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Safe Havens in Syria:
Missions and Requirements for an Air Campaign

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Introduction

Air power remains the arm of choice for Western policymakers contemplating humanitarian military intervention. Although the early 1990s witnessed ground forces deployed to northern Iraq, Somalia, and Haiti to protect civilians and ensure the provision of humanitarian aid, interveners soon embraced air power for humanitarian contingencies. In Bosnia, the North Atlantic Treaty Organization's (NATO's) success in combining air power with local ground forces to coerce the Serbs to the negotiating table at Dayton in 1995 suggested air power could help provide an effective response to humanitarian crises that minimized the risks of armed intervention.[1] And though NATO's failure four years later to prevent Serb "ethnic cleansing" operations in Kosovo may have demonstrated air power's limited ability to prevent the actual predatory behavior intervention is designed to address, Serb president Slobodan Milosevic's ultimate capitulation to NATO demands seemed to affirm the role of air power in responding to humanitarian contingencies.[2] More recently, NATO operations in Libya to protect civilians from impending atrocities at the hands of the Qaddafi regime have only further cemented the reputation of the "hammer and anvil" strategy of pairing Western air power with friendly ground forces used to such great effect in Afghanistan and Iraq in the intervening decade.[3] It is perhaps unsurprising, then, that the use of air power has been

[1] Robert A. Pape, "The True Worth of Air Power," *Foreign Affairs* 83, no. 2 (March-April 1994), pp. 116-130.

[2] Air power's relative contribution to Milosevic's ultimate capitulation remains hotly debated. For a sampling of this debate, see Daniel L. Byman and Matthew C. Waxman, "Kosovo and the Great Air Power Debate," *International Security* 24, no. 4 (Spring 2000), pp. 5-38; Daniel R. Lake, "The Limits of Coercive Air Power: NATO's 'Victory' in Kosovo Revisited," *International Security* 34, no. 1 (Summer 2009), pp. 83-112; Barry R. Posen, "The War for Kosovo: Serbia's Political-Military Strategy," *International Security* 24, no. 4 (Spring 2000), pp. 39-84; Adam Roberts, "NATO's 'Humanitarian War' over Kosovo," *Survival* 41, no. 3 (Autumn 1999), pp. 102-23; and Andrew L. Stigler, "A Clear Victory for Air Power: NATO's Empty Threat to Invade Kosovo," *International Security* 27, no. 3 (Winter, 2002-2003), pp. 124-157.

[3] The "anvil" in Afghanistan and northern Iraq (and to a lesser degree in Libya) was, of course, aided by Western special operations forces. With special forces assisting local allied ground forces to coordinate the use of air power, this strategy has been referred to as the "Afghan model." See Richard B. Andres, Craig Wills, and Thomas E. Griffith, Jr., "Winning with Allies: The Strategic Value of the Afghan Model," *International Security* 30, no. 3 (Winter 2005-06), pp. 124-160; and Stephen Biddle, "Allies, Airpower, and Modern Warfare: the Afghan Model in Afghanistan and Iraq," *International Security* 30, no. 3 (Winter 2005-6), pp. 161-176. For reports discussing Western special forces coordinating with Libyan rebels, see Eric Schmitt and Steven Lee Myers, "Surveillance and Coordination With NATO Aided Rebels," *New York Times*, August 21, 2011; and Mark Urban, "Inside story of the UK's secret mission to beat Gaddafi," *BBC News*, January 19, 2012.

looked to first in U.S. discussion of a possible military intervention to address the humanitarian situation today in Syria.[4]

Discussion of military intervention in Syria to address the humanitarian crisis resulting from President Bashar al-Assad's brutal crackdown on an anti-government uprising began to receive sustained attention in the U.S. media in early 2012, more than ten months after the first major protests began. Growing calls for intervention appeared to coincide with the Arab League's decision to suspend its month-long observer mission to the country in late January and a double veto by Russia and China of a United Nations Security Council resolution in early February demanding the Syrian government put an immediate end to the violence, withdraw its military forces from cities and towns, and allow for humanitarian access. It is also around this time that reports began surfacing of U.S. efforts to review possible military options in Syria.[5] Indeed, by early March, Chairman of the Joint Chiefs of Staff General Martin E. Dempsey testified before Congress that the Pentagon was reviewing military options at U.S. President Barack Obama's direction. It was then that Dempsey revealed he was preparing a "commander's estimate" of potential missions, Syrian capabilities, and the troops and time required for a military operation.[6] To date, however, the details of such planning have not been elaborated further and there has been virtually no systematic, open-source analysis of a possible Syrian contingency.[7]

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[4] For a sampling, see Fouad Ajami, "A Kosovo Model for Syria," *The Wall Street Journal*, February 10, 2012; Max Boot, "Toppling Syria's Assad," *Los Angeles Times*, June 5, 2012; Steven A. Cook, "It's Time to Start Thinking Seriously About Intervening in Syria," *The Atlantic*, http://www.theatlantic.com/international/archive/2012/01/its-time-to-think-seriously-aboutintervening-in-syria/251468/. Accessed May 1, 2012; Joseph I. Lieberman, "Turn the tide against Bashar al-Assad," *Washington Post*, May 17, 2012; Robert A. Pape, "Why We Shouldn't Attack Syria (Yet)," *New York Times*, February 2, 2012; and Jonathan Tepperman, "The Perils of Piecemeal Intervention," *New York Times*, March 8, 2012. A notable exception is Anne-Marie Slaughter, whose plan for the establishment of "no-kill zones" in Syria appears not to rely on Western air power. Anne-Marie Slaughter, "How to Halt the Butchery in Syria," *New York Times*, February 23, 2012.

[5] Barbara Starr, "U.S. Military Beginning Review of Syria Options," CNN Security Clearance, February 7, 2012. http://security.blogs.cnn.com/2012/02/07/us-military-beginning-review-of-syria-options/. Accessed May 1, 2012.

[6] Karen DeYoung, "U.S. officials warn against intervention in Syria," *Washington Post*, March 7, 2012.

[7] An important exception is Aram Nerguizian and Anthony H. Cordesman, "Instability in Syria: Assessing the Risks of Military Intervention," CSIS Working Draft (Washington, DC: Center for Strategic and International Studies, December 11, 2011), pp. 1-29. Though their analysis provides a detailed accounting of the Syrian order of battle, it stops short of analyzing the missions or capabilities that might be required of a military intervention for humanitarian objectives in Syria. With respect to subsequent

To begin assessing the scale, scope and likelihood for success of such an operation, I conduct an open-source analysis of a possible NATO-led intervention in Syria designed to address the country's ongoing humanitarian crisis. For simplicity, I assume the mandate for such an intervention would be in keeping with the most basic goals of the vetoed UN Security Council resolution and UN-Arab League Special Envoy Kofi Annan's Six-Point Peace Plan first proposed in March 2012: to defend Syrian cities and towns from government repression and to allow for humanitarian access to those in need of assistance. In keeping with NATO's past experience in responding to humanitarian crises, I focus largely on the missions and requirements for an air campaign. The intervention I explore, broadly conceived as the establishment of safe havens around particular population areas defended from the air, is neither the only option for achieving limited humanitarian objectives in Syria, nor is it the only possible application of air power to the problem. Indeed, a number of military operations with varying reliance on air power have been proposed in the context of a Syrian intervention. I focus on an air campaign to defend safe havens both because it has been frequently invoked in the debate over military intervention and because it can serve as a useful template for evaluating the utility of applying air power to the Syrian context more generally. Many of the considerations that attend the establishment of safe havens defended from the air would also apply to other uses of air power in a Syrian intervention, including the use of punitive air strikes or the establishment of a "buffer zone" along the Turkish border for the training and arming of Syrian rebels.

Attempting such an analysis is not without its limitations. First, I rely exclusively on open sources. Second, where useful, I employ extremely simple methods of analyzing complex military operations with the goal of arriving at rough-and-ready estimates of force requirements. Third, I choose to focus only on those aspects of an air campaign that are the most relevant for assessing the scale, scope, and likelihood for success of

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statements by the Obama administration on Syria, Secretary of Defense Leon Panetta and General Dempsey have been equally vague. See Ewen MacAskill, "US Military has contingency for civilian safe havens if Syria violence continues," *The Guardian*, April 19, 2012; Carlo Munoz, "Pentagon planning for Syria on hold, pending White House decision," DEFCON Hill, June 7, 2012, http://thehill.com/blogs/defcon-hill/operations/231623-pentagon-planning-for-syria-on-hold-pending-white-house-decision-. Accessed June 18, 2012; and Barbara Starr, "U.S. military completes initial planning for Syria," CNN Security Clearance, June 14, 2012. http://security.blogs.cnn.com/2012/06/14/u-s-military-completes-planning-for-syria/. Accessed June 18, 2012.

defending safe havens from the air. Such selective treatment necessarily excludes a host of political and military problems deserving of detailed examination in their own right.[8] Despite these limitations, this analysis can provide a discussion of some key considerations that would inform any decision to intervene in Syria, particularly those with a heavy reliance on air power. Moreover, it can provide insights into the more general problem of applying air power to humanitarian crises in the future.

The analysis presented here suggests an intervention in mid-2012 to establish safe havens in Syria defended from the air would be a major military undertaking, likely requiring greater resources, facing greater risks, and with a lower probability of success than any of NATO's previous air campaigns in response to humanitarian crises in Bosnia, Kosovo, or Libya. The establishment of safe havens around those Syrian cities and towns in the northwest of the country facing the brunt of the al-Assad regime's crackdown, and linked by a humanitarian corridor to the Turkish border to allow for the provision of humanitarian aid, would require cordoning off a sizeable piece of Syrian territory. The establishment of only a few "safe havens" would thus be tantamount to the establishment of an entire "safe zone" in the country's northwest, all of which would be off limits to Syrian fielded forces.

Using air power to prevent Syrian forces from entering this zone would first require the establishment of air superiority. Yet given the capabilities of Syria's ground-based air defenses, achieving air superiority over this zone would require suppressing or destroying such defenses over an even greater expanse of Syrian territory, and quite likely over the entirety of Syria itself. Establishing any additional safe havens in the south or east of the country would make this possibility a necessity. Given these considerations, achieving air superiority over Syria would likely require at least as many aircraft as NATO committed to the opening phases of operations over Serbia in Operation Allied Force, and almost certainly more so than were required to achieve command of the skies over Bosnia or Libya.

Even after achieving air superiority at mid- to high-altitudes, defending safe havens from the air would require a significant number of aircraft attempting a mission the U.S. Air Force and its allies have typically performed with little success, all while

[8] To aid the reader, many of these problems are explicitly identified in the course of analysis.

exposing NATO aircrews to greater risks than those experienced in previous "humanitarian" air campaigns. For despite developments in technology and doctrine over the previous decade to address the shortcomings of NATO operations in Kosovo, attempts to detect, identify, and engage elusive mobile targets such as small units of Syrian fielded forces or mobile surface-to-air missile (SAM) systems under restrictive rules of engagement—all while airborne—would pose a serious challenge for NATO air forces. Without assistance from professional, highly-trained forces on the ground capable of identifying targets, directing air strikes and providing some minimum of protection to Syrian civilians, it is unlikely NATO could protect safe havens and aid corridors from deter-mined elements of the al-Assad regime.

Moreover, the notion that Syrian air defenses are "five times" more sophisticated than Libya's or "ten times" more than Serbia's should not be understood as an indication of the time it would take to neutralize Syria's by comparison, but as an indication of the high level of persistent threat NATO would likely face from a moderately capable adversary for the duration of any air campaign.[9] Thus, depending on how adept Syrian forces are in handling mobile air defense systems, a NATO intervention limited to defending safe havens from the air could still pose quite significant risks to coalition aircrews. Facing such risks and a limited ability to defend Syrian civilians, NATO would have to decide whether to escalate to a broader campaign of coercion that might include strategic bombing, robust assistance to Syrian rebels, or the introduction of ground forces in order to alleviate the suffering of Syrian civilians. The original "low-risk" rationale for humanitarian intervention from the air thus appears far less persuasive for this particular form of intervention in Syria.

[9] Chairman of the Joint Chiefs of Staff Gen. Martin E. Dempsey made these comparisons to Libya and Serbia during testimony before the Senate in March. U.S. Senate Committee on Armed Services, *Hearing to Receive Testimony on the Situation in Syria*, 112th Cong., 2nd sess., March 7, 2012. An exchange between Sen. Reed and Gen. Dempsey confuses this point. Sen. Reed: "So from a perceptual view alone, the opening stages in any military operation would be an extended, almost exclusively [*sic*] air campaign by the United States against Syria, presumably supported politically by the Arab League, NATO, the EU, and everyone else. But the first kinetic part of the operation would be ours for several weeks before we actually started even [*sic*] going in and effectively protecting Syrians. Is that a fair judgment?" Gen. Dempsey, responds: "It is a fair judgment" and proceeds to discuss the legal basis for intervention. For comparison, consider the comments of Vice Adm. Daniel J. Murphy, principal naval commander of Operation Allied Force in Kosovo: "We never neutralized the IADS [Integrated Air Defense System]. We weren't any safer on Day 78 than we were on Day 1." Quoted in "The Navy in the Balkans," *Air Force Magazine* 82, no. 12 (December 1999), pp. 48-49. If Syria's air defenses are truly "ten times" Serbia's, it is entirely possible Syrian air defenses could survive well into the conduct of humanitarian operations.

This analysis proceeds in four parts. First, I describe the nature and the causes of the humanitarian crisis in Syria. Second, I briefly outline past efforts to address similar scenarios before presenting the contours of a notional intervention broadly conceived as the establishment of safe havens defended from the air. Third, I discuss select components of an air campaign and assess NATO force requirements. In the concluding section, I assess the possible outcomes of such an intervention and the implications of this analysis for the application of air power to humanitarian crises more generally.

I. Syria's Humanitarian Crisis

The proximate cause of the humanitarian crisis in Syria is government repression of a popular uprising seeking regime change. Since large-scale anti-government demonstrations broke out in March 2011, the al-Assad regime has come to identify two broad targets for its repressive security apparatus: 1) peaceful civilian protesters who have demonstrated in the tens of thousands for greater political freedoms and an end to the al-Assad regime; and 2) an insurgency conducted by elements of an armed opposition movement now known as the Free Syrian Army (FSA), composed mainly of volunteers and some soldiers who have defected from the Syrian armed forces.[10]

With respect to civilian protesters, Syrian security forces employed lethal force against largely peaceful demonstrations for about a month before any reported signs of armed resistance.[11] At that time, the death toll was just over 450, evidence that the regime was willing to kill substantial numbers of civilians to suppress peaceful demonstrations.[12] Even after evidence of some arming in late April, many of the government "sieges" of Syrian cities throughout the spring and summer of 2011 do not appear to have been accompanied by significant clashes between government forces and an armed

[10] The FSA is most often referred to in media reports as composed of army defectors. Detailed analyses suggest a larger proportion of the FSA more likely comes from civilian volunteers. For comprehensive reports on the Syrian opposition, see Joseph Holliday, "Syria's Armed Opposition," *Middle East Security Report 3* (Washington, DC: Institute for the Study of War, March 2012), pp. 1-57; and Joseph Holliday, "Syria's Maturing Insurgency," *Middle East Security Report 5* (Washington, DC: Institute for the Study of War," June 2012), pp. 1-35. See also Mohammed Najib, "Assad's Nemesis: analysing the FSA," *Jane's Defence Weekly*, December 14, 2011; and "Q&A: Nir Rosen on Syria's armed opposition," *Al Jazeera*, February 13, 2012. http://www.aljazeera.com/indepth/features/2012/02/201221315020166516.html. Accessed May 1, 2012.

[11] "Q&A: Nir Rosen on Syria's armed opposition."

[12] "Civilian death toll in Syria protests is 453: group," *Reuters*, April 27, 2011.

opposition.[13] The primary targets of state violence for much of the first six months of the uprising thus appear to have been civilian demonstrators themselves. As of June 2012, demonstrators reportedly continue to be the targets of regime forces in ongoing protests across the country.[14]

With respect to the insurgency, the first reports of large-scale clashes with an armed opposition occurred in early June 2011, during a government assault on the northern town of Jisr al-Shughour.[15] At the end of July, the FSA announced its formation.[16] Yet despite the occurrence of clashes between the government and an armed opposition as early as June, it appears government forces did not engage in significant clashes with armed resistance again until their assault on the central town of Rastan at the end of September.[17] Government sieges of the centers of protest had occurred in numerous locations across the country in the interim, suggesting the al-Assad regime was still targeting civilians and armed insurgents in largely separate operations. Since the assault on Rastan, however, engagements between government security forces and opposition fighters have continued in the midst of Syrian cities and towns experiencing ongoing protests.[18]

The government's month-long siege of Homs in February 2012 typifies the mix of state violence now fueling Syria's humanitarian crisis. The government's assault on Syria's third-largest city targeted rebel-held neighborhoods using tanks, heavy artillery, and sniper fire, reportedly killing hundreds of civilians in the process.[19] Some civilian

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[13] Such sieges occurred in cities including Dara'a in the south, Baniyas on the Mediterranean coast, Homs and Hama in central Syria, Deir al-Zour in the east, and portions of the capital, Damascus. Anthony Shadid, "Syria Escalates Crackdown as Tanks Go to Restive City," *New York Times*, April 25, 2011; Anthony Shadid, "Syria Broadens Deadly Crackdown on Protesters," *New York Times*, May 8, 2011; "Syrian tanks attack three central towns," *Al Jazeera*, May 29, 2011; Anthony Shadid, "With Police Absent, Protests Surge in Syrian City," *New York Times*, July 1, 2011; "Syrian tanks attack eastern city of Deir al-Zour," *BBC News*, August 7, 2011; Liz Sly, "Syrian tanks storm protest epicenter of Hama," *Washington Post*, July 31, 2011. Given the limited access to Syria by foreign journalists, however, it is difficult to assess the degree to which armed clashes occurred in the midst of these protests.

[14] See, for example, "Syrian forces kill 10 protesters in Aleppo: activists," *Reuters*, June 22, 2012.

[15] Mariam Karouny, "Syria to send in army after 120 troops killed," *Reuters*, June 6, 2011; Joseph Holliday, "Syria's Armed Opposition," p. 11.

[16] Najib, "Assad's Nemesis: analysing the FSA."

[17] "Syria forces storm main town, fight defectors-residents," *Reuters*, September 27, 2011.

[18] Holliday, "Syria's Armed Opposition."

[19] "Syria rebels leave besieged Baba Amr district of Homs," *BBC News*, March 1, 2012; Neil MacFarquhar, "Syrian Forces Overwhelm Stronghold of Rebels in Homs," *New York Times*, March 1, 2012.

casualties and the resulting humanitarian crisis may thus be viewed as byproducts of brutal counterinsurgency tactics, in addition to whatever violence is still being directed at peaceful demonstrators themselves. In a sign of the counterinsurgency campaign's growing contribution to the present crisis, towns previously ignored by the regime in the course of protests have now been targeted in the belief that residents are supporting the insurgency.[20] This type of violence has more recently escalated into deliberate massacres of civilians allegedly carried out by pro-government Alawite militias, the same Muslim sect to which President Bashar al-Assad belongs.[21] Previous reports also suggest elements of the largely Sunni armed opposition have committed human rights abuses, including executions, against Alawite civilians and members of the Syrian security forces.[22] This escalating cycle of violence has led some to predict Syria may now be on the brink of sectarian civil war.[23]

With the prospect of civil war looming, the regime's counterinsurgency campaign has transformed cities and towns across the country into "dangerous environments" for civilians stuck in the crossfire.[24] Civilians who remain in their homes are subjected to indiscriminate firepower by al-Assad's security forces ostensibly used to root out insurgents.[25] Civilians are also targeted directly, subjected to brutal forms of intimidation, torture, and execution in attempts to frighten the insurgency's supporters into fleeing

[20] Anne Barnard, "Neighbors Said to Be at Violent Odds in Syrian Crackdown," *New York Times*, March 28, 2012.

[21] These include massacres at Houla, Qubeir, and most recently, Tremseh. Rick Gladstone and Neil MacFarquhar, "Massacre Reported in Syria as Security Council Meets," *New York Times*, July 12, 2012.

[22] Human Rights Watch, "Syria: Armed Opposition Groups Committing Abuses: End Kidnappings, Forced Confessions, Executions," March 20, 2012. http://www.hrw.org/news/2012/03/20/syria-armed-opposition-groups-committing-abuses.

[23] Mariam Karouny and Dominic Evans, "Syria on brink of sectarian civil war, West says," *Reuters*, May 31, 2012.

[24] For a useful typology of the political-military causes of mass displacement as an occasion for humanitarian intervention, see Barry R. Posen, "Military Reponses to Refugee Disasters," *International Security* 21, no. 1 (Summer 1996), pp. 71-111. Using Posen's terminology, "collateral damage," or a "dangerous environment" would appear to be the relevant "cause" of the humanitarian situation in Syria today, to the extent displacement is considered an element of Syria's humanitarian crisis requiring a military response. For comparison, other "causes" of humanitarian military intervention might include genocide/politicide, ethnic cleansing, occupation, and primitive military logistics.

[25] "Syria: Stop Shelling of Residential Areas," Human Rights Watch, February 9, 2012. http://www.hrw.org/news/2012/02/09/syria-stop-shelling-residential-areas. Accessed May 1, 2012; "Syria: Witnesses Describe Idlib Destruction, Killings," Human Rights Watch, March 15, 2012. http://www.hrw.org/news/2012/03/15/syria-witnesses-describe-idlib-destruction-killings. Accessed May 1, 2012; and "Syria: Government Uses Homs Tactics on Border Town," Human Rights Watch, March 22, 2012. http://www.hrw.org/news/2012/03/22/syria-government-uses-homs-tactics-border-town. Accessed May 1, 2012.

armed centers of resistance.[26] As of early July 2012, the Syrian Observatory for Human Rights, an opposition watchdog group based in the UK, estimates more than 11,486 civilians have been killed in Syria since the government's crackdown began, with nearly 17,000 killed overall.[27] Though data on the distribution of deaths is not wholly reliable, one organization the U.N. has consulted in constructing its estimates suggests that the cities and towns suffering the greatest number of dead include Homs, Hama, Houla, al-Qusayr, and Rastan in the central-western part of the country; Idlib and Jisr al-Shughour in the northwest; Deir al-Zour in the east; Dara'a in the south; the capital, Damascus, and nearby Douma (for a map of Syria, see Figure 1).[28]

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[26] This appears to have been the case in Homs. Anne Barnard, "Massacre is Reported in Homs, Raising Pressure for Intervention in Syria," *New York Times*, March 12, 2012; Barnard, "Neighbors Said to Be at Violent Odds"; Human Rights Watch, *In Cold Blood: Summary Executions by Syrian Security Forces and Pro-Government Militias* (New York: Human Rights Watch, April 2012), pp. 1-23. See also Neil MacFarquhar, "U.N. Kept Out of a Town That Syria Says it 'Cleansed,'" *New York Times*, June 13, 2012; and Amnesty International, *Deadly Reprisals: Deliberate Killings and Other Abuses by Syria's Armed Forces*, (New York: Amnesty International, June 13, 2012), pp. 1-67.

[27] AFP, "Syria uprising toll tops 16,500: rights group," *Daily Star* (Beirut), July 2, 2012.

[28] "Martyr Counts by City of Death," Syrian Shuhada. http://syrianshuhada.com/default.asp?lang=en&a=st&st=6. Accessed June 18, 2012.

Figure 1: Political Map of Syria

Source: The Perry-Castaneda Map Collection at the University of Texas, Austin. Available at http://www.lib.utexas.edu/maps/middle_east_and_asia/syria_pol_2007.jpg. Accessed May 12, 2012.

Residents under siege have faced cuts to water, electricity, and phone lines and shortages of essentials such as food, medicine, baby formula, and gasoline.[29] In May 2012, the Red Crescent estimated that as many as 1.5 million people in Syria needed

[29] Shadid, "Syria Escalates Crackdown"; Shadid, "Syria Broadens Deadly Crackdown"; "Syrian tanks attack three central towns," *Al Jazeera*; "Syrian tanks attack eastern city," *BBC News*; MacFarquhar, "Syrian Forces Overwhelm Stronghold."

assistance obtaining food, water, or shelter.[30] Others have fled their homes, becoming internally displaced persons (IDPs) or refugees in camps outside Syria. As of late June 2012, the United Nations had registered more than 90,000 refugees who had fled Syria to the neighboring countries of Turkey, Jordan, Lebanon, and Iraq.[31] In the process, those fleeing have encountered newly-placed land mines along the Turkish and Lebanese borders.[32] The International Displacement Monitoring Centre, a non-governmental organization based in Geneva, estimates at least 156,000 were newly displaced in 2011, while UN Secretary General Ban Ki-moon has expressed fears that as many as one million are currently displaced inside Syria.[33] Countless others have been injured, imprisoned, tortured and forcibly disappeared.

Heavy-handed government repression, brutal counterinsurgency tactics, and sectarian killings by pro-government militias have thus resulted in a widespread humanitarian crisis across Syria. In the next section, I draw on NATO's responses to past humanitarian crises to frame a notional intervention broadly conceived as the establishment of safe havens defended from the air.

II. Models of Intervention

Military responses to humanitarian crises relying on the use of air power vary according to the nature of the violence that produce them and the specific geographic, demographic, political, and military factors that influence the feasibility of their implementation.[34]

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[30] "Syrians Defy Leaders to Aid Those in Need," *New York Times*, May 14, 2012; United Nations Office for the Coordination of Humanitarian Affairs, *Syria Humanitarian Bulletin* Issue 2 (June 21, 2012), pp. 1-5. http://reliefweb.int/sites/reliefweb.int/files/resources/Full_Report_4175.pdf. Accessed July, 2012.

[31] Office of the United Nations High Commissioner for Refugees, "Update No. 11: Syria Regional Refugee Response," (New York: United Nations, June 28, 2012), pp. 1-7. http://data.unhcr.org /syrianrefugees/regional.php. Accessed July 2, 2012.

[32] "Syria: Army Planting Banned Landmines," *Human Rights Watch,* March 13, 2012. http://www.hrw .org/news/2012/03/13/syria-army-planting-banned-landmines. Accessed May 1, 2012.

[33] "Internal displacement in the Middle East and North Africa," *Global Overview 2011* (Geneva, Switzerland: Internal Displacement Monitoring Centre, 2011), p. 73. Many of those displaced are presumably temporary. Secretary General Ban Ki-moon, "Opening remarks to the media on the Security Council resolution on Syria," UN News Centre, April 14, 2012. http://www.un.org/apps/news/infocus /sgspeeches/search_full.asp?statID=1505. Accessed June 18, 2012. UN Secretary General Ban Ki-moon's figures most likely include those displaced prior to 2011.

[34] For a useful typology and discussion of military responses to refugee disasters, see Posen, "Military Responses." The following discussion modifies this typology to focus directly on air power's contribution to military intervention in humanitarian crises. Naturally, other military responses to humanitarian crises that do not rely on air power are also possible.

These may include safe zones and safe havens premised on a strategy of denial, aerial bombing premised on a strategy of either punishment or denial, and offensive war combining the intervener's air power with the use of local ground forces. These are ideal types, and in reality elements of each may be combined. In the limited experience of the U.S. and NATO in applying air power to such scenarios, the track record has been mixed.

Safe Zones: These are large areas established to protect the civilian population where it already lives. These are most likely to be employed near an international border or where some other significant geographic, demographic, or political division exists that serves to separate afflicted civilians from the locus of the repressive regime's power. The intervention is designed to cordon off this area and prevent the entrance of hostile forces. Such zones are now often referred to as "no-go," "no-drive," or "no-kill" zones, and seem to be what some proponents of a so-called "buffer zone" have in mind in the Syrian context.[35]

Such an intervention was attempted in northern Iraq in the aftermath of the 1991 Persian Gulf War after Iraqi forces brutally suppressed a Kurdish insurrection, sparking large refugee flows to the Turkish and Iranian borders. Through a combination of air power and boots on the ground, and trading on the U.S.-led coalition's high level of credibility in the aftermath of its victory over Iraqi forces, the effort to mitigate the humanitarian crisis was largely successful. Creating this zone, however, resulted in a substantial commitment of resources to defend it from the air for more than a decade until the 2003 invasion of Iraq.

Safe Havens: These may be applicable when no obvious border, geographical feature or other division serves to neatly separate afflicted civilians from the forces that do them harm. The aim of this intervention, like that of a safe zone, is to create protected areas to which hostile forces are denied access. These areas may then serve as "havens" where civilians afflicted in areas outside them can seek refuge. The key difference is that these havens need not form a contiguous "zone," and may require linking together to a border, airfield, or port via a "humanitarian corridor" in order to ensure humanitarian

[35] Jon Hemming and Jonathon Burch, "Turkey considers Syria buffer zone; Annan seeks unity," *Reuters*, March 17, 2012. The "buffer zone" concept, however, has also been suggested as a place to organize and train the FSA, rather than as an area limited to the provision of humanitarian aid. When used deliberately to aid the rebels, this concept is more akin to the "offensive war" response considered below.

access to those who are suffering. Some version of this concept appears to be what former-French President Nicolas Sarkozy and French Foreign Affairs Minister Alain Juppé have had in mind for a Syrian intervention.[36]

Safe havens were attempted in six cities and towns of Bosnia during the civil war there in the early 1990s, defended by a relatively meager UN military presence, Bosnian Muslim infantry, and the threat of NATO air power. Minor air attacks were mounted on a number of occasions, but it was not until NATO's bombing campaign in August-September 1995 that significant force was brought to bear.[37] In combination with a Croat and Bosnian Muslim ground offensive, NATO air power was successful in ending the siege of Sarajevo and coercing the Serbs to the bargaining table at Dayton.[38] Moreover, four of the six safe havens were still standing by the end of the conflict, despite the limited ground forces tasked to defend them.

Although these successes should be acknowledged, two havens, Srebrenica and Žepa, fell to the Serbs. In Srebrenica, this resulted in the slaughter of 8,000 Muslims in July 1995.[39] The UN/NATO effort also did not end the sporadic shelling and sniping of civilians, nor prevent several intense assaults by Bosnian Serb forces on Bihać and Goražde. The track record in Bosnia is thus mixed, and its failures sufficient to require substantial modifications if the safe haven approach were ever implemented again in the future.

Aerial Bombing: Aerial bombing can be employed as part of a coercive strategy characterized as either punishment or denial.[40] A punishment strategy seeks to raise the costs of resistance by an adversary to intolerable levels by targeting a society's infrastructure, political leadership, or the civilian population itself. A denial strategy, however, seeks to degrade a state's war-fighting capabilities directly to convince an adversary that his military objectives are no longer attainable. These strategies need not

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[36] John Irish, "France presses for Syrian aid corridors at U.N.," *Reuters*, February 15, 2012; Simon Cameron-Moore, "Turkey seen as door to Syrian 'humanitarian corridor,'" *Reuters*, November 25, 2011.

[37] *NATO Handbook* (Brussels, Belgium: NATO Office of Information and Press, 2001).

[38] Pape, "The True Worth of Air Power."

[39] Mike Corder, "Srebrenica Genocide Trial to Restart," *Washington Post*, August 20, 2006.

[40] For an analysis and critique of the relative utility of punishment and denial, see Robert A. Pape, *Bombing to Win: Air Power and Coercion in War* (Ithaca, NY: Cornell University Press, 1996); and Karl Mueller, "Strategies of Coercion: Denial, Punishment, and the Future of Air Power," *Security Studies* 7, no. 3 (Spring 1998): 182-228.

be pursued in isolation, and are frequently employed in some combination, yet each still posits a distinct theory of coercive success.

Some combination of these strategies was employed in NATO operations over Kosovo, and to some extent in Libya. At the outset of operations in the former Yugoslavia, NATO described its war aims as seeking to “degrade” Serbian military capabilities to inflict harm on Kosovar Albanians and devoted significant resources to targeting Serbian fielded forces, their lines of communication, fuel and ammo stores and other requisites for war fighting.[41] By the end, however, NATO strategic air power had been used to target Serbian infrastructure, with targets including Serbia’s oil-refining capability, bridges, telephone exchanges, factories associated with the leadership’s inner-circle, its electrical-power grid, and other targets in downtown Belgrade.[42] The causes of Milosevic’s ultimate capitulation to NATO demands remain disputed.[43] What seems uncontroversial, however, is that aerial bombing was largely ineffective in preventing Serb attacks on Kosovar Albanians, the ostensible motivation for humanitarian intervention.[44]

Offensive War: In the context of military responses to humanitarian crises with a heavy reliance on air power, offensive war to destroy the adversary’s military power and even change the regime has opted for the use of the “hammer and anvil” strategy, pairing western air power’s “hammer” with local ground forces’ “anvil.” With advances in the development of precision-guided munitions, this strategy has grown particularly effective.[45] While the political viability of adopting this strategy appears to be a function of how willing are certain members of the international community to look the other way

[41] Steven Erlanger, “Conflict in the Balkans: The Overview; U.S. Appeal to Serbs to Halt Attack in Kosovo,” *New York Times*, March 23, 1999; William M. Arkin, “Operation Allied Force: ‘The Most Precise Application of Air Power in History,’ in Andrew J. Bacevich and Eliot A. Cohen, eds., *War Over Kosovo: Politics and Strategy in a Global Age* (New York: Columbia University Press, 2001), pp. 5-7.

[42] Arkin, “Operation Allied Force,” pp. 16-18.

[43] This debate tends to center on the relative importance of a credible threat of NATO ground invasion. See citations in fn. 2.

[44] Indeed, Serb forces may have expelled up to 90 percent of Kosovar Albanians from their homes by June 1999, and killed thousands more. *Under Orders: War Crimes in Kosovo* (New York: Human Rights Watch, 2010), pp. 4-18. Estimates for the number of Kosovar Albanians killed in the course of NATO’s 78-day bombing campaign are uncertain, but the number 10,000 is frequently cited. See Posen, “The War for Kosovo,” fn. 47.

[45] Pape, “The True Worth of Air Power,” p. 117.

and abandon a predatory regime when threatened with intervention, the military viability of implementing this strategy appears largely to hinge on the capabilities of the locals.[46]

This strategy was most recently employed in NATO operations over Libya, but was also used in Bosnia (quite effectively) and Kosovo (where it was largely ineffective). Libya offers useful within-case variation for assessing the viability of this strategy. NATO airpower, in combination with local militias, proved quite effective in repelling pro-Qaddafi forces from their siege of the Libyan port city of Misrata in May 2011.[47] Other rebel militias, however, particularly those based in Benghazi, appear to have been far less effective, even when supported by NATO air power.[48] In the end, U.S./NATO operations required more than seven months to achieve their war aims, and only stopped after Libyan leader Muammar Qaddafi was captured and killed. The resulting death toll has made Libya, by far, the "bloodiest" of the so-called Arab Spring uprisings to date.[49]

Each of these intervention models deserves consideration in application to Syria's present humanitarian crisis. Indeed, each of them has found its proponents in the public debate. Below, I consider a version of one such intervention model: safe havens defended from the air. The following, however, should not be interpreted as an argument or plan for military intervention. I make no claim as to whether this form of intervention should occur, nor do I claim it is a likely form of intervention to occur. It merely represents one scenario that could be considered representative of the types of operations NATO might conduct if it were to adopt a plan to defend safe havens from the air as a response to the type of humanitarian crisis described above. Other plans might also serve as responses to this kind of humanitarian crisis and themselves should be the subjects of further open-source analysis.

A Scenario: Safe Havens Defended from the Air

Establishing safe havens defended from the air would presumably have the goal of enforcing key elements of the UN Security Council resolution vetoed by Russia and

[46] Offering a similar argument in the context of the "Afghan model" is Biddle, "Allies, Airpower, and Modern Warfare: the Afghan Model in Afghanistan and Iraq."

[47] C.J. Chivers, "With Help from NATO, Libyan Rebels Gain Ground," *New York Times,* May 9, 2011.

[48] C.J. Chivers, "Libyan Rebels Don't Really Add Up to an Army," *New York Times*, April 6, 2011.

[49] C.J. Chivers and Eric Schmitt, "In Strikes on Libya by NATO, an Unspoken Civilian Toll," *New York Times*, December 17, 2011; Karin Laub, "Libyan estimate: At least 30,000 died in the war," *The Guardian*, September 8, 2011.

China in February 2012 and the Six-Point Peace Plan of UN-Arab League Special Envoy Kofi Annan proposed in March. These include demands of the Syrian government to put an immediate end to the violence and protect its population, withdraw its military forces from cities and towns, and allow for humanitarian access to those in need of assistance. To the extent secure safe havens would contribute to resolving Syria's underlying conflict in the form of a negotiated deal leading to a political transition, it would likely be in persuading al-Assad that killing civilians could no longer be considered a possible element of his strategy to prevail over the opposition.[50]

It is important to note, however, that even if NATO were successful in achieving these goals, there is no guarantee doing so would be sufficient to ensure a resolution to the conflict. Whether altering al-Assad's calculations in this way would be sufficient to resolve Syria's conflict is beyond the scope of this analysis. Rather, I aim to evaluate the scope, scale, and likelihood of success if NATO attempted to accomplish the humanitarian goals above having opted for a "safe havens" intervention. The narrower question here is not whether this form of intervention would resolve the conflict, but whether this intervention would be likely to protect civilians and improve their humanitarian situation, were it attempted.

In Bosnia, where the international community pursued similar aims, the UN adopted Chapter VII resolutions establishing "safe areas" around particular towns and their surroundings. These areas would be "free from any armed attack or any other hostile act which endanger[ed] the well-being and the safety of their inhabitants."[51] These were accompanied by demands that Bosnian Serb forces withdraw from the towns to a distance wherefrom they could not threaten the safe area's inhabitants. While the vetoed UN resolution on Syria was more ambitious in demanding the return of Syrian government forces to their barracks, I instead consider here the Annan plan's more limited demand that Syrian forces withdraw to a safe distance from population centers.

[50] In time, it might also serve to slowly tip the balance of power against al-Assad's forces in favor of Syria's armed opposition. This possibility, however, is largely bracketed for the purposes of the present analysis.

[51] U.N. Security Council, "Resolution 819 [Bosnia and Herzegovina]." April 16, 1993. http://www.un.org/Docs/scres/1993/scres93.htm. Accessed May 1, 2012; U.N. Security Council, "Resolution 824 [Bosnia and Herzegovina]." May 6, 1993. http://www.un.org/Docs/scres/1993 /scres93.htm. Accessed May 1, 2012.

Key considerations in the establishment of safe havens include their number, size, and location.[52] These choices, in turn, are influenced by the number of civilians at risk, their distribution in the area of conflict, and the political, military, and logistical constraints on supplying them with humanitarian aid. A number of Syrian population centers could serve as candidates for safe haven status. However, any proposed intervention with the aim to protect Syrian civilians and ensure the provision of humanitarian aid would almost certainly include the establishment of a safe haven in Homs, the city that has experienced the worst of the al-Assad regime's brutal repression.[53] It is worth noting that many other forms of intervention, including a safe zone or "buffer zone" along the Turkish border for the purposes of providing humanitarian relief and training Syrian rebels, would have little immediate influence on the humanitarian situation in Homs. The safe haven intervention considered here, then, is perhaps that which is most consistent with the humanitarian goals espoused in the vetoed UN resolution and Annan's Six-Point Peace Plan.

A Safe Haven in Homs

Homs is Syria's third-largest city, with a population of more than 650,000, and the capital of the Homs Governorate.[54] It is situated in west-central Syria on the country's main north-south artery approximately halfway between the capital, Damascus, and Aleppo, Syria's largest city. Its location is strategic, serving as the central link between the cities of the interior and the Mediterranean coast by approximately 80 km of highway running through the Homs Gap, a natural break occurring between the Jabal an-Nusayriya and Anti-Lebanon mountain ranges.[55] It is also a major industrial center, home to one of Syria's two oil refineries on the western edge of the city and the site of a major oil

[52] Posen, "Military Responses," pp. 98-104.

[53] Syrian Shuhada, the only source I am aware of that breaks down the death toll in Syria by city, and one of the sources that has informed U.N. estimates, reports 4,812 deaths in Homs as of July 1, 2012. The city suffering the next highest death toll is Hama, with 930 deaths. This suggests somewhere in the range of one-quarter to one-half of all civilian casualties in the Syrian conflict to date have occurred in Homs. http://syrianshuhada.com/default.asp?lang=en&a=st&st=6. Accessed July 2, 2012.

[54] "City Population." http://www.citypopulation.de/Syria.html. Accessed May 11, 2012. Population estimates are based on 2004 census data.

[55] Google Maps; "Hims," Britannica Online Encyclopedia. http://www.britannica.com/EBchecked /topic/266142. Accessed, May 1, 2012.

pipeline.[56] Demographically, Homs' sectarian diversity mirrors that of Syria as a whole.[57] Mainly Sunni Muslim, it also has sizable minorities of Christians and Alawites. Though some neighborhoods of Homs appear to be dominated by one sect, others are more mixed.[58] These demographic considerations suggest the potential for "intra-haven" strife, a problem which air power would have little ability to solve, and one that I bracket for present purposes.

Supplying Homs with humanitarian aid would require delivery either overland or by airdrop.[59] Supplies delivered overland could be transported from any of four locations: a Syrian port on the Mediterranean, a Syrian airfield somewhere outside of Homs, the Lebanese border, or the Turkish border. Below I briefly consider the viability of these four options.

The nearest port is Tartus, located approximately 94 km from Homs along the primary east-west highway through the Homs Gap. Tartus is Syria's largest port, with three piers and 24 berths, and served as the main gateway for the UN World Food Program's relief efforts in Iraq.[60] This would seemingly make Tartus an ideal candidate for supplying Homs. However, it is also home to a Syrian naval base, as well as Russia's only foreign naval facility outside the former Soviet Union.[61] While the Russian presence has historically been limited to a maintenance and resupply facility, reports suggest the facility is currently being renovated and expanded into a naval base capable of accommodating Russian heavy warships.[62] Other Syrian ports, including Baniyas and Latakia, lie farther north along the coast, meaning humanitarian convoys would have

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[56] The other is located in the Mediterranean port of Baniyas. The pipeline was damaged during the government siege in February 2012. "Explosion damages pipeline in Syrian city of Homs," *BBC News*, February 15, 2012.

[57] Anthony Shadid, "Sectarian Strife in City Bodes Ill for All of Syria," *New York Times*, November 19, 2011.

[58] Kelly McEvers and Rima Marrouch, "In Restive Syrian City, Signs of Sectarian Violence," *National Public Radio*, February 8, 2012. There have also been some reports of sectarian cleansing occurring in once-mixed neighborhoods since the start of the crackdown. Anthony Shadid, "Fear of Civil War Mounts in Syria as Crisis Deepens," *New York Times*, January 14, 2012.

[59] There do not appear to be any airfields in Homs proper or its immediate environs.

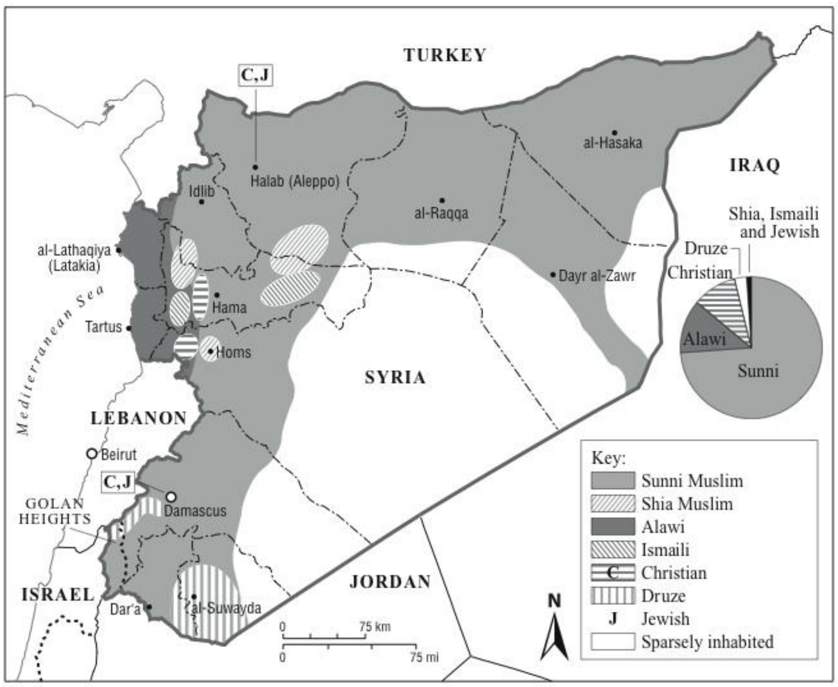
[60] "Syrian Arab Republic," World Food Program Logistics, http://logistics.wfp.org/country-operations/middle-east/syria. Accessed May 20, 2012.

[61] Ariel Cohen, "Swords and Shields: Russia's Med Menace," *United Press International*, October 15, 2008; Andrew E. Kramer, "Russian Warships Said to Be Going to Naval Base in Syria," *New York Times*, June 18, 2012.

[62] "Russian Navy to base warships at Syrian port after 2012," *RIA Novosti*, August 2, 2010; "Tartous," Global Security. http://www.globalsecurity.org/military/world/syria/tartous.htm. Accessed May 20, 2012.

longer distances to travel in order to reach Homs. The use of ports is also complicated by the fact that the Mediterranean coastal area is regarded as the Alawite heartland, the area where those most likely to resist foreign intervention reside (see Figure 2 for a map of Syria's demographic composition).[63] Given these considerations, the use of Syrian ports may involve greater costs than alternative methods of supply.

Figure 2: Syria – Sectarian Demography



Source: Seth Kaplan, "Syria's Ethnic and Religious Divisions," http://www.fragilestates.org/2012/02/20/syrias-ethnic-and-religious-divides/. Accessed May 3, 2012. Adapted from Flynt Leverett, *Inheriting Syria: Bashar's Trial by Fire* (Washington, DC: Brookings Institution Press, 2005), p. 3.

The nearest airfield is the dual-use air base at al-Qusayr, located approximately 39 km southwest of Homs by road (only 22 km "as the crow flies").[64] Its single 148 ft. x 10,000 ft. runway would provide the minimum runway length needed for C-17s and C-

[63] Flynt Leverett, *Inheriting Syria: Bashar's Trial by Fire* (Washington, DC: Brookings Institution Press, 2005), p. 3.

[64] "Syrian Airfields," Global Security. http://www.globalsecurity.org/military/world/syria/airfields.htm. Accessed, May 2, 2012; Google Maps. The dual-use airfield at Shayrat is also nearby, though marginally farther from the center of Homs.

130s to takeoff with their maximum load.[65] Using al-Qusayr would also have the advantage of involving the shortest lines of communication to supply Homs. However, although I do not calculate the tonnage of supplies that could be delivered in and out of al-Qusayr on a daily basis, the use of al-Qusayr alone would likely be insufficient to supply Homs' more than 650,000 residents and those seeking shelter from surrounding areas, let alone any additional safe havens. Defending such an airfield would also be an extremely risky proposition, considering the susceptibility of landing aircraft to low-altitude mobile and man-portable surface-to-air missiles. A sizeable contingent of ground forces would likely be required for such defense.[66] The use of airfields at al-Qusayr or elsewhere, then, would also seem to be more costly than alternative overland options.

The final two overland options would involve assembling humanitarian aid convoys across an international border, and driving them through a defended "humanitarian corridor" (and perhaps other safe havens) between that border and Homs. Lebanon would be the natural choice. It is approximately 35 km from Homs along roads to the nearest border crossings, and only 62 km to the border via the main highway linking Homs to the Lebanese port of Tripoli. Political considerations, however, make the Lebanese option exceedingly unlikely. Given al-Assad's support for the Lebanese militant group Hezbollah, and Hezbollah's position within the Lebanese government, it is difficult to imagine Lebanese consent to a Syrian intervention, humanitarian or otherwise.

An overland supply route linking Homs to the Turkish border would be the more likely, and least costly, choice in the event of a safe haven intervention premised on the need to alleviate the suffering in Homs. This is primarily because additional candidates for safe havens, established in those cities and towns that have also witnessed the worst of the al-Assad regime's repression and where civilians remain at risk, lie on or near the main north-south highway linking Homs to the area just south of the Turkish border.[67] These include Hama, Idlib, and Rastan, which fall just behind Homs in the list of those cities that have suffered the greatest number of dead since the outbreak of demonstrations

[65] See William D. O'Malley, *Evaluating Possible Airfield Deployment Options: Middle East Contingencies* (Santa Monica, Calif.: RAND Corporation, 2001) p. 13; "Syrian Airfields," Global Security.

[66] For an example of such an effort, see John Prados and Ray W. Stubbe, *Valley* of *Decision: The Siege of Khe Sanh* (New York: Dell, 1991).

[67] This appears to be the concept for a humanitarian corridor advocated by France in late 2011 and early 2012. See, again, Cameron-Moore, "Turkey seen as door to 'humanitarian corridor.'"

in March 2011.[68] While Homs lies almost 200 km south of the nearest major border crossing into Turkey at the Syrian town of Bab al-Hawa, Bab al-Hawa is only roughly 50 km by road to Idlib.[69] From there, it is only another 20 km to the main highway, along which lie Hama, Rastan, and ultimately, Homs. Turkey has also demonstrated far greater interest in addressing the humanitarian situation in Syria in comparison to Syria's other neighbors.[70] It is also the home of major NATO air bases (including Incirlik, used during Operation Provide Comfort to aid displaced Kurds in northern Iraq) and five ports along the Mediterranean that could be used to lift supplies.[71]

The following analysis therefore assumes safe havens would be established not only in Homs, but also in Hama and Idlib, and that these would be linked to the Turkish border via a humanitarian corridor in order to provide supplies overland (see Figure 3).[72] Given their locations, creating just these three havens and a humanitarian corridor to supply them would be tantamount to the creation of an entire "safe zone" in Syria's northwest.[73] There are certainly other locations in Syria deserving of safe haven "treatment." These, however, would be exceedingly difficult to link to the safe havens proposed here, and would likely require their own distinct method of supply and defense. In what follows, I focus on establishing only these havens in northwest Syria. It should be clear, however, that any intervention that sought safe havens elsewhere (e.g., Dara'a in

[68] Syrian Shuhada, "Martyr Counts by City of Death," http://syrianshuhada.com/default.asp?lang=en&a=st&st=6. Accessed June 20, 2012.

[69] Google Maps; Marc Champion, "Tension Rises at Syria-Turkish Border," *Wall Street Journal*, December 8, 2011.

[70] See, for example, Emre Peker and Tony Capaccio, "Turkey urges Syria aid corridors as Russia resists UN bid to condemn Assad," *Bloomberg*, March 6, 2012.

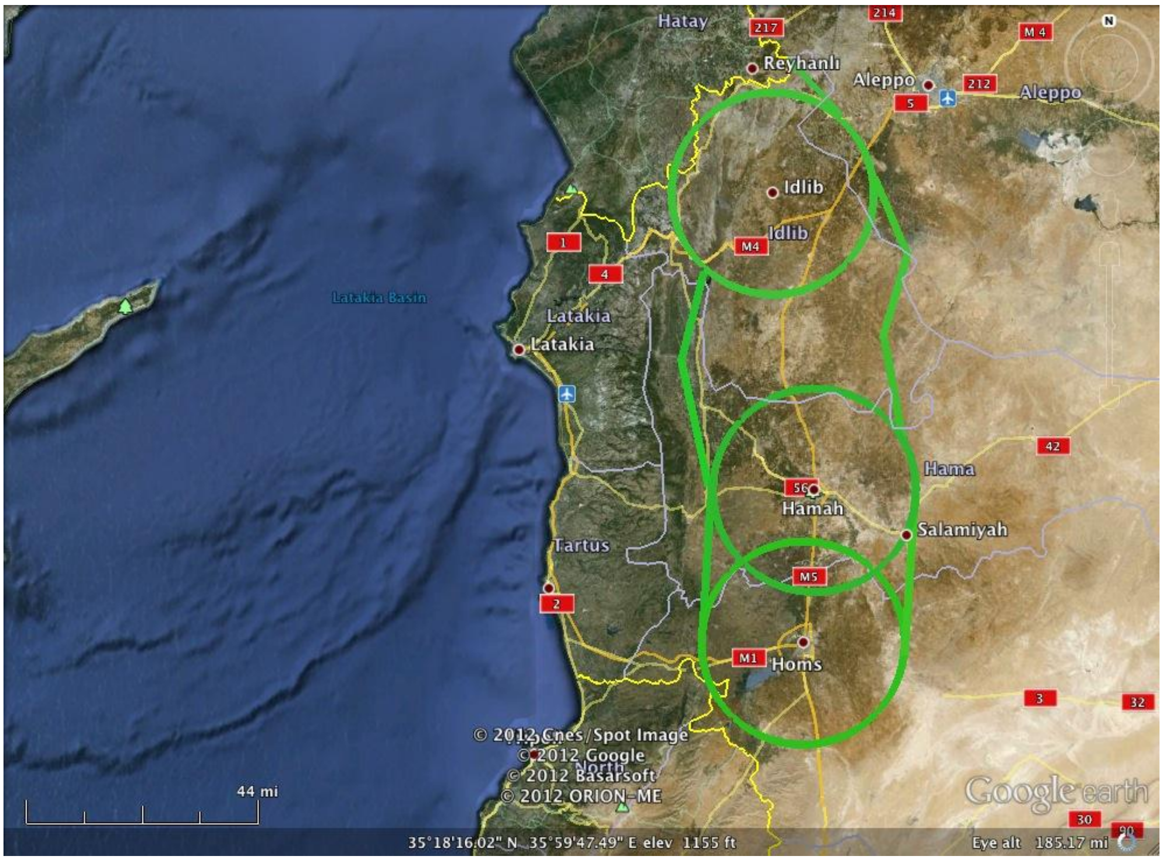
[71] "Incirlik Air Base History," U.S. Air Force Fact Sheet. http://www.incirlik.af.mil/library/factsheets/factsheet.asp?id=5344. Accessed June 20, 2012.

[72] By creating safe havens in Homs and Hama, Rastan would also be protected given its location along the humanitarian corridor linking these two cities.

[73] It is also worth mentioning that creating these havens would effectively cut off Damascus from Syria's largest city, Aleppo. (Damascus and Aleppo are connected via the main north-south artery linking Homs to the north). As of June 2012, the al-Assad regime had largely maintained control of Aleppo. It is possible, however, that severing the connection between those cities would lead Syrian forces to lose their grip on Aleppo, thereby hastening the downfall of the al-Assad regime. A second consequence of establishing a safe haven in Homs would be to isolate the Alawite Mediterranean coastal area from the interior. As Tartus and cities to the north are connected to the interior via Homs, cordoning off the area around Homs would also block direct access from Damascus to the Mediterranean. This could have any number of consequences for al-Assad's calculus. One, in particular, is the effect isolating the Alawite heartland might have on the possibility of al-Assad's "retreat" to the Mediterranean coast in order to establish an Alawite-controlled state. See Rami G. Khouri, "A terrifying menu for Syria's endgame," *Daily Star* (Beirut), January 28, 2012.

the south, Deir al-Zour in the east) would require even greater resources. To better assess the resources required for defending safe havens in the northwest from the air, I now turn to the missions and requirements of the air campaign.

Figure 3: Safe Havens in Northwest Syria



Note: This map is notional. It is only intended as an illustration for the purposes of this analysis.
Source: Google Earth.

III. Components of the Air Campaign

Any attempt to establish safe havens in northwest Syria defended from the air would first require establishing air superiority, allowing NATO to conduct operations "without prohibitive interference" by Syrian forces.[74] It is unlikely NATO could achieve a greater degree of dominance in the air unless the Syrians were particularly cooperative in

[74] "Counterair Operations," Air Force Doctrine Document 2-1.1 (United States Air Force, October 1, 2008), p. 3. The need for air superiority was seen as a key "lesson" of NATO operations in Kosovo. See Rebecca Grant, "Airpower Made It Work," *Air Force Magazine* 82, no. 11 (November 1999), pp. 30-37.

allowing their air defense systems to be targeted.[75] In Kosovo, NATO only formally declared air superiority at mid- to high-altitudes after roughly a month of bombing (and never at lower altitudes).[76] Given its relatively sophisticated air defenses, especially its ubiquitous low-altitude mobile air-defense systems, air superiority at mid- to high-altitudes is probably all that could be expected for the duration of similar operations in Syria.

Achieving air superiority would involve undertaking offensive counterair missions to destroy, disrupt, or degrade Syrian air capabilities. These missions would include targets such as aircraft and surface-to-air missile (SAM) batteries, as well as airfields, fuel storage facilities, munitions depots, command and control facilities, and other supporting infrastructure. While the U.S. possesses the electronic warfare capabilities necessary to penetrate Syrian air defenses for a discrete purpose and limited amount of time such as that demonstrated by the Israeli Air Force in its September 2007 strike against an alleged Syrian nuclear facility at Deir al-Zour, any sustained campaign would likely require a more robust effort to suppress (i.e., destroy) Syrian air defenses.[77]

In his testimony before the Senate in March 2012, General Dempsey explained that suppressing Syrian air defenses would "take an extended period of time and a great number of aircraft."[78] This section attempts to provide greater detail on what it would take for NATO to achieve air superiority over Syria during the opening phases of an air campaign to defend safe havens from the air. However, in addition to the missions of suppressing air defenses and neutralizing the Syrian air-to-air threat considered below, there are two major aspects of offensive counterair operations that would also be of vital

[75] The alternative, "air supremacy," would involve a degree of dominance in the air that would prevent "effective interference" by Syrian forces.

[76] As a result of attacks on fixed SA-2 and SA-3 SAM sites, NATO announced it had formally achieved air superiority at mid- to high-altitudes on April 24, 1999. Arkin, "Operation Allied Force," p. 17. Operations in Kosovo commenced March 24, 1999. Interestingly, reports suggest NATO had only destroyed approximately thirty percent of SA-3 target sites at this time. Paul Mann, "Operation Allied Force," *Aviation Week & Space Technology* 150, no. 17 (April 26, 1999). While this might suggest NATO adopted a relatively low threshold for destroyed SAMs before declaring air superiority, it is possible such systems had been sufficiently degraded without being destroyed, and therefore posed a minimal threat.

[77] On the Israeli strike, see Richard B. Gasparre, "The Israeli 'E-Attack' on Syria," Airforce Technology. http://www.airforce-technology.com/features/feature1625/. Accessed May 1, 2012.

[78] U.S. Senate Committee on Armed Services, *Hearing to Receive Testimony on the Situation in Syria*. Dempsey also noted that the Pentagon has "an estimate, based on gaming and modeling, of how long it would take to do that, given the density and the sophistication of their air defense system." This estimate, however, was only presented to Members of Congress in closed session.

concern to air campaign planners. I briefly mention them here given their importance to any intervention in Syria, though they do not occupy a central place in the following analysis of the specific missions required for defense of safe havens.

The first is the threat posed by Syrian surface-to-surface missiles and weapons of mass destruction (WMD). Syria is believed to possess chemical weapons, as well as cluster warheads for delivering these weapons.[79] In the event Syria's Scud missiles were armed with chemical warheads, these weapons could pose a significant threat to civilian population centers and military bases in Israel, Jordan, Lebanon, Iraq, and Turkey. Indeed, in December 2011, Syria test-fired a Scud-B missile a few hundred kilometers from the Israeli-Syrian border in a move Israel interpreted as a warning against foreign intervention.[80] However, Syria's use of its Scud missiles in the course of a NATO intervention to defend safe havens—let alone if those missiles were tipped with WMD warheads—would represent a serious escalation of the Syrian conflict. Such use would significantly increase the chances that any NATO humanitarian operation would become an offensive war for regime change and would likely be used if al-Assad believed NATO were committed to this objective.[81] Missions associated with the specific targeting of Syria's surface-to-surface missile batteries and securing Syria's WMD facilities merit additional research.[82] Given my focus on missions associated with defense of safe havens, however, I do not explicitly consider the problems associated with targeting Syrian surface-to-surface missiles and its WMD capabilities, while recognizing they

[79] Anthony H. Cordesman, "Syrian Weapons of Mass Destruction: An Overview" (Washington, DC: Center for Strategic and International Studies, June 2, 2008), pp. 1-20; For an overview of Syrian WMD capabilities, see Nuclear Threat Initiative, "County Profiles – Syria," http://www.nti.org/country-profiles/syria/. Accessed May 13, 2011.

[80] Yaakov Katz, "Israel ponders Syrian 'Scud' launch," *Jane's Defence Weekly*, December 7, 2011.

[81] Indeed, Qaddafi eventually launched his first Scud in August, nearly five months into NATO operations in Libya. It is perhaps surprising he waited so long, given that regime change had clearly been NATO's goal for some time. "Libya conflict: Gaddafi forces 'launched Scud missile,' *BBC News*, August 16, 2011.

[82] One report, for example, suggests Pentagon planners have considered a ground force of 75,000 troops necessary to secure Syria's chemical weapons facilities in the event of regime collapse. See Barbara Starr, "Military: Thousands of troops needed to secure Syrian chemical sites," CNN Security Clearance, February 22, 2012. http://security.blogs.cnn.com/2012/02/22/military-thousands-of-troops-needed-to-secure-syrian-chemical-sites/. Accessed May 20, 2012.

would be a significant concern for planners considering a diversity of Syrian interventions.[83]

The second is the threat posed by Syrian anti-ship missiles. Reports suggest Syria has recently augmented its aging coastal-defense forces with two Russian-made "Bastion" land-based mobile coastal defense systems each equipped with 36 supersonic Yakhont SS-N-26 anti-ship cruise missiles.[84] Acquiring these advanced anti-ship systems represents a dramatic improvement over Syria's stock of static, land-based SS-C-1B *Sepal* and SS-C-3 *Styx* anti-ship missiles, as well as its ship-mounted SS-N-2C *Styx* and CSS-N-8 *Saccade* anti-ship missiles.[85] Adding to the anti-ship threat are recent reports that Syria has also received advanced high-speed air-launched cruise missiles for use with its Su-24 fighter-bombers.[86] Given the likely need for naval assets in the event of an intervention in Syria, neutralizing the threats posed by Syrian anti-ship missiles would naturally occupy an important place in intervention planning and requires further open-source analysis. They, too, however are not given detailed treatment in what follows in favor of a greater focus on the specific missions and requirements for defense of safe havens.[87]

The surface-to-surface, WMD, and anti-ship missile threats having been identified, I now outline the Syrian order of battle with respect to its air-defense and air-to-air capabilities before turning to a discussion of the likely conduct of NATO offensive counterair efforts to establish safe havens.

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[83] For an analysis that considers the difficulties inherent to "Scud hunting," see William Rosenau, *Special Operations Forces and Elusive Enemy Ground Targets: Lessons from Vietnam and the Persian Gulf War* (Santa Monica, Calif.: RAND Corporation, 2001).

[84] Agence France-Presse, "Russia Delivers Missiles to Syria: Report," *Defense News*, December 1, 2011. http://mobile.defensenews.com/story.php?i=8436776&c=MID&s=POL. Accessed May 1, 2012; "Russia sends ship-killer missiles to Syria," *United Press International*, December 5, 2011. http://www.upi.com/Top_News/Special/2011/12/05/Russia-sends-ship-killer-missiles-to-Syria/UPI-77361323106694/. Accessed May 2, 2012.

[85] International Institute for Strategic Studies (IISS), "Middle East and North Africa," *The Military Balance 2012* (London: IISS, 2012), pp. 349-350.

[86] Jeremy Binnie, "Syria receives delivery of advanced anti-ship missiles," *Jane's Defence Weekly*, February 1, 2012.

[87] For an analysis of missions and requirements for countering anti-ship cruise missiles in the Iranian context, see Caitlin Talmadge, "Closing Time: Assessing the Iranian Threat to the Strait of Hormuz" *International Security* 33, no. 1 (Summer 2008), pp. 99-111.

Syrian Air-Defense Capabilities

Syria has historically devoted significant resources to its strategic air defense capabilities. However, it continues to rely on a large number of aging Soviet-designed systems. Its major land-based air defenses are operated by an Air-Defense Command with an estimated 60,000 personnel (including 20,000 reserves), making it larger than the Syrian Navy and Air Force combined. The Air-Defense Command is divided into two anti-aircraft divisions, organized into 25 brigades operating an estimated total of 130-150 surface-to-air missile batteries (see Table 1 for projected strength).[88] This results in two major air-defense commands, a North Zone and a South Zone.[89]

Syrian air defense brigades are equipped with towed SA-2 and SA-3 medium-range surface-to-air missile launchers, as well as mobile SA-6 launchers. The ranges and maximum altitudes for each system are displayed in Table 2. There are reports that Syria has undertaken some limited upgrades on its SA-2 and SA-3 systems since they were first put in service in the early 1970s.[90] Otherwise, these are the same types of systems that made up the bulk of Serb and Libyan air defenses on the eve of NATO counterair operations, and are thus presumably vulnerable to the same mix of cruise missiles, electronic countermeasures, and high-speed antiradiation missiles used to suppress or destroy those systems.[91]

From the perspective of targeting, the SA-2 and SA-3 systems include an early warning and acquisition radar, and associated engagement radar.[92] Destruction of their engagement radars alone would badly degrade their capabilities, although both radars and

[88] *The Military Balance, 2012*, p. 350; *Jane's World Air Forces* electronic database entry for "Syria – Air Force," April 5, 2012; "Air Defense Command (ADC)" Global Security. http://www.globalsecurity.org/military/world/syria/air-defense.htm. Accessed May 1, 2012. Per the discussion of limitations on this analysis mentioned above, it is important to note that open-source assessments as to the number and type of air-defense systems Syria employs are extremely uncertain and often contradictory.

[89] "Syrian Arab Army – Order of Battle," Global Security. http://www.globalsecurity.org/military/world/syria/army-orbat.htm. Accessed May 13, 2012; Anthony H. Cordesman, *Israel and Syria: The Military Balance and Prospects for War* (Westport, Conn.: Praeger Security International, 2008), p. 183.

[90] Cordesman, *Israel and Syria*, p. 183.

[91] Libya additionally possessed a limited number of SA-5 systems, which Syria also possesses, and are discussed below. International Institute for Strategic Studies (IISS), "Middle East and North Africa," *The Military Balance 2011* (London: IISS, 2011), p. 321.

[92] *Jane's Strategic Weapons Systems* electronic database, entry for "S-75 (SA-2 'Guideline')"; and *Jane's Land-Based Air Defence* electronic database, entry for "S-125 Neva/Pechora (SA-3 'Goa')."

even the launchers themselves might be targeted.[93] As the SA-2 and SA-3 are only semi-mobile (i.e., towed and difficult to redeploy), they are more vulnerable to NATO real-time targeting than Syria's mobile SAMs (discussed below). Their long-term survivability is therefore doubtful in the course of any sustained operations over Syria.

Table 1:

Syrian Air-Defense Command: Force Structure in 2011

Active Manpower	60,000 (incl. 20,000 reserves)
Surface-to-Air Missiles (SAMs)	**Launchers**
Self-propelled	
2K12 *Kub* (SA-6 *Gainful*)	195
Towed	
S-72 *Dvina* (SA-2 *Guideline*)	320
S-125 *Pechora* (SA-3 *Goa*)	148
Static	
S-200 *Angara* (SA-5 *Gammon*)	44
MANPAD	
9K32 *Strela*-2/2M (SA-7A *Grail*/SA-7B *Grail*)	4,000*
TOTAL	4,707

*Judged obsolescent by IISS (equipment whose basic design is more than four decades old and has not been significantly upgraded in the past decade).
Note: SAM numbers refer to launchers. Estimates are extremely uncertain. MANPAD figure is more uncertain, and most are likely with the Army.
Source: IISS, *The Military Balance 2012*, p. 350. Data updated through 2011; Cordesman, *Israel and Syria*, p. 184.

The Air-Defense Command also includes two air-defense regiments each comprised of two battalions operating a total of eight SA-5 batteries.[94] The SA-5 system

[93] Joint Publication 3-01 "Countering Air and Missile Threats," March 23, 2012, p. IV-12. Available at http://www.dtic.mil/doctrine/new_pubs/jointpub_operations.htm. Satellite imagery of known SAM sites in Libya suggests individual launchers at some sites were destroyed during Operation Odyssey Dawn and Unified Protector.

[94] IISS, *The Military Balance 2012*, p. 350.

is Syria's longest-range air defense asset, capable of reaching targets at altitudes up to 130,000 feet and ranges out to 250 kilometers.[95] The headquarters of a standard SA-5 regiment includes an early warning radar, while each battalion typically has a search and acquisition radar and a long-range engagement radar.[96] There is some evidence, however, that Syrian SA-5 sites may include multiple engagement radars to allow them to target additional aircraft.[97] These sites appear to be defended by a variety of low-altitude SAMs and anti-aircraft artillery.[98] However, given that the SA-5 systems are static, they would be highly vulnerable to precision-guided weapons delivered from standoff range, including the Tomahawk cruise missile.

Table 2:

Syrian Strategic Air Defenses

Air Defense System	**Range (km)**		**Altitude (ft.)**	
	Max	**Min**	**Max**	**Min**
2K12 *Kub* (SA-6 *Gainful*)	24	4	45,000	50
S-72 *Dvina* (SA-2 *Guideline*)	40	8	90,000	3,000
S-125 *Pechora* (SA-3 *Goa*)	30	6	60,000	150
S-200 *Angara* (SA-5 *Gammon*)	250	20	130,000	1,500

Source: Anthony H. Cordesman and Abdullah Toukan, "Israeli-Syrian Air and SAM Strength Analysis: Working Estimates of Force Numbers and Location," (Washington, DC: Center for Strategic and International Studies, November 10, 2008), pp. 20-21.

In addition to the strategic systems under control of the Air Defense Command, the Army possesses its own stock of mobile and shoulder-fired tactical surface-to-air

[95] Anthony H. Cordesman and Abdullah Toukan, "Israeli-Syrian Air and SAM Strength Analysis: Working Estimates of Force Numbers and Location," (Washington, DC: Center for Strategic and International Studies, November 10, 2008), p. 21.

[96] *Jane's Land-Based Air Defence* electronic database entry for "S-200 Angara/Vega (SA-5 'Gammon').

[97] Sean O'Connor, "Strategic SAM Deployment in Syria: Technical Report APA-TR-2010-0103," *Air Power Australia*, <http://www.ausairpower.net/APA-Syria-SAM-Deployment.html>. Accessed May 14, 2012.

[98] Cordesman and Toukan, "Israeli-Syrian Air and SAM Strength Analysis," p. 22.

missile launchers (see Table 3).[99] Suppressing and targeting for destruction the mobile medium-range SA-6, the system used to successfully shoot down an F-16 in Bosnia in 1995 and which posed a persistent threat to NATO aircraft over Serbia throughout the duration of the bombing campaign in 1999, would likely be a high priority during sustained air operations over Syria.[100] The SA-11, a more advanced system with the capability to engage multiple targets simultaneously (compared to the single target capability of the SA-6), with greater mobility and offering greater resistance to electronic countermeasures, would likely be given similar treatment.[101] Of particular concern, however, is the possibility that Syria's more recently acquired SA-17 and SA-22 systems would be integrated into its air defense network.[102] The SA-17, designed to replace the SA-11, is a relatively new medium-range mobile system, capable of reaching targets at altitudes up to 82,000 ft.[103] Reports suggest the variant recently acquired by Syria (the Buk-M2E) employs the latest phased array radar technology, allowing for the simultaneous detection of up to 10 targets and tracking of up to four.[104] Only two of the eight battalions Syria has reportedly contracted for, however, are suspected of having been delivered.[105] Recent reports also suggest Syria has acquired perhaps 36 short- to medium-range mobile SA-22 systems, but the number could be as high as 50.[106] The SA-

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[99] Some of these tactical systems may also be shared with the Air Defense Command. Cordesman, *Israel and Syria*, p. 184.

[100] Although Syria's SA-6 batteries appear to be employed as a component of its strategic air defenses under its Air Defense Command, I treat them here with Syria's "tactical" SAM systems given their shorter range and inherent mobility. Eric Schmitt, "Downing of U.S. Fighter Over Bosnia is Tied to Shortcoming of NATO Plane, "*New York Times*, July 8, 1995. NATO destroyed only three of an estimated 25 known SA-6 batteries in the course of operations over Serbia in 1999. Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational* Assessment (Santa Monica, Calif.: RAND Corporation, 2001), p. 63.

[101] Federation of American Scientists, "SA-11 GADFLY / 9K37M1 Buk-1M." http://www.fas.org /man/dod-101/sys/missile/row/sa-11.htm. Accessed May 12, 2012.

[102] The NATO reporting name for the Buk-M2E is the SA-17 "Grizzly," while the Pantsyr S1 is referred to as the SA-22 "Greyhound." Doug Richardson, "Syria identified as a Buk-M2E user," *Jane's Missiles & Rockets*, March 6, 2012; SIPRI Arms Transfer Database. http://www.sipri.org/ databases/armstransfers. April 13, 2012; and Andrew E. Kramer, "Russia Sending Air and Sea Defenses to Syria, Exporter Says," *New York Times*, June 15, 2012.

[103] Federation of American Scientists, "SA-17 Grizzly / Buk-MI-2." http://www.fas.org/man/dod-101/sys/missile/row/sa-17.htm. Accessed May 12, 2012; "Russia to exhibit Buk-M2 air defense system at LAAD 2007," *Ria Novosti*, April 17, 2007. http://en.rian.ru/russia/20070417/63769254.html. Accessed May 1, 2012; Rosoboronexport, *Air Defence Systems: Export Catalogue* (Moscow: Intervestnik Publishing House, 2003), pp. 18-19. www.rusarm.ru/cataloque/air_def/air_def.pdf. Accessed June 15, 2012.

[104] Richardson, "Syria identified as a Buk-M2E user."

[105] SIPRI Arms Transfers Database. http://www.sipri.org/databases/armstransfers. April 13, 2012.

[106] Ibid. Ten of those, however, may have been destined for Iran. Robin Hughes, "Iran set to obtain Pantsyr via Syria," *Jane's Missiles & Rockets*, May 23, 2007; *Jane's Strategic Weapon Systems* electronic

22 is among the latest Russian designs, intended for the defense of small-scale installations and other air defense systems against modern precision-guided weapons out to a range of 20 kilometers.[107] There has been some speculation this system may have been employed by Syrian air defense operators in the downing of a Turkish F-4 Phantom in June 2012.[108] Perhaps the only consolation with respect to Syria's advanced mobile SAM systems is the belief now that efforts to acquire modern and extremely capable long-range SA-20s from Russia have so far been unsuccessful.[109]

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database entry for "Tunguska/Pantsir-S1 (SA-19 'Grison'/SA-22 'Greyhound'). A report by the Russian defense think tank CAST, however, suggests only 12 of the 36 systems had been delivered as of June 2012. For a summary of the Russian report, see Dmitry Gorenburg, "New report on Russian interests in Syria, part 2: Russian arms sales," Russian Military Reform, June 29, 2012. http://russiamil.wordpress .com/2012/06/29/new-report-on-russian-interests-in-syria-part-2-russian-arms-sales/. Accessed July 3, 2012.

[107] Rosoboronexport, *Air Defence Systems: Export Catalogue*, p. 35; KBP Instrument Design Bureau, "Pantsir-S1 Air Defense Missile/Gun System," www.kbptula.ru/eng/zencom/panz.htm. Accessed June 15, 2012.

[108] Greg Jaffe, "Syrian downing of a Turkish jet serves as warning," *Washington Post*, June 26, 2012; Jonathan Marcus, "Syria-Turkey tension: Conflicting arguments on Phantom," *BBC News*, July 3, 2012. http://www.bbc.co.uk/news/world-middle-east-18689037. Accessed July 5, 2012.

[109] Sean Boyne, "Long Road to Progress," *Jane's Defence Weekly*, November 21, 2001; *Jane's World Air Forces* electronic database, entry for "Syria – Air Force"; Kramer, "Russia Sending Air and Sea Defenses to Syria, Exporter Says"; "Syria – Air Defense Command (ADC)," Global Security; and SIPRI Arms Transfers Database, April 13, 2012.

Table 3:

Syrian Army Air Defense Systems 2011

Surface-to-Air Missile (SAM) Systems	
Self-propelled	
9K33 *Osa* (SA-8 *Gecko*)	14
9K31 *Strela*-1 (SA-9 *Gaskin*)	20
9K37 *Buk* (SA-11 *Gadfly*)	20
9K35 *Strela*-10 (SA-13 *Gopher*)	30
9K40 *Buk* (SA-17 *Grizzly*)	(2)
96K9 *Pantsyr*-S1 (SA-22 *Greyhound*)	(36)
MANPAD	
9K32 *Strela*-2 (SA-7 *Grail*)	4,000*
9K38 *Igla* (SA-18 *Grouse*)	?
9K36 *Strela*-3 (SA-14 *Gremlin*)	100
TOTAL SAMs	4,184+
AA Guns	
Self-propelled	
23mm: ZSU-23-4	?
Towed	
23mm: ZU-23	600
37mm: M-1939	?
57mm: S-60	600
100mm: KS-19	25
TOTAL AA Guns	1,225+

*Judged obsolescent by IISS (equipment whose basic design is more than four decades old and has not been significantly upgraded in the past decade).
Note: Estimates are extremely uncertain. Numbers in parenthesis refer to uncertain deliveries or estimates made by SIPRI. MANPAD figures are more uncertain, and are shared with Air-Defense Command.
Source: IISS, *The Military Balance 2012*, 349. Data updated through 2011. SIPRI Arms Transfer Database (April 13, 2012); Doug Richardson, "Syria identified as a Buk-M2E user," *Jane's Defence Weekly*, March 6, 2012.

Syrian Air-to-Air Capabilities

The Syrian Air Force, though sizeable, is composed mainly of obsolete and obsolescent aircraft and lacks significant numbers of those that would be necessary to present serious resistance to NATO air forces. Credited with an estimated 365 aircraft considered combat capable, these are primarily low-grade export versions of Soviet designs now with obsolescent avionics.[110] Its most capable aircraft are its squadron of Su-24s (20 aircraft) and 2 squadrons of MiG-29s (35 aircraft total), both of which rely on technology of the late 1970s and early 1980s.[111] These shortcomings have led Syria to seek additional advanced combat aircraft, including the Russian MiG-29M ‘Fulcrum’ and MiG-31 ‘Foxhound.’[112] However, despite a series of reports suggesting Syria had concluded deals with the Russians for such aircraft, Russia has strongly denied the existence of a contract for the MiG-31s and there do not appear to be any confirmed deliveries of either aircraft as of June 2012.[113]

The remainder of Syria’s attack forces includes a mix of 50 Su-22s, 50 MiG-23BNs, and 119 obsolete MiG-21s, a substantial number of which are probably not operational.[114] In addition to the MiG-29s, other fighters include 50 MiG-23s in need of modernization, and 32 MiG-25s that are also probably not operational.[115] Thus, despite the imposing size of the Syrian air force, the antiquated state of much of its hardware suggests it would face serious limitations in attempting to conduct defensive counterair missions when confronted by advanced Western aircraft.

Deficiencies associated with Syria’s outdated hardware would only be compounded by its pilots’ lack of adequate training. There is little evidence that the Syrian Air Force conducts the kind of realistic training on a scale that would be required to defend Syrian air space from a NATO air campaign.[116] This is not to say, however,

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[110] *Janes’s World Air Forces* electronic database, entry for “Syria – Air Force.” Cordesman, *Israel and Syria*, p. 43. Estimates of the number of Syrian aircraft should be considered very uncertain. While the IISS estimates Syrian combat capable aircraft as numbering 555 in 2010, that number is revised down to only 365 for the latest estimates from 2011. IISS, *Military Balance 2012*, p. 350.

[111] Cordesman, *Israel and Syria*, pp. 178-181.

[112] *Jane’s World Air Forces* electronic database, entry for “Syria – Air Force.”

[113] “Russian arms exporter denies MiG-31 fighter contract with Syria,” *RIA Novosti*, October 27, 2010. http://en.rian.ru/mlitary_news/20101027/161102905.html. Accessed May 1, 2012; “Syria Buying $1 billion in Russian Weapons,” *Defense Industry Daily*, May 16, 2010. http://www.defenseindustrydaily.com/syria-buying-mig31s-mig35s-for-1-billion-03391/. Accessed June 20, 2012; SIPRI Arms Transfer Database, June 20, 2012. A recent report by the Russian defense think tank CAST suggests the first delivery of the MiG-29s is scheduled to occur towards the end of 2012. Gorenburg, “New report on Russian interests in Syria, part 2: Russian arms sales.”

[114] IISS, *Military Balance 2012*, p. 350, Cordesman, *Israel and Syria*, p. 178; and Neil MacFarquhar and Alan Cowell, “Syrian Pilot Granted Asylum in Jordan,” *New York Times*, June 21, 2012.

[115] *Jane’s World Air Forces* electronic database, entry for “Syria – Air Force”; IISS, *Military Balance 2012*, p. 350.

[116] Cordesman, *Israel and Syria*, p. 182.

that Syria would not attempt to put aircraft in the air in the event of an attack. During the 1982 air battle over Lebanon's Bekaa Valley, Syrian pilots continued to fly sorties against the Israeli Air Force (IAF) even after it became clear the battle was hopeless; the IAF shot down 82 Syrian aircraft without losing any in air combat.[117]

Although Syria is credited with around two dozen military or dual-use airfields, the majority of the Syrian Air Force's relatively high-quality modern aircraft appear to be concentrated in fewer than a dozen of these.[118] Foremost among them appear to be facilities at Dumayr, Hama, Marj Ruhayyil, Sayqal, Shayrat, and Tiyas.[119] The larger facilities, including Tiyas and Dumayr, appear to have somewhere in the vicinity of 50-60 hardened aircraft shelters, while others have far fewer. This is difficult to estimate, however, given inconsistencies in the quality of open-source satellite imagery.

Offensive Counterair Operations

What could be expected of the initial phases of NATO counterair operations to establish air superiority for the defense of safe havens in northwest Syria? Among the first targets would be the components of Syria's Integrated Air Defense System (IADS), including the system's major command and control (C2) facilities, its surface-to-air missile sites with their associated C2 centers, and Syria's early warning radars. Even though the proposed area of operations would be limited to northwest Syria, establishing air superiority over this area would likely require degrading or destroying elements of the Syrian IADS throughout the country, and might also include any early warning facilities that may be in Lebanon.[120] Efforts could not be restricted to the northwest because early warning and acquisition radars positioned elsewhere might still have the ability to cue air defense assets in or around the area of operations via the air defense system's

[117] Rebecca Grant, "The Bekaa Valley War," *Air Force Magazine* 85, no. 6 (June 2002), p. 61.

[118] "Syrian Airfields," Global Security.

[119] *Jane's World Air Forces* electronic database, entry for "Syria – Air Force." Tiyas, in particular, seems to be among Syria's best-equipped airbases. O'Malley, *Evaluating Possible Airfield Deployment* Options, pp. 86-90.

[120] On possible early warning sites in Lebanon, see Abraham Rabinovich, "Russia upgrades radar station in Syria to aid Iran," *Washington Times*, February 29, 2012. The opening phases of NATO operations in Allied Force proceeded in a similar manner, with attacks on Yugoslavia's IADS throughout the country, despite a focus on targeting Serb fielded forces in Kosovo. See "Report to Congress: Kosovo/Operation Allied Force After-Action Report" (U.S. Department of Defense, January 31, 2000), p. 7.

communication links. Given that Syria's surface-to-air missile systems are concentrated in the western part of the country, which is also Syria's most heavily populated area, concerns with collateral damage would be acute.[121] Such concerns might prohibit targeting certain elements of Syria's IADS and generally serve to prolong the counterair effort.

Among the first targets of the Syrian IADS would be its eight static, long-range SA-5 surface-to-air missile batteries and their supporting infrastructure. Due to their range of 250 km, the establishment of safe havens defended from the air anywhere in western Syria would necessitate destruction of Syria's SA-5 systems. Moreover, as the SA-5 is designed to hit slow, difficult to maneuver targets at high altitudes (e.g., bombers, tankers, airborne early warning and control aircraft, and surveillance platforms), it would likely be among the first targets of counterair operations, as bombers would likely be heavily employed in the initial phases of counterair operations and surveillance assets would be needed early on to assess the damage inflicted by initial bombing.[122]

In addition to the fixed SA-5 batteries, it would also be necessary to target Syria's estimated 90 semi-mobile SA-2 and SA-3 batteries.[123] Given their numbers, effective ranges, and their likely concentration in the western part of the country along the Mediterranean coast and the Homs-Aleppo corridor, these systems would pose a direct threat to aircraft defending safe havens in the northwest approaching by way of ingress routes over the Mediterranean or Turkey. The SA-2 and SA-3 sites in the South Zone of Syrian Air-Defense Command would also prove likely targets, for three reasons. First, in order to establish air superiority over the northwest, it would likely be necessary to suppress certain airbases in the south where Syrian high-quality combat aircraft are

[121] See Defense Secretary Leon Panetta's comments during his testimony before the Senate. U.S. Senate Committee on Armed Services, *Hearing to Receive Testimony on the Situation in Syria*.

[122] Targeting of the SA-5, despite the stealth of the B-2 bomber, also appears to have been among the first targets of U.S. operations in Libya. See Vice Adm. Bill Gortney, "DOD News Briefing with Vice Adm. Gortney from the Pentagon on the Libya Operation Odyssey Dawn," March 19, 2011. http://www.defense.gov/Transcripts/Transcript.aspx?TranscriptID=4786. Accessed April 15, 2012.

[123] Assuming six launchers to an SA-2 battery, and four launchers to an SA-3 battery, and given the figures in Table 1, this suggests there are approximately 90 total SA-2 and SA-3 batteries under Syria's Air-Defense Command. See also Cordesman and Toukan, "Israeli-Syrian Air and SAM Strength Analysis," p. 20, suggesting Syria possesses 45 SA-2 battalions and 42 SA-3 battalions.

based.[124] Suppressing such bases would require suppressing, if not destroying, the threat posed by their surrounding air-defense systems. Second, because the SA-2 and SA-3 systems are semi-mobile, any chance to eliminate such systems before they could be moved north to threaten NATO aircrews defending safe havens would be desirable. Third, even though the proposed safe havens would be located in northwest Syria, there would likely be targets of interest in Damascus and its surroundings, including C2 facilities associated with the Syrian IADS and other military facilities.[125] Although it might be possible to begin defending safe zones in the northwest with these southern SA-2 and SA-3 systems still intact (i.e., their ranges would not prohibit such operations, assuming they were deployed far enough to the south), it is unlikely they would simply be ignored.

Syria's estimated 50 mobile SA-6 batteries, designed as a low-altitude air defense system but capable of reaching targets up to 45,000 ft., would be among the more significant threats to ongoing operations over Syria.[126] At the same time, it is possible that destruction of large numbers of Syria's SA-6s might not be required before commencing counterland operations in defense of safe havens.[127] Given their far greater mobility, and the possibility that Syrian air defense operators might be cautious with use of their radars lest they be destroyed by high-speed antiradiation missiles launched by suppression aircraft accompanying the initial strikes, it is possible that significant numbers of SA-6 batteries and other mobile SAMs could survive the opening phases of counterair operations. Syrian SA-6 operators might then choose to ensure their own survival by continuing to emit only infrequently, but at the cost of being unable to use

[124] For comparison, during Operation Allied Force, five airfields were targeted during the initial phase of strikes. These were not limited to Kosovo, but included airfields in Serbia, and Montenegro. O'Malley, *NATO's Air War for* Kosovo, pp. 21-22.

[125] The Republican Guards, for example, are reportedly headquartered in Damascus, along with the Syrian Army 1st Corps. The 2nd Corps in headquartered in nearby Zabadani. "Syrian Arab Army – Order of Battle," Global Security. http://www.globalsecurity.org/military/world/syria/army-orbat.htm. Accessed May 3, 2012.

[126] Federation of American Scientists, "ZRK-SD Kub 3M9, SA-6 Gainful," http://www.fas.org/man /dod-101/sys/missile/row/sa-6.htm. Accessed June 20, 2012.

[127] Consider the comments of Vice Adm. Daniel J. Murphy, principal naval commander of Operation Allied Force in Kosovo: "The [Air Force] doctrine calls for neutralizing the IADS [Integrated Air Defense System] *before* taking on targets that count. Well, if we had followed that doctrine to the letter, we would have pounded nothing but IADS for 78 days." Quoted in "The Navy in the Balkans," *Air Force Magazine* 82, no. 12 (December 1999), p. 49.

their radars to effectively engage NATO aircraft. Were they to behave this way, degrading the Syrian IADS and destroying Syrian SA-5s, SA-2s, and most SA-3s might eventually lead NATO to declare air superiority at mid- to high-altitudes (i.e., to conduct operations "without prohibitive interference" by Syrian forces) without actually having destroyed large numbers of mobile SAM batteries.[128] In this case, subsequent counterland efforts in defense of safe havens would require a sustained jamming and suppression effort.

The likelihood that Syria's mobile SAM batteries would survival initial counterair attacks would be influenced by the skill and tactics of Syrian air defense operators along with the effectiveness of new technology employed by NATO air forces.

Whether Syrian air defense operators would exercise the skill and employ the tactics necessary to avoid immediate destruction, exemplified by the Serbs during NATO operations over Kosovo, is highly questionable. In Kosovo, well-trained Serb air defense operators remained dispersed, used camouflage and concealment, and operated their radars in an emission-control mode in order to ensure their survivability.[129] Although such tactics limited the lethality of their air defenses, it also allowed them to present a persistent threat to NATO aircraft throughout the 78-day bombing campaign and forced NATO aircraft to operate at higher altitudes than were optimal for targeting Serb fielded forces. Syrian operators, however, displayed far less skill during the 1982 air battle with Israel over Lebanon's Bekaa Valley. On the first day of Israel's attack, Syria lost 17 of its 19 deployed SAM batteries, and the remaining two the following day, all without an Israeli loss.[130] Syria's deviation from Soviet air defense doctrine emphasizing the use of mobility, camouflage, and decoys (used so effectively by the Serbs in 1999), led one analyst to describe Syrian operators' handling of their air defense systems in June 1982 as "appalling."[131] It is difficult to predict whether Syrian air defense operators would display dramatically better skill today. Assuming they have learned the futility of persistent radar

[128] NATO formally declared air superiority at mid- to high-altitudes in Kosovo in late April 1999, and was only successful in destroying three of an estimated 25 known SA-6 batteries in the course of the war. O'Malley, *NATO's Air War for Kosovo*, p. 63.

[129] Benjamin S. Lambeth, "Kosovo and the Continuing SEAD Challenge," *Aerospace Power Journal* 16, no. 2 (Summer 2002), pp. 8-21.

[130] Matthew M. Hurley, "The Bekaa Valley Air Battle, June 1982: Lessons Mislearned?" *Airpower Journal* 3, no. 4 (Winter 1989), pp. 60-70.

[131] Ibid.

emission by both direct experience and observation, however, NATO should be prepared for the prospect that Syrian air defense operators would fail to provide easy targets for destruction.

The effectiveness of upgrades to the technology employed by NATO aircraft conducting suppression of enemy air defense (SEAD) operations would further influence the ease with which NATO could target Syrian mobile SAMs for destruction. Partly in response to NATO difficulties in targeting mobile SAMs in Kosovo, the U.S. Defense Department has made significant investments over the past decade in programs designed to improve U.S. Air Force and Navy SEAD capabilities.[132] For the Air Force, this includes the R7 upgrade to the HARM Targeting System, which enables three or more aircraft conducting SEAD to obtain precise coordinates on the location of SAM radars after they emit. Once located, the radars can be targeted by coordinate-seeking munitions regardless of whether they have shut down.[133] Introduced in 2007, fielding of the R7 is now reportedly complete.[134]

The Air Force has also worked on an improved version of the HARM with a Global Positioning System (GPS) receiver and Inertial Measurement Unit (IMU) high-precision gyroscope added to the missile's control section, allowing the HARM to target a radar even after it has turned off.[135] As of February 2012, however, it appeared a contract for the HARM control section modification (HCSM) had yet to be awarded to a single contractor for full production.[136] The Navy's improved version of the HARM, the Advanced Anti-Radiation Guided Missile (AARGM), is also designed to target radars even after shut down using GPS guidance and a millimeter-wave seeker for enhanced

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[132] For a recent overview, see U.S. Government Accountability Office, *Airborne Electronic Attack: Achieving Mission Depends on Overcoming Acquisition Challenges* (2012), http://www.gao.gov/products /GAO-12-175.

[133] 693rd Armament Systems Squadron, "HARM Targeting System Ready Ahead of Schedule," U.S. Air Force News, October 14, 2006. http://www.af.mil/news/story.asp?storyID=123028953. Accessed June 15, 2012.

[134] U.S. Department of Defense, "Fiscal Year (FY) 2013 President's Budget Submission: Research, Development, Test & Evaluation, Air Force," Justification Book Vol. 3-A (February 2012), p. 193. http://www.saffm.hq.af.mil/shared/media/document/AFD-120207-048.pdf. Accessed June 15, 2012.

[135] David Hambling, "Thoroughly Modern Missile," *Defense Technology International* 2, no. 10 (December 1, 2008), p. 29.

[136] U.S. Department of Defense, "Fiscal Year (FY) 2013 President's Budget Submission: Missile Procurement" Justification Book Vol. 1 (February 2012), p. 123. http://www.saffm.hq.af.mil/shared/media/ document/AFD-120207-052.pdf. Accessed June 15, 2012.

radar detection.[137] After hardware and software failures, however, the AARGM was decertified and only resumed testing in late 2011 where it remained as of February 2012.[138] Thus, neither version of the improved HARM would presumably be fielded in preparation for a NATO air campaign in 2012 or the immediate future.

Any improvement over previous attempts to target mobile SAMs would thus have to come from the R7 upgrade to the HARM Targeting System. However, though this upgrade provides U.S. suppression aircraft greater capability to target mobile SAMs, Syrian mobile SAM operators might still be able to engage in the same kind of "shoot and scoot" tactics identified above. This may be possible if three or more platforms were not in a position to geo-locate SAM radar emissions or the SAM batteries were somehow able to relocate before SEAD aircraft were capable of coordinating an attack.

In addition to Syria's land-based air defense systems, counterair attacks would also be directed at some portion of Syria's aircraft and airfields. Defending safe havens and a humanitarian corridor in the northwest of Syria would mean suppressing more than half of Syria's airfields (i.e., those located in the north), including major bases at Hama, Shayrat, and Tiyas. At these airfields, it is unlikely NATO would attempt to destroy all of Syria's combat aircraft located in hardened shelters in the opening phases of an air campaign, unless Syria attempted significant resistance. Rather, the objective would be limited to keeping the Syrian Air Force grounded without necessarily destroying its aircraft.[139] It is likely, however, that a select number of Syrian airfields where its most

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[137] Hambling, "Thoroughly Modern Missile."

[138] U.S. Department of Defense, "Fiscal Year (FY) 2013 President's Budget Submission: Weapons Procurement, Navy" Justification Book Vol. 1 (February 2012), p. 125. http://www.bga-aeroweb.com/Defense/Budget-Data/AGM-88-HARM-NAVY-MOD-FY2013-FY2017.pdf. Accessed June 15, 2012.

[139] For a similar logic applied to Libya, see the comments of retired U.S. Air Force Lieutenant General Michael M. Dunn, president of the Air Force Association, interviewed in Peter S. Green and Tony Capaccio, "Libya's Qaddafi Under Threat From Allied Military Forces," *Bloomberg*, March 19, 2011. This logic likewise suggests other counterair tactics typical of major air campaigns, such as the cratering of runways, might not be necessary, and might even be counterproductive. The Pentagon, for example, went out of its way to illustrate the fact that the runways at a dual-use airfield targeted on the first night of Operation Odyssey Dawn were not destroyed given their civilian uses, while surrounding hardened aircraft shelters housing military aircraft were destroyed by precision-guided munitions. See Vice Adm. Bill Gortney, "DOD News Briefing with Vice Adm. Gortney from the Pentagon on the Libya Operation Odyssey Dawn," March 20, 2011. http://www.defense.gov/Transcripts/Transcript.aspx?TranscriptID=4787. Accessed April 15, 2012. See also Jeremiah Gertler, et al., "No-Fly Zones: Strategic, Operational, and Legal Considerations for Congress," Congressional Research Service, April 4, 2011. However, NATO did

capable combat aircraft are stationed, such as Tiyas, would be targeted, both to reduce the direct threat they pose and/or to serve as a deterrent to other Syrian pilots contemplating defensive counterair operations.[140] The same may be true for major airfields in the south, such as those at Dumayr, Sayqal, and Marj Ruhayyil. If we assume NATO would seek the destruction only of Syria's most capable combat aircraft in the form of its Su-24s and MiG-29s, along with its MiG-23s and Su-22s, this would amount to targeting approximately 205 hardened shelters and supporting infrastructure (C2, fuel, munitions, maintenance facilities) at approximately eight airfields depending on where these aircraft happened to be stationed at the time of intervention.

A notional target list to establish air superiority might therefore include the targets listed below. The list is suggestive, and does not include many other targets that are difficult to quantify using open sources (e.g., C2 facilities, operations and maintenance facilities, munition depots, etc.). This list is simply intended to provide some sense of the scale and scope of operations that would be necessary to begin defending safe havens from the air.

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seem to use cratering on at least one occasion in operations over Serbia, using a B-2 dropping JDAMs. Lambeth, *NATO's Air War*, p. 66.

[140] Requirements for adequate deterrence may grow smaller over time, as concerns over the reliability of Syrian pilots grow larger. See, for example, Neil MacFarquhar and Alan Cowell, "Syrian Pilot Granted Asylum in Jordan," *New York Times,* June 21, 2012.

Table 4:

Air Superiority Campaign Targets[141]

IADS C2 facilities, early warning radar sites	22+
SAM batteries (SA-2, SA-3, SA-5, SA-6)	150
Airfields (4 targets x 8 bases)	32
Aircraft shelters	205
SSM batteries	27
ASCM batteries	12
TOTAL	**448+**

Establishing air superiority might include some mix of cruise missile strikes against critical nodes of the Syrian IADS and SAM sites, B-2 stealth bombers armed with precision-guided bombs capable of penetrating the hardened aircraft shelters, and waves of land-based and/or carrier-based strike aircraft to target SAM batteries, fuel storage facilities, munitions depots, command and control facilities, and other supporting infrastructure, as well as to conduct fighter sweeps to eliminate the threat from any Syrian interceptors.[142]

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[141] Open-source estimates of the number of Syria's early warning radars are difficult to come by. Drawing on open-source satellite imagery, one analyst credits Syria with 22 such sites. See O'Connor, "Strategic SAM Deployment in Syria." This estimate does not include any radars that may be in Lebanon. For airfields, I consider C2, fuel, munitions, and maintenance facilities to represent one "target" each. For surface-to-surface missile batteries, Syria is credited with three SSM brigades, each with three SSM battalions. I assume each battalion is composed of three firing batteries. IISS, *The Military Balance 2012*, p. 349. Finally, for anti-ship cruise missile batteries, Syria is credited with one coastal defense brigade of 10 batteries, plus the two more recently acquired Bastion systems. Reports are conflicting as to the exact organization of the Bastion systems. I assume each system to be a battery composed of 12 mobile launchers. IISS, *The Military Balance 2012*, p. 349; Cordesman, *Israel and Syria*, p. 192; Norman Friedman, *The Naval Institute Guide to World Naval Weapons Systems*, 5th ed. (Annapolis: Naval Institute Press, 2006), p. 541; NPO Mashinostroyenia, "'Bastion mobile shore-based missile complex with 'Yakhont' ASM," www.npomash.ru/download/mobile_en.pdf. Accessed June 21, 2012.

[142] Judging from NATO experience in Kosovo, when the B-2 was first used in combat, and more recently in Libya, this combination of cruise missiles, the B-2 (with follow-on strikes by the B-1B or B-52), accompanied by a mix of land-based and carrier-based strike aircraft seems to be the recipe for initial strikes seeking to establish air superiority against a middling opponent with Soviet-designed air defenses. For useful summaries of the opening night of NATO operations in Kosovo, see Lambeth, *NATO'S Air War*, pp. 19-25; Arkin, "Operated Allied Force," pp. 7-10. On Libya, see John A. Tirpak, "Bombers Over Libya," *Air Force Magazine* 94, no. 7 (July 2011), pp. 37-39; Christian F. Anrig, "Allied Air Power Over

The cruise missile strikes would likely employ the Tomahawk land-attack missile (TLAM), which has historically been relied upon to attack well-defended targets in the opening days of major air campaigns before air defenses have been suppressed.[143] These strikes, in theory, need not be limited to fixed targets such as SA-5 and warning early radar sites. With the current Block IV tactical TLAM, capable of loitering over the battlefield and equipped with a two-way satellite data link allowing it to be redirected in midflight, the Block IV Tomahawk could also be used against time-sensitive targets such as the SA-2 and SA-3.[144] In fact, even an earlier version of the TLAM lacking these advanced capabilities was seemingly successful against the Serbs' semi-mobile SA-3s in Kosovo.[145] These Tomahawks could be delivered by a number of platforms, including the Navy's four converted Ohio class guided-missile submarines (SSGN), each capable of carrying 154 of the Block IV missiles.[146] Operation Odyssey Dawn witnessed the combat debut of the SSGN, and any intervention in Syria might also employ the SSGN and other naval assets capable of launching the Tomahawk similarly.[147]

Although Tomahawks were also used to strike some of Libya's hardened aircraft shelters during the opening night of Odyssey Dawn, if Syria's shelters are hardened in a manner similar to Iraq's prior to the 1991 Gulf War, then destroying them and the aircraft inside would likely require a penetrating munition.[148] Destroying 375 of Iraq's nearly 600 hardened aircraft shelters often required two 2,000-lb bombs per shelter armed with the

Libya: A Preliminary Assessment," *Air & Space Power Journal* (Winter 2011), pp. 89-109; and Tony Capaccio, "U.S., British Tomahawk Missiles 'First Phase' Opened Airspace over Libya," *Bloomberg*, March 20, 2011.

143 Barry D. Watts, *Six Decades of Guided Munitions and Battle Networks: Progress and Prospects* (Washington, DC: Center for Strategic and Budgetary Assessment, March 2007), p. 239.

144 Raytheon Company, "Tomahawk Cruise Missile," http://www.raytheon.com/capabilities/products/tomahawk/. Accessed April 24, 2012. The Block IV is also expected to be more accurate than previous versions, although its circular error probable (i.e., the radius of a circle around the aim point within which 50% of the impacts will hit), has not been made public.

145 Comments by Vice Adm. Daniel J. Murphy, Jr., "The Navy in the Balkans," pp. 48-49.

146 U.S. Navy Fact Sheet, "Guided Missile Submarines – SSGN," November 10, 2011. http://www.navy.mil/navydata/fact_display.asp?cid=4100&tid=300&ct=4. Accessed May 15, 2012.

147 Doug Richardson, "Air strikes target Libyan air defences," *Jane's Missiles & Rockets*, March 25, 2011.

148 For a useful discussion of Coalition efforts to target Iraq's hardened shelters, see Christopher M. Centner, "Ignorance is Risk: The Big Lesson from Desert Storm Air Base Attacks," *Airpower Journal* 6, no. 4 (Winter 1992), pp. 25-35. Based on Israel's inability to penetrate Syrian shelters during the 1973 war, it is likely that Syria's shelters are quite hardened, even if they do not approach the standard of Iraq's pre-1991. On Israel's difficulties in suppressing Syrian airfields in 1973, see John F. Kreis, *Air Warfare and Air Base Air Defense 1914-1973* (Washington, DC: Office of Air Force History, 1988), pp. 325-338.

BLU-109/B penetrating warhead.[149] The B-2 stealth bomber is capable of carrying 16 of these 2,000-lb GBU-31 JDAMs armed with a penetrating warhead, and therefore each B-2 sortie could be relied upon to destroy 8 hardened shelters.[150] Destroying Syrian shelters would thus require 26 sorties for B-2 bombers (assuming no help from follow-on strikes by the B-1B or B-52). This is no trivial thing considering the U.S. Air Force's 20 B-2 bombers are based in Missouri and would require multiple refuelings to make the roughly 30-hour round trip to Syria.[151] Despite its stealth, the B-2 would also need support from Navy EA-6B Prowler or EA-18G Growler electronic warfare and suppression aircraft, which is standard operating procedure for the B-2.[152]

Additional strike aircraft would likely be composed of some mix of land-based U.S. F-16s and F-15Es, British Typhoons and Tornado GR4s, and the French Rafale and Mirage fighter-bombers. These would need to be supported by a variety of suppression aircraft, electronic surveillance, and tankers as well as a recovery force in place capable of launching rescue missions in the event of a downed aircraft. This recovery force would be key, as the propaganda value attached to the capture of a downed pilot could prove a major blow to the political will sustaining such an operation.[153] In addition to these forces, a U.S. carrier committed to the intervention would add F/A-18 strike aircraft and other high-demand electronic warfare capabilities to the mix.

It is difficult to generate a meaningful estimate of the total number of strike and support aircraft that would be required for initial counterair operations based solely on the notional targets identified above.[154] Very crudely, however, if it is assumed that early

[149] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report* (Washington, DC: U.S. Government Printing Office, 1993), p. 227.

[150] "Air Force Almanac 2012: Gallery of USAF Weapons," *Air Force Magazine* 95, no. 5 (May 2012), pp. 82-83.

[151] "Air Force Almanac, 2012: Facts and Figures," *Air Force Magazine* 95, no. 5 (May 2012), p. 49.

[152] Tirpak, "Bombers Over Libya," p. 38.

[153] For a discussion of similar fears during NATO operations in Kosovo, see Christopher E. Haave and Phil M. Haun, eds., *A-10s Over Kosovo: The Victory of Air Power Over a Fielded Army as Told by the Airmen Who Fought in Operation Allied Force* (Maxwell AFB, A.L.: Air University Press, 2003), pp. 8-9; and during NATO operations in Libya, John A. Tirpak, "Lessons from Libya," *Air Force Magazine* 94, no. 12 (December 2011), p. 37.

[154] The notional target list does not include many other potential targets of interest that are difficult to identify given the use of open sources (e.g., C2 facilities, operations and maintenance facilities, munitions depots, etc.). Moreover, many of the targets that I do identify would likely be assigned to ship- or submarine-launched cruise missiles or to strategic bombers that may not be based in theater (see above discussion). Finally, the number of aircraft deployed in any Syrian intervention would likely be determined

warning radar and fixed SA-5 sites were targeted by Tomahawk cruise missiles and the hardened aircraft shelters by the B-2 or other bombers, this suggests that more than 213 highly dispersed targets would remain for the initial waves of strike aircraft. If each of these targets were assumed to represent an average of four desired points of impact (DPI), this suggests a minimum effort (E) of 852 destroyed DPI would be required for the initial wave of counterair strikes.[155] I further assume each strike aircraft is capable of delivering an average of four precision-guided munitions in a single sortie (m), a nominal sortie rate of two sorties per day per aircraft (s), and a 70-percent single-round probability of kill per munition (Pk). Assuming a general mission-capable rate (r) of 0.8 for the strike aircraft deployed for counterair operations, this suggests the following number of strike aircraft (F) would be required to complete the initial waves of counterair strikes in the opening 24 hours of counterair operations:

$$F = \frac{E}{rmPks} = \frac{852}{0.8 * 4 * 0.7 * 2} = 191 \text{ aircraft}$$

This number is roughly equivalent to the number of strike aircraft required for NATO operations at the start of Operation Allied Force over Serbia. NATO's Phase 1 of operations during Allied Force was largely focused on degrading the Serb IADS, with the possibility of needing to move on to Phase 2 operations against Serb fielded forces.[156] This largely mirrors the sequence of the proposed intervention here, with "Phase 2" operations seeking to defend safe havens from the air against attacks by Syrian fielded forces. On March 24 (Day 1) of Allied Force, NATO had 344 aircraft in Europe (214 U.S., 130 Allied), augmented by B-2 bombers flying from the continental United States.[157] Only 120 of these, however, were strike aircraft. These numbers quickly rose,

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as much by operational constraints (i.e., basing) than by the tactical requirements outlined here. I discuss basing options below.

155 A DPI is defined in military doctrine as "a precise point, associated with a target, and assigned as the impact point for a single unitary weapon to create a desired effect." DOD Dictionary of Military Terms. http://www.dtic.mil/doctrine/dod_dictionary/data/d/11638.html. Adopting an average of four DPI per target, given the variety of targets identified above, represents a very crude approximation. Generating a precise number of DPI, even for the notional target set identified above, would require much-finer parsing of the targets than that attempted here.

156 "Report to Congress," p. 7.

157 Ibid., p. 31.

and by April 13 (Day 20), the number of NATO aircraft had risen to 550 while in the midst of Phase 2 operations (250 of which were strike aircraft).[158] Thus, the opening phases of Allied Force required somewhere in the range of 120-250 strike aircraft.

Given Syria's more sophisticated IADS, initial counterair missions for a Syrian intervention would presumably require a greater number of sorties dedicated to jamming and the suppression of Syrian air defenses.[159] The 191 strike aircraft estimated above—more than two and a half wings of 72 fighters—thus seems reasonable as a lower bound for the number of strike aircraft that could be required to begin counterair operations over Syria. Assuming 35-40 percent of the total aircraft deployed would be support aircraft,[160] this would necessitate another 105-130 aircraft. Overall, one estimate, then, is to expect at least 300 aircraft would be necessary for the initial counterair efforts to degrade Syrian air defense and air-to-air capabilities.

In the next section, I seek more precision in an estimate of the forces required for intervention in looking specifically at the number and types of aircraft required to defend safe havens in northwest Syria from the air.

Defending Safe Havens from the Air

In order to defend safe havens from the air, NATO would likely declare "exclusion zones" around each haven in which Syrian heavy weapons would not be allowed to enter.[161] NATO initially established such zones around safe havens in Bosnia with a radius of 20 km, later extended to 25 km in the lead up to air strikes during Operation Deliberate Force.[162] The range of Syrian artillery, however, suggests wider zones might

[158] Anthony H. Cordesman, *The Lessons and Non-Lessons of the Air and Missile Campaign in Kosovo* (Westport, Conn.: Praeger, 2001), p. 36.

[159] Indeed, General Dempsey remarked that Syrian air defenses are "ten times more [sophisticated] than we experienced in Serbia." U.S. Senate Committee on Armed Services, *Hearing to Receive Testimony on the Situation in Syria*.

[160] This is roughly in line with the proportions of combat and support aircraft in Allied Force and other NATO operations in the Balkans. Proportions were calculated using figures in Eric Larson, et al., *Interoperability of U.S. and NATO Allied Air Forces: Supporting Data and Case Studies* (Santa Monica, Calif.: RAND Corporation, 2003), pp. 56-85.

[161] Such zones have more recently been referred to as "no-drive," "no-go," or even "buffer" zones.

[162] Robert C. Owen, *Deliberate Force: A Case Study in Effective Air Campaigning* (Maxwell Air Force, A.L.: Air University Press, January 2000), p. 103; and *NATO Handbook 2001*. A 25 km zone was also reportedly established around Misrata in the battle for that city during NATO operations in Libya. Richard Norton-Taylor and Nick Hopkins, "Libya Apache deployment signals Britain's escalating role in conflict," *Guardian*, May 25, 2011.

be required of a Syrian intervention (see Table 5 for artillery strength and ranges). Syria's most numerous artillery piece, the towed 130mm M-46, has an unassisted range of 27.5 km.[163] Judging from photographs of satellite imagery released by the U.S. State Department in February 2012, the M-46 has indeed been used by Syrian forces in the course of repression.[164] The proposed intervention therefore calls for wider exclusion zones, perhaps 30 km, around each safe haven and the humanitarian corridor that would link them to the Turkish border.

[163] Unassisted refers to the range of a standard artillery shell. Were Syria to employ rocket-assisted projectiles (RAPs), the range of its artillery would be substantially farther. I assume that even if Syria possessed RAPs, their numbers would be limited, and therefore choose to use the shorter range in estimating the size of Syrian exclusion zones.

[164] See "Satellite Images of Syrian Military Artillery," U.S. State Department, February 10, 2012, <http://www.stateondemand.state.gov/Latest-Stories/satellite-images-of-syrian-military-artillery/s/63057bec-e32d-4bee-9d9c-ba8531a3a90a>. Accessed May 16, 2012.

Table 5:

Syrian Artillery in 2011

Artillery	**No.**	**Max. Range**
Self-propelled		
122mm 2S1 Carnation	400	15,300m
122mm D-30	500	15,300m
152mm 2S3	50	17,230m (24,000m RAP)
Towed		
122mm M1938 (M-30)	150	11,800m
130mm M1954 (M-46)	700-800	27,500m (43,800m RAP
152mm D-20/ML-20 M1937	70	17,230 (24,000 RAP)
180mm S-23	10	30,400m (43,800m RAP)
Rocket Launcher		
107mm Type-63	200	8,005m
122mm: BM-21 (Grad)	300	20,380m
Mortars		
82mm	200?	3,000m
120mm M1943	400	5,150m
160mm M-160	Hundreds	8,040m
240mm M-240	up to 10	9,700m

Source: IISS, *The Military Balance, 2012*, p. 349; ranges drawn from FM 6-71 Appendix H (those not contained in FM 6-71 are compiled from various sources).

Defending these safe havens would involve undertaking counterland missions to prevent Syrian forces from entering the exclusion zones and destroying those forces that were somehow able to successfully enter.[165] While local friendly forces, namely the Free

[165] Since at least Operation Allied Force, there has been some debate in the Air Force around how to conceive of this mission. The ambiguity arises due to the fact that the Air Force conducts these operations without necessarily supporting friendly land forces (as doctrinally required of close air support (CAS) or air interdiction (AI)). A “derivative” counterland mission is now described in Air Force doctrine known as Strike Coordination and Reconnaissance (SCAR). SCAR seeks to “to coordinate multiple flights, detect targets, kill targets, neutralize enemy air defenses, and provide BDA [battle damage assessment].” SCAR crews thus seem to perform a similar function for interdiction as that of the forward air controller-airborne in relation to close air support. For recent doctrine, see “Counterland Operations,”

Syrian Army (FSA), might also be useful in defense of safe havens, I do not attempt to assess their potential contribution. As of early July 2012, the FSA has repeatedly proven unable either to hold major population centers or to compel Syrian forces to cease their assaults on the safe havens considered here.[166] Unless the units comprising the FSA were to experience significant improvements in their combat effectiveness as a result of greater experience, training, and arming by third parties, their contribution to the defense of safe havens would likely remain marginal to any intervention by a coalition of NATO air forces in mid-2012.[167] An intervention premised on Western air power supporting Syrian rebels in the conduct of an offensive war for regime change is another potential avenue for open-source analysis, but one I do not consider here. In this section, I limit my focus to what might be required to defend safe havens from the air in an attempt to improve the humanitarian situation on the ground. Thus, after discussing Syrian strength with respect to its land, security and intelligence forces, I briefly discuss the impact of weather and terrain on the conduct of operations before turning to the missions and requirements for NATO counterland efforts in defense of safe havens.

Syrian Land, Security, and Intelligence Forces

Elements of the Syrian Army, acting alongside Syrian security and intelligence services, are reportedly responsible for the majority of the repression producing the present humanitarian crisis in Syria. Because a foreign military intervention could have the effect of either provoking greater resistance from the Syrian military *or* causing an increase in

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Air Force Doctrine Document 2-1.3 (September 11, 2006), p. 8. In Libya, for example, efforts to target Qaddafi's fielded forces have been described as SCAR. On the debate, see Phil M. Haun, "Direct Attack – A Counterland Mission," *Air & Space Power Journal* 17, no. 2 (Summer 2003). On SCAR operations in Libya, John A. Tirpak, "Lessons from Libya."

[166] A growing number of reports do suggest, however, that elements of the FSA are in "control" of certain areas of the Syrian countryside, particularly in the north and northwest of the country. See Joseph Holliday, "Syria's Maturing Insurgency"; Jim Michaels, "Syrian rebels show 'huge growth' in capability," *USA Today*, July 9, 2012.

[167] While such an evolution may indeed be under way, it still remains far too early to tell if increased assistance to Syrian rebels will be enough to change the outcome of clashes between the FSA and Syrian government forces on the ground. For reports on greater efforts to arm the FSA and seeming improvements to their combat effectiveness, see Jay Solomon and Nour Malas, "U.S. Bolsters Ties to Fighters in Syria: CIA Helping With Logistics but Not Arms, Officials Say," *Wall Street Journal*, June 13, 2012; Eric Schmitt, "C.I.A. Said to Aid in Steering Arms to Syrian Opposition," *New York Times*, June 21, 2012; Neil MacFarquhar, "Turkish Border is Crucial Link in Syrian Conflict," *New York Times*, June 25, 2012. For a particularly optimistic account of the FSA's growing capabilities, see Joseph Holliday, "Syria's Maturing Insurgency."

the number of defections, it is difficult to predict which forces NATO would confront. I therefore assume NATO would be required to defend Syrian safe havens from any elements of the Syrian Army that have thus far demonstrated themselves to be instruments of repression.

The Syrian Army is estimated at 220,000 active duty personnel, including an estimated 175,000 poorly-trained conscripts. An additional 280,000 compose the reserves.[168] Although there have been reports of defections among the lower ranks, as well as a limited number of high-ranking officers, the majority of the armed forces appear to have remained loyal to the al-Assad regime.[169] There are no reliable estimates of the precise sectarian composition of the active-duty Syrian Army, however it is widely assumed that al-Assad's Alawite sect dominates the officer corps while Sunnis compose the majority of the Army's conscript-dependent force.[170] After demonstrations erupted in March 2011, the length of conscription was shortened from 21 down to 18 months, a possible indication of concern within the al-Assad regime about the reliability of Syria's Sunni conscripts.[171] One report, for example, suggests that of the 80,000 Syrian young men expected to report for their mandatory military service in 2012, "virtually none have responded."[172] This type of noncompliance appears to be a larger problem for the al-Assad regime than is the problem of soldiers defecting to the armed opposition.[173] There

[168] *Military Balance 2012*, p. 349; *Jane's World Armies* electronic database entry for "Syria."

[169] In March 2012, defections were estimated to range anywhere from 2,250 to 20,000 soldiers. Neil MacFarquhar, "Syrian Forces Overwhelm Stronghold of Rebels in Homs," *New York Times*, March 1, 2012. In June 2012, however, press reports acknowledged the high uncertainty of estimates and generally reported defections as in the "thousands." On a small number of higher-level defections in June and July 2012, see Rod Nordland, "Latest Syrian Defections Are From Higher Ranks," *New York Times*, June 25, 2012; and Dan Bilefsky, Alan Cowell, and Neil MacFarquhar, "General's Defection Confirmed as Syria Opposition Meets," *New York Times*, July 6, 2012.

[170] *Jane's World Armies* electronic database entry for "Syria." Estimates of the number of "elite Alawite troops" range from 60,000 – 180,000. Neil MacFarquhar, "Syrian Forces Overwhelm Stronghold of Rebels in Homs," *New York Times*, March 1, 2012. For estimates, see also Reva Bhalla, "Making Sense of the Syrian Crisis," *Stratfor Geopolitical Weekly*, May 5, 2011 <http://www.stratfor.com/weekly/20110504-making-sense-syrian-crisis>. Accessed May 1, 2012; Khaled Yacoub Oweis, "Interview: Ex-Syrian army commander calls for air strikes on Assad troops," *Reuters*, April 10, 2012. For a discussion of Alawi representation among the highest echelons of Syria's armed forces, see Hanna Batatu, *Syria's Peasantry, the Descendants of Its Lesser Rural Notables, and Their Politics* (Princeton, N.J.: Princeton University Press, 1999), pp. 217-225.

[171] "Factbox – Syria's military: what does Assad have?" *Reuters*, April 6, 2011.

[172] Neil MacFarquhar, "Syrian's Defection Signals Eroding Support for Assad," *New York Times*, July 6, 2012.

[173] Ibid.

have been no reports, however, of significant defections from members of al-Assad's Alawite sect.

The Syrian Army is organized into three corps under an Army Command headquartered in Damascus. The majority of the forces compose the 1st and 2nd corps, with a combined seven armored divisions (with as few as 8,000 soldiers each) and three mechanized divisions (11,000 soldiers each).[174] These are equipped with some 4,950 tanks, nearly 4,000 armored vehicles, 1,980 pieces of mobile and towed artillery, 500 rocket launchers, and hundreds of mortars (see Table 5 for a detailed breakdown of artillery, rockets, and mortars).[175] Although the elite Fourth Armored and Republican Guard divisions commanded by al-Assad's brother, Maher, are most commonly cited in press accounts of the ongoing repression in Syria (with an estimated 15,000-20,000 and 10,000 soldiers, respectively), units from across the Syrian Army have been named as participating in the crackdown.[176] Widespread participation would be consistent with comments made by Director of National Intelligence James R. Clapper before the Senate in February 2012, in which he claimed "80 percent of [Syrian] maneuver units" had been engaged in "assaults on the civilian population" in the past year.[177] In addition to those units above, the Syrian Army includes a Special Forces division with unconfirmed reports of participation in the crackdown, as well as a range of other independent formations.[178]

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[174] These numbers are approximate and may vary according to the specific composition of each division. "Syrian Arab Army - Organization," Global Security; *Jane's World Armies* electronic database entry for "Syria."

[175] IISS, *Military Balance 2012*, p. 349.

[176] Jeffrey White, "A Willingness to Kill," *Policy Watch #1840*, The Washington Institute for Near East Policy, August 16, 2011; Human Rights Watch, *'By All Means Necessary: Individual and Command Responsibility for Crimes Against Humanity in Syria* (New York: Human Rights Watch, December 2011), pp. 1-88; Yara Bayoumy, "Military defections expose cracks in Syrian army," *Reuters*, June 29, 2011. Some estimates of the manpower levels for the 4th Armored and Republican Guards are slightly higher: 25,000 to 35,000 troops combined. Aram Nerguizian and Anthony H. Cordesman, *Instability in Syria*; "Syria's Praetorian Guards: A Primer," *Middle East Intelligence Bulletin* 2, no. 7 (August 5, 2000). One estimate, however, suggests as many as 60,000 men serve in the Republican Guards and Fourth Armored Division. MacFarquhar, "Syrian's Defection Signals Eroding Support for Assad."

[177] U.S. Senate Committee on Armed Services, *Hearing on Worldwide Threats to U.S. National Security*, 112th Cong., 2nd sess., February 16, 2012.

[178] These include four light infantry brigades; two independent artillery brigades; two independent anti-tank brigades; and an independent tank regiment. *Military Balance 2012*, p. 349; *Jane's World Armies* electronic database entry for "Syria."

Although units employing the heavy weapons described above operating on the outskirts of concentrated population areas are the only targets that aircraft could reasonably be expected to find, fix, and target from the air, it is also worth noting other forces participating in the crackdown. First and foremost are Syria's intelligence and security services, including the Political Security Directorate, General Security Directorate, Military Intelligence, and Air Force Intelligence.[179] These services have been deployed throughout the country since the outbreak of demonstrations, and have played a key role in quelling the protests, including with the use of lethal force.[180] Thousands of plainclothes pro-government militiamen known as the *shabiha* have also participated in the crackdown.[181] Although there are no reliable estimates of the total number of personnel employed by the security and intelligence forces or forming the *shabiha*, it seems reasonable to assume they number in the tens of thousands, with one report suggesting an estimate as high as 150,000 personnel in the intelligence services alone.[182] Given their use of civilian means of transportation and their ability to infiltrate population areas, it is unlikely air power would be effective in alleviating that portion of Syria's humanitarian situation attributable to the brutality of these forces. This would likely include horrific acts of violence such as the massacres of Syrian civilians at Houla and Qubeir in the spring of 2012, which survivors and opposition forces claim were largely carried out by *shabiha* militiamen.[183]

Weather and Terrain

Weather and terrain would exercise a significant influence on the survivability of Syrian fielded forces in the course of counterland operations. Adverse weather and heavy cloud cover would complicate efforts to visually acquire and track moving targets, to assess

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[179] "Syria's Intelligence Services: A Primer," *Middle East Intelligence Bulletin* 2, no. 6 (July 1, 2000); Middle East Watch (Human Rights Watch/MENA), *Syria Unmasked: The Suppression of Human Rights by the Asad Regime* (New Haven: Yale University Press, 1991), pp. 48-51.

[180] Human Rights Watch, *In Cold Blood*, pp. 17-18; White, "A Willingness to Kill."

[181] Nada Bakri, "Deaths in Syria Tied to Rift Between Sects," *New York Times*, July 18, 2011.

[182] MacFarquhar, "Syrian's Defection Signals Eroding Support for Assad." In the 1980s, the largest of these organizations was the National Security Directorate, employing about 25,000 personnel. "Syria Intelligence & Security Agencies," Global Security. http://www.globalsecurity.org/intell/world/syria/intro.htm. Accessed May 3, 2012.

[183] "New 'massacre' reported in Syria's Hama province," *BBC News*, June 7, 2012. http://www.bbc.co.uk/news/world-middle-east-18348201. Accessed June 25, 2012.

concerns over collateral damage, and serve to reduce the effectiveness of any munitions relying on the use of a laser for terminal guidance.[184] Adverse weather during Operation Allied Force, for example, when cloud cover was greater than 50-percent more than 70-percent of the time, was reported to have "greatly aided the Serbs."[185] In Syria, cloud cover over the safe-haven area in the country's northwest is generally light throughout the year. It is minimal from May through October, when average daily cloud cover can be classified as "few" clouds (1-2 oktas), a figure comparable to cloud cover over the Libyan coast in the summer months.[186] From November through April, average daily cloud cover can be classified as "scattered" (3-4 oktas), with the exception of January, when the daily average reaches the level of "broken" (5-6 oktas). Thus, daily cloud cover over northwest Syria, even throughout most of the winter and spring, is less severe on average than the broken to overcast cloud decks frequently reported during NATO operations over Serbia.[187] This would presumably make Syrian fielded forces easier to engage than the Serbs were. At the same time, however, the possibility of dust storms and sand storms in Syria could present additional hazards that would aid the survivability of Syrian fielded forces.[188]

The relevant terrain is varied with both advantages and disadvantages for targeting Syrian fielded forces. Most of the terrain in Syria's northwest where the safe

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[184] This would largely affect attempts to engage moving targets. The satellite-guided Joint Direct Attack Munition (JDAM) and other GPS-modified munitions (including some of the newer laser-guide bombs enhanced with GPS receivers), have no doubt significantly reduced problems associated with engaging fixed targets in adverse weather. Broken and overcast cloud decks, however, would still pose substantial problems for engaging moving targets given reliance on the use of a laser for terminal guidance.

[185] "Report to Congress: Kosovo/Operation Allied Force After-Action Report," p. 60.

[186] Sky cover (cloud cover) data are taken from the World Meteorological Organization (WMO) with data collected over the period 1961-1990. The nearest WMO weather reporting station for the safe havens in northwest Syria is in Hama. Data are reported for monthly averages in okta, a unit of cloud-cover measurement that divides the sky into eighths. Cloud amounts can be described as "few" (1-2 oktas); "scattered" (3-4 oktas); "broken" (5-7 oktas); and "overcast" (8 oktas). Okta descriptions can be found at http://www.nws.noaa.gov/oso/oso1/oso12/document/jan96sum.htm. Data for Libya is unavailable, but approximated using the western Egyptian Mediterranean coastal city of Mersa Matruh. Data for Serbia and Kosovo are also unavailable, but approximated by comparison to cities in western Bulgaria. Data available at http://data.un.org/Explorer.aspx?d=CLINO.

[187] Broken cloud decks (5/8 cloud cover or more) over Serbia reportedly made it "practically impossible" to find a target from above unless the clouds were particularly thin. Haave and Haun, *A-10s Over Kosovo: The Victory of Air Power Over a Fielded Army as Told by the Airmen Who Fought in Operation Allied Force*, p. 181.

[188] Data on days with suspended/dust sand for Syria are not available on the World Meteorological Organization's website. Other sources report that the historical monthly average for days with suspended dust/sand in Damascus is just over two days per month. Walter D. Wilkerson, *Dust and Sand Forecasting in Iraq and Adjoining Countries* (Scotts Air Force Base, Ill.: Air Weather Service, November 1991), p. 10.

havens proposed here would be located lacks the extensive tree cover, mountains, and valleys exploited so deftly by the Serbs. At the same time, area within the exclusion zones also lacks the wide-open desert that made pro-Qaddafi loyalists so vulnerable to NATO air power during Operations Odyssey Dawn and Unified Protector. The majority of the havens and humanitarian corridor from Homs to Hama lie in the Orontes River basin, a cultivated plain lying between the foothills of the Jabal an-Nusayriya mountains to the west, and the desert to the east.[189] The western edge of the 30-km exclusion zones and humanitarian corridor described here would extend into the Nusayriya foothills (see Figure 3). Farther north, near Idlib and the Turkish border, the terrain again becomes more mountainous. These mountains could presumably be exploited for cover and concealment by Syrian fielded forces and mobile SAM operators, as done so by the Serbs. This would only be the case, however, for fielded forces appearing from the west.

The interior of the exclusion zones would provide far fewer natural features that could be exploited for cover and concealment. Within each zone, it is the hundreds of villages and towns that lie along the Homs-Aleppo corridor that would offer Syrian forces the best chance of avoiding NATO aircraft. Because al-Assad regime forces would already be present inside the exclusion zones at the start of any intervention, they could easily disperse and make use of structures in populated areas for the purposes of hiding their equipment for subsequent use. While desert terrain to the east of Homs and Hama would leave Syrian forces more exposed to attacks from the air, elements of the Syrian Army and other pro-government forces based in Aleppo (such as the Army's 3rd Corps) would still leave opportunities for threats to the exclusion zones and corridor to appear from the east.

Counterland Operations for Defense of Safe Havens

How might air power be used to defend safe havens in northwest Syria from the air? To answer this question, I develop a concept of operations to estimate the number of aircraft that would be required to sustain 24-hour coverage over safe havens in the northwest

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189 Michael R.T. Dumper and Bruce Stanley, eds., *Cities of the Middle East and North Africa: A Historical Encyclopedia* (Santa Barbara, Calif.: ABC-CLIO, 2007), p. 171.

capable of targeting a variety of mobile Syrian ground forces equipped with heavy weapons.

To defend safe havens against Syrian forces, aircraft must be available to prevent such forces from entering the 30 km exclusion zones and destroying those that do find their way inside the perimeter. The problem is that such targets are generally discrete and mobile, and have historically proven extremely difficult for aircraft to find, fix, track, target and engage before these targets have had the opportunity to move and hide.[190] As each stage in this targeting process takes time, the "sensor-to-shooter" cycle or "kill chain" must be as rapid as possible in order to have any chance of destroying these targets.

The most difficult stage is detecting and identifying such targets in the first place. In Kosovo, for example, signals and imagery intelligence might have provided an indication of targets active in a particular area, but locating those targets was often accomplished using the pilots' own eyes.[191] This task was complicated by the persistent threat posed by mobile SAMs, which forced NATO aircraft to fly at altitudes that made visual identification even more difficult.[192] Since Kosovo, however, greater use of Predator unmanned aerial vehicles (UAVs) and other intelligence, surveillance, and reconnaissance (ISR) assets have reportedly led to significant improvements in detecting mobile targets and transmitting this imagery directly to strike aircraft using military data links.[193] This has yet to be tested, however, in a truly hostile air defense environment.

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[190] This tactic is often referred to as "shoot and scoot." Difficulties associated with "Scud hunting" during the Persian Gulf War are frequently used to illustrate the problem of destroying elusive, mobile targets. For an illustration, see Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report*, pp. 83-89. For a useful introduction to the targeting process, see John A. Tirpak, "Find, Fix, Track, Target, Engage, Assess," *Air Force Magazine* 83, no. 7 (July 2000), pp. 24-28.

[191] *A-10s Over Kosovo*, pp. 137-142. Indeed, in Bosnia, visual identification was required per the rules of engagement. Owen, *Deliberate Force*, p. 319.

[192] *A-10s Over Kosovo*, p. 144.

[193] Christopher Bowie, *Destroying Mobile Ground Targets in an Anti-Access Environment*, Northrop Grumman Analysis Paper Series (December 2001), pp. 6-8; Michael W. Kometer, *Command in Air War: Centralized vs. Decentralized Control of Combat Airpower* (PhD diss., Massachusetts Institute of Technology, 2005), p. 184; George Mader, "Interview; Lieutenant General Ralph Jodice, Combined Forces Air Component Commander for Operation 'Unified Protector,'" *Jane's Defence Weekly*, April 17, 2012. Indeed, referring to NATO operations in Libya, Gen. Jodice commented that "the interaction that existed between the manned aircraft and unmanned ISR platforms had not been done before on that scale."

Given the MQ-1 Predator's ceiling of 25,000 ft., its survivability in a Syrian intervention is far from certain given the ubiquity of Syria's mobile and man-portable SAMs.[194]

These advances in detection, however, have not obviated the need to correctly identify emerging targets. Verifying a target's identity and receiving authorization to engage may require still additional time. This is particularly true in the absence of ground controllers with visual identification of a target and where concerns with collateral damage are acute—both of which would apply to the Syrian intervention considered here. In NATO operations over Libya, for example, pilots reported rejecting Predator images due to the time it took for such targets to be cleared through the air operations center.[195] Instead, they preferred relying on their own targeting pods. Indeed, aircraft equipped with Sniper XR pods, first deployed in 2005, and the export-version PANTERA pods are reported to have significantly improved pilots' ability to autonomously detect, identify, and engage mobile targets.[196]

Finally, even when targets are detected, identified, and tracked using ISR assets or aircraft flying strike coordination and reconnaissance (SCAR) missions and passing targeting information to strike aircraft, such aircraft must still be available to reach the target's location and deliver a weapon in time to destroy the target before it can move and hide.[197] Assuming relatively short windows to engage such targets, this means strike aircraft must be orbiting nearby. These considerations suggest that defending safe havens in Syria from the air would require a variety of assets capable of executing all of these steps in the targeting process, all while under the threat of Syria's numerous mobile and man-portable SAM systems.

It is possible to generate very rough estimates of the number of strike aircraft required to provide 24-hour coverage over safe havens in northwest Syria and a humanitarian corridor linking them to the Turkish border using a simple model. The

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[194] "MQ-1B Predator Fact Sheet," U.S. Air Force, January 5, 2012. http://www.af.mil/information /factsheets/factsheet.asp?id=122. Accessed June 25, 2012. The high-altitude RQ-4 Global Hawk, with a ceiling of 60,000 ft., as well as the U-2 would presumably fair better. http://www.af.mil/information /factsheets/factsheet.asp?id=13225. Accessed June 25, 2012.

[195] Robert Densmore, "French Pilots Over Libya Decline US Intel; Clearance Just Too Slow," *AOL Defense*, September 21, 2011. http://defense.aol.com/2011/09/21/french-pilots-over-libya-decline-us-intel-clearance-just-too-sl/. Accessed May 1, 2012.

[196] Comments by Lance "Cajun" Kildron to the author. "Sniper Pod Fact Sheet," U.S. Air Force, http://www.af.mil/information/factsheets/factsheet.asp?id=18864. Accessed June 12, 2012.

[197] On SCAR, see fn. 162.

concept of operations presented here draws on innovations for shortening the sensor-to-shooter response time developed for on-call close air support during Operation Iraqi Freedom and the conduct of SCAR missions during NATO operations in Libya.[198] Given the rapid response times required for the dynamic targeting of Syrian fielded forces threatening safe havens, I describe a concept of operations that involves utilizing an array of ISR assets and establishing orbits of strike aircraft available 24 hours a day to defend safe havens on extremely short timelines.

Before proceeding, however, two caveats should be mentioned. First, this model is not meant to suggest how operations would actually be conducted in a Syrian intervention, but rather to offer one method of gauging the possible scope and scale of operations for defense of safe havens from the air. Second, this model derives force requirements based on tactical requirements. In this case, these requirements are the need to rapidly target a range of Syrian fielded forces capable of threatening safe havens on relatively short timelines. In reality, the number of aircraft deployed in any intervention would in large part be dictated by operational constraints, with the availability of nearby air bases being the key consideration.

While NATO aircraft could potentially fly from bases in Italy, Greece, or the Balkans, the use of bases in Turkey (e.g., Incirlik) and Cyprus (e.g., Akrotiri), and perhaps even Jordan and Saudi Arabia, would be most desirable given their proximity to Syrian territory. Their availability would depend on at least the tacit support of host governments for a NATO intervention, which may be more forthcoming in some cases than in others. Were basing scarce, such an intervention would require at least one, if not two, aircraft carriers in the Mediterranean.[199] The following discussion assumes the

[198] Key assumptions and parameters for the following concept of operations are adapted from a model for on-call close air support developed by Bruce R. Pirnie, et al., *Beyond Close Air Support: Forging a New Air-Ground Partnership* (Santa Monica, Calif.: RAND Corporation, 2005), pp. 115-131. It should be noted that this model was not designed to generate force requirements for contingencies real or hypothetical, as employed here. It also draws on insights presented by Alan Vick, et al., in *Aerospace Operations Against Elusive Ground Targets* (Santa Monica, Calif.: RAND Corporation, 2001), pp. 29-56. I have adapted these to reflect recent NATO experience in Libya. For discussions of dynamic targeting in Libya, see Jean-Marc Brenot, "Libya: the French carrier battle group and dynamic targeting," *Jane's International Defence Review*, January 18, 2012; and Tirpak, "Lessons from Libya."

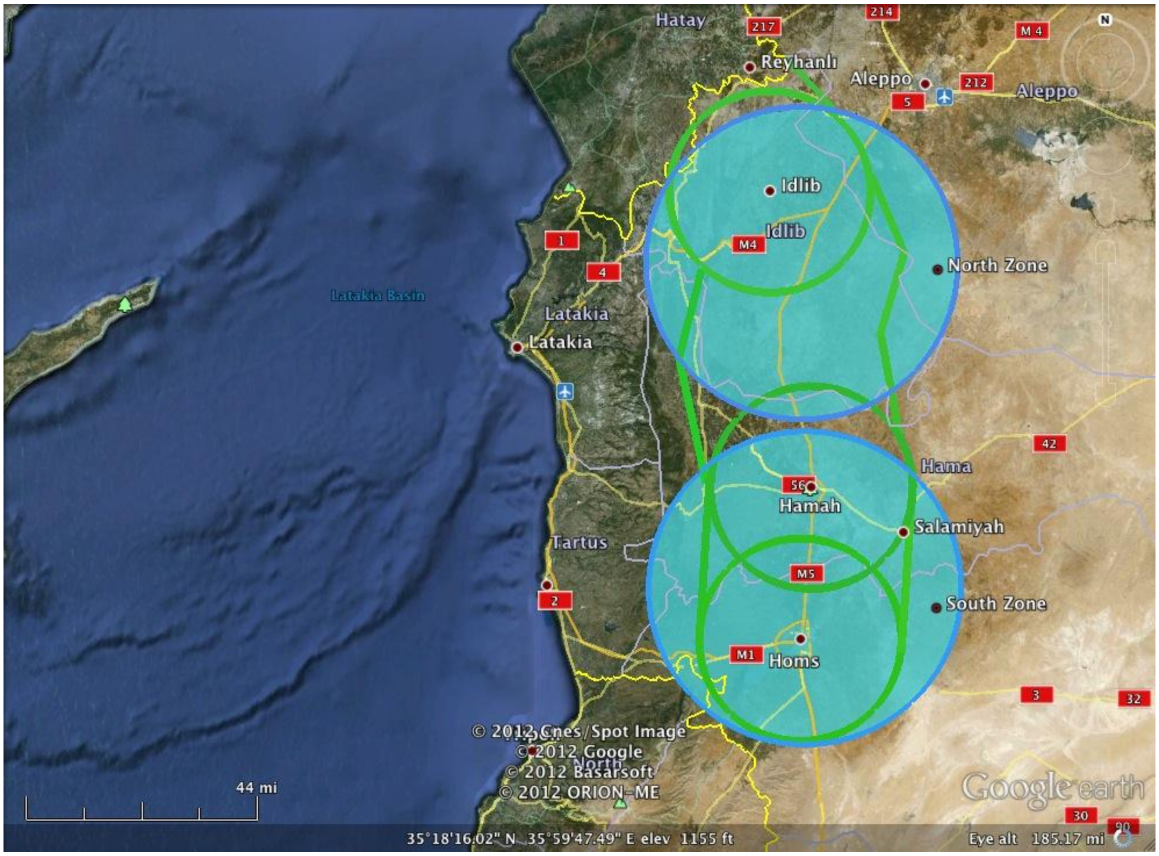
[199] The U.S. Navy typically only has three carrier groups deployed at sea capable of sustained operations at any time. In January 2012, it was announced that two carriers had been deployed to the Persian Gulf in the 5th Fleet's area of operations. Given ongoing commitments in the Pacific and the

availability of adequate nearby basing. In reality, basing would likely prove a serious constraint on the possibility of committing large numbers of aircraft to a Syrian intervention.

This model makes a number of assumptions. First, I assume that defending 30 km exclusion zones around Homs, Hama, and Idlib, linked by a humanitarian corridor to the Turkish border approximately 60 km wide x 200 km along the main north-south highway, would lend itself to the creation of two engagement zones: a northern and southern zone, each approximately 60 km x 100 km (6,000 km^2). For ease of computation, I assume both zones to be circles, each with radius 25 nautical miles (or about 45 km, for a larger area of 6,360 km^2). These notional zones are illustrated in Figure 4. For purposes of deconflicting the airspace, the southern zone might be approached via routes over the Mediterranean, and the northern zone via Turkey.

Persian Gulf, it is unlikely that any more than one U.S. carrier would be committed to a Syrian intervention (if any). Federation of American Scientists, “Aircraft Carriers.” http://www.fas.org/programs/ssp/man /uswpns/navy/aircraftcarriers/carriers.html. Accessed May 12, 2012; “Where are the Carriers?” Global Security. January, 25, 2012. http://www.globalsecurity.org/military/ops/where.htm. Accessed May 12, 2012; Lisa Daniel, “Panetta: U.S. presence in Gulf unchanged by Iranian threats,” *Armed Forces Press Service*, January 18, 2012.

Figure 4: Engagement Zones Over Safe Havens in Northwest Syria



Note: This map is notional. It is only intended as an illustration for the purposes of this analysis. Each shaded engagement zone (labeled here as North Zone and South Zone) has a radius of approximately 25 nautical miles. By making a simplifying assumption that each zone be a circle with 25 nmi radius rather than track the precise borders of the exclusion zones and humanitarian corridor called for by the intervention described here, the zones illustrated above do not cover the same precise area. This is done for ease of computation.
Source: Google Earth.

I further assume 100-percent detection, i.e., there are enough ISR assets in the air (Predator UAVs, Global Hawk, Rivet Joint, JSTARS, pod-equipped jets conducting reconnaissance, etc.) to ensure that any Syrian forces that attempted to enter, or "pop up" inside the perimeter of the exclusion zones would be detected. This is obviously an unrealistic assumption, even with a wide range of ISR assets available, which in reality would likely be scarce.[200] The actual detection rate would likely be much lower, and

[200] This is true of NATO operations in Libya. During such operations, NATO operated only two Predator UAVs, had some use of the Global Hawk and the U-2, one JSTARS, one Rivet Joint, and one UK Sentinel or French Atlantique 2. Gen. Jodice believes he did "not enjoy a full spectrum of ISR assets." See Mader, "Interview: Lieutenant General Ralph Jodice."

might partly reflect the level of protection desired for the safe havens, in addition to concerns of UAV survivability in light of Syrian air defenses and any logistical constraints that would prevent a full array of ISR assets being allocated to a Syrian contingency. Better protection would require more ISR platforms. For my purposes, I assume away the need to estimate the number of ISR assets required for detection and simply assume a rate of 100 percent to convey the idea that detection does not vary in this model.

Moving down the targeting chain, I further assume two minutes are required for command and control procedures, i.e., the time between the target's detection by ISR assets and strike aircraft being allocated and directed toward the target area by the air operations center. The time required to allocate strike aircraft might be longer in the event of heightened concerns over collateral damage in areas with a high concentration of civilians. These times are notional, and in reality would be highly variable. Two minutes are further assumed for target verification, authorization, and initial weapons delivery. That is, once the strike aircraft arrives in the target area, it takes only two minutes for the strike aircraft to acquire the target using its targeting pod, confirm the identity of the target, and receive clearance to engage before releasing the first munition. One minute is assumed for the release of each additional munition.[201]

Given the need to strike mobile targets before they have time to move and hide, I assume the total time between detection and final weapons delivery must occur within a 15-minute window. If longer engagement windows were allowed, it might be possible to keep some strike aircraft on strip alert at nearby bases or on carriers in the Mediterranean. The 15-minute window assumed here, however, would most likely require strike aircraft already airborne and orbiting nearby.[202] If there are too many targets for strike aircraft to hit within this window, I calculate the need for a separate orbit of strike aircraft awaiting tasking in the center of either engagement zone and capable of moving toward the target area simultaneously.

[201] I ignore the flight time required for the munition to reach the target, although this would add additional time, particularly if the strike aircraft were flying at high altitudes.

[202] Even 15 minutes might be considered too long a window to engage certain types of mobile targets adopting "shoot and scoot" tactics. In Desert Storm, for example, Scud transporter-erector-launchers (TELs) might launch and relocate to a hide location 5 miles away within 10 minutes. Allen P. Hazlegrove, "Desert Storm Time-Sensitive Surface Targeting: A Successful Failure or a Failed Success?" *Defense Analysis* 16, no. 2 (2000), pp. 139-140.

I use several additional parameters to make estimates, all of which assume the strike aircraft to be F-16s.[203] First, I assume the F-16 would fly at a high subsonic cruise speed of 500 knots. Based on the size of the two engagement zones above (25 nmi radius each), this would leave the F-16 a maximum of 3 minutes for fly-out from the center of either zone to reach any point within its zone. Second, I assume strikers would be capable of loitering in an orbit at the center of either engagement zone for approximately four hours, with an additional two hours of transit time (round trip) to the orbit and back to base.[204] Sustaining these orbits would require substantial support from aerial refueling tankers.[205] Given the surface-to-air missile threat, it is unlikely tanker tracks could be established overland within each engagement zone, and more likely would be placed across the Turkish border or in the Mediterranean. Placing the striker orbits at the center of each engagement zone (rather than near any tankers) thus represents a "best case scenario" for minimizing the time to respond to emerging targets. Third, I assume a mission-capable rate of 0.739, based on the average rates for the F-16C+ during Operation Iraqi Freedom.[206] The mission-capable rate reflects the readiness of available aircraft, given that some aircraft would be unavailable due to breakdown. Fourth, I assume the F-16 is equipped with four laser-guided bombs (e.g., the GBU-12 500-lb. bomb).[207] Finally, I assume the F-16 flies in a two-ship formation (lead and wing), and each aircraft in a pair attacks targets in the area sequentially. When combined, these

[203] The F-16 is one of the most common aircraft shared by NATO allies. In addition to F-16s, the F-15E and other NATO-ally aircraft (Rafales, Tornados) might also perform this role. Given their different loadouts, use of different aircraft for this role would generate different estimates than those presented here.

[204] It is difficult to make any "standard" estimate of the transit time required to sustain these orbits, as it entirely depends on the location of available air bases. If aircraft were flying from Incirlik in Turkey, or Akrotiri in Cyprus, transit times might be substantially shorter than two hours round trip. If based farther away, however, they could be much longer. I pick two hours as a sample transit time (round trip).

[205] Indeed, the availability of tankers and the location of "divert" bases in the event of a failed aerial refueling attempt would likely exert significant constraints on loiter time and the possibilities for minimizing response time for dynamic targeting. The availability of aerial refueling tankers was reportedly the "critical factor" in keeping close air support "stacks" manned in Operation Iraqi Freedom. Chris Finn, "Air Aspects of Operation Iraqi Freedom," *Air Power Review* 6, no. 4 (Winter 2003), p. 9. With tanker tracks in the Mediterranean during Operation Unified Protector over Libya, again U.S. aircraft experienced significant limitations on the amount of time they could spend on strike sorties deep into the heart of Libyan territory. Comments by Lance "Cajun" Kildron to the author.

[206] See Department of the Air Force, *Operation Iraqi Freedom—By the Numbers*, U.S. Central Command Air Forces, Assessment and Analysis Division, Prince Sultan Air Base, Saudi Arabia (April 30, 2003), p. 10.

[207] The 500 lb. bomb, rather than a larger bomb, would likely be used in order to minimize the possibility of collateral damage.

assumptions suggest that a single two-ship pair of F-16s could travel from the center of each engagement zone to any point within the zone and release *all* of their munitions within a 15-minute window.[208] These assumptions should therefore be considered quite favorable to NATO targeting procedures and NATO aircrews operating under optimal conditions for munitions delivery.

With these assumptions and parameters, it is possible to generate estimates for the number of orbits and sorties required to sustain coverage over each engagement zone in order to engage a variety of potential targets challenging the safe havens. However, to estimate the total number of aircraft required to sustain these orbits, a sortie generation model is needed. To calculate sortie rates, I use a simple model based on historical F-16 and F-15 maintenance data developed by analysts at the RAND Corporation that employs the following formula:[209]

$$SR = \frac{24 \text{ hours}}{FT + TAT + MT}$$

where

SR = sortie rate

FT = flight time

TAT = turnaround time

MT = maintenance time

Flight time refers to the total amount of time in transit and on station, which in this case is six hours. Turnaround time refers to the time required to prepare aircraft for their missions (e.g., servicing, refueling, arming, etc.) and is assumed here to equal three hours. Maintenance time refers to scheduled maintenance, and is calculated to reflect the fact that more maintenance is required when flight times are longer.[210]

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[208] For a sample calculation, see the appendix.

[209] The details of this model can be found in Appendix B of John Stillion and David T. Orletsky, *Airbase Vulnerability to Conventional Cruise-Missile and Ballistic Missile Attacks* (Santa Monica, Calif.: RAND Corporation, 1999), pp. 81-84. Given the parameters specified here, the sortie rate is calculated as 1.46. See appendix.

[210] The model uses 3.4 hours of maintenance time per sortie and an additional 0.68 hours of maintenance time for every hour the aircraft is in the air, based on empirical data. Therefore, MT = 3.4 + 0.68FT.

Combining this sortie generation model with the assumptions and parameters above suggests the following results for the number of orbits, strike aircraft airborne at any one time, sorties per day, and aircraft required to sustain 24-hour coverage over only one of two engagement zones proposed for northwest Syria.[211] It is important to note that these estimates do not assume Syrian forces would challenge the safe havens at any particular rate. Instead, they reflect a potential need for aircraft, i.e., the number of aircraft that would be required in the event that a particular number of Syrian targets (tanks, artillery, rocket launchers, armored fighting vehicles, etc.) presented a challenge to the safe havens. Moreover, these targets need not appear all together or at the same time. The figures below would also apply to combinations of smaller groups of Syrian forces so long as they appeared at different times in the course of a four-hour period.

Table 6:

Orbits and Strike Aircraft Per Engagement Zone

Emerging Targets	No. of Orbits	Strike Aircraft Airborne	No. of Sorties	No. of Aircraft
2	1	2	12	12
4	1	2	12	12
8	1	2	12	12
16	2	4	24	23
32	4	8	48	45
64	8	16	96	90

Note: Aircraft are rounded up to the nearest integer.

As Table 6 demonstrates, if the effort required to defend safe havens were limited to engaging only two emerging targets within a 15-minute window every four hours (recall the four-hour loiter time discussed above), then only one orbit of two F-16s would be required to stand-by at the center of the engagement zone to be directed to the target area.[212] Sustaining this orbit 24-hours a day would require 12 aircraft given sortie rates

[211] For sample calculations, see appendix.

[212] It should be noted that this figure does not suggest that two emerging targets would necessarily be destroyed. The figures presented in Table 6 simply require that at least one munition be dropped on each emerging target, i.e., that strike aircraft be capable of "engaging" each target.

and the mission-capable rate for the F-16 based on performance in Operation Iraqi Freedom.

These requirements grow substantially when more than two emerging targets may appear near or in the exclusion zones surrounding safe havens. For example, if defending safe havens required engaging up to 32 emerging targets within any 15-minute window during a four-hour period, this would require 8 F-16s orbiting nearby, and roughly 45 aircraft to sustain these orbits 24-hours a day.[213] If there were a need to engage up to 64 emerging targets, approximately 90 aircraft would be required to ensure 24-hour coverage. These numbers are based on the needs of only one engagement zone. To sustain 24-hour coverage over both zones given the possibility of up to 64 emerging targets requiring engagement within 15-minute windows in any four-hour period, the results here suggest 180 strike aircraft would be required for the effort, roughly two and a half full fighter wings.

What might this number of potential targets look like? As noted above, widespread participation by elements of the Syrian Army has been reported in the course of the al-Assad regime's crackdown, contrary to the impression left by media reports that Maher al-Assad's Fourth Armored Division has been responsible for the bulk of the regime's repression. If a typical Syrian armored division were divided up into battalion-sized elements with some mix of tanks, armored fighting vehicles, artillery and rocket launchers typically used in the Army's assaults on Syrian cities and towns, these notional elements might include something on the order of 15 tanks, 9 armored fighting vehicles, 2 self-propelled artillery pieces and 1 rocket launcher (for a total of 27 targets).[214] A

[213] As mentioned above, aircraft on strip alert at nearby bases or carriers would be more likely in the event aircraft were needed to "surge" in response to large numbers of targets appearing at the same time. The use of strip alert, in general, would be feasible if more than 15 minutes were permitted to engage emerging targets given the increased time required for fly-out to the target area.

[214] These numbers are very rough approximations based on multiple, conflicting accounts of the Syrian Army's order of battle. I assume the typical Syrian armored division to be composed of three armored brigades, one mechanized brigade, and one artillery regiment. Each brigade or regiment is assumed to be composed of four battalions employing the relevant equipment. For a Syrian armored division of 8,000, these would result in approximately 20 battalion-sized elements of 400 troops. I further assume 90 tanks and 30 armored fighting vehicles to an armored brigade, 90 armored fighting vehicles and 40 tanks to a mechanized brigade, and 30 self-propelled artillery pieces and 20 rocket launchers to an artillery regiment. Artillery regiments also contain some mix of towed artillery pieces. For assessments of the Syrian Army's order of battle, see Richard M. Bennett, "The Syrian Military: A Primer," *Middle East Intelligence Bulletin* 3, no. 8 (August/September 2001); Cordesman, *Israel and Syria*, p. 166; IISS, *The Military Balance 2012*, p. 349; "Syrian Arab Army – Organization," Global Security. http://www.globalsecurity.org/military/world

small number of towed artillery pieces would also be added to this mix. The aircraft requirements based on engaging up to 64 emerging targets calculated above would thus reflect the potential need to engage roughly two of these battalion-sized elements during any four-hour period (30 tanks, 18 armored fighting vehicles, 4 self-propelled artillery pieces, 2 rocket launchers, and some towed artillery).[215] The Syrian Army has somewhere in excess of 200 of these battalion-sized elements at its command.[216] Though media and opposition reports only infrequently mention specific numbers of Syrian equipment involved in government assaults, one or two battalion-sized elements seem plausible for the size of units used in attacks against smaller Syrian villages and towns. Larger division-sized elements, however, have been used in major operations, as in the government's siege of Homs in February 2012 and its assault on Idlib in April.[217]

The estimates for the number of aircraft presented here reflect only the number of strike aircraft waiting on call at the center of each engagement zone. These strike packages would require a number of additional assets. First, as mentioned above, they would require ISR platforms such as Predator UAVs, Global Hawk, and JSTARS capable of detecting emerging targets and passing information to strike aircraft. Given Syria's air defenses, however, it is unclear whether Predator UAVs could be employed. This might put particular demand on the use of high-altitude ISR platforms such as Global Hawk and the U-2. Second, an airborne early warning and control aircraft, such as the E-3 Sentry, would also be required to coordinate strike aircraft. Third, these aircraft would require jamming support from the EA-6B Prowler or EA-18G Growler along with suppression aircraft such as the F-16CJ in order to mitigate the threat posed by enemy air defenses. This would be a major concern given the threat posed by Syrian mobile and man-portable

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/syria/army-org.htm. Accessed June 25, 2012; and *Jane's World Armies* electronic database entry for "Syria."

[215] Were these estimates based on a typical mechanized division rather than armored division, the mix of targets would include greater numbers of armored fighting vehicles and fewer tanks.

[216] This assumes a strength of seven armored divisions, one Republican Guard armored division, and three mechanized divisions. This does not include independent formations, special forces, and combat support units. IISS, *Military Balance 2012*, p. 349. Again, these calculations are meant only to offer very rough estimates.

[217] Roy Gutman, "A Syrian rebel commander bemoans lack of international aid," *McClatchy Newspapers*, April 8, 2012. Gutman cites a Syrian rebel commander as estimating that the Syrian military had deployed 7,000 to 8,000 troops, 250 tanks and a large number of armored vehicles to Idlib. In addition, he estimated "thousands" of *shabiha* militiamen were also present driving in civilian vehicles. It is unclear, however, whether these estimates simply reflect the rebel's understanding of the size of a typical Syrian division, or actually reflect a "bottom-up" estimate of Syrian forces on the ground.

surface-to-air missile systems. In addition, given the need for 24-hour coverage, a major contingent of tankers would be required to ensure timely aerial refueling. Indeed, the feasibility of the entire notion of persistent coverage to defend safe havens from the air would rest, in part, on the availability and location of tankers and the location of "divert" bases in the event of a failed attempt at aerial refueling. All of these aircraft would be required to support the strike aircraft conducting counterland operations in defense of safe havens, amounting to well over 200 daily sorties (192 strike sorties plus support) given the possible need to engage up to 64 emerging targets threatening each zone within a 15-minute window in any four-hour period.

The number of strike sorties dedicated to each engagement zone can be compared to the number of daily average strike sorties conducted by NATO aircraft in Kosovo during the first five weeks of the air war while targeting was presumably still focused on the Serbian IADS and fielded forces. By April 27th (Day 34) of Operation Allied Force, NATO had flown 4,432 attack sorties, averaging 130 attack sorties per day.[218] This daily average was essentially unchanged until the last three weeks of the war, when NATO dramatically expanded the scope of the air campaign.[219] Given that Kosovo is larger than either of the two engagement zones proposed here, but smaller than their combination, it seems plausible that defending safe havens in either engagement zone could require the 96 sorties calculated here, for a total of 192 daily strike sorties combined. By way of further comparison, the U.S./NATO averaged approximately 80 strike sorties per day during Operation Odyssey Dawn (March 19 – March 30), and NATO averaged approximately 45 strike sorties per day during Operation Unified Protector over Libya (March 31 – October 31, 2011).[220] In both Kosovo and Libya, however, these strike sortie figures include a whole range of targets in addition to those missions focused on Serbian and pro-Qaddafi fielded forces. In any Syrian intervention, many more additional strike sorties targeting the Syrian IADS and other targets would be required beyond those calculated above. These figures therefore suggest that NATO operations in Syria to

[218] Cordesman, *The Lessons and Non-Lessons*, p. 41. It should be noted these strike sorties were not limited to targeting Serb fielded forces, but included an array of targets.

[219] Ibid.

[220] "Operation UNIFIED PROTECTOR Final Mission Stats," NATO Factsheet, November 2, 2011. http://www.nato.int/cps/en/natolive/71679.htm, Accessed May 1, 2012; and author's calculations based on briefings by Vice Adm. Bill Gortney, March 19 – March 28, 2011. http://www.defense.gov/transcripts/default.aspx?mo=3&yr=2011. Accessed May 1, 2012.

defend safe havens in the northwest could easily be the most substantial humanitarian intervention yet attempted by NATO forces.

IV. Implications and Conclusion

The United States and its NATO allies no doubt possess the capabilities required to achieve some measure of air superiority over northwest Syria and to maintain patrols over population centers to defend them from some incursions by Syrian forces equipped with heavy weapons. But as this analysis shows, an intervention to establish only three safe havens, in Homs, Hama, and Idlib, linked to each other and to the Turkish border via a humanitarian corridor, would be a substantial military undertaking. Given Syria's air defense capabilities, the ubiquity of its tanks, artillery, rockets, and mortars, and tens of thousands of al-Assad-regime allies willing to carry out acts of repression, it does not require any heroic assumptions to suggest that such an intervention would require greater resources, face greater risks, and have a lower probability of success, than any of NATO's previous air campaigns in response to humanitarian crises in Bosnia, Kosovo, or Libya.

This conclusion is derived from two major considerations. First, Syria possesses an air defense system with enough mobile surface-to-air missile systems that any attempt to defend safe havens from the air would require a major, sustained suppression effort for the duration of the campaign. This would not simply require a large expenditure of resources up front in order to degrade Syria's integrated air defense system (although such a large expenditure would indeed be required); Syria's strategic air defenses could likely be degraded or destroyed relatively quickly. The problem is that Syria would still possess large numbers of tactical mobile SAMs (some quite advanced) that the United States and its NATO allies have historically had little success in destroying outright when adversaries have failed to be anything less than cooperative. Although the severity of the problem would depend on the skill and tactics of Syrian air defense operators, and might be mitigated by recent advances in targeting technology (e.g., the R7 upgrade to the HARM Targeting System discussed above), the sheer number of Syrian mobile SAMs in comparison to those possessed by NATO's previous opponents in instances of humanitarian intervention would still drive these conclusions. Sheer numbers suggests that NATO aircrews attempting to carry out patrols over northwest Syria would face a persistent, high-level threat from Syria's tactical surface-to-air missiles. Given the sizeable number of strike aircraft that would be required to provide 24-hour coverage over safe havens in the northwest, defending these aircrews could easily require more jamming and suppression aircraft than that employed in any of NATO's previous humanitarian interventions.

Second, the al-Assad regime still maintains enough strength on the ground, whether elite elements of the Syrian Army, the thousands employed by its security and intelligence services, or its *shabiha* militias, to ensure that determined allies of the regime could still carry out attacks against civilians that would perpetuate Syria's humanitarian crisis. Even if NATO were willing to deploy enough strike aircraft to maintain 24-hour coverage over safe havens in the northwest capable of engaging significant numbers of Syrian fielded forces within short periods of time, it would still have only limited ability to detect and identify hostile elements from the air. Crews flying strike coordination and reconnaissance missions would have little ability to prevent the infiltration of Syrian forces carrying small arms and capable of carrying out many of the repressive tactics that have thus far contributed to Syria's humanitarian crisis (e.g., the massacres at Houla and Qubeir).[221] Large numbers of UAVs would aid in the detection effort, but recent experience in Libya suggests that even the latest in advanced intelligence, surveillance, and reconnaissance technology cannot overcome human limitations on identifying and authorizing attacks on these targets, particularly under restrictive rules of engagement where concerns with collateral damage are acute. These considerations suggest forces on the ground would be required to achieve a high level of target detection and identification.

Faced with the risks posed by Syria's tactical air defenses and only a limited ability to detect and identify hostile forces threatening Syrian civilians, NATO would have to decide whether to escalate to strategic bombing, engage in a robust effort to train,

[221] Although the U.N.'s Commission of Inquiry on Syria has thus far been unable to positively identify the perpetrators of the killings at Houla, the commission believes that "forces loyal to the Government may have been responsible for many of the deaths." The opposition and survivors, however, have repeatedly placed blame on *shabiha* militiamen for the massacres. United Nations Human Rights Council, Twentieth Session, Agenda item 4, *Oral Update of the Independent International Commission of Inquiry on the Syrian Arab Republic*, A/HRC/20/CRP.1. June 26, 2012. http://www.ohchr.org/Documents/HRBodies /HRCouncil/RegularSession/Session20/COI_OralUpdate_A.HRC.20.CRP.1.pdf. Accessed July 2, 2012.

arm, and support local ground forces, or even introduce NATO or allied ground forces to decisively tip the balance of power against the al-Assad regime. The original “low-risk” rationale for humanitarian intervention from the air simply would not apply to this particular form of a Syrian intervention.

What does this mean for the application of air power to humanitarian crises more generally? In situations where hostile forces are intermingled with the civilians an intervener seeks to protect—as in Syria today—a premium is placed on correctly identifying those hostile forces, and having the ability to precisely target them. Over the previous two decades, advances in precision-guided munitions have no doubt dramatically improved NATO’s ability to carry out the latter. The use of precision-guided munitions has steadily increased over the years, composing 8 percent of munitions delivered in the Persian Gulf War, 30 percent in Kosovo, 60 percent in Afghanistan, 70 percent in the 2003 Iraq War, and culminating in virtually 100 percent of munitions delivered in NATO operations over Libya.[222]

Over the same period, we have also witnessed a growing ability on the part of the U.S. and its allies to engage in time-sensitive and dynamic targeting, with increasing numbers of strike sorties carried out against targets selected only after aircraft were already airborne.[223] While this suggests that the ability of the U.S. and its allies to detect and identify targets in real-time has also improved, this should not be attributed solely to dramatic advances in technology, including UAVs or other ISR assets capable of remaining airborne for long periods of time monitoring the battlefield. The ability to rapidly detect, identify and cue strike aircraft to their targets has no doubt been underwritten by the availability of forces on the ground, used to such lethal effect in Afghanistan and Iraq, and to some degree in Libya as well.[224] Furthermore, this growing ability has developed largely in the presence of poor to mediocre air defenses on the part of U.S. and NATO adversaries. These skills remain to be tested in a truly hostile air defense environment. Finally, even with forces on the ground, pilots still require the

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[222] Christopher J. Bowie, Robert P. Haffa, Jr., and Robert E. Mullins, “Trends in Future Warfare,” *Joint Forces Quarterly* 35 (2004), pp. 129-133; Eric Schmitt, “NATO Sees Flaws in Air Campaign Against Qaddafi,” *New York Times*, April 14, 2012.

[223] Bowie, et al., “Trends in Future Warfare,” p. 131.

[224] Eric Schmitt and Steven Lee Myers, “Surveillance and Coordination With NATO Aided Rebels,” *New York Times*, August 21, 2011; Mark Urban, “Inside story of the UK’s secret mission to beat Gaddafi,” *BBC News*, January 19, 2012; Kometer, *Command in Air War*, pp. 180-203.

situational awareness necessary to correctly identify their targets, information unlikely to be "transmitted" solely by UAV imagery. Gaining this awareness requires aircraft to fly at low altitudes, and the authorization to do so is precisely what is lacking in environments rife with low-altitude mobile surface-to-air missile systems—as in Syria today.

Thus, despite a decade of advances in ISR technology since NATO operations over Kosovo, the problem of emerging target detection and identification would still pose a major challenge for NATO air forces without help from boots on the ground, and was so even in the relatively permissive airspace over Libya.[225] The "true worth" of air power, then, still appears largely to reside in its effectiveness when combined with highly trained and capable ground forces. To hope for air power as a "low-risk" alternative to the use of ground forces in Syria or future humanitarian interventions would thus be to misunderstand the basis for air power's relative success to date.

APPENDIX: **Calculating Orbits and Strike Aircraft Per Engagement Zone**

Calculating a Sample Orbit: Assuming a 15-minute window to complete an engagement with emerging targets, two minutes for command and control procedures, and two minutes for target verification, authorization, and initial weapons delivery once arriving in the target area, this leaves a total of 11 minutes for fly-out to the target area and all additional munitions release by a two-ship pair of F-16s. Assuming each aircraft releases its munitions sequentially, and one minute is required for each aircraft to drop additional munitions after the first, the lead F-16 could release its three additional bombs in another three minutes. Assuming the second F-16 again requires two minutes for initial weapons delivery, it would take a total of five minutes for the second F-16 to release all of its munitions. Weapons delivery thus leaves a maximum of 3 minutes for initial fly-out to the target area. Given a cruise speed of 500 knots, and an engagement zone with radius 25 nautical miles, this would leave a maximum of 3 minutes for fly-out from the center of each engagement zone to any point within the zone. Given that a two-ship pair can release all 8 of its munitions within this 15-minute window, the need for additional orbits

[225] Robbin Laird, "French Libya Lessons Learned: Better Targeting, Flexible ROEs, Limits to Armed UAVs," *AOL Defense*, September 23, 2011.

of strike aircraft is driven entirely by the loadouts of the F-16 rather than by the need to shorten response time.

Calculating Sortie and Aircraft Requirements: Assuming strike aircraft are capable of loitering in an orbit at the center of each engagement zone for approximately four hours, this assumes six sorties are required to maintain one aircraft in one orbit at the center of each engagement zone for the purposes of ensuring 24-hour coverage. Because each F-16 flies in a pair (lead and wing), this means 12 sorties per orbit would be required to sustain 24-hour coverage. As a pair of F-16s can engage up to eight emerging targets in the same target area, any number of targets less than or equal to eight can be engaged within a 15-minute window in any four-hour period given this figure of 12 sorties per day (as in lines 1-3 of Table 6). Given the possibility that more than eight targets might emerge in any four-hour period, this would require additional orbits, each of which would require 12 sorties a day in order to be sustained.

To calculate aircraft requirements, the following sortie generation model developed by analysts at the RAND Corporation and based on F-16 maintenance data is used:

$$SR = \frac{24 \text{ hours}}{FT + TAT + MT}$$

where

SR = sortie rate

FT = flight time

TAT = turnaround time

MT = maintenance time

Given the scenario described above, flight time (FT) is six hours. This assumes one hour for transit time to the orbit, four hours on station, and one additional hour for the aircraft to return to base. With particular bases in mind, this parameter could be changed to reflect the distance from a particular base to the safe haven area in northwest Syria, given a typical cruise speed (e.g., 500 kn). Turnaround time (TAT) is assumed to be three hours. Maintenance time (MT) is calculated using a separate equation, to reflect the fact that more maintenance is required when flight times are longer. The model uses 3.4 hours of maintenance time per sortie and an additional 0.68 hours of maintenance time for every hour the aircraft is in the air. This reflects the fact that maintenance time is longer when flight times are longer. Thus:

$$MT = 3.4 + 0.68FT$$

Given a flight time (FT) of 6 hours per sortie, this means:

$$MT = 3.4 + 0.68 * 6 = 7.48 \text{ hours}$$

The sortie rate is thus:

$$SR = \frac{24}{(6 + 3 + 7.48)} = 1.46 \text{ sorties per day}$$

To generate 96 sorties a day (as in line 6 of Table 6) assuming a 100-percent mission capable rate (i.e., every aircraft in theater is available to fly sorties), approximately 66 aircraft would be required. The figures presented in Table 6, however, rely on a mission-capable rate (MC) of 0.739, based on the average rates for the F-16C+ during Operation Iraqi Freedom. The number of aircraft (F) required to sustain a particular number of sorties (S) is thus calculated according to the following:

$$F = \frac{S}{SR * MC}$$

To generate 96 sorties as in line 6 of Table 6 (rounding to the nearest aircraft):

$$F = \frac{96}{1.46 * 0.739} = 90 \text{ aircraft}$$