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The Rocket Campaign against Israel during the 2006 Lebanon War

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Introduction

When the Israeli government decided on the night of July 12, 2006, to exercise force in response to the Hizbullah's provocative raid of that morning - a raid that resulted in the capture of two and the death of eight more Israeli soldiers - it recognized and accepted the risk of a massive retaliatory rocket attack on northern Israel by the Hizbullah. At the onset of what was to later to be officially dubbed the "Second Lebanon War," the head of the IDF's operation branch, Major General Gadi Eisenkot, remarked that Israelis had already experienced major missile attacks during the 1991 Gulf War, with minimal loss of lives.[1] Neither were there any illusions about the extent of the threat. In the same interview, Eisenkot conceded that the Hizbullah's rockets could reach Haifa as well as points further south and called upon Israeli civilians to show fortitude and perseverance. Evidently, Israel's top echelons, both civilian and military, considered the risk of a rocket attack on Israel's northern districts when debating their response to the Hizbullah's latest challenge.

Indeed, Israel's North has suffered intermittent rocket attacks from Southern Lebanon, consisting of salvoes of unguided Katyusha type rockets, for almost a quarter of a century. Before and during the 1982

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This review is based entirely on open sources whose copiousness, quantity and quality are truly characteristic of the present age of the internet. The conclusions and recommendations are the author's own. The author wishes to thank all of the colleagues and friends who supplied him with material on the rocket campaign. In particular, the author wishes to thank Mr. Tal Inbar of the Fisher Institute for his invaluable assistance regarding the heavier types of rockets used in the campaign. The contributions of the rocket experts of the defense consultancy company Aerodan Systems were astute and useful. Special thanks go to Avia Trachtingot for her priceless help in researching the vast pool of media reports from the war period.

Lebanon War, the rockets were fired by Arafat's Palestine Liberation Organization (PLO). Subsequent to the PLO's expulsion from Lebanon, the attacks came from the Iranian-inspired, locally manned militia of the Hizbullah. Israel launched the First Lebanon War in 1982 in order to silence the PLO rocket launchers that had been terrorizing northern Israel and disrupting its economy. With the Hizbullah occupying the military vacuum left after the PLO's expulsion from Lebanon, Israel's northern districts were again subjected to recurring rocket attacks. During Operation Accountability in 1993 and again in 1996 during Operation Grapes of Wrath, Israel's military used massive firepower against Southern Lebanon in an effort to bring about a cessation of such attacks on Israel. On both occasions, Israel's military action elicited massive and continuous rocket attacks on Israel's northern border districts to a depth of about 12 km, resulting in loss of lives and considerable damage to the cities of Nahariya and Kiryat Shmona. On both occasions, Israel's military actions failed to suppress the rocket fire. The attacks continued unabated during the fighting, terminating only when political arrangements brought the fighting to a stop.

In 1996, Operation Grapes of Wrath established a precarious "balance of terror" between Israel's air power and the Hizbullah's rocket artillery. According to the unwritten "understandings" that brought that campaign to an end, the Hizbullah pledged to refrain from rocket attacks on Israeli territory as long as Israel refrained from attacking Lebanese towns and villages. Since the Hizbullah was entrenched among the villages of Southern Lebanon, this apparent *quid pro quo* was really a clear achievement for the militia, providing it with the essential freedom to mount a growingly sanguine guerilla campaign against Israel's military presence in Southern Lebanon that eventually led to Israel's unilateral retreat from Southern Lebanon in May 2000.

The lessons to be learned from the rockets' key role in chasing Israel out of Lebanon did not escape the Hizbullah. In the ten years between Operation Grapes of Wrath in 1996 and the 2006 Lebanon War, almost no Hizbullah rockets fell in northern Israel, yet this quiescence was misleading. The Hizbullah exploited the pause in order to build up a massive infrastructure of rocket power, unprecedented in its size and lethality. This development did not escape Israel's attention –

indeed, the Hizbullah took pains to make its rocket threat as plain to Israel as it could. In his May 2005 "Resistance and Liberation Day" speech, Sheikh Nasrallah, the Hizbullah's charismatic leader, bragged about possessing "more than 12,000" rockets and extolled their potential to deter Israeli attacks on Lebanon. Neither were Israel's public and leadership uninformed about the growing peril. The Israeli media frequently reported on the increasing threat to northern Israel, and Israel's leaders were repeatedly and thoroughly briefed by its intelligence agencies on the deteriorating security situation along the Lebanese border.

Yet, when the outbreak of Second Lebanon War on July 12, 2006 elicited the anticipated reaction, Israel's efforts to block the attack, or even to lessen the severity of the damage incurred, proved, on the whole, almost as futile as in the 1980s and 1990s. The 33 day long rocket attack in the summer of 2006 was more extensive, more lethal and reached deeper into Israel than any of its predecessors. Yet, as before, it proved impervious to Israel's response measures, terminating only when a general ceasefire brought the fighting to a halt. The rockets caused suffering, death and destruction in cities, towns and villages hitherto spared from the Hizbullah's rockets, including Israel's third largest city, Haifa. It left scores of people dead and hundreds severely wounded. It damaged and destroyed thousands of homes, triggered massive displacement of the local population and constituted a major disruption to economic activity in Israel's highly industrialized northern districts.

While some of Israel's military responses to the rocket attack apparently had some effect, and while some of the Hizbullah's key threats – concerning Tel Aviv, for example – failed to materialize, the fact remains that the Hizbullah managed to sustain a lethal rocket campaign throughout the entire war, its launchers falling silent only when Israel ceased its military operations. This marked a clear victory for the Hizbullah and its arms, and by implication, without disparaging the bravery of Israel's soldiers and the dogged resolve of its civilian population, a clear defeat to Israel's armed forces and military doctrine. The ultimate outcome of 2006 Lebanon War is still under debate within Israel. Some analysts see its political outcome as an Israeli achievement and a setback to the Hizbullah, and thereby to

its Iranian mentors. Yet the rocket campaign ended in an unequivocal military defeat, placing Israel at growing risk in the future. Thus the rocket campaign of the Second Lebanon War deserves careful scrutiny in its own right, not merely as one of the myriad aspects of the war, but rather as *the* central theme that shaped the course, dictated the length, and molded the outcome of the entire conflict. The purpose of this study is to chart and analyze the course of the rocket campaign of the summer of 2006, to highlight the achievements and failures of attacker and defender alike, and to draw conclusions.

The rockets that the Hizbullah rained on northern Israel were aimed to maximize casualties among its civilian population. Some military installations were targeted, but infrequently and without the usual Hizbullah fanfare. The declared purpose of the attacks was to make life insufferable for the people of northern Israel. The goal of Israel's counteractions was to stop the attacks or at least mitigate their impact. Like all terror onslaughts, the rocket attacks of summer 2006 had multiple objectives - among them, political, economic and psychological - beyond its pure military aim. However, for the sake of clarity, the scope of this paper is limited to the military dimension of the rocket campaign, with brief references to other aspects when necessary.

The Hizbullah's Rockets: Anticipation vs. Actuality

The Hizbullah began to build up its cache of rockets following the death of Syrian President Hafez Assad and the accession of his son, Bashar Assad, to power. Initially, the Hizbullah received Syrian-made 220 mm and 302 mm rockets, with respective ranges of 70 and 100 km.[2] Later on, Iranian-made Fadjr and Zelzal rockets were transferred to the Hizbullah through Syria.

In the years preceding the 2006 Lebanon War, reports of a growing arsenal of rockets abounded in Israel's media. In 2002, Israeli papers estimated that the Hizbullah had about 10,000 rockets. The Hizbullah's own leader declared in a televised speech delivered on May 25, 2005, that his organization owned "more than 12,000 rockets." A noted Israeli analyst disclosed that on the eve of the

campaign, the Hizbullah had about 14,000 rockets, of which about 10,000 were "short-range" (i.e. with a range of 20 km or less).[3] Israel was mainly concerned about the longer-range rockets supplied by Iran: the 240 mm Fadjr-3 with a range of 43 km, the 320 mm Fadjr-5 with a range of 75 km, and the 600 mm Zelzal-2 with a range of 250 km.[4] The Fadjr-3 and Fadjr-5 could hit the main port of Haifa and cities further to the south. The Zelzal-2 with its warhead of half a ton could reach as far as Tel Aviv and beyond. Practically speaking, the Iranian long-range rockets could hit nearly every major Israeli city. The stated policy of the Hizbullah, namely that its rockets would be fired deep into Israel in retaliation to Israeli strikes within Lebanon, was taken at face value by Israel's leaders. The IDF carried out an exercise a few days before the outbreak of the conflict that was eerily prescient of coming events, the abduction of Israeli troops by the Hizbullah, followed by a massive Israeli escalation, in turn generating a general rocket campaign against Israel's northern and central districts as far as Tel Aviv.[5] Thus, the Hizbullah's rockets were an anticipated reaction when the government decided to respond in force to the provocation of July 12.

It was therefore surprising to many observers, the author included, that only few if any Iranian rockets hit Israel throughout the entire campaign. Only once during the fighting was the debris of a 240 mm rocket – presumably an Iranian-made Fadjr-3 – displayed by the Israeli police in Haifa. On another occasion, following an Israel Air Force (IAF) attack on Southern Beirut, a heavy rocket was seen falling in flames,[6] and the Al Jazeera broadcast from the scene of its impact showed a burnt cylindrical object that could have been the damaged motor of a Zelzal-2 rocket. Apart from these two occasions, no Iranian-made rockets were reported by the media, and no further debris of such rockets was reportedly found within Israel.

Instead, Israel was hit by long-range rockets of Syrian origin. Besides the standard 122 mm Grad rocket, familiar from all previous rocket attacks, the Hizbullah employed an improved version with a 50 km range, hitting Haifa from launch points near Tyre. Beyond this, the Hizbullah fired a number of 220 mm rockets with an estimated range of 70 km, and a number of 302 mm rockets with a range of 90–100

km, both of Syrian origin and both previously unknown to be used by the Hizbullah.

The 220 mm rockets made in Syria, may have been copies – perhaps license produced – of the old Soviet 220 mm Uragan rockets. Video footage from IAF attacks on 220 mm launchers show two kinds, one with four launch tubes and one with 12 tubes. None look like the 16-tube Uragan MLRS, although the four-barrel type bears some resemblance.

The provenance of the 302 mm rocket is even more mysterious. Video footage from an attack on one launcher reveals a six-rocket launcher built on a twin axel vehicle. The surprising fact is that the barrels are of square rather than circular section, evidence of a fixed-fin rather than a folding-fin rocket. No square section rocket launcher has ever been observed in Iranian parades or displays. The closest approximation to the 302 mm rocket system used by the Hizbullah is the Chinese WS-1 MLRS, also of 302 mm caliber, the latest version of which has six square section launch tubes installed on a three axel vehicle. The resemblance between the two launchers suggests that this rocket is a Syrian copy – probably license produced – of the Chinese WS-1 system.

Thus, contrary to expectations, Syrian rockets played the major role in the campaign, while Iranian rockets were practically absent from it. The mystery of the absent Iranian rockets deserves closer scrutiny. Three hypotheses can be offered to explain this riddle: first, that there were no Iranian rockets in Lebanon, all reports of them resulting from some elaborate ruse designed by the Hizbullah, by Iran, or by a third party, for some unfathomable purpose; second, that the entire cache of Iranian rockets was destroyed by the IAF's preemptive strike of July 13 (see p. 20); and third, that the Iranian authorities refused to allow the Hizbullah to use Iranian rockets during the campaign.

The first hypothesis is very unlikely. A senior Iranian official (and former ambassador of Iran to Damascus) publicly confirmed the transfer of Iranian rockets to the Hizbullah.[7] In addition, Iran's supply of the Iranian C–802 anti-ship missile that nearly sank the Israeli Navy's ship Hanit demonstrated the country's willingness to provide

the Hizbullah with its best weapons. The Hizbullah's possession of Iranian rockets should therefore be considered a fact. Why then were they not used against Israel?

One possibility is that they were all destroyed at one fell swoop by Israel's preemptive strike of July 13. Yet the IDF's own statement following that operation claimed the destruction of most – but not all – of the Iranian rockets, and warned that the Hizbullah still retained some capability to use them against Israel. Furthermore, the appearance of a damaged Zelzal rocket in the skies of Beirut on July 17 was evidence that some rockets of this type did survive the July 13 strike, which in turn lends credence to the supposition that more Iranian rockets could still have been serviceable later on.

The third and last hypothesis, that the Iranians did not grant the Hizbullah permission to use the surviving Iranian rockets is thus the most plausible one. Iran's position during the initial stages of the campaign was somewhat ambivalent. Officially, Iran "supported" but did not "participate in" the Hizbullah's cause.[8] This rather cool attitude made sense considering the fact that, at the same time as the outbreak of the Second Lebanon War, Iran was facing a delicate situation elsewhere, striving to dissuade the leaders of the G8 countries, convening at the time in St. Petersburg, from ganging up against Iran's nuclear program. It was obviously advantageous for Iran to maintain a low profile in Lebanon at the time, and reports of Iranian rockets causing havoc in Israeli cities could have been counterproductive.

Be it as it may, the absence of Iranian rockets did not stop the Hizbullah. It carried on with the aid of its Syrian rockets, raising another unanswered question: did the Syrian rockets come from the Hizbullah's own stockpile, stashed away since their shipment earlier in the decade, or were they transferred from Syria at the onset of the conflict? If they first alternative were true, it would indicate a serious failure on the part of Israel both to locate and to destroy the cache of Syrian rockets in time. If the second alternative were true, it would indicate a failure on Israel's part to block the transfer of arms to the Hizbullah during the campaign.

Operating Modes of the Hizbullah's Rockets

Here, too, reality greatly differed from expectations. Israeli sources indicated before the war that while the longer-range rockets were carried on and fired from mobile multiple barrel launchers, the overwhelming majority of shorter-range rockets were hidden away in basements and private apartments within residential areas and were intended to be fired separately from individual launch tubes. Since the destruction of cheap and easily replaceable launch tubes was rightly seen as futile, the IDF focused its efforts on the mobile launchers, and invested heavily in quick-reaction sensor-to-shooter technologies needed to pinpoint and destroy such launchers either before or after firing.

From the photographic material released by the IDF during the campaign, it was evident that many of the Hizbullah's rockets, particularly the heavier 220 mm and 302 mm types, were indeed based on mobile multiple barrel launchers. Photographs released by the IDF during the war showed Hizbullah mobile launchers hidden in and firing from densely built residential areas, often sheltered between closely spaced high-rise apartment buildings. A favorite tactic of the Hizbullah in the earlier stages of the conflict was to pull back mobile rocket launchers into covered parking spaces within residential buildings once their ammunition was spent, so as to hide them from the prying sensors of overhead IDF air vehicles. Later on, some launchers were seen being abandoned to their fate once their ammunition was fired, their crews retreating on motorbikes into buildings within villages.

Very surprising was a major operational mode for the shorter 122 mm Grad rockets, large numbers of which were used against Israel's northern towns. When the fighting was over, Israel's media disclosed that a large number of such rockets had been fired from *stationary* multiple barrel launchers, positioned in the open countryside rather than within residential areas. In what was a clearly counterintuitive yet brilliant tactic, multiple rocket assemblies – some improvised from steel tubes held together with concrete - were placed in small, superbly camouflaged concrete bunkers, dug inside thick natural groves or agricultural plantations, making them virtually invisible to

air surveillance. Like the launching ramps of the V-1 flying bombs in WWII, the Hizbullah's fixed launchers were aligned in predetermined directions and could not traverse. To fire the rockets, the bunkers were opened, the rocket assembly was hydraulically or manually tilted from its horizontal position to the required angle, and the salvo was fired by means of a remote control box located in a nearby house. Each individual launcher was pretargeted at an individual Israeli destination, yet enough such launchers were dug into the ground of Southern Lebanon so as to hit most Israeli towns and villages (according to various media reports, 40 to 150 such sites existed).[9]

The descriptions and photographic evidence brought back by Israeli troops from the few stationary launching sites overrun indicate a remarkable ingenuity on the part of the Hizbullah in terms of their preparation and operation. Carefully concealed from air and ground observation, using clever yet simple devices to render them effective, they exhibit a MacGyver-like proficiency for turning simple everyday implements into deadly tools of war.[10]

Careful scrutiny of the available sources renders a grand total of 475 attacks during the entire war, an average of between eight and nine rockets per attack, a reasonable figure in light of the number of launch tubes of individual rocket launchers (usually more than 12, although a few six, four and even two-barrel launchers were observed). The grand total of 475 attacks yields an average of between 15 and 16 attacks per day. There is no way to tell how many launchers were involved in each day's operations, but the impression gained from these figures is that the number was not very high, and that most, if not all, launchers, whether mobile or stationary, fired only once every 24 hours.

Types of Warheads

Each and every type of rocket fired by the Hizbullah was fitted with antipersonnel warheads designed to maximize casualties among unprotected civilians. The warheads consisted of high explosives mixed with steel balls or shards, activated on impact by percussion fuses. These warheads sent projectiles hurtling to great distances – on one occasion an Israeli civilian was killed 300 meters from a rocket's impact point. Curiously enough, on various occasions, the Hizbullah fired Chinese-made Type-81 cluster munitions rockets into Israel, containing anti-armor bomblets. Since such ordnance is designed to destroy military equipment and is relatively ineffective against buildings or persons, the reason for its use by the Hizbullah is unclear. Perhaps the Hizbullah was trying to retaliate against Israel's own use of cluster munitions. Another likely explanation is that the Hizbullah was aiming at Israel's armored corps massing for the land offensive in Southern Lebanon, but hit civilian population centers due to the inherent inaccuracy of its rockets.[11]

Volume and Intensity of Fire

According to an official statement by the IDF Home Front Command, a total of 3,970 rockets impacted within Israel between the onset of the rocket attack on July 12 and its cessation on August 13.[12] General Ben Israel estimates a somewhat larger tally of 4,200 rocket hits.[13] The actual figure might differ from both assessments and could well remain unknown forever. A number of rockets that fell into the Mediterranean Sea and into the Sea of Galilee were probably not counted, and it is more than likely that some rockets that fell in the open countryside of northern Israel remain undiscovered. Conversely, some rockets could have been counted twice. All in all, it is safe to assume that approximately 4,000 rockets hit Israel during the campaign, taking into account a margin of error of about five percent. Considering the two-day pause in the rocket attack (during the partial ceasefire following the Kafr Kana tragedy), the average volume of fire during the 31 days of action was approximately 130 rockets per day. This figure should be compared with the average of approximately 55 rockets per day fired by the Hizbullah in 1996, during the two-week long Operation Grapes of Wrath.[14] The more

than twofold increase in the Hizbullah's firepower marks the quantum leap in its military capability during the decade between the two campaigns.

According to data released by the Israeli police after the war, close to 23 percent of the rockets fell within the municipal boundaries of cities, towns and villages – i.e. within built up areas.[15] While this score is typical for low-accuracy, free flight rockets, it nevertheless demonstrates the significance of such rockets when used *en masse*. In all, 907 rockets landed on or near buildings, civilian infrastructures and industrial plants, including the highly flammable facilities of the Haifa oil refinery[16] – a veritable Blitz, far surpassing anything that Israel had suffered before, even during the Iraqi Scud attacks in 1991.

The overwhelming majority of the rockets were of the lighter types – the standard 122 mm Katyusha and its smaller 107 mm version. Only about 457 rounds were of the heavier caliber, mostly the 220 mm type.[17] Of the longer-range 302 mm type rockets, few (perhaps no more than two dozen) ever reached Israel, although more were apparently fired. Examination of the published images of 302 mm rocket debris indicate that rockets of this type were not reliable, and that many such rockets disintegrated in flight or exploded prematurely. Since the 302 mm was the longest-range rocket used by the Hizbullah during the campaign, all attacks on Israeli towns south of the Haifa–Afula line were carried out with this type of weapon. While alarms were sounded on several occasions in communities south of Haifa, no rocket impacts followed them, except on one occasion on August 3, when a single rocket landed in the vicinity of the town of Hadera causing no damage or casualties. This is another indirect indication of the unreliability of the 302 mm rocket. Presumably, the alarms were activated by the detection of incoming rockets that failed to arrive at their destinations due to malfunctions. It should be noticed that one of the video clips released by the IDF clearly shows at least two rockets disintegrating after leaving their launchers, although their type is unclear in the clips.

The Hizbullah fired its rockets from four launching zones: the outskirts of the city of Tyre, used for attacks against the western communities of northern and central Israel, particularly Haifa; the

southern region of the Beqaa Valley, used for launching most of the longer-range rockets and for attacks against the Golan Heights; the central region of Southern Lebanon north of the Litani River, from where long-range 122 mm and 220 mm rockets were launched against southern Galilee; and the central region of Southern Lebanon south of the Litani river, were most of the fixed launchers were concentrated. In all, 44 localities within Israel came under attack, including Israel's major port city, Haifa; the holiday resort town of Tiberias on the shore of the Sea of Galilee; and the border towns of Naharia and Kiryat Shmona. The southernmost target was the town of Hadera, about 42 km south of Haifa. The easternmost target was the town of Katzrin in the Golan Heights. The four most heavily attacked towns were Kiryat Shmona (1012 rockets), Naharia (808 rockets), Maalot–Tarshiha (642 rockets), and Safed (471 rockets).[18] The total number of rockets that landed in these four cities and their environs account for 74 percent of the total number of rockets fired by the Hizbullah during the entire war.

The brunt of the rocket attacks fell on civilian targets, although some evidence exists of attempts to hit military targets. The heavy fire on Safed can be attributed to the location of the IDF's Northern Command headquarters within the city's limits.[19] Attacks on Mount Meron might have been aimed at the well-known IAF installation on its top. The town of Migdal Ha'emek, east of Haifa, was attacked at least three times (July 22, August 4 and 6). In 1973, the same town suffered hits from Syrian FROG rockets aimed at the nearby IAF air base of Ramat David. The 2006 attacks could thus be interpreted as the Hizbullah's attempt to foil operations from that air base. Nevertheless, the overwhelming majority of the rocket attacks were openly directed at civilian targets. In fact, the Hizbullah's Al-Manar TV network bragged nightly of the lengthening list of Israeli towns and cities attacked to date, with subtitles in Hebrew obviously aimed at undermining Israel's morale. When Human Rights Watch accused the Hizbullah of war crimes for attacking Israel's civilians, the Hizbullah coolly responded that it had had the perfect right to attack them in retaliation to Israel's attacks on Lebanon's civilians.

The overwhelming majority of the attacks occurred in the daytime, commencing about an hour or two after sunrise and usually ending at

sunset or soon thereafter. Of the grand total of 475 rocket attacks recorded in our sources, only 17 attacks – i.e. less than four percent - occurred after dark or before sunrise. No obvious explanation can be offered for the rarity of nighttime attacks. There is no evidence that the Hizbullah observed its fire to try to correct its aim, a procedure that would have required daylight. Attributing the preference for daylight to the attempt to hide launch point locations is also unlikely, since the Hizbullah was well aware of Israel's infrared sensors that could register rocket launches in broad daylight. Perhaps the Hizbullah hoped to inflict more casualties by attacking during business hours when Israelis were driving or concentrated in shopping zones. Another explanation could be the rocket crews' need for rest, and time to refit and reload their launchers.

The rate of fire varied considerably during the campaign (see chart of daily firings, Fig. 2 in the appendix). In the first two weeks, the rate of fire averaged at about 75 rockets per day. The rate abated to almost zero on the two days of the quasi-ceasefire that followed the Kafr Kana tragedy,[20] and rose to an average of about 150 rockets per day in the third week of the war. Significantly, the intensity of the fire doubled after a series of IDF statements that most of the heavy rocket launchers had been eliminated. Towards the end of the fourth week of the campaign, the rate of fire slackened to just 30 or 40 on August 12. That week also saw some relief in the pattern of attack, particularly for downtown Haifa, with no rockets impacting there during that period. On August 12, the last day of the campaign, however, the Hizbullah launched its heaviest attack yet - 253 rockets of all types - against the long-suffering communities of northern Israel, downtown Haifa included. After a hiatus, even the 302 mm rockets returned to action that day with a successful attack on Haifa, one such rocket impacting as far as the southern exit of the city.[21]

In all, there is no doubt that the Hizbullah dominated the battle of the rockets. Throughout the campaign, it managed to maintain a steady stream of rockets into Israel, in spite of the incapacitation or destruction of its Iranian rockets and in the face of furious Israeli onslaught (see below). The Hizbullah controlled its rate of fire during the entire campaign, increasing and decreasing it at will. It reserved its severest attack for the last day of the campaign, signaling to Israel

and to the world at large that the Hizbullah, its command and control structure, its weapon stockpiles, and the discipline and morale of its troops had survived whatever the IDF could throw at it during 33 days of incessant fighting. Although the Hizbullah failed to hit central Israel in spite of repeated threats to do so, the rocket campaign on the whole was a remarkable achievement for the organization, and by the same token, a significant setback for Israel.

Effects of the Rocket Campaign

The rocket attacks caused considerable loss of life and material damage in Israel. According to most sources, 53 Israelis died (41 of them civilians),[22] approximately 250 Israelis were severely wounded, and several thousands more were injured to varying degrees from direct rocket fire.[23] A significant number of civilians - estimates range from 100,000 to 250,000 - fled to other parts of Israel, at least temporarily. An estimated one million Israelis were compelled to stay in or near shelters during the entire campaign. The towns that suffered the most hits, Kiryat Shmona, Naharia and Safed, turned into virtual ghost towns,[24] with many of the remaining inhabitants living in communal shelters, public services barely functioning, no traffic lights, and a complete cessation of commercial activity. Some impression of the damage caused by the rocket campaign can be gained from Fig. 4.

The rocket attacks destroyed or severely damaged about 2,000 dwellings, including houses and apartments. Dozens of civilian infrastructure sites were hit, including hospitals and public utilities. Scores of industrial plants were damaged. Israel’s major seaport in Haifa was shut down, and all commercial maritime traffic was routed to the southern seaport of Ashdod. Haifa's oil refinery, the largest in the country, suspended its operation for fear of a major disaster if its stored fuels and chemicals were hit. The same was true of the major chemical industries in the Haifa Bay area. The Israeli navy flotilla stationed in Haifa’s harbor evacuated its base and relocated to an emergency port in Hadera. Rockets ignited hundreds of forest and bush fires in the parched, mid-summer Israeli countryside, burning thousands of acres of carefully reforested natural reserves.

A simple index of lethality is the number of rockets per fatality (RPF). Obviously, a low RPF signifies high lethality and vice versa. As computed from the figure of 55 fatalities, the lethality index during the entire campaign averaged at 72 RPF. This figure however was not constant and tended to rise (i.e. lethality decreased) as the rocket attack unfolded. From an RPF of 50 during the first few days, lethality declined to an RPF of approximately 70 for most of the rest of the campaign and declined even further towards its conclusion (see Fig. 3).[25] This does not mean that the lethality of the rocket campaign was linked to the intensity of the attacks. The decline in lethality could be explained by the effect of passive defenses (as shall be discussed further on) and by the emptying of the towns that suffered the most hits. In nearly empty Safed, for example, there was only one fatality during the entire war, despite the 470 rockets that hit the town.

In all, the population of northern Israel demonstrated a remarkable degree of resilience and perseverance. Those who could do so left, but most stayed in the danger zones and endured the ordeal with significant fortitude, maintaining their daily routines as much as possible. Like other populations under attack, the casualties, damages and disruption of daily life did not result in a breakdown of morale. Support for the war continued throughout the campaign, and the few anti-war demonstrations held were for the most part unattended by the general public and unsupported by the media. The population of northern Israel seemed to grimly prepare itself to sit out the war and make the best of the situation. While retail came to an almost complete halt throughout northern Israel, a surprising number of industries and businesses - more than 60 percent, according to Israel's Ministry of Trade - maintained their peacetime production level. It seems that a measure of the London Blitz spirit of “business as usual” prevailed in the stricken districts.

In the central and southern regions of Israel, life went on with the characteristic zest of the high summer season. The sharp contrast between the largely paralyzed north and the busy routine of the center and south brought accusations of complacency and “bubble” mentality. Despite economic losses in the north, Israel’s economy on the whole hardly displayed any visible stress, and as soon as the

fighting was over, continued to boom in what paradoxically turned out to be one of the banner years in Israel's economic history.

Israel's Response Measures

Response measures to missile and rocket threats usually consist of passive defense, active defense, preemption and fire suppression. This section reviews Israel's responses to the rocket attack on each of the above planes.

Passive Defense

Passive defense played a crucial and invaluable role in saving lives and reducing casualties throughout the conflict. Israel's building regulations mandate that all private dwellings must contain a bombproof zone. Before the Iraqi Scud attack in 1991, regulations demanded the construction of individual or communal underground bomb shelters. In light of the lessons of the Gulf War missile attacks, the code was revised, requiring each apartment or private house to contain a reinforced room with concrete walls and steel doors and shutters. Most residences in northern Israel complied with this code.[26] In Israel's northernmost cities, especially Kiryat Shmona, communal bomb shelters offered refuge to people who lacked individual shelters. Thus, most of the residents in the stricken areas could protect themselves when alerted in time.

Israel maintains a permanent civil defense organization that operates remote controlled alert sirens in each major community. Timely alert depends on early warning, which the IDF's sensors were meant to provide. This apparently took some time to set up, as is evident from the relative lack of timely alerts during the first few days of the campaign.[27] Thereafter, the IDF Home Front Command managed to provide timely and focused alerts throughout the campaign. Alerts were issued approximately 30 seconds before a rocket’s arrival (sometimes more, depending on the specific type of rocket fired) and were specific to the anticipated impact zone. The effect of this combination of early warning and sheltering is reflected in the relatively low number of fatalities. A simple analysis of the mortality figures demonstrates the effectiveness of passive defense quite

convincingly: at least 72 percent of the 53 people killed as a result of the attack were caught in the open.[28] These people were either struck without or before the alert, did not hear the alert (particularly those traveling in cars), refused to take shelter, or could not reach shelter in time. Of those killed inside, most perished in houses that lacked shelters or reinforced rooms.

The effectiveness of passive defense was probably enhanced by the choice of warheads used by the Hizbullah. The antipersonnel charges of all of its rockets, including the heavier type, with their mixture of explosives and pellets, proved deadly against persons in the open, but much less so against persons within structures. The steel balls and shards lost their energy quite quickly when impacting on brick or cement walls and steel doors and shutters, saving the lives of the people sheltering behind them. Once this became clear, the IDF's Home Front Command instructed people who lacked individual shelters to take refuge on the southern side of north-facing walls in their apartments. Since all of the rockets were fired from the north, this provided an adequate shield. In one case, two of the apartments in an apartment building in Haifa were practically obliterated by a rocket. Upon hearing the alert, the residents moved into the southernmost rooms within their apartments, resulting in a light casualty figure of just six wounded and no fatalities.

The key factor in the success of Israel's passive defense was the early warning provided by the IDF. While it took some time to set up, the system worked reliably and offered timely warnings throughout most of the conflict. This was an unprecedented achievement, since never before had Israel provided its own early warnings against ballistic threats. While timely warnings played a role in defense against the Iraqi Scud attacks of 1991, they were then provided by American systems. The success of passive defense during the Second Lebanon War testified to the maturity and effectiveness of Israel's own detection and early warning systems against ballistic missiles and rockets.

Active Defense

Active defense played no visible part in the Second Lebanon War. Israel operates an array of active defense systems including the Arrow missile defense system and the Patriot PAC II extended air defense system. The Arrow is designed to defend against ballistic missiles with ranges far exceeding those of the Hizbullah's rockets, and it seems that most, if not all, of the rocket types used during the campaign fell below the Arrow's operational envelope. On the other hand, the longer-range rockets used, such as the 100 km 302 mm type, could well have fallen within the Patriot's operational envelope.

The IAF Air Defense Command deployed several batteries of Patriot missiles in Haifa and Safed several days after the commencement of the hostilities.[29] However, there is no report of their actual use. Following the impact of a single 302 mm rocket on Hadera on the night of August 3, some websites reported that Patriot missiles had been fired against it. The IAF however, denied this, stating that the hostile rocket had flown outside the area defended by the deployed batteries of Patriots. No attempt was made by the IAF to intercept the 302 mm rockets used to attack Haifa on the last day of the war, and no explanation was offered with regard to this passivity on the part of Israel's active defense assets.

Preemption and Fire Suppression

It was in the fields of preemption and fire suppression that the IDF made its most determined effort to overcome the rocket attack. Concealed during the fighting, the fact that the IAF had launched a major preemptive attack came to light shortly after the end of the campaign. It was reported that on July 13, the second day of the campaign, the IAF had launched a devastating operation, code named "Specific Gravity," against the Hizbullah's depots of Iranian supplied rockets, destroying 59 launchers in 34 minutes.[30] According to Major General (Res.) Ben Eliyahu, former commander of the IAF, the attack was meticulously planned and was rehearsed for a couple of years before the conflict. This major stroke was apparently expected to suppress the rocket attack if not stop it completely, and its results were apparently perceived by the IDF as decisive, prompting Prime

Minister Olmert to declare that the achievements of the IDF had "already changed the face of the Middle East."[31]

As discussed, the July 13 preemptive strike denied the Hizbullah the use of its Iranian-supplied rockets but did not prevent it from using its previously stored (or freshly supplied) Syrian-made ones. Thereafter, the campaign turned into a slugging match between the Hizbullah's rocket teams and the IDF's airmen and soldiers. The IDF employed artillery, special forces, and manned and unmanned aircraft in an effort to suppress the rocket fire. Their combined effect was, on the whole, limited.

Israel used tube and rocket artillery to fire more than 100,000 rounds of ammunition into Southern Lebanon. It is not clear what the objectives of the artillery fire were: support for the ground action, suppression of the rockets or both. In any case, there is no evidence that artillery fire had any effect on the Hizbullah's launchers. Since Israel's artillery lacks modern precision ammunition, it is reasonable to assume that its contribution to the suppression of the launchers could never have amounted to much.

Israel's special forces conducted dozens of raids behind Hizbullah lines, most of them still covert. One special operation disclosed was conducted in the vicinity of the town of Tyre on the night of August 4. The IDF defined the objective of the operation as the elimination of Hizbullah rocket personnel, and described its results as successful. Numerous other undisclosed special operations were probably conducted in effort to suppress the rocket fire. Their effect is hard to judge. Obviously, they neither stopped the rocket fire nor slowed it down, but such operations may have compelled the Hizbullah to relocate their launchers and shift the direction of their fire from the Western Galilee to other regions of northern Israel.

It was the airborne component of the IAF - attack aircraft and UAVs - that carried the brunt of the battle to suppress the Hizbullah's rocket fire. Judging from the photographic evidence released and from post-war descriptions, it is clear that the IDF invested a significant amount of resources and ingenuity in what was dubbed "launcher hunting" by

aircraft. Apparently, this was Israel's sole major response measure, prepared ahead of time to deal with the looming rocket threat.

The dozen or so video clips released by the IDF during the fighting show the destruction of about 15 Hizbullah launchers of at least five types. Close examination of the clips indicates the use of different types of ordnance and tactics. In one case, a Hizbullah crew is seen driving its launchers into the indoor parking lot of a residential building, which is thereafter hit by an Israeli bomb. In another case, a Hizbullah crew is seen abandoning its launcher and fleeing on foot a few seconds before its weapon is destroyed. A 302 mm rocket launcher is seen being tended by its crew, apparently in an effort to move it into hiding, as it is hit and destroyed. In a video clip from the last week of the war, a Hizbullah crew is seen abandoning its launcher as soon as its ammunition is spent, coolly riding a motorbike into an abandoned village and taking shelter in a house that is promptly bombed by the IAF. Various Israeli sources claimed that towards the end of the war, each and every mobile rocket launcher that opened fire was promptly destroyed.

According to Major General (Res.) Giora Romm, former IAF Chief of Staff, the IAF "achieved most of its objectives." Most of the 220 mm and 302 mm rocket launchers were destroyed, half of them in the preemptive strike on July 13 and the rest in the relentless launcher hunting campaign. As for the Zelzal-2 rocket stockpile, General Romm estimates that the vast majority of the estimated 200 rockets of this type were destroyed in the same preemptive attack.[32]

According to Major General (Res.) Ben Israel, former Head of the Directorate of Defense R&D in the Israeli Ministry of Defense, the IAF succeeded in destroying 93 mobile launchers (as well as 33 individual launch tubes) during the launcher hunting campaign. The average result of the IAF's launcher hunting was therefore about three launchers per day. The sheer technical achievement of locating and destroying small, agile targets like rocket launchers was impressive and doubtlessly chalked up a first in military history. As we shall see later on, long-range rocket attacks, presumably mounted by mobile launchers, averaged at about four per day. Thus, a destruction rate of three launchers per day could mean that on the average, 75 percent of

the launchers that opened fire on any given day were promptly destroyed.

Yet, in spite of the impressive achievement of what should have been a crippling rate of attrition of the Hizbullah's firepower, the available data confirms unequivocally that the fire suppression effort was not effective. As clearly seen in Fig. 2, the number of incoming rockets did not diminish – if anything, the intensity of the attack grew steadily. Simply put, the IAF's fire suppression effort failed to stop or even slow the rate of the rocket attack against Israel. The causes of this failure have been extensively debated both during and immediately after the war, and will be discussed in some detail in the next section. In the final analysis, the Hizbullah's ability to maintain the intensity of its rocket fire on Israel became the measure of its success in the Second Lebanon War. Israel's failure to stop the rocket attack is generally regarded - with much justice - as Israel's defeat and the Hizbullah's victory.

The Hizbullah's UAV Attack

While not directly associated with the rocket campaign, the Hizbullah's foiled UAV attack on Israel was linked with it and thus deserves a place of its own in this review. On the night of August 7 and on the night of August 13, the Hizbullah launched a total of four attack UAVs against Israel. Since those attacks occurred when the ceasefire was already in the offing, it is reasonable to assume that they were meant to strike Israel "south of the south of Haifa," so as to fulfill Nasrallah's vow. The UAVs were probably programmed to hit the Tel Aviv metropolitan area instead of the Zelzal rockets that had been destroyed by Israel (or vetoed by Iran).

The type of the UAV employed was the Ababil-T, a specialized version of the Ababil reconnaissance air vehicle adapted for ground attack missions and carrying a small explosive charge of about 30 kg. As such, the Ababil-T was nothing less than a true - if a bit slow-flying - cruise missile.

The UAVs were launched from the area of Tyre and flew south above the Mediterranean to the west of the Israeli coastline. Subsequent to

take off, one UAV vanished, another veered off course and crash landed in Israel's western Galilee and the last two were intercepted by Israeli fighter aircraft and shot down with air to air missiles (AAM). Later, the remains of at least one of them were recovered from the sea floor.

Previous to the 2006 Lebanon War, the Hizbullah flew reconnaissance UAVs of the Mirsad type over northern Israel on three different occasions without being detected, intercepted or hindered in any other way by Israel's air defenses. The UAVs of the Mirsad class and the Ababil-T used in the August 7 and 13 attacks have small dimensions and minute signatures. Locating and tracking them, not to speak of intercepting them with supersonic fighter jets is a major technological and organizational challenge. Hence, the IAF's success in foiling the UAV attack was an impressive achievement, particularly against the backdrop of the IDF's relative helplessness in foiling the rocket attack.

This incident chalked up two more firsts for the Second Lebanon War: the first use of UAVs for terror attacks, and the first downing of UAVs by AAMs fired from fighter aircraft.

Evaluation

The rocket campaign of the Second Lebanon War was a textbook example of an asymmetric confrontation between the heavily equipped modern army of an industrial state on one side and a lightly equipped but well entrenched and dedicated militia on the other. Stealth, cunning, and simple technology clashed against massive firepower and the best and latest of high technology, and to the surprise of many experts, the militia prevailed, maintaining its power to launch rockets at an undiminished rate until very end of the fighting. How did this happen?

Israel's military leadership was initially confident of the IDF's ability to reduce the volume of rocket fire if not to bring it to a complete stop. In his abovementioned interview on July 14, Major General Eisenkot voiced his opinion that although the Hizbullah still retained the capacity to fire rockets into Israel, "We have to be prepared for

several more days [of rocket attacks], perhaps a bit longer." On July 17, IDF Deputy Chief of Staff Major General Moshe Kaplinsky expressed his confidence that the Hizbullah would be so weakened that it would not be able to continue firing into Israel.[33] Commander of the Northern Command Major General Udi Adam declared that the rate of the rocket fire was already declining, and voiced his confidence that the rockets could be overcome.[34] These confident statements were made before the decision to launch a massive ground action to overrun the rocket launching sites, and reflected confidence – unshared by leading Israeli experts[35] – in the IAF's ability to overcome the rocket attack by itself. Clearly, this was not the case. Again, the question is why?

One explanation for this failure was offered by Major General (Res.) Yitzhak Ben Israel. According to his theory,[36] the failure was relative rather than absolute. He distinguishes between the shorter-range rockets, with a less than 20 km range, and the longer-range rockets consisting of the 122 mm extended range Grad and the Syrian-made 220 mm and 302 mm rockets. According to his explanation, the IAF's campaign was very effective against the longer-range rockets, inasmuch as it succeeded in preempting the Iranian-made heavy rockets in its July 13 attack, and later on, in conducting a relentlessly and highly successful launcher-hunting campaign against the remaining mobile launchers, utilizing highly innovative and sophisticated sensor-to-shooter technologies. According to Ben Israel, 93 mobile launchers were successfully attacked and destroyed during the hunting campaign. In fact, towards the end of the war, the survivability of the mobile launchers approached nil, and practically every launcher that opened fire was promptly destroyed.

According to Ben Israel's account, the IAF should not have been given the task of eradicating the short-range rockets in the first place, because there was no way to do so from the air. This was due to the fact that the shorter-range rockets were fired individually from highly dispersed single tube launchers, deployed inside residential buildings or under the cover of thick vegetation. Not only was there no way to locate them before they fired, but to try to destroy them after they fired would be a waste of effort, individual launchers being for all practical purposes, disposable items. Short-range rocket fire could

have been suppressed, according to this theory, only by a ground action designed to overrun their deployment and launching areas, an action that failed to materialize until the end of the war.

General Ben Israel's explanation of the IDF's failure is currently popular in Israel's defense establishment. It basically absolves the IAF from responsibility for the failure, shifting the blame to the IDF's High Command (more specifically to its recently resigned Chief of Staff Lieutenant General Dan Halutz) for hesitating to launch a major ground offensive in time. Yet a close examination of the available data from open sources raises some serious doubts about the validity of Ben Israel's thesis.

Let us examine each of the two claims put forth by this theory. The first is that the long-range rockets were effectively dealt with by the IAF. However, notwithstanding the fact that no rocket hit central Israel during the war, long-range rockets (with a range of more than 20 km) were fired by the Hizbullah throughout the entire war. If the launcher hunting campaign was indeed as effective as claimed by Generals Romm and Ben Israel, the intensity of the long-range rocket fire should have dwindled along with the destruction of the launchers. Yet the facts fail to show any such decline. It is almost impossible to ascertain from open sources the exact number of long-range rockets that impacted in Israel on each day of the war. However, data is available on which localities were attacked as well as the number of times they were attacked each day. Thus, assuming that any attack beyond 18 km from the Lebanese border was made by longer-range rockets (since it hardly conceivable that the Hizbullah would risk positioning its mobile launchers less than 2 km from the Israeli lines), by counting the number of daily attacks beyond the line shown in Fig. 5, we derived the approximate number of attacks by long-range launchers on each day of the war (see chart in Fig. 6).[37] While the data does not include information about the number of rockets fired in each attack, it is sufficient for our purposes, since each individual attack represented an intact long-range rocket launcher opening fire from somewhere in Lebanon. The intensity of the long-range rocket attacks (i.e. their frequency) is plotted by charting the cumulative number of attacks as a function of time (Fig. 7).

During the war, the IDF claimed that its launcher hunting operations forced the Hizbullah to withdraw its launchers from the vicinity of Tyre to more eastern locations, thus reducing the rate of attacks on the westernmost communities within Israel. To investigate this claim, we charted the number and intensity of attacks on the westernmost targets - Acre, Haifa and points further south (Figs. 8 and 9 respectively).

For the first claim of Ben Israel's theory to be substantiated, the intensity of the long-range rocket attacks should have declined as more and more launchers were put out of action. Yet this is not evident from our intensity charts. As can be seen from the chart in Fig. 7, the intensity of the long-range rocket attacks remained fairly constant throughout the war, averaging at four attacks per day. Thus, the facts indicate that no matter how many launchers the IAF destroyed and at what rate, the Hizbullah managed to sustain its long-range rocket fire throughout the war.

The charts for the western sectors yield a similar picture. There too, the Hizbullah managed to maintain a steady barrage of long-range rockets with an average rate of about 2.8 attacks per day. There is no evidence that would indicate any shifting of the attacks from the western sectors to more easterly ones. If the Hizbullah moved launchers from the Tyre area, it is not reflected by the pattern of the attacks on the westernmost sectors in Israel, which steadily constituted about two thirds of the total number of long-range rocket attacks.

Judging by the intensity of the fire rather than the claimed number of destroyed launchers, the inescapable conclusion is that the IAF failed for the most part to suppress the Hizbullah’s long-range rocket fire. The claim that the IAF succeeded in the launcher hunting campaign, brilliant as it was, is refuted by cold facts.

How does this finding tally with the impressive evidence of launcher destruction as seen in IDF released video clips? Two possibilities come to mind. First, that some of the launchers seen in the IDF videos were decoys. The available data does not preclude this possibility. The total number of long-range attacks during the war was just 138. When divided by the number of days of full scale attacks, this yields

an average of between four and five attacks per day. Making the reasonable assumption that each launcher fired only once a day, this means that no more than four or five long-range launchers were used on average on any given day, with a peak of nine to ten launchers on a day of maximum effort (August 2, in the case of the long-range rockets). This means that a relatively small stockpile of decoys – no more than a few dozen – could have been fed into the launching sites, a few at a time. The placement of a few decoys each day could have sufficed to draw away some of the IAF fire and to let a significant number of real launchers escape to fight another day.

Second, it is quite reasonable to assume that the Hizbullah, forewarned by its capable intelligence service that Israel would use sophisticated technologies to destroy its launchers, prepared enough spare units to replace its anticipated losses. There is no reliable information in the open literature on how many long-range launchers the Hizbullah had in its arsenal before the war – figures of 200 and 400 were mentioned in the Israeli media during the war.[38] If these figures were accurate, the Hizbullah would have experienced no difficulty in replacing the 100 or so launchers destroyed in the course of the launcher hunting campaign. The required rate of replacement – a few launchers per day – would have been quite manageable.

Judging by the video records of the launcher hunting campaign released, the IAF invested considerable resources in quick response technologies. According to media reports, it succeeded in reducing its sensor-to-shooter cycle time to one minute – a brilliant and unprecedented achievement.[39] There is no reason to doubt the IAF's claim that towards the end of the war, every launcher that opened fire was eliminated shortly thereafter. Yet, according to the above analysis, it may well be that the considerable resources invested were spent in vain. The Hizbullah seemed to have been preparing for exactly such an eventuality and countered it, not with any sophisticated technologies of its own, but by the simple expedient of treating its own launchers as expendable. The IAF's carefully prepared technologies for launcher hunting proved irrelevant and futile.

Where did the replacement launchers come from? One possibility is that they were stashed away in hideouts. Another possibility is that they were smuggled across the Syrian border during the fighting and trickled to the Hizbullah's rocket teams as the need arose. If they were stashed in hideouts, it would signify a failure on the part of Israeli intelligence to locate and destroy them in while they were still in storage. If they came from Syria, it would signify a failure on the part of the IDF to seal off the Syrian border.

Whether sidetracked by decoys or frustrated by abundant replacements, the carefully contrived and undoubtedly expensive technologies nurtured by the IAF for destroying launchers proved technically sound yet operationally irrelevant. Simply put, the Hizbullah succeeded in outsmarting the IAF.

The second claim of the theory is that the short-range rockets were fired from individual, single tube, disposable launchers, thus impervious to suppression from the air. To substantiate this claim, it is necessary to show that a sizable proportion of the attacks on localities 20 km or less from the Lebanese border involved single rockets. Yet once again, the evidence fails to substantiate this claim.

A detailed examination of the reports on rocket attacks throughout the war uncovers no evidence of attacks by single rockets. Invariably, all reports by civilians and reporters in the attacked communities mention alerts followed by "falls" in plural (*nefilot* in Hebrew) – that is, several rockets falling in sequence. Scouring private blogs and video clips from attacked communities in websites such as U-Tube reinforces this impression. It seems that the Hizbullah fired nearly all of its rockets, whether short or longer-range, in salvoes. In fact, it would be make little sense for the Hizbullah to have done otherwise. Unguided rockets are inherently inaccurate, and firing them from individual launching tubes would further detract from their accuracy due to the alignment errors of each individual tube. The short-range rockets – which after all constituted about 90 percent of the Hizbullah's arsenal – would be significantly more effective, causing maximum damage and shock in Israel, if fired in salvoes rather than one by one. And indeed, several reputable sources reported after the war that the Hizbullah had done exactly that. While some of the short-

range rockets may have been fired independently, most of them were fired in salvoes from multiple – but stationary – launchers. As described above, the Hizbullah used its ingenious array of highly concealed stationary launchers (Figs. 10 and 11) for firing short-range rockets.[40]

This was indeed a clever and innovative method of combining stealth with effective concentration of fire. The IDF was clearly unaware of the stationary launchers' location, and perhaps even of their existence, well into the war. With the required technical preparation, there is no reason why the coordinates of any rocket launcher, whether mobile or stationary, could not be pinpointed with precision once it had opened fire.[41] Had such preparation been carried out before the war, the eradication of stationary launchers by any of the IAF's precision munitions could have been accomplished easily – they could have been silenced within few hours. Thus there are no grounds to claim that the short-range rocket fire was insuppressible. The IDF failed to suppress it, not because it was *incapable* of doing so, but because it was *unprepared*.

In summary, contrary to the prevailing belief in Israel that the IAF managed to eradicate the long-range rockets but was powerless to eradicate the short-range ones, the truth may have been exactly the opposite. The IAF could not and did not eradicate the long-range rockets but was perfectly capable of eradicating the short-range rockets. Had it done so in time, the war could have ended with a clear Israeli victory and without resorting to a costly ground action. The IAF's failure to eradicate both the longer and shorter-range rockets led to one of the most humiliating defeats in Israel's military history.

This is a sobering conclusion that leads in turn to broader questions concerning Israel's pre-war mindset and the IDF's military doctrine. Such questions are beyond the scope of this paper. However, there is another aspect of the issue that merits serious attention. Post-war studies in Israel focus exclusively on the disappointing performance of the IDF during the Second Lebanon War. It would be a grave mistake to ignore the other side of the equation, namely the unexpectedly robust performance of the Hizbullah. Underestimation of the enemy is a prescription for disaster. Israel's military leaders

would do well to contemplate the fact that in the battle of the rockets, it was the Hizbullah that outfoxed Israel, not the other way round.

Impact on Israel's Military Doctrine

Artillery rockets are imprecise and generally not extremely lethal weapons when used against military targets and in small numbers. The Second Lebanon War demonstrated that, when used in massive numbers against civilian targets, artillery rockets have a strategic impact. This fact was fully appreciated by the Hizbullah, guiding its efforts to build a deterrent against Israel's military superiority. In Israel, however, it failed to register, in spite of the painful experience of mass rocket attacks in the 1980s and 1990s. Why Israel's civilian and military leadership failed to perceive what the Hizbullah fully understood is beyond the scope of this paper. Be it as it may, it is clear that Israel's top leaders saw the rockets as a strictly tactical threat and left it to be dealt with by the military.

We have seen that although the IDF was fully aware of the Hizbullah's growing arsenal of rockets, it was apparently confident that firepower alone, chiefly from the air, was adequate to counter it. It is now quite clear that this was the prevailing doctrine before the 2006 Lebanon War. The sharp contrast between the resources obviously poured into the launcher busting technologies displayed during the war, and the long-term neglect of ground force training revealed during the same war, as well as the halfhearted dabbling in anti-rocket defenses,[42] is striking.

The failure of this doctrine should not have come as a surprise. What happened in 2006 was nothing but a repeat performance of previous failures. The PLO rocket attacks of the 1980s ceased only when Israel's ground forces overran the launch sites in the 1982 Lebanon War. In 1993 and again in 1996, the Hizbullah ceased its rocket fire only when Israel made political concessions. Instead of drawing the obvious lessons from past experience, the IDF persisted in its adherence to firepower – buttressed by high technology – as its main response to the rocket issue. When this response failed once again in the opening phases of the 2006 Lebanon War, the IDF remained clueless. It had to bite the bullet and gird itself for a ground offensive,

much to its own dislike. Israel's hesitancy and unpreparedness for this change of direction outran the political clock, forcing it to end the war short of achieving most of its declared aims. Thus, the IDF's erroneous military doctrine and its refusal to learn from past lessons cost Israel the war.

The root cause of this shortsightedness by the IDF high command, and the precise role of the IAF in promoting a military doctrine that obviously favored it over the ground forces in the battle over the budget cannot be addressed in this paper. Nevertheless, it seems, at least by declaration, that the lesson has now been learned. At the January 2007 Herzliya Conference, Israeli Minister of Defense Amir Peretz announced a revision in Israel's military doctrine, adding defense to its three traditional constituents – deterrence, preemption and offense. Head of the Strategic Division in the IDF Plans and Policy Directorate, Brigadier General Udi Dekel, expanded on this theme. According to his statement at the same conference, the defensive component of the revised military doctrine applies to Israel's home front. Simply put, the IDF accepts responsibility for defending Israel's civilian population against missiles and rockets.

While this announcement constituted a remarkable admission that the IDF had hitherto ignored homeland defense against ballistic threats, it cleared the way for a revised doctrine of response to the rocket threat, adding active defense and ground action to firepower. Translating the new doctrine into action, the IDF has scrapped all plans for further reduction of its ground forces, and condoned (if somewhat grudgingly) a new active defense program against short and ultra short-range rockets. In view of the considerable shift of budget allocations necessary for the implementation of the revised doctrine, it remains to be seen how long it will survive in the face of the inevitable opposition within the IDF, chiefly from the IAF.

Implications for Israel's National Security

In retrospect, it can now be seen that the Hizbullah devised a two-pronged strategy to overturn Israel's predominance in terms of manpower, machinery and technology: first, massive rocket fire was used against Israel's homeland in order to provoke Israel into

launching a ground offensive; second, well entrenched defense in depth was employed in order to defeat the ground offensive. Put succinctly, the Hizbullah aimed to bait Israel into entering its carefully laid trap with rocket fire.[43] From the Hizbullah's viewpoint, the number of Israelis dead would measure Israel's defeat. As the organization's leader stated during the campaign, his aim was to kill Israeli troops, not to defend real estate.

The rockets – simple, cheap and plentiful – were at the heart of the Hizbullah's doctrine. Unless neutralized in some way, they would force Israel to choose between humiliating concessions and the butcher's bill of a full-scale ground offensive. When the time came, this faced Israel's leadership with a dilemma. Had Israel succeeded in stopping the rocket attack, the dilemma would have been avoided and the course of the Second Lebanon War might have taken a different path. As stated after the war by Israel's then Chief of Staff, General Dan Halutz, "If the Katyusha fire would have stopped within a day or two, it is almost certain that Israel's military action would have ceased."[44]

The lessons of the 2006 Lebanon War are bound to be learned and emulated by Israel's other nearby foes, namely Syria and the Palestinian factions. The outcome of the rocket campaign against Israel in the war may well prompt the Palestinian factions to intensify their already ongoing rocket attacks against southern Israel, both in terms of quality and quantity. The Hamas in Gaza is already stocking up on longer-range rockets, and may well adapt the Hizbullah's two-pronged strategy. Syria, a patron of the Hizbullah with its own vast stockpile of rockets and ballistic missiles, might be tempted to devise a doctrine of attrition by rocket and missile fire instead of a full-scale, 1973-style invasion, to gain back the Golan Heights. As long as simple, unsophisticated, cheaply produced rockets cannot be overcome, they are now and will remain in the future a veritable strategic threat to Israel's national security. It is essential that Israel's soldiers and scientists devise a way to neutralize this threat.

NOTES

[1] "Chief of Operation Branch: The IDF's Objective is to Get the Terrorists," IDF Official Website, July 15, 2006 (Hebrew), http://www1.idf.il/DOVER/site/homepage.asp?clr=1&sl=HE&id=-8888&force=1.
[2] See, for example, Reuven Erlich, "Syria as a Strategic Prop for Hezbollah and Hamas," Intelligence and Terror Information Center, August 3, 2006, www.terrorism-info.org.il.
[3] Maj. Gen. (Res.) Yitzhak Ben Israel, "The Hizbullah Rocket War July 12th – August 14th, The Land Battle," lecture presentation at the 32nd Tel Aviv Workshop for Science, Technology and Defense on the topic of "The Land Battle in the Age of Technology," January 16, 2007. Lecture slides courtesy of Major General (Res.) Ben Israel. Major General (Res.) Giora Romm estimates the total number of Hizbullah rockets before the war as 13,000. See "A Short History of the Second Lebanon War," Fisher Institute of Strategic Aerospace Analysis, Publication No. 22, December 2006.
[4] The ranges of the Fadjr-3 and 5 are taken from the Iranian Aerospace Industry's official export brochure, see www.aio.ir. The range of the Zelzal-2 is taken from Ze'ev Schiff, "How the IDF Blew Chance to Destroy Short-range Rockets," *Ha'aretz*, September 5, 2006.
[5] Ben Israel, "The Land Battle in the Age of Technology."
[6] "IDF: 'Plane Downed in Lebanon' – Long-range Missile," Ynet News, July 17, 2006, www.ynetnews.com.
[7] The senior official referred to is Ali Akbar Mohtashamipour, one of the founders of the Hizbullah and former Iranian ambassador to Syria. See "An Iranian Figure who had a Key Role in Founding the Hezbollah Publicly Announced that Long-range Iranian Zelzal-2 Rockets were Delivered to the Organization," Intelligence and Terror Information Center, August 8, 2006, www.terrorism-info.org.il.
[8] Numerous Iranian statements indicated a policy of retaining distance from the fighting. See, for example, Iranian Armed Forces Chief of Staff Maj. Gen. Hassan Firouzabadi's statement that "Iran will never be brought into the Lebanon War from the military standpoint" in "Iran Will Never Enter Lebanon War: Official," Islamic Republic News Agency, July 22, 2006, www.irna.ir.
[9] See Schiff, "How the IDF Blew Chance to Destroy Short-range Rockets."
[10] MacGyver, the hero of the popular American television series by the same name, entertained viewers with his clever use of simple materials and tools to extricate himself from deadly situations.
[11] For a description of the cluster munitions used by the Hizbullah, see "Question and Answers: 122mm Cluster Munitions Rockets," Human Rights Watch website, October 18, 2006, www.hrw.org.
[12] "Home Front Command: Return to Routine in all the North's Population Centers," Ynet News, August 14, 2007 (Hebrew), www.ynet.co.il/articles/0,7340,L-3291201,00.html.
[13] Ben Israel, "The Land Battle in the Age of Technology."
[14] Operation Grapes of Wrath was launched by Israel on April 11, 1996, and ended with a ceasefire on April 27, 1996. The fighting was limited to heavy fire exchanges

between Israel and the Hizbullah, without any ground action. During the 14 full days of fighting, the Hizbullah fired 777 short-range 122 mm type rockets into Israel.

[15] According to the Israel Police, out of the total of 3,970 rockets that fell in Israel during the fighting, 907 rockets (i.e. 22.8 percent) hit inside built up areas. See "Home Front Command: Return to Routine in all the North's Population Centers," Ynet News.

[16] See "Rocket Hit Oil Refineries during Lebanon War," *Globes*, March 22, 2007.

[17] This data is computed from the detailed list released by the Israel Police of the localities that suffered rocket hits and the number of rockets that hit each locality. The number of rockets that fell on localities that lie beyond the range of short-range rockets (namely Acre, Tiberias, Shefar'am, Haifa and its suburbs, Migdal Ha'emek, Nazareth, Afula, Beit She'an, Zichron Yaakov and Hadera) adds up to 457. See "Home Front Command: Return to Routine in all the North's Population Centers," Ynet News.

[18] See "Home Front Command: Return to Routine in all the North's Population Centers," Ynet News.

[19] See Meron Rapoport, "To be a Black Hole," *Ha'aretz*, March 10, 2007 (Hebrew).

[20] On July 30, 27 civilians – mostly children – were killed in the village of Kafr Kana by the IAF's bombing of a residential building suspected to be a shelter for rocket launchers.

[21] Different sources vary considerably with regard to the daily number of rocket hits. The chart in Fig. 3 is taken from the Jewish Virtual Library, and seems to be at odds with the published number of rockets on August 2 and 13 – 250 and 253 respectively. Partial charts released by the Israeli police during the war show significantly different daily numbers. However, the general trend in Fig. 1 - particularly the doubling of the average number of rockets in the third week of the war - seems to agree with other sources.

[22] Some sources note 55 deaths, but this figure may include two elderly people who died of heart attacks during the rocket attacks.

[23] The number of people who suffered physical injury is unclear, since Israel's emergency services list trauma as an injury.

[24] Only about 15 percent of Safed's population, 25 percent of that of Kiryat Shmona and 50 percent of that of Naharia stuck it out throughout the war. See Rapoport, "To be a Black Hole."

[25] Computation based on data on the number of fatalities at various stages of the war published in the Hebrew Wikipedia, see "The Second Lebanon War," Wikipedia, http://he.wikipedia.org. The figures offered by this source seem to be reliable, and are supported in part by other sources.

[26] Exceptions were mainly in the older sections of major towns, built before the ratification of the Israeli building code, and in scattered villages in the Galilee.

[27] As late as July 16, the fourth day of the campaign, alerts were still unreliable, as indicated by the death of eight employees of the Israel Railroad Authority (IRA) as a result of a rocket that impacted on a maintenance shed equipped with a regulation bomb shelter. According to the General Manager of the IRA, his employees were outside the shelter due to the absence of any alert of the imminent rocket hit. See

"We Told Ourselves – Now it's our Turn," Ynet News, July 16, 2006 (Hebrew), www.ynet.co.il.

[28] Based on media reports from the war period, at least 38 fatalities (out of the total 53 fatalities) occurred in the open.

[29] Three batteries were deployed in Haifa, see "3 Patriot Batteries Stationed in Haifa," Ynet News, July 15, 2007, www.ynetnews.com. A day later, on July 16, an undisclosed number of batteries of Patriots were deployed in Safed. See "The Second Lebanon War," Hebrew Wikipedia.

[30] Aluf Benn, "Report: IAF Wiped Out 59 Iranian Missile Launchers in 34 Minutes," *Ha'aretz*, October 24, 2006.

[31] "Lebanon 2006: Yoman Milchama," Sikur Memukad website, August 1, 2006, 19:10.

[32] Romm, "A Short History of the Second Lebanon War."

[33] "The IDF Can Weaken the Hizbullah Significantly," IDF Website, July 18, 2006 (Hebrew), http://www1.idf.il/DOVER/site/homepage.asp?clr=1&sl=HE&id=-8888&force=1.

[34] "Commander of the Northern Command: The Rate of Katyusha Attacks is Declining," IDF Website, July 18, 2006 (Hebrew), http://www1.idf.il/DOVER/site/homepage.asp?clr=1&sl=HE&id=-8888&force=1.

[35] In a recent interview in Defense News, Dr. Yuval Steinitz, former chairman of Israel's Knesset Committee for Foreign and Defense Affairs, disclosed his doubt, as of late 2003, that the growing Hizbullah rocket threat could be dealt by air power alone, and described how he had brought his concern to the attention of Prime Minister Ariel Sharon. He went on to disclose that then IDF Chief of Staff Lt. General Yaalon, testifying before his committee in 2005, insisted that the IAF could "Gain control of Lebanon in a way that would suppress most of the rocket launchers." See Barbara Opall, "Interview with Yuval Steinitz," *Defense News*, January 29, 2007.

[36] Maj. Gen. (Res.) Yitzhak Ben Israel, "The Land Battle in the Age of Technology."

[37] This may well be an underestimation, since some Israeli localities less than 18 km from the border may have been hit by long-range rockets fired from deep within Lebanon.

[38] "Medium and Long-range Rocket Alignment Severely Hit," Ynet News, July 31, 2006 (Hebrew), mentions that the Hizbullah had 400 launchers at the onset of the war, www.ynet.co.il.

[39] Barbara Opall, "Sensor to Shooter in 1 Minute," *Defense News*, October 2, 2006.

[40] Barbara Opall, "Combating the Hizbollah Network," *Defense News*, September 10, 2006.

[41] Details of how this can be achieved are intentionally omitted here.

[42] An anti-rocket defense system, dubbed "Magic Wand" was launched barely one year before the 2006 war, after a leisurely source selection process. The system is designed to defend against the higher end rockets, such as Zelzal-2s and against future threats such as cruise missiles. Even if it had been operational in time for the 2006 war, the system's contribution to the defense of northern Israel could not have been significant.

[43] For example, in his August 8 televised speech, Nasrallah stated that his warriors were "waiting impatiently" for the entry of Israeli troops into Lebanon. See "Nasrallah to Haifa's Arabs: Leave the City," MSN News, August 8, 2006 (Hebrew), www.news.msn.co.il.

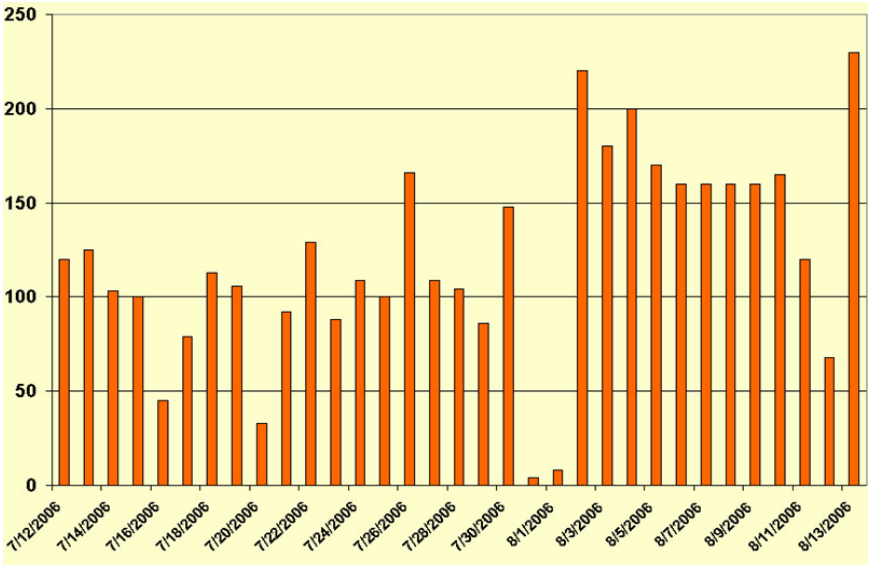
[44] Interview with Lt. Gen. Dan Halutz, *Yediot Aharonot*, October 1, 2006, supplement.

Appendix

Fig. 1 - Rocket Launch Zones in Lebanon

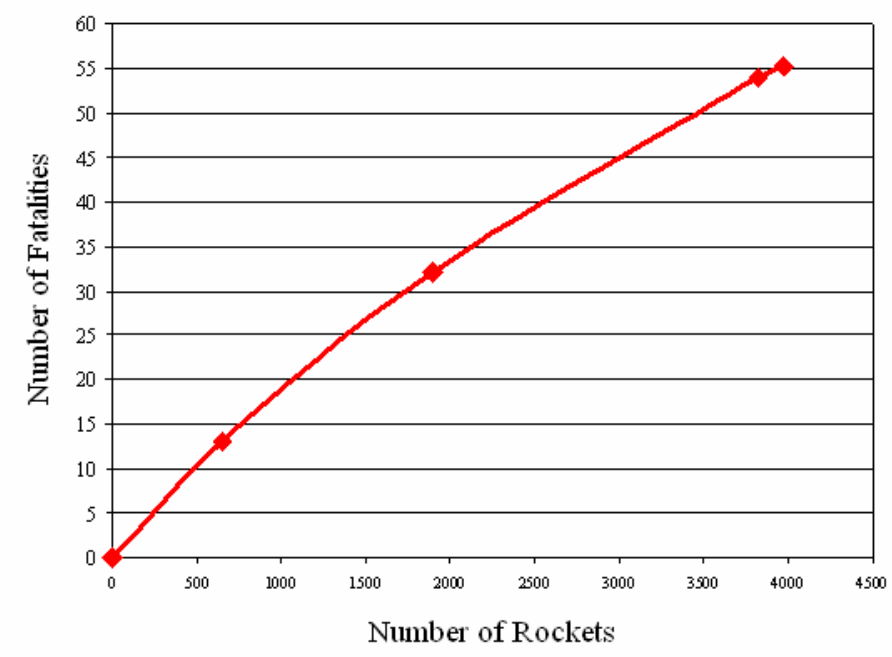
Source: The launch sites in this figure are based on "That is Not How to Stop the Firing of Katyushas," Ynet website, September 13, 2006 (Hebrew), www.ynet.co.il. The distribution of types of rockets per target is taken from the archives of Sikur Memukad website, www.sikurmemukad.com/Lebanon2006/. Original map taken from Microsoft Encarta Reference Library.

Fig. 2 – Rocket Impacts per Day



Source: Chart taken from archive of Jewish Virtual Library, November 2006, www.jewishvirtuallibrary.org.

Fig. 3 – Fatalities as a Function of Rocket Impacts



Source: Figure based on "Course of the War, Table of Main Stages" in "The Second Lebanon War," Hebrew Wikipedia, http://he.wikipedia.org. The table charts the weekly numbers of rockets and casualties from which the author compiled the above graph.

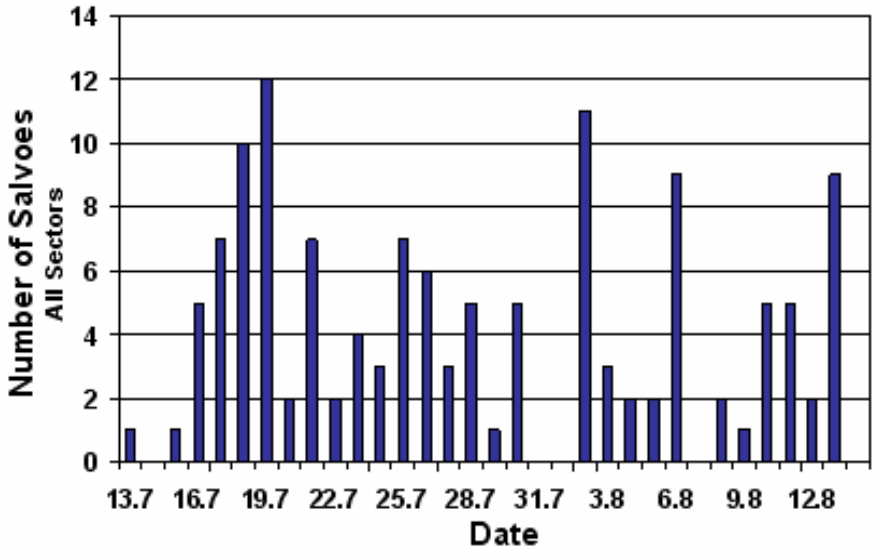
Fig. 4 – Rocket Damage in Northern Israel

Source: Pictures of Haifa taken from "War in the North," a PowerPoint presentation prepared by the Israel Police.

Fig. 5 – 18 km Demarcation Line from the Lebanese Border

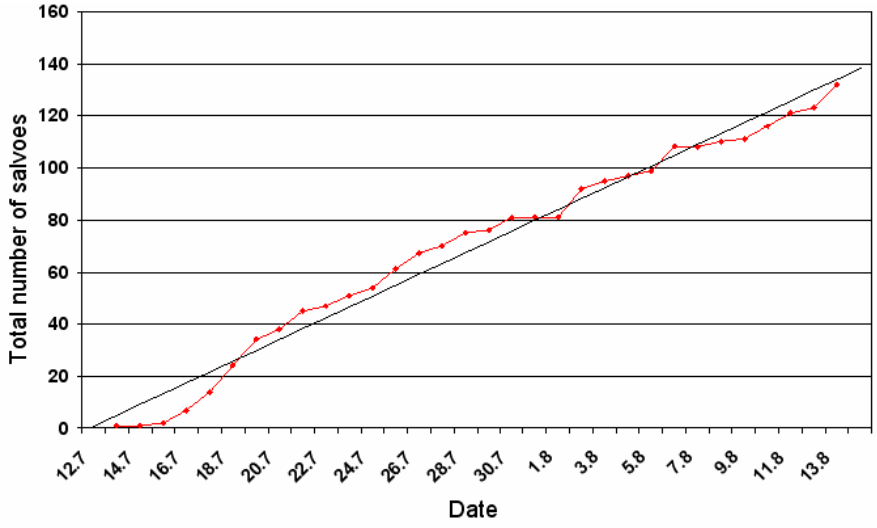
Source: Original map taken from the computerized atlas in Microsoft Encarta Reference Library.

Fig. 6 – Number of Daily Salvoes of Long-range Rockets, All Sectors



Source: Figure based on the detailed archives of Sikur Memukad website, www.sikurmemukad.com/Lebanon2006/. The method of deriving the figures is explained on pp. 24-25.

Fig. 7 – Cumulative Number of Long-range Salvoes as a Function of Time, All Sectors



Source: Figure based on the detailed archives of Sikur Memukad website, www.sikurmemukad.com/Lebanon2006/. Fig. 7 is simply an integration of the finer points of the data in Fig. 6.

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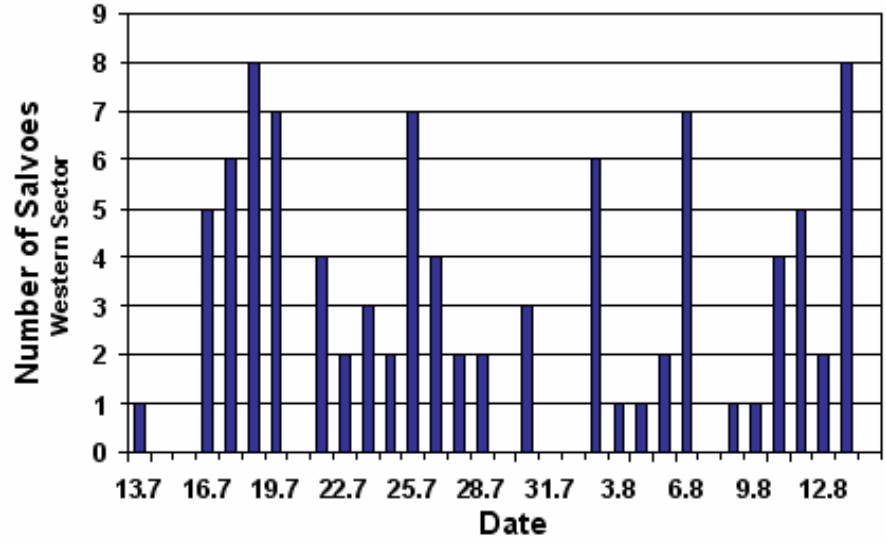
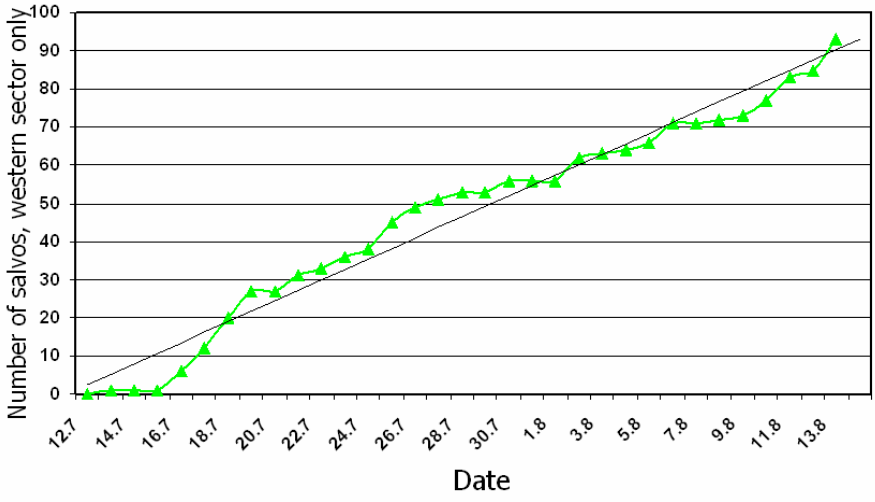
Fig. 8 – Number of Daily Salvoes of Long-range Rockets, Western Sector



Source: Figure based on the detailed archives of Sikur Memukad website, www.sikurmemukad.com/Lebanon2006/. The method of deriving the figures is explained on p. 25.

Fig. 9 – Cumulative Number of Long-range Salvoes as a Function of Time, Western Sector



Source: Figure based on the detailed archives of Sikur Memukad website, www.sikurmemukad.com/Lebanon2006/. Fig. 9 is simply an integration of the finer points of the data in Fig. 8.

Fig. 10 – Stationary Multiple Short-range Rocket Launcher – Inside View

Source: Inside view of a concealed stationary short-range rocket launcher employed by the Hizbullah. Picture released by the IDF Spokesman's Office.

Fig. 11 – Stationary Multiple Short-range Rocket Launcher – Outside View

Source: Outside view of a concealed stationary short-range rocket launcher employed by the Hizbullah. Picture released by the IDF Spokesman's Office.

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