road lighting

A major road (Highway 40) crosses the crater, connecting the town of Mizpe-Ramon with the city of Eilat to the south. There are no roadlights within the crater area itself; however, a small road segment leading down into the crater from the town of Mizpe-Ramon is partially lit by eight roadlights only at its top first 200 meters due to a dangerous curve. This lighting is required by Israeli Department of Transportation safety regulations. The road lights (250W HPS) fitted in full cut-off luminaires are mounted on 12 meter poles. While their construction is in accordance with the Parks lighting guidelines, due to the extreme elevation differences between their location and the crater floor, there is considerable light spillage from the back of the each luminaire, which can be easily viewed from parts of the crater, as a distant light source. The INPA together with Netivei Israel – (National Transport Infrastructure Company Ltd.) are currently addressing this issue by designing custom-made shutters which will be installed behind each luminaire to prevent back light spillage. This change is planned to be completed during 2017.



**Figure 47:** Road lights at the curve on Road 40 leading down to the crater floor. See text for explanation.

Photo Credits: Andreas Hänel, Dark Sky Germany, Noam Leader, INPA, Gilad Guzani, "Directed Light".



## Section 5 – Letters of Support

1. INPA Southern District – Mr. Gilad Gabay, District Manager.
2. Ramat Negev Regional Council - Mr. Shmuel Rifman, Mayor.
3. Mitzpe Ramon Local Council – Mr. Roni Marom, Mayor
4. Wise observatory, Tel-Aviv University – Prof. Dan Maoz, Director.
5. Israeli Astronomical Association – Mr, Nadav Rotenberg, Chairman.
6. The Israel Society of Ecology & Environmental Sciences – Mrs. Michal Green, Chairwoman.
7. Society for the Protection of Nature in Israel – Mr. Alon Rothschild, Biodiversity Policy Coordinator.
8. Thr Israel Lighting Association – Dr. Inna Nissenbaum & Prof. Abraham Haim, chairpersons.
9. The "Guiding Light Group" volunteer organization – Mr. Gilan Gozani, Head of the Technical group.



SOUTHERN DISTRICT MANAGER

November 20, 2016

To the Board of Directors  
International Dark-Sky Association  
3223 North First Avenue  
Tucson, Arizona  
85719-2103

As the manager of the Israel Nature & Parks Authority Southern District, I am pleased to support the Ramon Crater Nature Reserve's silver-tier nomination for International Dark sky Park designation.

The Ramon Crater Nature Reserve has become throughout the years, a symbol of ground-breaking nature conservation achievements and Israel's premier location for observing a pristine night sky. All this has been attained through intense long-term efforts by dedicated INPA rangers, scientists and planners and, as well as through fruitful partnerships with local communities and governmental agencies.

The Ramon Crater's magnificent night skies are easily seen by tens of thousands of visitors each year, and the mild summer climate makes this reserve an especially favorable night sky destination, in particular during the warm summer months of the desert region.

The Reserve's management, maintenance and interpretive staff have embraced the night sky as one of their most precious and sought-after natural resources. I am proud to support their nomination package.

Sincerely

Gilad Gabay  
Southern District Manager  
Israel Nature & Parks Authority  
HaAvot St. 19  
Beer-Sheva 84215  
Israel



י"ג אדר א, תשע"ו  
22 פברואר, 2016

תמיכה בהכרזה על מכתש רמון כשמורת אור כוכבים בינלאומית

למועצה האזורית רמת הנגב ולרשות הטבע והגנים קשרי עבודה רבים ומבורכים. אין לי ספק שהכרזתו של מכתש רמון כשמורת אור כוכבים בינלאומית תתרום רבות להנצחה ולשימור של הערכים הייחודיים של חבל ארץ זה, יהווה מוקד תיירות חשוב ויתרום לשיפור איכות חיי הקהילות בתחומי המועצה האזורית

אני שמח להביע את תמיכת המועצה האזורית רמת הנגב ביוזמתה של רשות הטבע והגנים להכרזה על מכתש רמון כשמורת אור כוכבים בינלאומית, תואר הניתן ע"י ארגון International Dark Sky Association.

המועצה האזורית רמת הנגב הינה קהילה צומחת בליבו של אזור מדברי, המונה כ- 6000 תושבים המתגוררים ב-14 ישובים קיבוצים, מושבים וישובים קהילתיים. שיטחה של רמת הנגב הוא הגדול ביותר בישראל: 4.2 מיליון דונם, המהווים כ- 22% משטחה של ישראל. בתחום המועצה האזורית רמת הנגב מצויים רבים מאתרי הטבע החשובים והמרשימים של ישראל ובכללם מכתש רמון. מכתש רמון מהווה דוגמא מרשימה לייחודו ועוצמתו של המדבר ושל הר הנגב הגבוה. המכתש מהווה גם סמל למראה שמי לילה זרועי כוכבים, מראה אשר הולך ונעלם ממרבית שטחה של ישראל, אך עדיין נשמר בקפדנות ובמלוא עוצמתו בתחומי המועצה. עדות להצלחה זו ניתן לראות בכל קיץ, בליל מטר הפרסאידיים השנתי, כאשר למעלה מ-50,000 מבקרים פוקדים את המכתש וסביבותיו ואתרי טבע נוספים בתחומי המועצה כדי לחזות במראה הנדיר.

למועצה האזורית רמת הנגב ולרשות הטבע והגנים קשרי עבודה רבים ומבורכים. אין לי ספק שהכרזתו של מכתש רמון כשמורת אור כוכבים בינלאומית תתרום רבות להנצחה ולשימור של הערכים הייחודיים של חבל ארץ זה, יהווה מוקד תיירות חשוב ויתרום לשיפור איכות חיי הקהילות בתחומי המועצה האזורית.

בברכה,

שמואל ריפמן  
ראש המועצה

העתק: רוני מרום – ראש מ.מ מצפה רמון

טל: 08-6564152 | פקס: 08-6553296 | [mirit@rng.org.il](mailto:mirit@rng.org.il)

ד.ג. חלוצה 85515 | טל. 08-6564111 | פקס. 08-6564100 | [www.rng.org.il](http://www.rng.org.il) | בפייסבוק: מועצה אזורית רמת נגב

אשלים | באר מילכה | חוות דרך היין | טללים | כמהין | מדרשת בן-גוריון | מחנה טלי | מרחב-עם  
משאבי שדה | ניצנה | עוזו | קדש ברנע | רביבים | רוח מדבר | כפר רתמים | שאנטי במדבר | שדה בוקר | שיזף



22 February 2016

To: IDA Board of Directors  
International Dark-Sky Association  
3223 North First Avenue  
Tucson, Arizona 85719-2103

**support for the designation of the Ramon Crater as an International Dark Sky Park**

I am pleased to express the support of the Ramat Negev Regional Council to the initiative of the Israel Nature & Park Authority to declare the Ramon Crater as an International Dark Sky Park, a title issued by the International Dark Sky Association.

The Ramat Negev Regional Council is a growing community in the heart of a desert region, comprising 6,000 residents living in 14 Kibutzim, moshavim and other community settlements. The area of Ramat Negev is the largest of all regional councils, encompassing 4200 square km, roughly 22 percent of the total land of Israel. Within the Ramat Negev Regional Council's boundaries are many of Israel's most valued and unique natural wonders, among them the Ramon Crater. The Ramon Crater is a supreme example of the uniqueness and inspiring beauty of the desert and the Negev Highlands. The crater is also a symbol of outstanding star-filled night skies, a sight which is quickly disappearing from most of the country, but is preserved in its full splendor within the boundaries of the Ramat Negev Regional Council. A testament to this success can be seen each summer, during the peak annual Perseid meteor shower, when more than 50,000 visitors arrive at the Ramon Crater and other nature sites within the Council range to witness this rare sight.

The Ramat Negev Regional Council and the Israel Nature & Parks Authority have a long standing and beneficial professional cooperation. I have no doubt that the designation of the Ramon Crater as an IDA International Dark Sky Park will serve to the conservation and preservation of the unique natural values of the region, will act as an important tourism venue and will contribute to the quality of life of the Ramat Negev Regional Council's community.

**srifman@rng.org.il | Tel: 972-8-6564152 | Mobile: 972-50-5246780**

**Tel: 972-8-656411 | Fax: 972-8-6553296 | D.N .Halutza ,Israel 855 1500 | www.rng.org.il | http://www.facebook.com/ramatnegev**

**Ashalim | Beer Milca | Tlalim | Kmehin | Kfar Retamim | Midreshet Ben Gurion | Merchav Am | Mashabey Sade  
Nitzana | Ezuz | Kadesh Barnea | Revivm | Sde Boker | Tali campus | Desert spirit | Shanti House | Shezaf**

**המועצה המקומית מצפה רמון**  
**The Local Council of Mitzpe Ramon**  
**לשכת ראש המועצה**



To:  
IDA Board of Directors  
International Dark-Sky Association  
3223 North First Avenue  
Tucson  
Arizona 85719-2103

Letter of support for the designation of the Ramon Crater as an International Dark Sky Park

I am pleased to express my support on behalf of the Mitzpe Ramon Local Council to the initiative of the Israel Nature & Park Authority to declare the Ramon Crater as an International Dark Sky Park, a title issued by the International Dark Sky Association.

The town of Mitzpe Ramon resides in the heart of the Negev highlands, on the northern rim of the Ramon Crater, at an altitude of 900 meters above sea level, a location and altitude which give Mitzpe Ramon a unique climate year-round. Mitzpe Ramon was established sixty years ago, and has since developed into a diverse and vibrant community, comprising of more than 6,000 residents.

In recent years the town is turning towards desert, ecological and astronomical tourism. As part of this process several hotels have been built, among them small boutique hotels, as well as other tourism businesses. Additionally, with the cooperation of the Israel Nature & Parks Authority and others, hiking trails within the Ramon Crater have undergone restoration, and lately a new part of the Israel National Bicycle Trail has been paved near the crater.

The Ramon Crater and the town of Mitzpe Ramon have become in recent years a symbol for the Israeli public of magnificent night sky views, unaffected by light pollution. The town is home to the only scientific Space Observatory in Israel, the Weiss Observatory, operated by scientists from the Tel-Aviv University. Every summer the town hosts the "Star Shower" event, with the participation of thousands of visitors who come to view the annual summer meteor shower. In order to turn the viewing into an ultimate and unique experience during the nights of the event, the Mitzpe Ramon council, together with local businesses, the Israel Road Company, army bases and others – all turn off the lights within the town and its surroundings. This reduces light pollution, which is already low and allows for breathtaking views of

**"כי אין לך דבר רב עוצמה כרעיון שהגיעה שעתו להתגשם" – ויקטור הוגו**

שדרות בן גוריון 1 ת.ד. 1 מיקוד 80600 טלפון: 08-6596201 פקס: 08-6587478  
דואר אלקטרוני: [lishka@mitzpe-ramon.muni.il](mailto:lishka@mitzpe-ramon.muni.il)

**המועצה המקומית מצפה רמון**  
**The Local Council of Mitzpe Ramon**  
**לשכת ראש המועצה**



the night sky even from within the town. Moreover, as part of the town's commitment to reducing light pollution, the town council has passed new regulations to minimize light pollution from outdoor lighting, and is now advancing plans for changing existing street lighting to energetically efficient and environmentally friendly lighting.

Mitzpe Ramon is facing development and progress. We are working to develop the town through tourism and various tourism-related enterprises, and planning which takes into consideration the landscape, climate and nature. I am confident that the initiative of the Israel Nature & Park Authority to declare the Ramon Crater as an IDA International Dark Sky Park is worthy and will contribute to the development of Mitzpe Ramon and entire region into a unique place on a national and international level.

I therefore highly recommend to the IDA Board of Directors to approve this proposal.

Roni Marom

Mayor

Mitzpe- Ramon local council

*"כי אין לך דבר רב עוצמה כרעיון שהגיעה שעתו להתגשם" – ויקטור הוגו*

שדרות בן גוריון 1 ת.ד. 1 מיקוד 80600 טלפון: 08-6596201 פקס: 08-6587478  
דואר אלקטרוני: lishka@mitzpe-ramon.muni.il

IDA Board of Directors  
3223 North First Avenue  
Tucson, AZ 85719  
USA

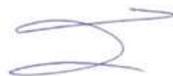
November 17, 2015

Dear IDA Board of Directors,

I am writing in enthusiastic support of the initiative by the Israel Nature and Parks Authority to designate the Ramon Crater area in Israel as an International Dark Sky Park. Wise Observatory, which I direct, is a professional astronomical research facility owned and operated by Tel-Aviv University. Our observatory, established in 1971 near the rim of the Ramon Crater, has continuously produced cutting edge science. We owe our success in large part to geographical factors: the longitude, which gives us an edge in tracking time-critical phenomena when it is daylight at most other world observatories; the large fraction of clear nights at this desert location; and not least, the dark skies in this area, one of the last in our densely populated and largely light-polluted country.

Conserving the dark skies in the Ramon Crater area is of the utmost importance for the continuation of our scientific research, but no less for preserving this increasingly rare resource for the public at large. The Ramon area is already well known among the Israeli public as the prime star-viewing location in the country and indeed, Tel-Aviv University and Wise Observatory routinely lead and promote astronomical public outreach activities in the area. A status of a Dark Sky Park will help halt encroachment by light-polluting development and will ensure that we can continue professional and amateur enjoyment of this unique heritage.

Sincerely,



Dan Maoz, George S. Wise Professor  
Chair, School of Physics and Astronomy  
Director, Wise Observatory

האגודה הישראלית לאסטרונומיה  
<http://www.astronomy.org.il>  
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ת.ד 149 גבעתיים



**To: Board of Directors**  
**International Dark-Sky Association**  
3233 North First Avenue  
Tucson, Arizona 85719-2103

Dear Sir. Madam.

The Israeli astronomical Association is a volunteers based astronomy club whose goal is to bring Israeli's, young and elders alike, closer to astronomy and science. The IAA is operating for more than 50 years and holding many public astronomical events throughout the year such as Lectures, sidewalk observation, conventions and start parties; all in effort to expose as many people as possible to the beauty of astronomy.

Light pollution which includes many different aspects of negative influence of night lighting, is part of an increasing world trend that creates a significant problem to continue making astronomical observations for amateur and professional astronomers. The issue is scaled in Israel since it's a small and dense country. Large cities and human settlements are taking over the country leaving almost no room for dark sky areas. Dark sky areas are hard to come by and astronomers are travelling all over the country in find of such places. The Israeli Negev and the Ramon Makhtesh in particular is one of the places left for astronomy lovers to observe the night's sky.

The Israeli Astronomical Association holding a monthly astronomical observations, open to the public at the Ramon Makhtesh Area. This is a main part of the outreach program of the Israeli Astronomical Association and the dark sky at Makhtesh Ramon takes a main role in it.

The IAA fully support the Israel Nature & Parks Authority in their proposal to announce the Ramon Makhtesh as International Dark Sky Park. This action will continue the legacy of the area as the astronomical heaven in Israel.

Declaring the International Dark Sky Park will allow us to keep the dark sky at the Makhtesh dark. While continue to attract more audience from around the world to visit the Ramon Crater International Starlight Reserve and fall in love with the night sky in many forms.

**Nadav Rotenberg**

Chairman, Israeli Astronomical Association

February 8, 2016

Board of Directors  
International Dark-Sky Association  
3223 North First Avenue, Tucson, Arizona 85719-2103

**Support from the Israel Society of ecology and environmental Sciences to designate Dark Sky Park of The Ramon Crater.**

To the IDA board of directors,

This letter is to show that the Israeli Society of Ecology and Environmental Sciences (hereafter ISEES) is fully supporting the efforts by the Israel Nature and Parks Authority to declare the "The Ramon Crater International Starlight Reserve" as an International Dark Sky Park.

The Ramon crater is a unique geological phenomena and an ecological important area. This designation and acceptance is an important step in wildlife conservation in the area and will be an important tool in the protection of life in the crater. The Ramon crater is an important research area and as such will benefit from conditions as natural as possible.

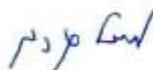
The crater edge is also home to the largest scientific telescope in Israel (The Florence and George Wise Observatory of Tel Aviv University) which will also benefit from the proclamation and the following guidelines for the area.

The ISEES is a professional society representing thousands of researchers from universities and research facilities across Israel, private sector professionals, regulators and the public under the same roof.

The ISEES strives to promote science-based decisions in the national level and to share the importance and excitement of environmental sciences with the public as well as with policy makers. We are sure that this proclamation along with the public affairs surrounding it will bring together scientists from different disciplines, communities from the area and the wider public from around Israel.

Sincerely

Michal Green



Chair of the board,

The Israel Society of Ecology and Environmental Sciences



November 24, 2014

Dr. Noam Leader  
Head of the Ecology Department  
Science Division, Israel Nature & Parks Authority  
Am veOlam 3 St.  
Jerusalem 95463

Dear Dr Leader,

The Society for the Protection of Nature in Israel (SPNI) would like to submit its support in the declaration of The Ramon Crater International Starlight Reserve. As Israel's largest and most veteran environmental NGO, an IUCN member and *Birdlife International* affiliate, SPNI recognize the negative impact of light pollution on man and nature.

The Ramon crater area is home to unique Biodiversity, both on the ground and in the air (nocturnal birds, insects and bats). As a desert habitat, most of the inhabiting species are nocturnal and sensitive to light pollution.

The Ramon area is also a known astronomic viewpoint for both professionals and amateurs. All will benefit from the conservation of dark sky, lighted only by natural star and moon light.

The reserve, to be first of its kind in the area, will set an example and a new standard that will surely support our activities to minimize light pollution in the operation of different stakeholders: zoning committees, local municipalities, infrastructures, etc. Hence, SPNI fully supports the declaration of The Ramon Crater International Starlight Reserve.

Sincerely,

Alon Rothschild

**Alon Rothschild**  
**Biodiversity Policy Coordinator**  
**Society for the Protection of Nature in Israel**

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03/01/16

Support of the Application of creating The Ramon Crater International Starlight Reserve Park

Dear IDA Board of Directors,

We, the managing board of the Israel Lighting Association support the Israel Nature & Parks Authority's application for establishing a Dark Sky Natural Park in the Ramon Crater in the Negev desert.

The need for such parks is multifaceted:

- For astronomical viewing of the universe;
- For health reasons -healthy sleeping;
- For the diversity of animals and plants that have evolved in response to diurnal and nocturnal biorhythms.

An International Dark Sky Park will help connect the State of Israel to international efforts and organizations aimed at protecting such assets.

Therefore, we strongly support the project of creating The Ramon Crater International Starlight Reserve Park in Machtesh Ramon.

**Dr. Inna Nissenbaum, Chairman,**  
**prof. Abraham Haim, vice Chairman**



**The Israel Lighting Association (R.A.)**

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International Dark-Sky Association  
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Head of the DL Technical Group  
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## In Support of the Application of the Ramon Crater International Starlight Reserve

Selecting an optimal location for Dark Sky Park should be done mainly according to three major aspects:

- 1) Low cloud coverage throughout the year.
- 2) Stability and transparency of the atmospheric layers.
- 3) Darkness level of the night sky.

The first criterion relies only on the heavens, and Ramon Crater is blessed with about 270 nights of clear sky yearly (similar to the best telescope sites).

The second aspect is also well covered. Though the Ramon Crater is situated close to the African Dust route, the high elevation and desert weather assure excellent conditions. Being located far away from heavy industrial areas and power plants also has a tremendous impact.

Lastly, the low density of population in this area vastly limits the artificial light. Some of the nearby population centers have already accepted regulations of eliminating light pollution, and accepting the Ramon Crater as "International Dark Sky Park" will drive the few who have not, to accept and act upon these regulations and rules.

The crater is already home to the largest telescope in Israel and several other robotic telescopes. These telescopes are involved with some of the latest astronomical research around the globe.

Adding to that, every new moon, many amateur astronomers gather in the crater area for a star party (sometimes in their hundreds).

Furthermore, on the nights of meteor showers, thousands of people gather around in well-organized areas to enjoy the beauty of the night sky.

Other aspects that should be noted are that the Ramon Crater is crossed by a single road and a single power line (both using the shortest possible route). Only special camping areas can be used during the nights all others are "Day Only Camps" (enforced by nature guides). All birds and animals are protected by law, some of which are unique to this area.

Therefore, on behalf of the "Guiding Light" group, I encourage the committee to declare the Ramon Crater, as an International Starlight Reserve.

Sincerely  
Gilad Gozani  
Head of the Tech. Group  
Directing-Light  
gili\_g@sysmetric-ltd.com  
+972544451376

The "Guiding Light Group" was founded on October 2011 as a group of volunteers from all around Israel. Its aim was to help the authorities and individuals, to improve the way exterior lights are used from aspects such as: energy consumption, glare and spill, improving uniformity and limiting the level in accordance to standards, promoting dimming for new and renew designs, setting limits to all other exterior lights (such as advertising signs, decorating lights, private lights) limiting LED light CCT to 3000K and more. The group assists in 3 major ways: **Explanation** of the light pollution aspects, noting the light **Standards** and levels that should be used, and helping in designing proper **Solutions** to any interested party.

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*"It's not dark yet, but its getting there."*

Bob Dylan, Nobel Prize Literature laureate 2017