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Observing the new Moon

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ABSTRACT

The first appearance of the new Moon has been used throughout history and is still used today to determine religious calendars. Many methods for predicting the Moon's appearance have been proposed throughout history and new models are still being developed. All these models have to be tested against observations to test their validity. To this end, ancient and modern astronomers have collected observations of new and old crescent Moons. Here we present the results of 539 observations of the Moon made over several years by many experienced observers in good weather conditions. In addition to determining whether or not the Moon was seen, the times of its first and last appearance were also carefully recorded. The addition of the appearance time means that even an easily visible Moon, recorded when it can barely be seen, may be compared with a visibility criterion. The observational data base greatly expands on previously published reports.

Key words: methods: observational – Moon.

1 INTRODUCTION

The first appearance of the new Moon has been used throughout history to determine the calendar. The Moslem, Hindu and Hebrew calendars are based on lunar months. Most lunar calendars today have abandoned the practice of observing the Moon each month in favour of calculations. However, there are still many who observe religious calendars that rely on observations of the Moon, namely, many Moslems (Ilyas 1994) as well as smaller religious groups such as Karaites (Shamuel 1996) and some Christian sects (Labombarbe 2000; Rood 2000). In addition, most mainstream Jewish authorities believe that the months of the Hebrew calendar will return to being determined by observation (Hoffman & Kaatz 2001). In practice, about a billion people today live according to calendars determined by the appearance of the Moon.

Prediction of visibility is a multidisciplinary problem requiring astronomy, optics, meteorology and physiology. Methods for determining the visibility of the Moon have been developed over thousands of years. One common theme is apparent in all the methods. They are all a measure of the minimum contrast required to observe the Moon. The contrast is a ratio of two components: the illuminance of the Moon and the brightness of the sky. A visibility criterion has to provide a model for each of these parameters and combine them.

For example, the Babylonians (about 2500 years ago) used the time since conjunction as a measure of the Moon's brightness and the lag time (time between Sunset and Moonset) as a measure of the brightness of the sky (Bruin 1977). According to this criterion, the Moon must be at least 24 h after conjunction to be bright enough to see *and* the lag time must be at least 48 min for the sky to be dark enough for the Moon be seen.

Other criteria from before the modern era, such as those of Maimonidies, Ibn Tariq, Al-Kwarizmi and Al-Batani, invariably relied on the angles between the Sun and the Moon and the time since conjunction (Ilyas 1994). For example, Maimonidies used the difference in ecliptic longitude as a measure of the Moon's brightness and the lag time as a measure of the darkness of the sky. Maimonidies went one step further by saying that the Moon was easier to see during the winter than during the summer and easier to see from high ground, but did not quantify these statements (Maimonidies 1178).

Modern science started to consider the problem only in the last 150 years (Fotheringham 1910; Maunder 1911). The Moon's brightness may be measured by the difference in azimuth, angular separation (known as arc of light) or crescent width (Ilyas 1994; Loewinger 1996). The darkening of the sky may be measured by difference in altitude. The most popular criterion today is that of Yallop (1998) who uses a combination of geocentric difference in altitude and semitopocentric crescent width. The use of topocentric measures would be expected to yield more consistent results but little difference is observed. All the above criteria rely on angles between the Sun and the Moon and can all be expressed approximately in terms of altitude and azimuth differences.

Bruin (1977) was the first to use photometric arguments to support his lunar visibility criterion based on astronomical angles. Schaefer (1988) was the first to attempt a fully photometric method for predicting visibility of the Moon. He calculated the brightness of the Moon and sky directly and compared the contrast with a known threshold contrast. However, his published methods (Schaefer 1988, 1993, 1998), while having considerable potential for improving

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prediction accuracy, are complicated and have yet to be widely adopted. The principal problem is that the contrast varies by several orders of magnitude while a small difference in contrast can make the difference between being visible and not being visible. With Schaefer's method, it was possible to predict the longitude of the limit of lunar visibility, known as the lunar date-line (Ilyas 1994), to a standard deviation of 7° that corresponds to 0°.4 in lunar elongation (Schaefer 1996). Hoffman & Kaatz (2001) used observations of planets and the Moon near the twilit horizon and the measurements of Koomen et al. (1952) of the twilight sky in addition to Schaefer's equations in an attempt to provide a more accurate photometric criterion for the new Moon's visibility. However, neither method took into account the varying shape of the Moon and there is no evidence that Kaatz's method is any more accurate than that of Schaefer. I hope to address this issue in greater detail in a future paper.

The above methods are designed to indicate if the Moon will be visible or not. When an observer comes to a religious court[1] to give evidence of the Moon's appearance, he is expected to say when the Moon appeared and how high it was (altitude). The court must be able to calculate the time of appearance in order to know if he is telling the truth. The method of Yallop (1998) gives a parameter of 'ease of visibility' that can be adapted to give a probability of visibility at any instant (Hoffman & Kaatz 2001). The photometric methods of Schaefer and of Kaatz can also be used to determine if visibility is possible at that time.

There are many occasions, when the Moon is near the limit of visibility, that out of a group of observers only some will observe it. There are also occasions when the Moon is predicted to appear but does not because the sky is hazy (even without clouds). None of the above prediction methods takes account of this but each religion deals with this uncertainty in its own way. None the less, all religions make use of the concept that there is a limit beyond which the Moon cannot be seen whatever the weather conditions and however good the observer.

Moslems use a number of methods for determining the visibility of the Moon (Ilyas 1994). In principle, it must be possible to see the Moon with the naked eye under perfect conditions either locally or somewhere else in the world. Seeing the Moon with a telescope under less than perfect conditions is taken by many Moslems to be a valid sighting. However, seeing the Moon with a telescope in a hazy sky does not necessarily mean that it would be visible to the eye in a clear sky.

Most Karaites use the concept of 'possibility of visibility' (Ben Shlomo 1872; Shamuel 2001). This means that the month starts once the Moon could be visible against the clearest of skies. The Karaites use records of previous observations. If the Moon (either old or new) has been seen previously with a similar lagtime and illumination, then a new month is started even if the Moon is not seen (Ben Shlomo 1872). More recently, the distance to the Moon has been added to this method (Shamuel 2001).

The Jewish Sanhedrin would usually base their decision on actual observations each month. However, it would need to know if the observations being reported were possible in order to check their credibility (Maimonidies 1178). The requirement of the Sanhedrin to make the calculation of the 'possibility of visibility' is considered a Torah commandment. Maimonidies describes a method for this calculation based on the lagtime and ecliptic elongation (Maimonidies 1178). However, his criterion is usually over-optimistic but occasionally the opposite is the case (Loewinger 1996). In other words, his method yields a lot of false positive predictions and a few false negatives.

[1]Moslem, Karaite or – when there is a Sanhedrin – Jewish. Today the Jewish (Hebrew) calendar is based on calculation. When there was a Sanhedrin (high religious court) until about 1600 years ago, the calendar was based directly on observation. Jewish tradition has it that the Sanhedrin will be re-established and will return to this previous method of determining the Jewish calendar.

2 COLLECTION OF OBSERVATIONS

Members of the Israeli New Moon Society have observed the Moon (Tables 1 and 2). The new Moon was first located with binoculars or by the naked eye with reference to the position of the Sun or the planets Mercury, Venus and Jupiter, or by direct measurement of altitude and azimuth (Hoffman & Kaatz 2000a). It is sufficient to locate the Moon using the hand to measure angles (Hoffman & Kaatz 2001). However, the use of poles on an equatorial mount (M. Shamuel, private communication; see also http://www.geocities.com/SoHo/Atrium/4075/09_2000.html), a fixed pole placed in the distance at the expected position of the Moon (Aguirre 1996) or binoculars on an altazimuth mount provide greater accuracy. Regardless of the method used to locate the Moon, an experienced observer can produce reliable results for the time of the first appearance of the Moon (Hoffman & Kaatz 2001). This time of the appearance, even when the Moon will be easily visible a few minutes later, is at its limit of visibility and is an important addition to the data base. Most previous data bases (Fotheringham 1910; Maunder 1911; Schaefer 1988; Loewinger 1996; Yallop 1998, see also http://www.saao.ac.za/sky/database.html) of this type do not include the time of first appearance. If they do include the time, it does not necessarily refer to the limit of visibility but to when the Moon was first seen, even though it may have been already clearly visible. A larger data base of observations has been reported from the Moonwatch programme (Doggett & Schaefer 1994). This consists of thousands of observations, by the general public (not necessarily experienced observers), of five new Moons.

The results (Tables 1 and 2) analysed were from experienced observers who were known to be able to find the new Moon as soon as it was visible or to follow the old Moon until it faded; they did not report that clouds or that some error had prevented them from making an accurate observation. It is difficult to define an experienced observer. I have defined an experienced observer as someone who produces a reliable observation near the limit of visibility. This can mean either seeing a difficult Moon or seeing an easy Moon early. With some training and practice, most adults and children over 7 (in some cases 5) years old can produce reliable results. On one hand great care was taken not to relate the selection of the experienced observers to any preconceived criterion. On the other hand, in the rare cases when an observation was clearly a long way from being visible using any criterion, then it was rejected. In all these cases, there were other reasons why the observation was unreliable, such as the Moon being reported at the wrong time, in the wrong position or wrong orientation.

Of the 1047 reports, 539 observations of the crescent Moon fitted the category of good observations. In many cases, it was easy to reject an imperfect observation because the observer either reported that the Moon appeared from behind cloud or that the Moon was already clearly visible when he first saw it. In either case the Moon was not seen at its limit of visibility in a cloudless sky.

The observers were given the following instructions in order to reduce the chance of false positive sightings. 'An observer that is looking hard sometimes tends to imagine that he has seen the Moon. To be sure that you really saw it, divert your gaze for a moment then

Table 1. Observations of the new Moon: Name, observers that requested to remain anonymous are called Anon No.; Lat. is latitude in degrees, North positive; Long. is longitude in degrees, East positive; Hgt is height above sea level in metres; Date is the Gregorian date in the form year/month/date; TZ is the time zone in hours ahead of UTC; Seen, Y if seen, N if not seen – if N appears with a time, the Moon was only seen with binoculars; First seen, local time first seen, only good observations listed; Last seen, local time last seen, only good observations listed; T is temperature in °C; P is pressure in mbar; RH is relative humidity in per cent; Age, time between conjunction and (geometric topocentric) sunset (sunrise in Table 2); Lag, Time between (geometric topocentric) sunset and moonset – in Table 2, time between moonrise and sunrise; ARCL, arc of light, geocentric height of Moon at sunset (sunrise in Table 2) – there is no correction for refraction in this and the following values; ARCV, arc of vision, geocentric elongation of the Moon at sunset (sunrise in Table 2); DAZ, azimuth difference, azimuth of Sun minus geocentric azimuth of Moon – in Table 2, azimuth of Moon minus azimuth of Sun; q is Yallop's q value for ease of visibility (see text).

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	T	P	RH	Age	Lag	ARCL	ARCV	DAZ	q
Tuvia Kaatz	31.13	34.88	426	1993/12/14	2	Y	17:01		15		60	29.1	75	14.4	15.0	7.3	0.70
Miriam Kaatz	32.08	34.88	40	1994/07/10	3	Y	20:00		25		65	43.1	56	12.2	11.8	18.7	0.66
Tuvia Kaatz	32.08	34.88	40	1994/07/10	3	Y	20:02		25		65	43.1	56	12.2	11.8	18.7	0.66
Benjamin Pories	32.08	34.88	40	1996/03/20	2	Y	18:08		15		65	29.0	71	15.4	15.7	2.3	0.74
Ruth Pories	32.08	34.88	40	1996/03/20	2	Y	18:08		15		65	29.0	71	15.4	15.7	2.3	0.74
Miriam Kaatz	32.08	34.88	40	1996/03/20	2	Y	18:08		15		65	29.0	71	15.4	15.7	2.3	0.74
Tuvia Kaatz	32.08	34.88	40	1996/03/20	2	Y	18:11		15		65	29.0	71	15.4	15.7	2.3	0.74
Benjamin Pories	32.08	34.88	40	1996/04/19	3	Y	19:10		18		65	41.3	93	19.6	19.6	7.6	1.37
Miriam Kaatz	32.08	34.88	40	1996/04/19	3	Y	19:10		18		65	41.3	93	19.6	19.6	7.6	1.37
Tuvia Kaatz	32.08	34.88	40	1996/04/19	3	Y	19:14		18		65	41.3	93	19.6	19.6	7.6	1.37
Miriam Kaatz	31.78	35.22	740	1996/05/18	3	Y	19:54		20		50	28.7	53	11.2	11.1	9.0	0.22
Tuvia Kaatz	31.78	35.22	740	1996/05/18	3	Y	19:56		20		50	28.7	53	11.2	11.1	9.0	0.22
Tuvia Kaatz	32.08	34.88	40	1997/02/08	2	Y	17:40		13		65	24.2	69	14.4	14.8	1.6	0.62
Shlomit Sheraga	32.08	34.88	40	1997/02/08	2	Y	17:39		13		65	24.2	69	14.4	14.8	1.6	0.62
Benjamin Pories	32.22	34.81	0	1997/05/07	3	N			21		70	19.6	39	8.7	8.7	7.5	−0.12
Ruth Pories	32.22	34.81	0	1997/05/07	3	N			21		70	19.6	39	8.7	8.7	7.5	−0.12
Benjamin Pories	32.08	34.88	40	1997/06/06	3	Y	19:55		24		65	33.6	58	12.3	12.0	12.9	0.45
Ruth Pories	32.08	34.88	40	1997/06/06	3	Y	19:50		24		65	33.6	58	12.3	12.0	12.9	0.45
Ruth Pories	32.08	34.88	40	1997/07/06	3	Y	19:53		26		65	46.1	65	13.8	13.4	17.6	0.79
Benjamin Pories	32.08	34.88	40	1997/08/05	3	Y	19:20		30		60	56.3	70	15.3	15.0	20.9	1.13
Ruth Pories	32.08	34.88	40	1997/08/05	3	Y	19:20		30		60	56.3	70	15.3	15.0	20.9	1.13
Ruth Pories	32.08	34.88	40	1997/09/03	3	Y	19:02	19:44	25		65	40.1	49	11.1	11.1	14.4	0.36
Ruth Pories	32.08	34.88	40	1997/11/01	2	Y	17:07		17		65	28.8	58	12.0	12.4	7.9	0.35
Tuvia Kaatz	32.08	34.88	40	1997/12/01	2	Y	16:34		13		65	36.3	87	16.6	17.4	9.2	1.06
Benjamin Pories	32.08	34.88	40	1997/12/01	2	Y	16:33		13		65	36.3	87	16.6	17.4	9.2	1.06
Ruth Pories	32.08	34.88	40	1997/12/01	2	Y	16:36		13		65	36.3	87	16.6	17.4	9.2	1.06
Benjamin Pories	31.26	35.22	600	1997/12/30	2	Y	17:10		12		63	21.8	60	12.0	12.3	2.4	0.28
Ruth Pories	31.26	35.22	600	1997/12/30	2	Y	17:09		12		63	21.8	60	12.0	12.3	2.4	0.28
Shlomit Sheraga	31.26	35.22	600	1997/12/30	2	Y	17:19		12		63	21.8	60	12.0	12.3	2.4	0.28
Benjamin Pories	32.08	34.88	40	1998/04/27	3	Y	19:24		18		65	28.5	70	15.0	15.0	9.1	0.77
Ruth Pories	32.08	34.88	40	1998/04/27	3	Y	19:22		18		65	28.5	70	15.0	15.0	9.1	0.77
Miriam Kaatz	32.08	34.88	40	1998/04/27	3	Y	19:27		18		65	28.5	70	15.0	15.0	9.1	0.77
Tuvia Kaatz	32.08	34.88	40	1998/04/27	3	Y	19:32		18		65	28.5	70	15.0	15.0	9.1	0.77
Magdi Shamuel	31.81	34.64	0	1998/04/27	3	Y	19:28					28.5	71	15.0	15.0	9.1	0.78
Yaakov Braham	31.81	34.64	0	1998/06/25	3	Y	19:50					36.9	65	13.7	13.3	14.7	0.70
Ruth Pories	32.08	34.88	40	1998/06/25	3	Y	19:45		24		65	36.9	65	13.6	13.2	14.8	0.69
Shlomit Sheraga	32.08	34.88	40	1998/06/25	3	Y	19:46		24		65	36.9	65	13.6	13.2	14.8	0.69
Miriam Kaatz	31.77	35.18	725	1998/07/24	3	N			23		55	26.9	36	8.2	8.0	11.0	−0.11
Tuvia Kaatz	31.77	35.18	725	1998/07/24	3	N			23		55	26.9	36	8.2	8.0	11.0	−0.11
Benjamin Pories	31.77	35.18	725	1998/07/24	3	N			23		55	26.9	36	8.2	8.0	11.0	−0.11
Ruth Pories	31.77	35.18	725	1998/07/24	3	N			23		55	26.9	36	8.2	8.0	11.0	−0.11
Shlomit Sheraga	31.77	35.18	725	1998/07/24	3	N			23		55	26.9	36	8.2	8.0	11.0	−0.11
Isaac Sergani	31.26	35.22	600	1998/07/25	3	Y	19:40					50.9	78	16.9	16.4	19.2	1.28
Yehudah Cohen	31.93	34.86	60	1998/08/23	3	Y	19:22					38.2	54	12.0	11.9	13.8	0.45
Miriam Kaatz	32.08	34.88	40	1998/08/23	3	Y	19:25		30		60	38.2	53	11.9	11.9	13.8	0.45
Naama Katz	32.08	34.88	40	1998/08/23	3	Y	19:21		30		60	38.2	53	11.9	11.9	13.8	0.45
Tuvia Kaatz	32.08	34.88	40	1998/08/23	3	Y	19:27		30		60	38.2	53	11.9	11.9	13.8	0.45
Yoseph Musa	31.32	34.61	140	1998/08/23	3	Y	19:30					38.2	54	12.1	12.1	13.7	0.47
Benjamin Pories	32.08	34.88	40	1998/08/23	3	Y	19:22		30		60	38.2	53	11.9	11.9	13.8	0.45
Ruth Pories	32.08	34.88	40	1998/08/23	3	Y	19:25		30		60	38.2	53	11.9	11.9	13.8	0.45
Isaac Sergani	31.26	35.22	600	1998/08/23	3	Y	19:30					38.1	54	12.1	12.1	13.6	0.47
Magdi Shamuel	31.81	34.64	0	1998/08/23	3	Y	19:25					38.2	54	12.0	12.0	13.8	0.46
Avi Dabah	31.81	34.64	0	1998/09/22	2	Y	17:38					46.6	70	15.3	15.6	15.5	0.98
Magdi Shamuel	31.81	34.64	0	1998/09/22	2	Y	17:39					46.6	70	15.3	15.6	15.5	0.98
Devorah Gordon	31.83	35.24	774	1998/10/21	2	Y	17:25	17:40				28.8	54	11.6	11.9	7.6	0.27

Table 1 – *continued*

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	*T*	P	RH	Age	Lag	ARCL	ARCV	DAZ	*q*
Nehemia Gordon	31.83	35.24	774	1998/10/21	2	Y	17:27	17:40				28.8	54	11.6	11.9	7.6	0.27
Yoseph Musa	31.32	34.61	140	1998/10/21	2	N	17:33	17:40				28.8	54	11.7	12.0	7.6	0.28
Benjamin Pories	32.08	34.88	40	1998/10/21	2	Y	17:22		25		70	28.8	54	11.6	11.8	7.7	0.27
Ruth Pories	32.08	34.88	40	1998/10/21	2	Y	17:22		25		70	28.8	54	11.6	11.8	7.7	0.27
Shlomit Sheraga	32.08	34.88	40	1998/10/21	2	Y	17:22		25		70	28.8	54	11.6	11.8	7.7	0.27
Magdi Shamuel	31.81	34.64	0	1998/10/21	2	Y	17:22					28.8	54	11.6	11.9	7.7	0.27
Elliyahu Katz	31.96	35.25	820	1998/10/21	2	Y	17:24					28.8	54	11.6	11.9	7.7	0.27
Yaakov Braham	31.81	34.64	0	1998/11/20	2	Y	16:52					34.1	72	14.1	14.7	8.3	0.65
Yehudah Cohen	31.93	34.86	60	1998/11/20	2	Y	16:50					34.1	72	14.1	14.7	8.3	0.65
Devorah Gordon	31.83	35.24	774	1998/11/20	2	Y	16:52	17:12				34.1	72	14.1	14.7	8.3	0.65
Nehemia Gordon	31.83	35.24	774	1998/11/20	2	Y	16:55	17:12				34.1	72	14.1	14.7	8.3	0.65
Yoseph Musa	31.32	34.61	140	1998/11/20	2	Y	16:59					34.2	72	14.2	14.8	8.2	0.66
Magdi Shamuel	31.81	34.64	0	1998/11/20	2	Y	16:53					34.1	72	14.1	14.7	8.3	0.65
Yehudah Cohen	31.93	34.86	60	1998/12/20	2	Y	16:43					39.9	91	17.1	18.0	8.9	1.12
Yoseph Musa	31.32	34.61	140	1998/12/20	2	Y	16:45					39.9	91	17.2	18.1	8.7	1.13
Isaac Sergani	31.26	35.22	600	1998/12/20	2	Y	17:05					39.9	91	17.2	18.1	8.7	1.13
Magdi Shamuel	30.88	34.46	260	1998/12/20	2	Y	16:42					40.0	91	17.3	18.2	8.6	1.14
Hatim Salim	31.77	35.20	725	1999/03/18	2	Y	18:10	18:10	17.5	922	29	20.9	50	11.1	11.4	5.6	0.19
Yaakov Braham	31.81	34.64	0	1999/04/17	3	Y	19:17					35.8	93	19.6	19.7	9.6	1.47
Yosi Gaber	31.93	34.86	60	1999/04/17	3	Y	19:22					35.7	93	19.5	19.7	9.6	1.47
Roy Hoffman	31.79	35.31	430	1999/04/17	3	Y	19:16	19:37	21.5	968	40	35.7	93	19.5	19.7	9.6	1.47
Elliyahu Katz	31.96	35.25	820	1999/04/17	3	Y	19:09					35.7	93	19.5	19.6	9.6	1.46
Hatim Salim	31.95	35.17	850	1999/04/17	3	Y	19:17	19:30	18.7			35.7	93	19.5	19.6	9.6	1.46
Magdi Shamuel	31.81	34.64	0	1999/04/17	3	Y	19:17					35.8	93	19.6	19.7	9.6	1.47
Yosi Gaber	31.93	34.86	60	1999/05/16	3	Y	19:40					28.4	68	14.2	14.1	10.4	0.69
Devorah Gordon	31.83	35.24	774	1999/05/16	3	Y	19:40					28.3	68	14.2	14.1	10.3	0.69
Nehemia Gordon	31.83	35.24	774	1999/05/16	3	Y	19:43					28.3	68	14.2	14.1	10.3	0.69
Roy Hoffman	31.79	35.31	430	1999/05/16	3	Y	19:40	20:00	21.5	959	59	28.3	68	14.2	14.1	10.3	0.69
Miriam Kaatz	32.08	34.88	40	1999/05/16	3	Y	19:45	20:20	21		75	28.4	68	14.2	14.1	10.4	0.69
Tuvia Kaatz	32.08	34.88	40	1999/05/16	3	Y	19:47	20:20	21		75	28.4	68	14.2	14.1	10.4	0.69
Elliyahu Katz	31.96	35.25	820	1999/05/16	3	Y	19:33					28.3	68	14.2	14.1	10.4	0.69
Yoseph Musa	31.32	34.61	140	1999/05/16	3	Y	19:42					28.4	68	14.3	14.2	10.2	0.70
Benjamin Pories	32.08	34.88	40	1999/05/16	3	Y	19:43		21		75	28.4	68	14.2	14.1	10.4	0.69
Ruth Pories	32.08	34.88	40	1999/05/16	3	Y	19:35	20:24	21		75	28.4	68	14.2	14.1	10.4	0.69
Isaac Sergani	31.26	35.22	600	1999/05/16	3	Y	19:39					28.3	68	14.3	14.2	10.2	0.70
Shlomit Sheraga	32.08	34.88	40	1999/05/16	3	Y	19:44	20:20	21		75	28.4	68	14.2	14.1	10.4	0.69
Magdi Shamuel	29.63	34.88	833	1999/05/16	3	Y	19:28	20:33				28.3	68	14.6	14.5	9.7	0.73
Oded Yehudah	31.93	34.86	60	1999/05/16	3	Y	19:40					28.4	68	14.2	14.1	10.4	0.69
Roy Hoffman	31.79	35.23	750	1999/06/14	3	N			19.5	919	77	21.6	42	9.0	8.9	9.5	−0.02
Hatim Salim	31.79	35.23	750	1999/06/14	3	N			19.5	919	78	21.6	42	9.0	8.9	9.5	−0.02
Isaac Sergani	31.26	35.22	600	1999/06/14	3	N						21.6	42	9.1	9.0	9.4	−0.02
Roy Hoffman	31.79	35.31	430	1999/06/15	3	Y	19:18	21:00	24.5	962	68	45.6	102	21.0	20.2	16.8	1.80
Tuvia Kaatz	32.08	34.88	40	1999/06/15	3	Y	19:30		25		62	45.7	102	20.9	20.1	16.9	1.79
Ruth Pories	32.08	34.88	40	1999/06/15	3	Y	19:27		25		62	45.7	102	20.9	20.1	16.9	1.79
Hatim Salim	31.77	35.20	725	1999/06/15	3	Y	19:55	20:45	19			45.6	102	21.0	20.2	16.8	1.80
Shlomit Sheraga	32.08	34.88	40	1999/06/15	3	Y	19:28		25		62	45.7	102	20.9	20.1	16.9	1.79
Roy Hoffman	31.79	35.31	430	1999/07/14	3	Y	19:48	20:31	28.5	953	53	38.3	72	15.4	14.9	15.2	0.96
Bruce Brill	31.63	35.21	680	1999/08/12	3	Y	19:51	19:59				29.2	51	11.3	11.2	11.0	0.30
Devorah Gordon	31.83	35.24	774	1999/08/12	3	Y	19:45	20:06				29.2	51	11.3	11.2	11.1	0.29
Nehemia Gordon	31.83	35.24	774	1999/08/12	3	Y	19:45	20:06				29.2	51	11.3	11.2	11.1	0.29
Elliyahu Katz	31.96	35.25	820	1999/08/12	3	Y	19:41					29.2	51	11.2	11.1	11.1	0.29
Miriam Kaatz	32.08	34.88	40	1999/08/12	3	N			26		68	29.3	50	11.2	11.1	11.1	0.29
Tuvia Kaatz	32.08	34.88	40	1999/08/12	3	Y	19:50	20:00	26		68	29.3	50	11.2	11.1	11.1	0.29
Benjamin Pories	32.08	34.88	40	1999/08/12	3	Y	19:44	19:44	26		68	29.3	50	11.2	11.1	11.1	0.29
Ruth Pories	32.08	34.88	40	1999/08/12	3	Y	19:43	20:00	26		68	29.3	50	11.2	11.1	11.1	0.29
Isaac Sergani	31.26	35.22	600	1999/08/12	3	Y	19:46					29.2	51	11.4	11.3	10.9	0.30
Magdi Shamuel	31.81	34.64	0	1999/08/12	3	Y	19:42					29.3	51	11.3	11.2	11.1	0.29
Shlomit Sheraga	32.08	34.88	40	1999/08/12	3	N			26		68	29.3	50	11.2	11.1	11.1	0.29
Yehudah Cohen	31.93	34.86	60	1999/09/11	2	Y	17:45					41.8	70	15.4	15.6	15.0	0.98
Roy Hoffman	31.79	35.31	430	1999/09/11	2	Y	17:42	18:26	24	963	65	41.7	70	15.5	15.6	14.9	0.99
Elliyahu Katz	31.96	35.25	820	1999/09/11	2	Y	17:42	17:42				41.7	70	15.4	15.6	15.0	0.98
Yoseph Musa	31.32	34.61	140	1999/09/11	2	Y	17:48					41.8	71	15.6	15.8	14.8	1.00
Isaac Sergani	31.26	35.22	600	1999/09/11	2	Y	17:53					41.7	71	15.6	15.8	14.8	1.00

Table 1 – *continued*

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	T	P	RH	Age	Lag	ARCL	ARCV	DAZ	*q*
Magdi Shamuel	31.81	34.64	0	1999/09/11	2	Y	17:47					41.8	70	15.5	15.6	14.9	0.99
Yoseph Musa	31.32	34.61	140	1999/10/10	2	Y	17:42	17:58				27.6	53	11.7	12.0	7.9	0.29
Devorah Gordon	31.78	35.24	725	1999/11/09	2	Y	16:51		17.5	924	65	34.8	68	13.7	14.2	9.4	0.61
Nehemia Gordon	31.78	35.24	725	1999/11/09	2	Y	16:54	17:42	17.5	924	65	34.8	68	13.7	14.2	9.4	0.61
Anon 6	59.93	10.75	0	1999/11/09	1	Y	16:36	17:06	2	984	59	35.0	67	6.9	7.5	15.2	−0.06
Roy Hoffman	31.78	35.24	725	1999/11/09	2	Y	16:54	17:43	17.5	924	65	34.8	68	13.7	14.2	9.4	0.61
Miriam Kaatz	32.08	34.88	40	1999/11/09	2	Y	16:55		26		55	34.8	68	13.6	14.2	9.5	0.61
Tuvia Kaatz	32.08	34.88	40	1999/11/09	2	Y	17:00		26		55	34.8	68	13.6	14.2	9.5	0.61
Elliyahu Katz	31.96	35.25	820	1999/11/09	2	Y	16:58					34.8	68	13.7	14.2	9.5	0.61
Yoseph Musa	32.08	34.85	40	1999/11/09	2	Y	17:05					34.8	68	13.6	14.2	9.5	0.61
David Pisanti	31.78	35.24	725	1999/11/09	2	Y	16:51		17.5	924	65	34.8	68	13.7	14.2	9.4	0.61
Benjamin Pories	32.08	34.88	40	1999/11/09	2	Y	17:01		26		55	34.8	68	13.6	14.2	9.5	0.61
Ruth Pories	32.08	34.88	40	1999/11/09	2	Y	16:49		26		55	34.8	68	13.6	14.2	9.5	0.61
Anon 11	59.93	10.75	0	1999/11/09	1	Y	16:36	17:06	2	984	59	35.0	67	6.9	7.5	15.2	−0.06
Hatim Salim	31.77	35.20	725	1999/11/09	2	Y	16:53	17:08				34.8	68	13.7	14.2	9.4	0.61
Shlomit Sheraga	32.08	34.88	40	1999/11/09	2	Y	16:55		26		55	34.8	68	13.6	14.2	9.5	0.61
Magdi Shamuel	32.08	34.85	40	1999/11/09	2	Y	16:55					34.8	68	13.6	14.2	9.5	0.61
Anon 5	59.93	10.75	0	1999/11/10	1	Y	16:05	17:27	3			59.0	93	7.9	9.6	26.1	0.67
Anon 9	59.93	10.75	0	1999/11/10	1	Y	16:05	17:27	3			59.0	93	7.9	9.6	26.1	0.67
Magdi Shamuel	31.81	34.64	0	1999/12/08	2	N						16.0	37	7.7	7.8	2.2	−0.31
Gershom Tsipris	31.66	35.17	900	1999/12/09	2	Y	16:56					40.0	82	15.3	16.1	9.9	0.87
Kalonymus Freedman	31.79	35.31	430	1999/12/09	2	Y	16:52		13	967	55	40.0	82	15.3	16.1	9.9	0.87
Devorah Gordon	31.83	35.24	774	1999/12/09	2	Y	16:47	17:22				40.0	82	15.3	16.1	9.9	0.87
Yossi Green	31.79	35.31	430	1999/12/09	2	Y	16:49	17:22	13	967	52	40.0	82	15.3	16.1	9.9	0.87
Jonathan Hoffman	31.79	35.31	430	1999/12/09	2	Y	16:49	17:22	13	967	52	40.0	82	15.3	16.1	9.9	0.87
Roy Hoffman	31.79	35.31	430	1999/12/09	2	Y	16:47	17:22	13	967	52	40.0	82	15.3	16.1	9.9	0.87
Miriam Kaatz	32.08	34.88	40	1999/12/09	2	Y	16:45		16		63	40.0	82	15.2	16.1	10.0	0.86
Tuvia Kaatz	32.08	34.88	40	1999/12/09	2	Y	16:55		16		63	40.0	82	15.2	16.1	10.0	0.86
Benjamin Pories	32.08	34.88	40	1999/12/09	2	Y	16:50		16		63	40.0	82	15.2	16.1	10.0	0.86
Ruth Pories	32.08	34.88	40	1999/12/09	2	Y	16:45		16		63	40.0	82	15.2	16.1	10.0	0.86
Anon 4	59.93	10.75	0	2000/01/08	1	Y	15:50	17:10	5			44.2	118	9.0	10.8	18.1	0.44
Anon 5	59.93	10.75	0	2000/01/08	1	Y	15:40	17:10	5			44.2	118	9.0	10.8	18.1	0.44
Anon 6	59.93	10.75	0	2000/01/08	1	Y	15:36	16:45	3	990	54	44.2	118	9.0	10.8	18.1	0.44
Yoseph Musa	31.32	34.61	140	2000/01/08	2	Y	17:05					44.6	95	17.9	18.9	9.8	1.26
Berit Ruud	60.88	10.93	200	2000/01/08	1	Y	15:44	16:54	4			44.0	120	8.5	10.4	18.3	0.39
Isaac Sergani	31.26	35.22	600	2000/01/08	2	Y	17:00					44.6	95	17.9	18.9	9.8	1.26
Anon 4	59.93	10.75	0	2000/03/07	1	Y	18:06	19:10	8			35.6	92	11.4	12.0	14.9	0.51
Mette Hustad	59.93	10.75	0	2000/03/07	1	Y	18:12	19:19				35.6	92	11.4	12.0	14.9	0.51
Magdi Shamuel	31.81	34.64	0	2000/03/07	2	Y	17:50					34.4	77	16.5	16.9	7.5	0.97
Devorah Gordon	31.83	35.24	774	2000/04/05	2	N						21.7	48	10.7	10.9	7.0	0.15
Nehemia Gordon	31.83	35.24	774	2000/04/05	2	N						21.7	48	10.7	10.9	7.0	0.15
Anon 6	59.28	10.47	0	2000/04/05	2	N			−1	1010	52	23.9	51	7.1	7.2	11.9	−0.18
Roy Hoffman	31.77	35.20	725	2000/04/05	2	N			22	926	54	21.8	48	10.7	10.9	7.0	0.15
Noach Treitel	31.77	35.20	725	2000/04/05	2	N			22	926	54	21.8	48	10.7	10.9	7.0	0.15
Miriam Kaatz	32.08	34.88	40	2000/04/05	2	N						21.8	48	10.7	10.8	7.0	0.15
Tuvia Kaatz	32.08	34.88	40	2000/04/05	2	N						21.8	48	10.7	10.8	7.0	0.15
Elliyahu Katz	31.96	35.25	820	2000/04/05	2	N						21.7	48	10.7	10.8	7.0	0.15
Naama Katz	31.96	35.25	820	2000/04/05	2	N						21.7	48	10.7	10.8	7.0	0.15
Hatim Salim	31.95	35.17	850	2000/04/05	2	N						21.8	48	10.7	10.8	7.0	0.15
Isaac Sergani	31.26	35.22	600	2000/04/05	2	N						21.7	48	10.8	10.9	6.9	0.15
Magdi Shamuel	31.81	34.64	0	2000/04/05	2	N						21.8	48	10.7	10.9	7.0	0.15
Miriam Kaatz	32.08	34.88	40	2000/05/05	3	Y	19:26		22		58	36.1	90	18.5	18.4	10.1	1.29
Tuvia Kaatz	32.08	34.88	40	2000/05/05	3	Y	19:31		22		58	36.1	90	18.5	18.4	10.1	1.29
Avigail Katz	32.08	34.88	40	2000/05/05	3	Y	19:23		22		58	36.1	90	18.5	18.4	10.1	1.29
Elliyahu Katz	32.08	34.88	40	2000/05/05	3	Y	19:19		22		58	36.1	90	18.5	18.4	10.1	1.29
Naama Katz	32.08	34.88	40	2000/05/05	3	Y	19:15		22		58	36.1	90	18.5	18.4	10.1	1.29
Yoseph Musa	31.32	34.61	140	2000/05/05	3	Y	19:20					36.1	89	18.6	18.6	9.9	1.31
Benjamin Pories	32.08	34.88	40	2000/05/05	3	Y	19:29		22		58	36.1	90	18.5	18.4	10.1	1.29
Ruth Pories	32.08	34.88	40	2000/05/05	3	Y	19:17		22		58	36.1	90	18.5	18.4	10.1	1.29
Shlomit Sheraga	32.08	34.88	40	2000/05/05	3	Y	19:16		22		58	36.1	90	18.5	18.4	10.1	1.29
Magdi Shamuel	31.81	34.64	0	2000/05/05	3	Y	19:20					36.1	90	18.5	18.5	10.0	1.30
Yehudah Cohen	31.93	34.86	60	2000/06/03	3	Y	19:53					28.4	67	13.6	13.5	10.0	0.59
Israel Eshchar	31.79	35.18	675	2000/06/03	3	Y	19:53	20:25				28.4	67	13.7	13.5	9.9	0.59

Table 1 – *continued*

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	*T*	P	RH	Age	Lag	ARCL	ARCV	DAZ	*q*
Yosi Gaber	31.93	34.86	60	2000/06/03	3	Y	19:53					28.4	67	13.6	13.5	10.0	0.59
Jonathan Hoffman	31.79	35.31	430	2000/06/03	3	Y	19:47	20:13	22.5	959	50	28.4	67	13.7	13.5	9.9	0.59
Roy Hoffman	31.79	35.31	430	2000/06/03	3	Y	19:47	20:13	22.5	959	50	28.4	67	13.7	13.5	9.9	0.59
Lionel Isaacs	31.79	35.31	430	2000/06/03	3	Y	19:48	20:10	22.5	959	50	28.4	67	13.7	13.5	9.9	0.59
Yoseph Musa	31.32	34.61	140	2000/06/03	3	Y	19:54					28.4	67	13.8	13.6	9.8	0.61
Isaac Sergani	31.26	35.22	600	2000/06/03	3	Y	20:02					28.4	67	13.7	13.6	9.8	0.60
Magdi Shamuel	31.81	34.64	0	2000/06/03	3	Y	19:43					28.4	67	13.7	13.5	9.9	0.60
Shari Damast	31.77	35.20	725	2000/07/02	3	N			26.5	921	61	21.4	46	9.7	9.6	8.2	0.03
Lionel Isaacs	31.77	35.20	725	2000/07/02	3	N			26.5	921	61	21.4	46	9.7	9.6	8.2	0.03
Yosi Gaber	31.93	34.86	60	2000/07/02	3	N						21.4	46	9.7	9.6	8.3	0.03
Devorah Gordon	31.83	35.24	774	2000/07/02	3	N						21.4	46	9.7	9.6	8.2	0.03
Nehemia Gordon	31.83	35.24	774	2000/07/02	3	N						21.4	46	9.7	9.6	8.2	0.03
Roy Hoffman	31.77	35.20	725	2000/07/02	3	N			26.5	921	61	21.4	46	9.7	9.6	8.2	0.03
Miriam Kaatz	32.08	34.88	40	2000/07/02	3	N			17		65	21.4	46	9.7	9.5	8.3	0.03
Tuvia Kaatz	32.08	34.88	40	2000/07/02	3	N			17		65	21.4	46	9.7	9.5	8.3	0.03
Elliyahu Katz	31.79	35.18	675	2000/07/02	3	N	20:13	20:13				21.4	46	9.7	9.6	8.2	0.03
Danny Levy	31.79	35.18	700	2000/07/02	3	N						21.4	46	9.7	9.6	8.2	0.03
Ruth Pories	32.08	34.88	40	2000/07/02	3	N			17		65	21.4	46	9.7	9.5	8.3	0.03
Isaac Sergani	31.26	35.22	600	2000/07/02	3	N						21.4	46	9.8	9.7	8.1	0.04
Magdi Shamuel	31.81	34.64	0	2000/07/02	3	N						21.4	46	9.7	9.6	8.3	0.03
Shlomit Sheraga	32.08	34.88	40	2000/07/02	3	N			17		65	21.4	46	9.7	9.5	8.3	0.03
Shay Walter	31.81	34.73	30	2000/07/02	3	N						21.4	46	9.7	9.6	8.3	0.03
Shari Damast	31.72	35.14	820	2000/07/03	3	Y	19:48	21:10				45.4	102	21.1	20.3	16.9	1.83
Miriam Kaatz	32.08	34.88	40	2000/07/03	3	Y	19:50		30		75	45.4	102	21.0	20.2	17.1	1.82
Tuvia Kaatz	32.08	34.88	40	2000/07/03	3	Y	19:53		30		75	45.4	102	21.0	20.2	17.1	1.82
Benjamin Pories	32.08	34.88	40	2000/07/03	3	Y	19:44		30		75	45.4	102	21.0	20.2	17.1	1.82
Ruth Pories	32.08	34.88	40	2000/07/03	3	Y	19:40		30		75	45.4	102	21.0	20.2	17.1	1.82
Liora Ravid	32.08	34.88	40	2000/07/03	3	Y	19:40		30		75	45.4	102	21.0	20.2	17.1	1.82
Yehudit Rosenstein	32.08	34.88	40	2000/07/03	3	Y	19:49		30		75	45.4	102	21.0	20.2	17.1	1.82
Noach Treitel	31.72	35.14	820	2000/07/03	3	Y	19:48	21:10				45.4	102	21.1	20.3	16.9	1.83
Yaakov Braham	31.81	34.64	0	2000/08/01	3	Y	19:41					38.1	78	16.8	16.5	15.0	1.18
Jonathan Hoffman	31.79	35.31	430	2000/08/01	3	Y	19:28	19:59	27.5	957	52	38.1	78	16.8	16.5	15.0	1.18
Roy Hoffman	31.79	35.31	430	2000/08/01	3	Y	19:28	19:59	27.5	957	52	38.1	78	16.8	16.5	15.0	1.18
Miriam Kaatz	32.08	34.88	40	2000/08/01	3	Y	19:47		27		68	38.1	78	16.7	16.4	15.1	1.17
Tuvia Kaatz	32.08	34.88	40	2000/08/01	3	Y	19:52		27		68	38.1	78	16.7	16.4	15.1	1.17
Yoseph Musa	31.32	34.61	140	2000/08/01	3	Y	19:40					38.1	78	16.9	16.6	14.9	1.19
Benjamin Pories	32.08	34.88	40	2000/08/01	3	Y	19:54		27		68	38.1	78	16.7	16.4	15.1	1.17
Ruth Pories	32.08	34.88	40	2000/08/01	3	Y	19:34		27		68	38.1	78	16.7	16.4	15.1	1.17
Magdi Shamuel	31.81	34.64	0	2000/08/01	3	Y	19:35					38.1	78	16.8	16.5	15.0	1.18
Noach Treitel	31.80	35.19	800	2000/08/01	3	Y	19:38	19:52				38.1	78	16.8	16.5	15.0	1.18
Miri Burgin	31.76	35.22	750	2000/08/30	3	Y	19:30	19:48				29.7	60	13.4	13.5	11.1	0.60
Nilit Darwish	31.93	34.86	60	2000/08/30	3	Y	19:19					29.7	60	13.4	13.4	11.1	0.60
Yosi Gaber	31.93	34.86	60	2000/08/30	3	Y	19:19					29.7	60	13.4	13.4	11.1	0.60
Roy Hoffman	31.79	35.31	430	2000/08/30	3	Y	19:20	19:39	25	957	62	29.7	60	13.4	13.5	11.1	0.60
Tuvia Kaatz	32.08	34.88	40	2000/08/30	3	Y	19:26		27		58	29.7	60	13.4	13.4	11.2	0.60
Ruth Pories	32.08	34.88	40	2000/08/30	3	Y	19:16		27		58	29.7	60	13.4	13.4	11.2	0.60
Chaim Sabato	31.79	35.31	430	2000/08/30	3	Y	19:21		25	957	62	29.7	60	13.4	13.5	11.1	0.60
Yisrael-Meir Sabato	31.79	35.31	430	2000/08/30	3	Y	19:21		25	957	62	29.7	60	13.4	13.5	11.1	0.60
Yoseph Musa	31.34	34.60	140	2000/08/30	3	Y	19:17					29.7	60	13.5	13.6	11.0	0.61
Magdi Shamuel	31.34	34.60	140	2000/08/30	3	Y	19:19					29.7	60	13.5	13.6	11.0	0.61
Randy Wohl	31.80	35.31	390	2000/08/30	3	Y	19:23	19:39				29.7	60	13.4	13.4	11.1	0.60
Yehudah Cohen	29.63	34.88	833	2000/09/28	3	Y	18:55	19:03				19.5	44	10.3	10.5	5.4	0.07
Yosi Gaber	29.63	34.88	833	2000/09/28	3	Y	19:00	19:03				19.5	44	10.3	10.5	5.4	0.07
Devorah Gordon	29.63	34.88	833	2000/09/28	3	N						19.5	44	10.3	10.5	5.4	0.07
Nehemia Gordon	29.63	34.88	833	2000/09/28	3	N						19.5	44	10.3	10.5	5.4	0.07
Mordecai Haina	31.93	34.86	60	2000/09/28	3	N	18:48	18:50				19.5	44	10.1	10.2	5.8	0.05
Magdi Shamuel	29.63	34.88	833	2000/09/28	3	Y	18:45	19:03				19.5	44	10.3	10.5	5.4	0.07
Yehudah Cohen	31.93	34.86	60	2000/10/28	2	Y	17:06					30.9	62	12.8	13.3	9.8	0.51
Yosi Gaber	31.93	34.86	60	2000/10/28	2	Y	17:06					30.9	62	12.8	13.3	9.8	0.51
Ariel Fridman	32.08	34.88	40	2000/10/28	2	Y	17:14		22		54	30.9	62	12.8	13.2	9.9	0.50
Devorah Gordon	31.83	35.24	774	2000/10/28	2	Y	17:04					30.8	62	12.8	13.3	9.8	0.51
Nehemia Gordon	31.83	35.24	774	2000/10/28	2	Y	17:05					30.8	62	12.8	13.3	9.8	0.51
Mordecai Hani	31.93	34.86	60	2000/10/28	2	Y	17:06					30.9	62	12.8	13.3	9.8	0.51

Table 1 – *continued*

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	*T*	P	RH	Age	Lag	ARCL	ARCV	DAZ	*q*
Jonathan Hoffman	31.79	35.31	430	2000/10/28	2	Y	17:00		19.5	969	46	30.8	62	12.8	13.3	9.8	0.51
Roy Hoffman	31.79	35.31	430	2000/10/28	2	Y	16:58	17:23	19.5	969	46	30.8	62	12.8	13.3	9.8	0.51
Miriam Kaatz	32.08	34.88	40	2000/10/28	2	Y	17:12		22		54	30.9	62	12.8	13.2	9.9	0.50
Tuvia Kaatz	32.08	34.88	40	2000/10/28	2	Y	17:10		22		54	30.9	62	12.8	13.2	9.9	0.50
Elliyahu Katz	31.96	35.25	820	2000/10/28	2	Y	17:05					30.8	62	12.8	13.2	9.8	0.51
Yoseph Musa	31.32	34.61	140	2000/10/28	2	Y	17:08					30.9	62	12.9	13.4	9.7	0.52
Shuki Ovadiah	31.32	34.61	140	2000/10/28	2	Y	17:08					30.9	62	12.9	13.4	9.7	0.52
Benjamin Pories	32.08	34.88	40	2000/10/28	2	Y	17:13		22		54	30.9	62	12.8	13.2	9.9	0.50
Ruth Pories	32.08	34.88	40	2000/10/28	2	Y	17:02		22		54	30.9	62	12.8	13.2	9.9	0.50
Isaac Sergani	31.26	35.22	600	2000/10/28	2	Y	17:07					30.9	62	12.9	13.4	9.7	0.52
Magdi Shamuel	31.81	34.64	0	2000/10/28	2	Y	17:05					30.9	62	12.8	13.3	9.8	0.51
Eli Tanani	31.93	34.86	60	2000/10/28	2	Y	17:06					30.9	62	12.8	13.3	9.8	0.51
Chris Corbally	32.29	−111.05	762	2000/11/26	−7	Y	17:40	17:50				25.1	51	10.1	10.5	6.7	0.08
Fay Libbey	32.29	−111.05	762	2000/11/26	−7	Y	17:40	17:50				25.1	51	10.1	10.5	6.7	0.08
John Polacheck	32.29	−111.05	762	2000/11/26	−7	Y	17:40	17:50				25.1	51	10.1	10.5	6.7	0.08
Patrick Price	32.29	−111.05	762	2000/11/26	−7	Y	17:40	17:50				25.1	51	10.1	10.5	6.7	0.08
Toshiko Yoshioka	32.29	−111.05	762	2000/11/26	−7	Y	17:40	17:50				25.1	51	10.1	10.5	6.7	0.08
Lior Eshdat	31.77	35.20	725	2000/11/27	2	Y	16:42					39.3	77	14.5	15.4	11.9	0.82
Roy Hoffman	31.77	35.20	725	2000/11/27	2	Y	16:38	17:27	15	927	57	39.3	77	14.5	15.4	11.9	0.82
Magdi Shamuel	31.81	34.64	0	2000/11/27	2	Y	16:31					39.4	77	14.5	15.4	11.9	0.82
Danny Levy	29.61	34.88	734	2000/12/26	2	N						21.4	41	8.4	8.7	4.9	−0.18
John Polacheck	32.29	−111.05	762	2000/12/26	−7	Y	17:43	17:58				31.0	61	11.5	12.1	8.1	0.30
Yossi Green	31.79	35.31	430	2000/12/27	2	Y	16:40		10.5	972	77	45.3	92	16.6	17.8	12.2	1.15
Roy Hoffman	31.79	35.31	430	2000/12/27	2	Y	16:38	17:30	10.5	972	77	45.3	92	16.6	17.8	12.2	1.15
Yoseph Musa	31.32	34.61	140	2000/12/27	2	Y	16:47					45.3	92	16.8	17.9	12.1	1.16
Anon 11	31.79	35.31	430	2000/12/27	2	Y	16:43		10.5	972	77	45.3	92	16.6	17.8	12.2	1.15
Magdi Shamuel	31.81	34.64	0	2000/12/27	2	Y	16:44					45.3	92	16.6	17.8	12.2	1.15
Randy Wohl	31.80	35.31	390	2000/12/27	2	Y	16:45		10.5	972	77	45.3	92	16.6	17.8	12.2	1.14
John Polacheck	32.29	−111.05	762	2001/01/25	−7	Y	17:55					35.7	71	13.9	14.5	8.6	0.63
Fay Libbey	32.29	−111.05	762	2001/01/25	−7	Y	18:00					35.7	71	13.9	14.5	8.6	0.63
Isaac Sergani	31.32	34.61	140	2001/01/25	2	N	17:39	17:41				26.0	49	10.1	10.4	6.5	0.06
Magdi Shamuel	31.00	34.78	370	2001/01/25	2	Y	17:37	17:38				26.0	49	10.1	10.5	6.5	0.07
Ariel Fridman	32.08	34.88	40	2001/02/24	2	Y	17:55		17		55	31.2	62	13.1	13.5	7.5	0.48
Yosi Gaber	31.93	34.86	60	2001/02/24	2	Y	17:38					31.2	62	13.1	13.5	7.4	0.48
Lionel Isaacs	31.80	35.06	630	2001/02/24	2	Y	17:51					31.2	62	13.1	13.5	7.4	0.48
Miriam Kaatz	32.08	34.88	40	2001/02/24	2	Y	17:52		17		55	31.2	62	13.1	13.5	7.5	0.48
Tuvia Kaatz	32.08	34.88	40	2001/02/24	2	Y	18:00		17		55	31.2	62	13.1	13.5	7.5	0.48
Elliyahu Katz	31.96	35.25	820	2001/02/24	2	Y	17:41					31.1	62	13.1	13.5	7.4	0.48
Danny Levy	31.79	35.18	700	2001/02/24	2	Y	17:51					31.1	62	13.1	13.5	7.4	0.48
Yoseph Musa	31.32	34.61	140	2001/02/24	2	Y	17:54					31.2	62	13.2	13.6	7.3	0.49
Ruth Pories	32.08	34.88	40	2001/02/24	2	Y	17:42		17		55	31.2	62	13.1	13.5	7.5	0.48
Magdi Shamuel	31.81	34.64	0	2001/02/24	2	Y	17:46					31.2	62	13.2	13.5	7.4	0.48
Yosi Gaber	31.93	34.86	60	2001/03/26	2	Y	18:03					38.5	82	17.6	17.8	7.9	1.11
Devorah Gordon	31.93	34.86	60	2001/03/26	2	Y	18:05					38.5	82	17.6	17.8	7.9	1.11
Nehemia Gordon	31.93	34.86	60	2001/03/26	2	Y	18:05					38.5	82	17.6	17.8	7.9	1.11
Roy Hoffman	31.77	35.20	725	2001/03/26	2	Y	17:51	19:04	20.5	927	47	38.5	82	17.6	17.9	7.9	1.11
Miriam Kaatz	32.08	34.88	40	2001/03/26	2	Y	18:00		13.5		62	38.5	82	17.6	17.8	8.0	1.10
Tuvia Kaatz	32.08	34.88	40	2001/03/26	2	Y	18:05		13.5		62	38.5	82	17.6	17.8	8.0	1.10
Elliyahu Katz	31.98	35.28	1016	2001/03/26	2	Y	17:54:40					38.5	82	17.6	17.8	8.0	1.10
John Polacheck	32.29	−111.05	762	2001/03/26	−7	Y	19:08	19:12				48.2	105	22.2	22.6	8.9	1.82
Benjamin Pories	32.08	34.88	40	2001/03/26	2	Y	18:10		13.5		62	38.5	82	17.6	17.8	8.0	1.10
Ruth Pories	32.08	34.88	40	2001/03/26	2	Y	17:52		13.5		62	38.5	82	17.6	17.8	8.0	1.10
Gilah Sergani	31.26	35.22	600	2001/03/26	2	Y	18:02					38.5	81	17.7	17.9	7.7	1.11
Isaac Sergani	31.26	35.22	600	2001/03/26	2	Y	18:02					38.5	81	17.7	17.9	7.7	1.11
Magdi Shamuel	31.81	34.64	0	2001/03/26	2	Y	17:55					38.5	82	17.6	17.9	7.9	1.11
Noach Treitel	31.77	35.20	725	2001/03/26	2	Y	17:56	18:09	21	927	46	38.5	82	17.6	17.9	7.9	1.11
Israel Eshchar	31.79	35.18	675	2001/04/24	3	Y	19:46	19:46				24.7	52	11.3	11.4	6.8	0.21
Yossi Green	31.79	35.31	430	2001/04/24	3	N	19:31	19:31	15.5	963	60	24.7	52	11.3	11.4	6.8	0.21
Rina Hoffman	31.79	35.31	430	2001/04/24	3	N	19:31	19:31	15.5	963	60	24.7	52	11.3	11.4	6.8	0.21
Roy Hoffman	31.79	35.31	430	2001/04/24	3	Y	19:29	19:40	15.5	963	60	24.7	52	11.3	11.4	6.8	0.21
Yoseph Musa	31.32	34.61	140	2001/04/24	3	Y	19:47					24.8	52	11.4	11.5	6.7	0.22
Isaac Sergani	31.26	35.22	600	2001/04/24	3	Y	19:47					24.7	52	11.4	11.4	6.7	0.22
Magdi Shamuel	31.81	34.64	0	2001/04/24	3	Y	19:41					24.8	52	11.3	11.4	6.8	0.21

Table 1 – *continued*

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	*T*	P	RH	Age	Lag	ARCL	ARCV	DAZ	*q*
Michael Wohlfarth	31.79	35.31	430	2001/04/24	3	Y	19:39	19:40	15.5	963	60	24.7	52	11.3	11.4	6.8	0.21
Robert Bloom	32.29	−111.05	762	2001/05/23	−7	Y	19:42	19:53				23.5	52	10.8	10.8	6.9	0.14
Sandy Bloom	32.29	−111.05	762	2001/05/23	−7	Y	19:42	19:53				23.5	52	10.8	10.8	6.9	0.14
John Polacheck	32.29	−111.05	762	2001/05/23	−7	Y	19:42	19:53				23.5	52	10.8	10.8	6.9	0.14
Adam Cowan	31.74	34.99	325	2001/05/24	3	Y	19:48					37.7	90	18.2	18.0	9.5	1.21
Yosi Gaber	31.93	34.86	60	2001/05/24	3	Y	19:30					37.8	91	18.2	18.0	9.6	1.21
Yossi Green	31.79	35.31	430	2001/05/24	3	Y	19:37	19:37	27.5	961	27	37.7	90	18.2	18.0	9.5	1.21
Jonathan Hoffman	31.79	35.31	430	2001/05/24	3	Y	19:36	19:36	27.5	961	27	37.7	90	18.2	18.0	9.5	1.21
Roy Hoffman	31.79	35.31	430	2001/05/24	3	Y	19:37	20:16	27.5	961	27	37.7	90	18.2	18.0	9.5	1.21
Isaac Sergani	31.26	35.22	600	2001/05/24	3	Y	19:45					37.7	90	18.3	18.1	9.3	1.22
Magdi Shamuel	31.81	34.64	0	2001/05/24	3	Y	19:40					37.8	91	18.2	18.0	9.5	1.21
Bruce Brill	31.63	35.21	680	2001/06/22	3	Y	20:09					28.8	68	13.8	13.6	8.8	0.58
Adam Cowan	31.74	34.99	325	2001/06/22	3	Y	20:00					28.8	68	13.8	13.6	8.8	0.58
Yosi Gaber	31.93	34.86	60	2001/06/22	3	Y	20:05					28.8	68	13.8	13.6	8.9	0.58
Nehemia Gordon	31.83	35.24	774	2001/06/22	3	Y	20:01					28.8	68	13.8	13.6	8.8	0.58
Miriam Kaatz	32.08	34.88	40	2001/06/22	3	Y	20:01					28.8	68	13.8	13.6	8.9	0.58
Tuvia Kaatz	32.08	34.88	40	2001/06/22	3	Y	20:08					28.8	68	13.8	13.6	8.9	0.58
Elliyahu Katz	31.96	35.25	820	2001/06/22	3	Y	20:05					28.8	68	13.8	13.6	8.9	0.58
Ruth Pories	32.08	34.88	40	2001/06/22	3	Y	19:54					28.8	68	13.8	13.6	8.9	0.58
Magdi Shamuel	31.81	34.64	0	2001/06/22	3	Y	19:50					28.8	68	13.8	13.6	8.8	0.58
Yaakov Braham	31.81	34.64	0	2001/07/21	3	N	20:05	20:10				20.9	50	10.7	10.6	6.8	0.13
Amatziah Etzion	31.96	35.25	820	2001/07/21	3	Y	20:21	20:21				20.9	50	10.6	10.6	6.8	0.13
Shabtai Etzion	31.96	35.25	820	2001/07/21	3	N	20:10	20:21				20.9	50	10.6	10.6	6.8	0.13
Yaakov Etzion	31.96	35.25	820	2001/07/21	3	N	20:10	20:21				20.9	50	10.6	10.6	6.8	0.13
Yehudah Etzion	31.96	35.25	820	2001/07/21	3	N	20:10	20:21				20.9	50	10.6	10.6	6.8	0.13
Benny Lerer	31.73	35.14	650	2001/07/21	3	Y	20:00	20:10				20.9	50	10.7	10.6	6.8	0.13
Danny Levy	31.79	35.18	700	2001/07/21	3	N	20:08	20:24				20.9	50	10.7	10.6	6.8	0.13
Rich Lobert	33.73	−111.93	490	2001/07/21	−7	Y	19:53	20:38	38	1005.9	24	30.8	71	14.6	14.3	11.4	0.75
Miriam Kaatz	32.08	34.88	40	2001/07/21	3	N						20.9	50	10.6	10.6	6.9	0.13
Tuvia Kaatz	32.08	34.88	40	2001/07/21	3	N						20.9	50	10.6	10.6	6.9	0.13
Elliyahu Katz	31.96	35.25	820	2001/07/21	3	N	20:10	20:21				20.9	50	10.6	10.6	6.8	0.13
Ruth Katz	31.96	35.25	820	2001/07/21	3	N	20:10	20:21				20.9	50	10.6	10.6	6.8	0.13
Eli Merzbach	32.79	35.36	400	2001/07/21	3	N						20.9	50	10.5	10.5	7.0	0.12
Benjamin Poris	32.08	34.88	40	2001/07/21	3	N						20.9	50	10.6	10.6	6.9	0.13
Ruth Pories	32.08	34.88	40	2001/07/21	3	N						20.9	50	10.6	10.6	6.9	0.13
Magdi Shamuel	31.81	34.64	0	2001/07/21	3	N	20:03	20:10				20.9	50	10.7	10.6	6.8	0.13
Zvi Shwartz	31.96	35.25	820	2001/07/21	3	N	20:00	20:10				20.9	50	10.6	10.6	6.8	0.13
Hillel Skolnik	31.73	35.14	650	2001/07/21	3	Y	20:10	20:10				20.9	50	10.7	10.6	6.8	0.13
Shneir Weinfeld	31.73	35.14	650	2001/07/21	3	Y	20:05	20:10				20.9	50	10.7	10.6	6.8	0.13
John Polacheck	32.29	−111.05	762	2001/08/19	−7	Y	19:22	19:24				23.1	54	12.0	11.9	8.3	0.34
Yosi Gaber	31.93	34.86	60	2001/08/20	3	Y	19:20					37.3	79	17.2	17.1	15.1	1.26
Miriam Kaatz	32.79	35.44	300	2001/08/20	3	Y	19:09		30		59	37.3	78	17.0	16.8	15.3	1.24
Tuvia Kaatz	32.79	35.44	300	2001/08/20	3	Y	19:20		30		59	37.3	78	17.0	16.8	15.3	1.24
Rina Hoffman	31.79	35.31	430	2001/08/20	3	Y	19:16	19:30	27	962	66	37.3	79	17.2	17.1	15.0	1.26
Roy Hoffman	31.79	35.31	430	2001/08/20	3	Y	19:15	19:58	27	962	66	37.3	79	17.2	17.1	15.0	1.26
Yoseph Musa	31.32	34.61	140	2001/08/20	3	Y	19:12					37.3	79	17.4	17.3	14.9	1.28
Benjamin Pories	32.79	35.44	300	2001/08/20	3	Y	19:21		30		59	37.3	78	17.0	16.8	15.3	1.24
Ruth Pories	32.79	35.44	300	2001/08/20	3	Y	19:07	20:24	30		59	37.3	78	17.0	16.8	15.3	1.24
Magdi Shamuel	29.63	34.88	833	2001/08/20	3	Y	19:07					37.3	80	17.8	17.7	14.3	1.32
Eran Yoseph	29.63	34.88	833	2001/08/20	3	Y	19:07					37.3	80	17.8	17.7	14.3	1.32
Randy Wohl	31.80	35.31	390	2001/08/20	3	Y	19:25	19:45				37.3	79	17.2	17.1	15.0	1.26
John Polacheck	32.29	−111.05	762	2001/09/17	−7	N	18:48	18:52				14.9	39	9.1	9.2	4.5	−0.10
Yehudah Cohen	31.93	34.86	60	2001/09/18	3	Y	18:40					29.2	62	13.8	13.9	11.5	0.68
Ariel Fridman	32.08	34.88	40	2001/09/18	3	Y	18:48					29.2	62	13.7	13.9	11.5	0.68
Yosi Gaber	31.93	34.86	60	2001/09/18	3	Y	18:40					29.2	62	13.8	13.9	11.5	0.68
Roy Hoffman	31.79	35.31	430	2001/09/18	3	Y	18:45	19:12		962		29.2	62	13.8	14.0	11.4	0.69
Tuvia Kaatz	32.08	34.88	40	2001/09/18	3	Y	18:55					29.2	62	13.7	13.9	11.5	0.68
Benjamin Pories	32.08	34.88	40	2001/09/18	3	Y	18:45					29.2	62	13.7	13.9	11.5	0.68
Ruth Pories	32.08	34.88	40	2001/09/18	3	Y	18:43					29.2	62	13.7	13.9	11.5	0.68
Magdi Shamuel	31.81	34.64	0	2001/09/18	3	Y	18:45					29.2	62	13.8	14.0	11.4	0.69
Eli Tanani	31.93	34.86	60	2001/09/18	3	Y	18:42					29.2	62	13.8	13.9	11.5	0.68
Robert Bloom	32.29	−111.05	762	2001/10/17	−7	Y	18:12	18:24				29.4	60	12.7	13.1	11.4	0.55
Fay Libbey	32.29	−111.05	762	2001/10/17	−7	Y	18:12	18:24				29.4	60	12.7	13.1	11.4	0.55

Table 1 – *continued*

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	*T*	P	RH	Age	Lag	ARCL	ARCV	DAZ	*q*
Jeff Kohn	32.29	−111.05	762	2001/10/17	−7	Y	18:12	18:24				29.4	60	12.7	13.1	11.4	0.55
Fred Madsen	32.29	−111.05	762	2001/10/17	−7	Y	18:12	18:24				29.4	60	12.7	13.1	11.4	0.55
John Polacheck	32.29	−111.05	762	2001/10/17	−7	Y	18:02	18:24				29.4	60	12.7	13.1	11.4	0.55
John Polacheck	32.29	−111.05	762	2001/11/15	−7	N						17.7	37	7.8	8.1	5.7	−0.24
Ruth Pories	32.08	34.88	40	2001/11/16	2	Y	16:51	16:55				31.9	63	12.3	12.9	11.8	0.52
Avi Wiserothen	32.08	34.88	40	2001/11/16	2	Y	16:53	16:55				31.9	63	12.3	12.9	11.8	0.52
Miriam Kaatz	32.08	34.88	40	2001/12/16	2	Y	16:34		14		80	41.8	86	15.2	16.4	14.3	1.03
Tuvia Kaatz	32.08	34.88	40	2001/12/16	2	Y	16:39		14		80	41.8	86	15.2	16.4	14.3	1.03
Benjamin Pories	32.08	34.88	40	2001/12/16	2	Y	16:45		14		80	41.8	86	15.2	16.4	14.3	1.03
Ruth Pories	32.08	34.88	40	2001/12/16	2	Y	16:33		14		80	41.8	86	15.2	16.4	14.3	1.03
Sandra Bevacqua	32.29	−111.05	762	2002/01/14	−7	Y	17:44	18:27	21		11	35.1	71	13.4	14.1	10.4	0.62
Robert Bloom	32.29	−111.05	762	2002/01/14	−7	Y	17:44	18:27	21		11	35.1	71	13.4	14.1	10.4	0.62
Fay Libbey	32.29	−111.05	762	2002/01/14	−7	Y	17:44	18:27	21		11	35.1	71	13.4	14.1	10.4	0.62
Joshua Polacheck	32.29	−111.05	762	2002/01/14	−7	Y	17:44	18:27	21		11	35.1	71	13.4	14.1	10.4	0.62
John Polacheck	32.29	−111.05	762	2002/01/14	−7	Y	17:44	18:27	21		11	35.1	71	13.4	14.1	10.4	0.62
Burnell Bisbee	32.22	−111.10	953	2002/03/14	−7	N	18:31	19:07	19		16	23.4	43	9.7	9.9	6.5	−0.01
Christopher Corbaly	32.22	−111.10	953	2002/03/14	−7	Y	18:53	18:59	19		16	23.4	43	9.7	9.9	6.5	−0.01
Faye Libbey	32.22	−111.10	953	2002/03/14	−7	N	18:31	19:07	19		16	23.4	43	9.7	9.9	6.5	−0.01
Aileen O'Donoghue	32.22	−111.10	953	2002/03/14	−7	Y	18:53	18:59	19		16	23.4	43	9.7	9.9	6.5	−0.01
John Polacheck	32.22	−111.10	953	2002/03/14	−7	Y	18:53	18:59	19		16	23.4	43	9.7	9.9	6.5	−0.01
Frank Younger	32.22	−111.10	953	2002/03/14	−7	Y	18:53	18:59	19		16	23.4	43	9.7	9.9	6.5	−0.01
Elliot Hochman	32.29	−111.05	762	2002/04/13	−7	Y	19:08		28		14	30.5	61	13.1	13.2	6.1	0.43
Mary Ickes	32.29	−111.05	762	2002/04/13	−7	Y	19:08		28		14	30.5	61	13.1	13.2	6.1	0.43
Faye Libbey	32.29	−111.05	762	2002/04/13	−7	Y	19:08		28		14	30.5	61	13.1	13.2	6.1	0.43
Allister MacDonald	32.29	−111.05	762	2002/04/13	−7	Y	19:08		28		14	30.5	61	13.1	13.2	6.1	0.43
Sandra MacDonald	32.29	−111.05	762	2002/04/13	−7	Y	19:08		28		14	30.5	61	13.1	13.2	6.1	0.43
Linda Mellis	32.29	−111.05	762	2002/04/13	−7	Y	19:08		28		14	30.5	61	13.1	13.2	6.1	0.43
John Polacheck	32.29	−111.05	762	2002/04/13	−7	Y	19:08		28		14	30.5	61	13.1	13.2	6.1	0.43
Sue Welch	32.29	−111.05	762	2002/04/13	−7	Y	19:08		28		14	30.5	61	13.1	13.2	6.1	0.43
Devorah Gordon	31.83	35.24	774	2002/05/13	3	N						29.6	64	13.1	13.1	5.7	0.42
Nehemia Gordon	31.83	35.24	774	2002/05/13	3	N						29.6	64	13.1	13.1	5.7	0.42
Jonathan Hoffman	31.79	35.31	430	2002/05/13	3	N	19:50	19:55	24.5	963	28	29.6	64	13.1	13.1	5.7	0.42
Roy Hoffman	31.79	35.31	430	2002/05/13	3	N	19:49	19:56	24.5	963	28	29.6	64	13.1	13.1	5.7	0.42
Lionel Isaacs	31.78	35.30	500	2002/05/13	3	N			24.5	963	28	29.6	64	13.1	13.1	5.7	0.42
Elliyahu Katz	31.96	35.25	820	2002/05/13	3	N						29.6	64	13.1	13.1	5.7	0.42
Dean Koenig	32.29	−111.05	762	2002/05/13	−7	Y	19:15		36		14	39.4	88	17.7	17.6	7.1	1.07
Larry Moore	32.29	−111.05	762	2002/05/13	−7	Y	19:15		36		14	39.4	88	17.7	17.6	7.1	1.07
John Polacheck	32.29	−111.05	762	2002/05/13	−7	Y	19:22		36		14	39.4	88	17.7	17.6	7.1	1.07
Yitschak Reiss	31.79	35.31	430	2002/05/13	3	N			24.5	963	28	29.6	64	13.1	13.1	5.7	0.42
Isaac Sergani	31.26	35.22	600	2002/05/13	3	N						29.6	63	13.2	13.2	5.6	0.42
Mike Smith	32.29	−111.05	762	2002/05/13	−7	Y	19:17		36		14	39.4	88	17.7	17.6	7.1	1.07
Randy Wohl	31.80	35.31	390	2002/05/13	3	N						29.6	64	13.1	13.1	5.7	0.42
Robert Bloom	32.29	−111.05	762	2002/06/11	−7	Y	19:53	20:26	33		14	26.7	62	12.3	12.2	5.9	0.32
Kim Joyiens	32.29	−111.05	762	2002/06/11	−7	Y	19:53	20:26	33		14	26.7	62	12.3	12.2	5.9	0.32
Faye Libbey	32.29	−111.05	762	2002/06/11	−7	Y	19:51	20:26	33		14	26.7	62	12.3	12.2	5.9	0.32
John Polacheck	32.29	−111.05	762	2002/06/11	−7	Y	19:53	20:26	33		14	26.7	62	12.3	12.2	5.9	0.32
Jana Sweets	32.29	−111.05	762	2002/06/11	−7	Y	19:53	20:26	33		14	26.7	62	12.3	12.2	5.9	0.32
Devorah Gordon	31.83	35.24	774	2002/06/12	3	Y	19:41		19	922	74	40.9	96	18.9	18.6	9.3	1.29
Elliyahu Katz	31.98	35.28	1016	2002/06/12	3	Y	19:34					40.9	96	18.9	18.6	9.4	1.29
Ruth Katz	31.98	35.28	1016	2002/06/12	3	Y	19:42					40.9	96	18.9	18.6	9.4	1.29
T'oma Mikha'el	31.83	35.24	774	2002/06/12	3	Y	19:38		19	922	74	40.9	96	18.9	18.6	9.3	1.29
Yoseph Musa	31.32	34.61	140	2002/06/12	3	Y	19:36					40.9	96	19.0	18.7	9.1	1.30
Ruth Pories	32.08	34.88	40	2002/06/12	3	Y	19:36					40.9	96	18.9	18.6	9.4	1.29
Isaac Sergani	31.26	35.22	600	2002/06/12	3	Y	19:45					40.9	96	19.0	18.7	9.1	1.30
Yitzchak Shlisel	31.98	35.28	1016	2002/06/12	3	Y	19:37					40.9	96	18.9	18.6	9.4	1.29
Nehemia Gordon	31.83	35.24	774	2002/07/11	3	Y	19:57	20:15	21	921	72	30.3	72	14.6	14.4	8.4	0.68
Roy Hoffman	31.83	35.24	774	2002/07/11	3	Y	19:58	20:15	21	921	72	30.3	72	14.6	14.4	8.4	0.68
Elliyahu Katz	31.98	35.28	1016	2002/07/11	3	Y	19:57					30.3	72	14.6	14.4	8.5	0.68
Yoseph Musa	31.32	34.61	140	2002/07/11	3	Y	19:57					30.3	72	14.7	14.5	8.3	0.69
Ruth Pories	32.08	34.88	40	2002/07/11	3	Y	19:58		31		59	30.3	72	14.6	14.4	8.5	0.68
Isaac Sergani	31.26	35.22	600	2002/07/11	3	Y	20:03					30.3	72	14.7	14.5	8.3	0.69
Magdi Shamuel	31.81	34.64	0	2002/07/11	3	Y	19:50					30.3	72	14.7	14.5	8.5	0.68
Shierel Tuito	31.83	35.24	774	2002/07/11	3	Y	20:01	20:15	21	921	72	30.3	72	14.6	14.4	8.4	0.68

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Table 1 – *continued*

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	T	P	RH	Age	Lag	ARCL	ARCV	DAZ	*q*
Yaakov Braham	31.81	34.64	0	2002/08/09	3	Y	20:00	20:10				21.2	52	11.4	11.4	6.4	0.22
Bruce Brill	31.63	35.21	680	2002/08/09	3	N						21.2	52	11.4	11.4	6.3	0.22
Nehemia Gordon	31.83	35.24	774	2002/08/09	3	Y	19:55	19:58				21.2	52	11.4	11.4	6.3	0.21
Magdi Shamuel	31.81	34.64	0	2002/08/09	3	Y	19:52	20:15				21.2	52	11.4	11.4	6.4	0.22
Hillel Skolnick	31.73	35.14	650	2002/08/09	3	Y	19:45	20:07				21.2	52	11.4	11.4	6.3	0.22
Miriam Kaatz	32.08	34.88	40	2002/08/10	3	Y	19:15					45.2	93	20.0	19.6	17.6	1.73
Tuvia Kaatz	32.08	34.88	40	2002/08/10	3	Y	19:16					45.2	93	20.0	19.6	17.6	1.73
Ruth Pories	32.08	34.88	40	2002/08/10	3	Y	19:07					45.2	93	20.0	19.6	17.6	1.73
Yoseph Musa	31.32	34.61	140	2002/09/07	3	N						12.7	36	8.4	8.5	3.2	−0.21
Miriam Kaatz	32.08	34.88	40	2002/09/08	3	Y	18:46					36.7	73	16.0	16.2	15.5	1.14
Tuvia Kaatz	32.08	34.88	40	2002/09/08	3	Y	18:55					36.7	73	16.0	16.2	15.5	1.14
Yoseph Musa	31.32	34.61	140	2002/09/08	3	Y	18:56					36.7	73	16.2	16.4	15.3	1.16
Ruth Pories	32.08	34.88	40	2002/09/08	3	Y	18:44					36.7	73	16.0	16.2	15.5	1.14
Gilah Sergani	31.26	35.22	600	2002/09/08	3	Y	18:54					36.7	73	16.2	16.4	15.2	1.16
Isaac Sergani	31.26	35.22	600	2002/09/08	3	Y	18:55					36.7	73	16.2	16.4	15.2	1.16
Isaac Sergani	31.26	35.22	600	2002/09/09	3	Y	18:35					60.6	110	23.3	23.9	28.2	2.84
Miriam Kaatz	32.08	34.88	40	2002/10/07	2	Y	17:27		25		62	27.9	56	12.1	12.4	11.9	0.49
Tuvia Kaatz	32.08	34.88	40	2002/10/07	2	Y	17:32		25		62	27.9	56	12.1	12.4	11.9	0.49
Yoseph Musa	31.32	34.61	140	2002/10/07	2	Y	17:26					28.0	56	12.3	12.6	11.8	0.51
Ruth Pories	32.08	34.88	40	2002/10/07	2	Y	17:22		25		62	27.9	56	12.1	12.4	11.9	0.49
Magdi Shamuel	31.81	34.64	0	2002/10/07	2	Y	17:20	17:45				28.0	56	12.2	12.5	11.9	0.50

look back to see if the Moon really is visible.' The observations were recorded on specially provided forms (Hoffman & Kaatz 2000b), by e-mail or verbally (Hoffman & Kaatz 2000b).

Out of 1047 observations (for 100 of which the Moon was not visible) only four false positive sightings were received. However, these false positives reported the wrong position, time or orientation for the Moon. In the first case, [Ruth Pories, Lat. 32.08°E, Long. 34.88°N, height 40 m, 1999/11/9 17:34 (UTC + 2)] was reported while two other observers at the site reported that it was cloudy. When I asked the observer, she said that she thought that she had seen the Moon through the clouds once but was not sure. As with all reports where the observer was not sure if the Moon was seen, this was rejected. In the second case [Rebecca Constans-Blum, Lat. 31.78°E, Long. 35.24°N, height 725 m, 1999/11/9 16:45 (UTC + 2)] the observer, despite being inexperienced, reported seeing the Moon several minutes before anyone else in a group of over 40. She later admitted that she did not have a watch and had guessed the time. In the other two cases [Jonathan Hoffman, Lat. 31.79°E, Long. 35.31°N, height 430 m, 2000/7/3, 19:29 (UTC + 3); Yosi Green, Lat. 31.79°E, Long. 35.31°N, height 430 m, 2001/12/16, 16:20 (UTC + 2)] the observers pointed in the wrong direction when asked where they saw the Moon. Tables 1 and 2 contain only reliable observations therefore these rejected sightings are not included.

All reports were checked against the original handwritten records when these were available. In all cases where the observations were marginal, the reports were checked more carefully than usual. Here are two examples where marginal reports were accepted. On 2000/3/4 I observed a very difficult old Moon (Table 2). Having followed it for several minutes with binoculars, I could just make it out with the naked eye. I diverted my gaze and returned to see the Moon four times before losing it about 1.5 min later. The Moon appeared in the predicted position and orientation. In another case on 2001/7/21, Lat. 31.66°E, Long. 35.25°N, (Table 1) several people saw the new Moon with binoculars and only Amatzia Etzion saw the Moon with the naked eye. On questioning, he reported the correct position and orientation of the crescent and stated that he had diverted his gaze and returned to see the Moon a second time. On the same date, the Moon was seen from Lat. 31.73°N, Long. 35.14°E by three people (Table 1) who reported the correct position and orientation.

Returning to false positives, there is a previous report of three out of 20 false such observations (Doggett & Schaefer 1994). From my results this means that, when the Moon is genuinely invisible, we can expect 4 per cent of observers to report seeing the Moon. This comes to 6 per cent if these results are combined with those of Doggett and Schaefer. Of the negative sightings, eight were because the observer was not looking at the right time or from a location where the Moon could not possibly have been seen.

I expect the main application of this data base will be to check the validity of visibility criteria. Here I give one example of a criterion based on astronomical angles as given by Yallop (1998). Yallop uses two parameters, the geocentric vertical separation between the Sun and Moon (ARCV – arc of vision) and a semitopocentric crescent width [w' such that $w' = sd'$ (1 – cosARCL) where sd' is the topocentric semidiameter of the Moon and ARCL (arc of light) is the geocentric angular separation between the Sun and the Moon]. From this, he calculates the parameter for the ease of visibility:

$$q = \frac{\mathrm{ARCV} - 11.8731 + 6.3226w' + 0.7319w'^2 - 0.1018w'^3}{10}.$$

In applying Yallop's criterion, the Moon is definitely visible if q is greater than 0.43 and definitely not visible if q is less than −0.06. In between these values the Moon may or may not be visible depending on weather conditions and the eyesight of the observer (Fig. 1).

The data base can be used in a similar manner for other criteria whether they are based on astronomical angles or on photometric methods.

3 CONCLUSIONS

A large data base of observations of crescent moons has been acquired. The addition of the time of first and last visibility allows us to use even easy Moons in testing visibility criteria, as the Moon is reported at the time when it is at its limit of visibility.

Table 2. Observations of the old Moon. See Table 1 for explanation.

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	T	P	RH	Age	Lag	ARCL	ARCV	DAZ	*q*
Yoseph Musa	31.32	34.61	140	1998/12/17	2	Y		06:36				42.1	99	19.2	19.9	6.4	1.34
Magdi Shamuel	31.81	34.64	0	1998/12/17	2	Y		06:41				42.0	100	19.1	19.8	6.6	1.34
Magdi Shamuel	31.81	34.64	0	1999/03/16	2	Y	05:40	05:53				38.9	52	11.1	11.5	18.4	0.60
Yoseph Musa	31.32	34.61	140	1999/04/14	3	Y		06:33				49.0	63	13.9	14.1	25.0	1.27
Magdi Shamuel	31.81	34.64	0	1999/04/14	3	Y		06:32				49.0	63	13.7	13.9	25.1	1.25
Roy Hoffman	31.79	35.31	430	1999/05/14	3	Y	05:13	05:41	14	965	45	33.3	40	9.3	9.1	18.3	0.33
Magdi Shamuel	31.81	34.64	0	1999/05/14	3	Y		05:43				33.3	40	9.2	9.1	18.2	0.32
Roy Hoffman	31.79	35.31	430	1999/07/12	3	Y	04:59	05:21	23	957	23	23.6	51	10.7	10.6	9.0	0.17
Yitschak Reiss	31.79	35.31	430	1999/07/12	3	Y	05:05	05:17	23	957	23	23.6	51	10.7	10.6	9.0	0.17
Magdi Shamuel	31.81	34.64	0	1999/09/08	2	Y		05:34				42.6	105	22.0	22.3	2.8	1.73
Roy Hoffman	31.79	35.31	430	1999/10/08	2	Y	04:54	05:24	21	966	72	31.9	74	16.0	16.2	−1.3	0.80
Tuvia Kaatz	32.08	34.88	40	1999/10/08	2	Y		05:26				31.9	74	16.0	16.2	−1.2	0.80
Roy Hoffman	31.79	35.31	430	1999/12/06	2	Y	05:35	06:20	11	967	77	42.1	97	19.1	19.7	4.7	1.29
Miriam Kaatz	32.08	34.88	40	1999/12/06	2	Y		06:17				42.0	98	19.0	19.6	4.8	1.29
Tuvia Kaatz	32.08	34.88	40	1999/12/06	2	Y		06:15				42.0	98	19.0	19.6	4.8	1.29
Magdi Shamuel	31.81	34.64	0	1999/12/06	2	Y		06:26				42.0	97	19.0	19.6	4.7	1.29
Anon 4	59.93	10.75	0	2000/02/02	1	Y	07:00	09:34	−6			77.4	106	7.5	10.2	35.0	1.27
Roy Hoffman	31.79	35.31	430	2000/02/04	2	Y	05:51	06:13	8	970	55	32.5	49	9.9	10.4	11.5	0.17
Tuvia Kaatz	32.08	34.88	40	2000/02/04	2	Y	06:00	06:10	5		80	32.4	49	9.8	10.3	11.5	0.16
Magdi Shamuel	31.81	34.64	0	2000/02/04	2	N		06:13				32.4	49	9.9	10.4	11.5	0.17
Roy Hoffman	31.79	35.31	430	2000/03/04	2	Y	05:18	06:08	11	968	60	49.2	61	12.4	13.1	20.8	0.87
Miriam Kaatz	32.08	34.88	40	2000/03/04	2	Y	05:40	06:02	12		75	49.2	60	12.3	13.0	20.9	0.85
Tuvia Kaatz	32.08	34.88	40	2000/03/04	2	Y	05:40	06:00	12		75	49.2	60	12.3	13.0	20.9	0.85
Magdi Shamuel	31.81	34.64	0	2000/03/04	2	Y		06:10				49.1	61	12.4	13.1	20.8	0.86
Jonathan Hoffman	31.79	35.31	430	2000/04/03	2	N			14	964	80	38.7	36	8.2	8.3	19.1	0.23
Roy Hoffman	31.79	35.31	430	2000/04/03	2	Y	05:14	05:16	14	964	80	38.7	36	8.2	8.3	19.1	0.23
Yossi Green	31.79	35.31	430	2000/05/02	3	Y	05:57	06:01	17	962	58	49.3	57	12.8	12.6	24.7	1.06
Roy Hoffman	31.79	35.31	430	2000/05/02	3	Y	05:21	06:04	17	962	58	49.3	57	12.8	12.6	24.7	1.06
Miriam Kaatz	32.08	34.88	40	2000/05/02	3	Y	05:10	06:09	17		75	49.3	56	12.6	12.4	24.8	1.04
Tuvia Kaatz	32.08	34.88	40	2000/05/02	3	Y	05:10	06:08	17		75	49.3	56	12.6	12.4	24.8	1.04
Roy Hoffman	31.79	35.31	430	2000/06/01	3	Y	04:51	05:32	19	962	46	33.6	49	10.9	10.6	16.9	0.46
Roy Hoffman	31.79	35.31	430	2000/06/30	3	Y	04:50	05:47	22	958	28	40.7	89	18.4	17.8	16.0	1.42
Miriam Kaatz	32.96	35.49	770	2000/06/30	3	Y		05:47	18		42	40.7	88	18.1	17.5	16.4	1.39
Tuvia Kaatz	32.96	35.49	770	2000/06/30	3	Y		05:46	18		42	40.7	88	18.1	17.5	16.4	1.39
Magdi Shamuel	31.81	34.64	0	2000/06/30	3	Y		05:46				40.6	89	18.4	17.8	16.0	1.42
Roy Hoffman	31.79	35.31	430	2000/07/30	3	Y	05:14	05:28	26	959	30	23.5	63	13.0	13.1	4.7	0.43
Miriam Kaatz	32.08	34.88	40	2000/07/30	3	N			28		78	23.5	63	13.0	13.0	4.8	0.42
Tuvia Kaatz	32.08	34.88	40	2000/07/30	3	N			28		78	23.5	63	13.0	13.0	4.8	0.42
Magdi Shamuel	31.81	34.64	0	2000/07/30	3	N						23.4	63	13.0	13.1	4.7	0.42
Miriam Kaatz	32.08	34.88	40	2000/08/28	3	Y		05:57	22		80	31.0	87	17.9	18.2	1.5	1.12
Tuvia Kaatz	32.08	34.88	40	2000/08/28	3	Y		05:57	22		80	31.0	87	17.9	18.2	1.5	1.12
Miriam Kaatz	32.08	34.88	40	2000/09/26	3	Y		06:40	20		92	40.3	107	22.5	23.0	−0.5	1.83
Tuvia Kaatz	32.08	34.88	40	2000/09/26	3	Y		06:34	20		92	40.3	107	22.5	23.0	−0.5	1.83
Magdi Shamuel	31.81	34.64	0	2000/09/26	3	Y		06:45				40.3	107	22.5	23.0	−0.7	1.83
Roy Hoffman	31.79	35.31	430	2000/09/27	3	N			18	962	80	16.3	42	9.5	9.7	−3.2	−0.06
Roy Hoffman	31.79	35.31	430	2000/10/26	2	Y	05:15	05:41	13	966	88	28.1	71	15.3	15.5	−1.8	0.71
Miriam Kaatz	32.08	34.88	40	2000/11/24	2	Y		06:24	16		60	42.8	106	21.0	21.6	4.0	1.60
Tuvia Kaatz	32.08	34.88	40	2000/11/24	2	Y		06:22	16		60	42.8	106	21.0	21.6	4.0	1.60
Magdi Shamuel	31.81	34.64	0	2000/11/24	2	Y		06:30				42.8	106	21.1	21.6	3.9	1.60
Roy Hoffman	31.79	35.31	430	2000/11/25	2	N			12	969		18.8	48	10.0	10.1	−0.2	−0.02
Miriam Kaatz	32.08	34.88	40	2000/12/24	2	Y		06:32	13.5		55	36.6	81	15.1	15.8	8.1	0.80
Yoseph Musa	31.32	34.61	140	2000/12/24	2	Y		06:30				36.7	80	15.2	16.0	7.9	0.81
Magdi Shamuel	31.81	34.64	0	2000/12/24	2	Y		06:37				36.6	80	15.1	15.9	8.0	0.81
Roy Hoffman	31.79	35.31	430	2001/02/21	2	Y	06:00	06:20	6	964	78	52.0	61	12.0	12.9	20.5	0.80
Roy Hoffman	31.79	35.31	430	2001/04/21	3	Y	05:52	06:16		963		60.3	59	13.1	13.1	27.2	1.21
Miriam Kaatz	32.08	34.88	40	2001/04/21	3	Y		06:09				60.3	59	13.0	13.0	27.3	1.19
Tuvia Kaatz	32.08	34.88	40	2001/04/21	3	Y		06:09				60.3	59	13.0	13.0	27.3	1.19
Miriam Kaatz	32.08	34.88	40	2001/05/21	3	Y		05:34	14		78	48.1	61	13.4	13.0	21.8	0.95
Tuvia Kaatz	32.08	34.88	40	2001/05/21	3	Y		05:31	14		78	48.1	61	13.4	13.0	21.8	0.95
Roy Hoffman	31.79	35.31	430	2001/06/20	3	Y	04:57	05:32	21.5	962	33	33.3	64	13.5	13.2	12.9	0.63
Miriam Kaatz	32.08	34.88	40	2001/06/20	3	Y	05:05	05:27	15		78	33.3	64	13.5	13.1	13.0	0.62
Tuvia Kaatz	32.08	34.88	40	2001/06/20	3	Y	05:05	05:22	15		78	33.3	64	13.5	13.1	13.0	0.62
Isaac Sergani	31.26	35.22	600	2001/06/20	3	Y		05:20				33.3	65	13.7	13.3	12.7	0.64

Table 2 – *continued*

Name	Lat.	Long.	Hgt	Date	TZ	Seen	First seen	Last seen	T	P	RH	Age	Lag	ARCL	ARCV	DAZ	q
Magdi Shamuel	31.81	34.64	0	2001/06/20	3	Y		05:42				33.3	64	13.5	13.1	12.9	0.63
Roy Hoffman	31.79	35.31	430	2001/07/19	3	Y	05:30	05:52	24.5	954	27	40.9	107	21.4	21.0	10.1	1.70
Roy Hoffman	31.79	35.31	430	2001/07/20	3	N			23.5	956	39	16.9	46	9.5	9.5	2.9	−0.07
Roy Hoffman	31.79	35.31	430	2001/08/18	3	Y	05:27	05:44		959		23.8	70	14.4	14.7	0.3	0.61
Miriam Kaatz	32.08	34.88	40	2001/09/16	3	Y		06:22	20.5		91	31.0	90	18.8	19.2	−1.7	1.28
Tuvia Kaatz	32.08	34.88	40	2001/09/16	3	Y		06:18	20.5		91	31.0	90	18.8	19.2	−1.7	1.28
Roy Hoffman	31.79	35.31	430	2001/10/15	2	Y	05:02	05:58	19.5	964	59	39.6	111	23.4	23.8	−1.1	1.98
Roy Hoffman	31.79	35.31	430	2001/10/16	2	N			15.5	966	86	15.6	43	9.7	9.8	−3.2	−0.03
John Polacheck	32.29	−111.05	762	2001/12/13	−7	Y	06:15	07:00				30.4	75	14.2	14.8	6.7	0.66
Miriam Kaatz	32.08	34.88	40	2002/04/10	3	Y		06:23	12		98	64.0	56	12.1	12.3	27.2	1.07
Tuvia Kaatz	32.08	34.88	40	2002/04/10	3	Y		06:08	12		98	64.0	56	12.1	12.3	27.2	1.07
Roy Hoffman	31.79	35.31	430	2002/04/11	3	N			15.5	959	50	40.0	27	6.5	6.5	17.8	−0.07
Roy Hoffman	31.79	35.31	430	2002/06/09	3	Y	05:00	05:36	27.5	959	22	45.2	73	15.5	15.0	16.2	0.96
Miriam Kaatz	32.08	34.88	40	2002/06/09	3	Y		05:37	20		65	45.2	73	15.4	14.9	16.3	0.95
Tuvia Kaatz	32.08	34.88	40	2002/06/09	3	Y		05:27	20		65	45.2	73	15.4	14.9	16.3	0.95
John Polacheck	32.29	−111.05	762	2002/06/09	−7	Y	04:30	04:45				35.4	58	12.2	11.9	12.7	0.43
Roy Hoffman	31.79	35.31	430	2002/07/09	3	Y	05:07	05:26	24	957	45	31.7	76	15.3	15.1	6.9	0.73
Miriam Kaatz	32.96	35.49	770	2002/07/09	3	Y		05:28	20		62	31.7	77	15.1	14.9	7.2	0.71
Tuvia Kaatz	32.96	35.49	770	2002/07/09	3	Y		05:21	20		62	31.7	77	15.1	14.9	7.2	0.71
Magdi Shamuel	31.81	34.64	0	2002/07/09	3	Y		05:37				31.6	76	15.2	15.1	6.9	0.72
Isaac Sergani	31.26	35.22	600	2002/09/06	3	Y		06:03				23.8	68	14.5	14.8	−2.7	0.63
Magdi Shamuel	31.81	34.64	0	2002/09/06	3	Y		06:05				23.8	69	14.5	14.8	−2.6	0.63

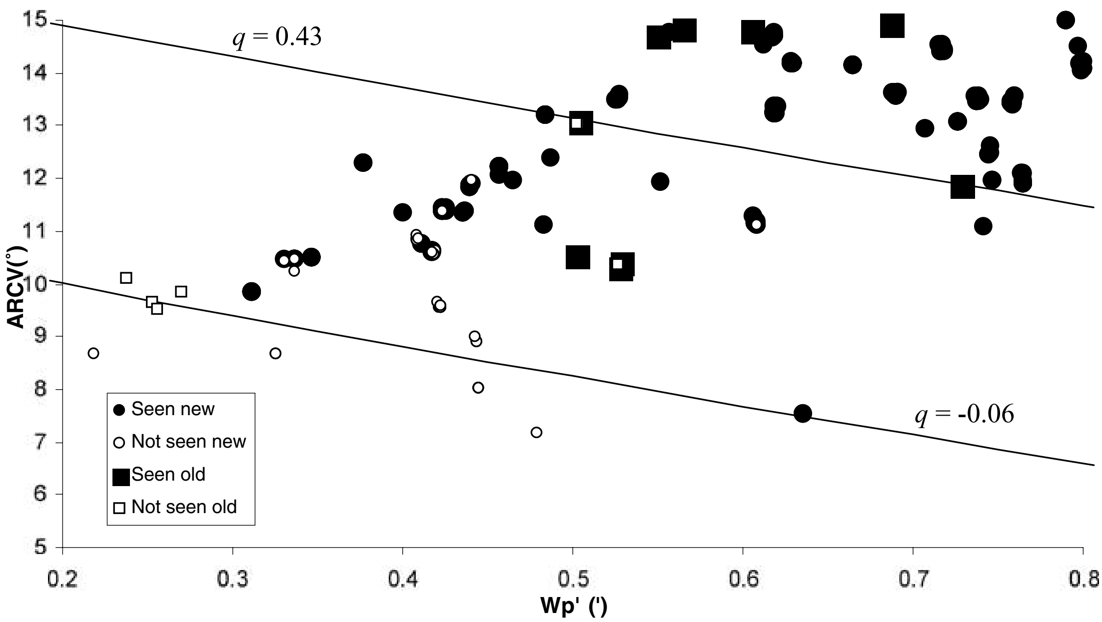

Figure 1. Application of Yallop's criterion to the data base.

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