A CHINESE INVASION OF TAIWAN

Although coercive scenarios (e.g., limited missile strikes) are usually regarded as the most likely form of Chinese use of force against Taiwan, we assessed the more extreme case of an outright air and amphibious invasion of the island. We chose to focus on this challenging contingency for six reasons.

First, some analysts argue—despite the common wisdom—that “immediate and full-scale invasion” is the most likely form of conflict between the two sides. One writes:

Massive surprise attacks have distinguished PLA opening campaigns in the past, such as in Korea in [1950], India in 1962, and Vietnam in 1979. More importantly, [Chinese] military planners believe that the gulf in cross-strait relations would be so wide by the time the leadership resorted to force that limited attacks would be futile in dissuading Taiwan . . . and that the only viable option would be to invade the island. (Cheung, 1997, p. 57.)

Second, as the “worst-case” scenario, it is of interest to military planners whose responsibility it is to deter potential adversaries from dangerous courses of action. Whether China could succeed in invading Taiwan, and under what circumstances, may be an open question. But the enormous political implications and tragic human and economic costs that would ensue should Beijing make the attempt are not.

Third, the possibility of a direct Chinese invasion of Taiwan—and expectations regarding the outcome of such an attack—is important in
shaping overall perceptions of the balance between the two sides. Evidence that an invasion appears likely or unlikely to succeed could have an impact on Taiwan’s ability to deter any Chinese use of force.

Fourth, while China has other options for using force to coerce or punish Taiwan, the seizure and holding of the island represents a very high-order threat and is the only alternative that guarantees Beijing’s control when hostilities end.1 So, in some sense, the credibility of the invasion threat underwrites the other, lower-level options such as limited missile strikes or maritime harassment. Schelling (1966) notes, “It is the threat of damage, or of more damage to come, that can make someone yield or comply. It is latent violence that can influence someone’s choice.”2 Clearly China could, if it wished, inflict a great deal of damage on Taiwan. If, however, the ROC possesses a robust ability to defeat an invasion attempt, Taiwan could effectively resist forced unification if it were willing to absorb the blows.3

Fifth, while it seems unlikely that China would undertake such a desperate gamble, it is important to think through how the PLA might essay the operation and what steps would be needed to defeat it. After all, it was always terribly unlikely that the Soviet Union would launch a massive nuclear attack on the United States. Still, hundreds if not thousands of war games, exercises, and analyses were invested in exploring the “what-ifs” of the contingency, precisely because the consequences of failing to deter it were so dire. While a Chinese invasion of Taiwan would represent a much less dire turn of events than global nuclear holocaust would have been, it is nonetheless a serious enough prospect to warrant at least some attention.

Finally, an invasion scenario incorporates a number of elements that could be components of other coercive strategies directed against Taiwan. Although lesser-order conflicts might be more likely to occur,

---

1There are numerous discussions of alternatives available to China for using force against Taiwan. See, for example, U.S. Department of Defense, 1999; Bitzinger and Gill, 1996; Dreyer, 1999, especially p. 12; and Anderson, 1999.

2Emphasis in the original.

3If China were willing to unleash its nuclear arsenal on Taiwan, it could almost certainly destroy the ROC as a functioning society and subsequently militarily occupy the rubble. We shall not speculate as to whether such a Pyrrhic triumph would ever appear attractive to the mainland. We shall say only that neither this argument nor our analysis contemplates Chinese use of nuclear weapons against Taiwan.
many of them—such as a naval blockade or a protracted low-intensity battle of attrition over the Taiwan Strait—would involve key elements of the cases we examine here. Perhaps the most obvious and significant of these lesser contingencies would be the employment of conventionally armed surface-to-surface missiles (SSMs) against targets in Taiwan.

Since China’s 1995 and 1996 “tests,” Beijing’s arsenal of ballistic missiles has figured prominently as a potential coercive instrument vis à vis Taiwan. It seems likely that any invasion scenario would begin with a barrage of Chinese missiles raining down on key military targets on the island: command and control (C²) centers, air-defense sites, and air bases. Similar targets would likely be at the heart of any coercive air and missile attacks on Taiwan, at least initially. Therefore, our findings regarding the effectiveness of such strikes in degrading Taiwanese defenses in the context of an invasion would have at least some applicability to the broader question of the military utility of China’s missile force.

**ANALYTIC STRUCTURE AND METHODOLOGY**

**Scoping the Problem**

Our notional war is set in 2005. Although the Chinese would have a number of options as to the phasing and timing of an attack in that time frame, analytically we can divide the campaign into four segments.

---

4In our analysis, China expends much of its available missile inventory in the attacks on Taiwan, and its front-line aircraft are very heavily committed to the campaign. Some might argue that the PRC would withhold a substantial portion of its forces even from a large-scale attack on Taiwan to ensure that it retained some level of coercive power should the assault fail. We did not consider this strategy for three principal reasons. First, a “fleet in being” strategy is not necessarily a viable alternative for the power that is on the strategic and tactical offensive. As will be seen, our analysis suggests that the PRC has a very hard row to hoe in a full-scale war with Taiwan, even when it commits forces of the size and quality we include. Any reduction in the number of forces Beijing engages would only have worsened these outcomes. Second, most analysts—ourselves included—believe that China would only resort to an all-out attack on Taiwan as a last resort, when all other avenues of influence have been exhausted. In this event, if Taiwan survived a massive attack by China it would, in the aftermath, presumably not be particularly susceptible to more-limited coercive tactics. Finally, the PRC’s nuclear capabilities provide it with something of an ultimate trump card in any event.
• In the first phase, the two sides would fight for air superiority. Elements of this operation would include Chinese missile and air attacks on ROC air bases, surface-to-air missile (SAM) sites, early warning (EW) radars, and C² facilities in addition to air-to-air combat.⁵

• The second phase, which could begin simultaneously with the first, would be a struggle for maritime control, involving air, surface, and submarine forces as well as land-based antiship missile (ASM) units. Elements of antiair warfare (AAW), antisurface warfare, and antisubmarine warfare (ASW) would all be involved.

• Once air superiority was achieved by the mainland, invasion preparation would begin. Followup air strikes would focus on destroying coastal strongpoints, destroying ROC artillery and armor concentrations, and generally “softening up” the island’s defenses.

• The fourth phase would involve actual landing operations on the Taiwanese shore. This phase could include amphibious landings, paratroop assaults, and heliborne attacks directed at gaining a substantial foothold on the island and collapsing Taiwanese resistance.⁶

Our attention is focused mainly on the battle for air superiority and, secondarily, on the contest for control of the seas.⁷

---

⁵We assume that the Taiwanese will concentrate their resources on defense and not launch offensive strikes against air bases on the mainland.

⁶Whether the amphibious assault would be the focal point of the invasion or a supporting operation is a point of some debate but is essentially irrelevant to our analysis. Also, were the Chinese invasion successful, there could be a fifth phase in which the PRC attempts to consolidate its hold on the island, perhaps in the face of determined U.S. attempts to dislodge it. We did not consider any such scenarios in this study.

⁷RAND colleague Michael Swaine notes that even in our base case, we assume that the Chinese military will have made a number of major advances in capabilities; indeed, we will comment on several of the most salient such points as we go along. Our perspective in this study is that of conservative defense planners. Hence, we will tend, where there is uncertainty, to give the Chinese the benefit of the doubt. Some will assuredly argue that we leaned too far in that direction, while others will just as certainly assert the contrary. We believe that we have struck a decent balance between reasonable conservatism and “cloud-cuckoo-land”; we are under no illusions that it is the only such balance.
Historically, it is virtually a truism that control of the air and control of the sea are absolute prerequisites for a successful amphibious or airborne assault. It was the absence of air superiority—which the Luftwaffe had failed to win in the Battle of Britain—that prevented Adolf Hitler from attempting an invasion of Great Britain in 1940–1941. Conversely, it was the Allies’ total dominance of air and sea that enabled General Dwight D. Eisenhower to breach Germany’s Atlantic Wall in June 1944. The Taiwan Strait is considerably wider than the English Channel and poses a formidable barrier to a potential invader, further strengthening our conviction that no Chinese attack can hope to succeed without first gaining mastery of the airspace above the strait and then of the waters themselves.

This may be particularly true in the context of a PRC attack on Taiwan. The People’s Liberation Army Navy (PLAN) owns enough amphibious lift to move about a division of troops at a time, hardly enough to establish and sustain a firm foothold in the face of determined Taiwanese resistance. Therefore, many analyses contemplate a kind of “Dunkirk in reverse,” with China employing numerous commercial vessels to transport troops, equipment, and supplies across the strait. Such an operation, involving unarmed merchant shipping, would be sheer folly unless China had secured almost uncontested dominance of the air and sea. Similarly, the kind of large-scale airborne and air assault operations often suggested as part of a PRC attack would be virtually suicidal unless the ROC’s air defenses had been thoroughly suppressed.

---

8 See, for example, U.S. Secretary of Defense, 1999. A less official but more entertaining depiction of such an operation is Yuan Lin, 1997, translated in Foreign Broadcast Information Service FBIS-CHI-97-268.

9 Commercial vessels are not compartmented to withstand damage as warships are, nor are their crews trained in the kinds of damage-control procedures that can mean the difference between life and death in a combat situation. It is also worth noting that many commercial bottoms would require an operating port to offload their cargoes. Seizing such a facility intact would present an enormous challenge to the Chinese.

10 The People’s Liberation Army (PLA) currently has only very limited airborne and air-assault capabilities. Each of the three airborne “divisions” is roughly the strength of a U.S. airborne brigade. Given the existing inventory of transport aircraft in the PLA Air Force (PLAAF), it is unlikely that even one “division’s” worth of troops could be dropped in a single lift.
Finally, the surface forces of the two navies consist of warships that have very limited air defense capabilities. In the absence of air superiority, the PLAN’s warships would be very vulnerable to air attack in the confined waters of the strait.

We therefore conclude that the battle for air superiority in particular is the linchpin of the campaign.

**Air War Methodology**

For our work, we needed a tool that was sufficiently high-level to permit construction of an open-source database with reasonable effort, while detailed enough to facilitate extensive parametric analyses of the air war. For purposes of credibility, we also wanted a model that had been employed in—and calibrated for—numerous other studies. We chose RAND’s Joint Integrated Contingency Model (JICM) as best fitting these criteria. JICM is a theater combat model designed to support the kind of exploratory analysis that we emphasized in this project.\(^{11}\) After preparing a database from open-source materials, we conducted more than 1,700 model runs to examine both a baseline scenario and numerous what-ifs.\(^{12}\)

We made an initial set of model runs to identify the factors that seemed likely to play a determining role in the outcome of the war over the strait. We then conducted extensive sensitivity analyses on seven variables:

- The size and composition of the air forces committed to the attack by the PRC.
- Each side’s possession of beyond-visual-range (BVR), “fire-and-forget” medium-range air-to-air missiles (AAMs).

---

\(^{11}\)For a full description of JICM, see Jones and Fox (1999).

\(^{12}\)Among the sources used were: International Institute of Strategic Studies, 1998; U.S. Naval Institute, 1999; Taylor, 1988; Wang, 1999; Jane’s Information Group, 1998; Sharpe, 1998; Cullen and Foss, 1997; Jackson, 1998; *World Navies Today*, 1998–1999; U.S. Secretary of Defense, 1999; and various issues of the following journals: *Aviation Week & Space Technology, International Defense Review, Jane’s Defence Weekly, and Jane’s Intelligence Update*. 
The number and quality of short- and medium-range ballistic missiles (SRBMs and MRBMs) used by the Chinese.

The number of advanced precision-guided munitions (PGMs), such as laser-guided bombs (LGBs) and Global Positioning System (GPS)-guided weapons in the Chinese inventory.

The ability of the Republic of China Air Force (ROCAF) to generate combat sorties.

The quality of the ROCAF’s aircrew.

The extent, if any, of U.S. air forces, both land and sea based, committed to Taiwan’s defense.

We will briefly discuss each in turn.13

PRC Force Size and Composition. Significant uncertainty surrounds the number of air forces the PLAAF would commit to a struggle with Taiwan. Only a limited number of bases are available within operating distance of the strait, and the PLAAF has virtually no capabilities for midair refueling of fighter aircraft. Also, the airspace in and around Taiwan is very limited, which would restrict the number of aircraft that either side could commit to the fight at any one time. Finally, the PLAAF has had little experience with the management of large groups of aircraft and would likely experience serious C2 difficulties in a complex, swirling air battle.

To reflect this uncertainty, we used two differently sized Chinese air forces in our analysis, as shown in Table 2.1. The base case reflects our best estimate of the number of aircraft that could be operated from the existing array of PLAAF bases in the vicinity of Taiwan.14 Note that this force includes the bulk of China’s most modern fighters, such as the Su-27.

13A more complete discussion of the JICM representation of the China-Taiwan air war may be found in Appendix B to this report.

14Our assessment is that the PLAAF would have to become much more skillful in employing large groups of aircraft to take maximum advantage of a force of this size. Although it is highly unlikely that such progress could be made by 2005, we believe that principles of conservative planning, from the defender’s point of view, analytically justify our assumption that forces of this size could be used.
Table 2.1

PLAAF Forces Committed to Taiwan Contingency

<table>
<thead>
<tr>
<th>Type</th>
<th>Base Case</th>
<th>Big Force</th>
<th>Advanced Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Su-27 Flanker</td>
<td>72</td>
<td>72</td>
<td>144</td>
</tr>
<tr>
<td>Q-5 Fantan</td>
<td>120</td>
<td>216</td>
<td>0</td>
</tr>
<tr>
<td>JH-7</td>
<td>48</td>
<td>48</td>
<td>72</td>
</tr>
<tr>
<td>J-7 Fishbed</td>
<td>168</td>
<td>288</td>
<td>144</td>
</tr>
<tr>
<td>J-8 Finback</td>
<td>144</td>
<td>288</td>
<td>144</td>
</tr>
<tr>
<td>J-10</td>
<td>24</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>Su-30 Flanker</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>H-6 Badger</td>
<td>48</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>AWACS</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>49</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Totals</td>
<td>679</td>
<td>1,039</td>
<td>679</td>
</tr>
</tbody>
</table>


The “big” force is half again as large as the base case and is meant to represent a strategy whereby the PLAAF forward deploys additional aircraft to take the places of those lost in action. In our analysis, enough of these “attrition replacements” flowed forward on a daily basis to keep 679 jets in action up to the limit of 1,039 total aircraft committed. 15

A second uncertainty we wanted to capture concerns the pace of PLAAF modernization. To reflect this, we created the “advanced” force shown in the table. The same size as the base case, it contains more than twice as many fourth-generation fighters (216 versus 96).

**AA-12 and AMRAAM.** Both China and Taiwan have been actively pursuing the acquisition of modern air-to-air weapons, with China seeking to buy the Russian AA-12/R-77 Adder and Taiwan negotiating for the U.S. AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM). 16 While neither side currently fields such a weapon, it is

---

15This may also overstate Chinese capabilities. We have seen no evidence that the PLAAF has extensively rehearsed rapidly deploying air force squadrons from one base to another, for example.

16In April 2000, the U.S. announced that it would sell AMRAAM to Taiwan but keep the weapons stored in the U.S. until China fielded a comparable capability. Most analysts
certainly possible that one or both will by 2005.\textsuperscript{17} We therefore analyzed four cases of BVR capability: one in which neither side possesses them; a second, in which Taiwan has AMRAAMs (carried by its fleet of F-16s); a third, in which the PLAAF has AA-12s (carried by its Su-27s, J-10s, and, in the advanced case, Su-30s); and the fourth, in which both sides are so equipped. Air forces with BVR weapons were given sufficient stockpiles to last for four days of intensive combat.

**China’s Missile Force.** We explored the potential impact of ballistic missiles on the campaign by postulating two different missile forces for the Chinese. Table 2.2 lists the number of missiles we made available for use in the base case. These are weapons with either advanced unitary high-explosive or cluster munition warheads. Half of the DF-15s also employ GPS-aided guidance (as noted) to increase their accuracy. Half of our cases used these 310 missiles. In the others, we doubled the size of the PRC’s missile force to 620 missiles.

<table>
<thead>
<tr>
<th>Missile Type</th>
<th>Quantity</th>
<th>Range (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF-3</td>
<td>20</td>
<td>2,800</td>
</tr>
<tr>
<td>DF-21</td>
<td>80</td>
<td>1,800</td>
</tr>
<tr>
<td>DF-11</td>
<td>50</td>
<td>280</td>
</tr>
<tr>
<td>DF-15</td>
<td>80</td>
<td>600</td>
</tr>
<tr>
<td>DF-15 with GPS</td>
<td>80</td>
<td>600</td>
</tr>
</tbody>
</table>

SOURCE: Lennox, 1999, and authors’ projections.

\textsuperscript{17}Taiwan does have a number of French MICA missiles deployed on its fleet of Mirage 2000 fighters. The MICA can be fitted with an active radar seeker that, combined with an inertial navigation system, guides it autonomously to targets at short ranges. However, maximum-range launches—the kind preferred by fighter pilots—require the missile to receive targeting updates from the Mirage radar until the active radar can lock on and track the bogey. So, while the MICA is the most advanced AAM currently available to either side, it does not completely fit the description of a true “fire-and-forget” AAM.
We assumed that Taiwan would deploy no effective active missile defenses by 2005.18

**Chinese PGM Inventories.** Another uncertainty regards the number and quality of air-delivered PGMs, such as LGBs and satellite-guided munitions, available to the PLAAF in 2005. In half of our runs, the Chinese employ a very limited supply of about 300 PGMs, a quantity broadly consistent with the very limited capabilities possessed by today’s PLAAF. The other half of our cases featured a much larger Chinese stockpile of 3,000 PGMs for use against Taiwanese targets.

**ROCAF Sortie Generation.** The JICM calculated degradation to sortie generation capabilities resulting from Chinese air and missile attacks on Taiwanese air bases. In case of war, these installations are likely to also be the targets of attacks by Chinese special operations forces (SOF), which could further impede flight operations. Also, the ROCAF has never been called on to maintain a very high tempo under wartime conditions, and we wished to explore the impact of any inability on its part to sustain such intense activity. We therefore used three different levels of ROCAF sortie rates: 100 percent of baseline, 75 percent, and 50 percent.19

**ROCAF Pilot Quality.** Pilot training is a key variable in air combat. Our base case assumption, deriving from unclassified estimates of flying hours and conversations with experts both in the United States and Taiwan, is that a ROCAF pilot is about 80 percent as well-trained as his U.S. counterpart, while a PLAAF flyer is only about half as good as the American. To see what effect pilot skill might have on combat outcomes, in half the cases, we more pessimistically rated ROCAF aircrew as only 60 percent as skillful as U.S. flyers.

---

18It is possible that Taiwan could begin deployment of PAC-3 surface-to-air missiles with improved antimissile capabilities by 2005, but it seems to us doubtful that it could have them operational in sufficient numbers to greatly affect the outcome of the sorts of massive attacks China employs in this analysis.

19In this case “baseline” refers to the sortie generation potential of a base before taking into account any damage from Chinese air and missile attacks. Assume a base is capable of generating 200 sorties per day when undamaged and operating at full efficiency. It would produce 200, 150, and 100 sorties each day at the 100, 75, and 50 percent levels of efficiency. If it had also absorbed 10 percent damage from Chinese strikes, these values would be reduced to 180, 135, and 90, respectively.
**U.S. Forces Engaged.** Even if we assume that the United States would directly assist Taiwan in its defense against invasion, it is unclear how much force would be brought to bear quickly—during the crucial four-day period covered by our simulations. To capture this uncertainty, we used six different levels of direct U.S. combat involvement:

- No U.S. forces engaged.
- A single CVBG operating east of Taiwan.
- A single wing of USAF 72 F-15C fighters stationed at Kadena AB on Okinawa.
- One CVBG and one F-15 wing.
- Two CVBGs.
- Two CVBGs and one F-15 wing.

Operationally, we assumed that the carrier, operating close to the war zone, could surge additional sorties to meet incoming Chinese attacks. The USAF fighters are based so far away, however, that they could not be so responsive; they were assumed to maintain combat air patrol orbits.\(^\text{20}\)

Combining all the possible permutations of these factors (three PLAAF force structures, four BVR cases, two levels of Chinese SSM, two levels of PLAAF PGM stocks, three levels of ROCAF sortie generation, two levels of ROCAF crew training, and six levels of U.S. involvement) yields our 1,728 cases, as shown in Table 2.3.\(^\text{21}\)

---

\(^{20}\)Twenty-five percent of all U.S. fighter sorties, both land- and carrier-based, were withheld for local air defense and other unmodeled missions.

\(^{21}\)Note that each case represents a unique configuration of these seven parameters. Therefore, results across cases do not represent outcome “probabilities” in the sense that they would in, for example, a Monte Carlo analysis. Neither should a small percentage of bases be interpreted as a reason for complacency. The analysis focuses on variables that are neither random nor truly independent; they represent instead the results of policy choices by the actors involved, and several of them are under the control of the Chinese. The results therefore should be read as identifying situations—less well-trained ROC pilots confronting an advanced PRC threat without U.S. assistance, for example—that appear to bode more or less well for Taiwan’s defensive prospects. The bigger the percentage of bad cases, the more such situations there appear to be, and the weaker we would judge Taiwanese defensive capabilities.
Table 2.3
Cases for Exploratory Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Values Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLAAF force</td>
<td>Base, big, advanced</td>
</tr>
<tr>
<td>Advanced BVR capabilities</td>
<td>None, Taiwan only, PRC only, both</td>
</tr>
<tr>
<td>PRC missile force</td>
<td>310, 620</td>
</tr>
<tr>
<td>PLAAF PGMs used</td>
<td>300, 3,000</td>
</tr>
<tr>
<td>ROCAF base sortie rate</td>
<td>100%, 75%, 50%</td>
</tr>
<tr>
<td>ROCAF pilot quality</td>
<td>80%, 60%</td>
</tr>
<tr>
<td>U.S. forces engaged</td>
<td>None, CVBG, FW, CVBG plus FW, 2 CVBGs, 2 CVBGs plus FW</td>
</tr>
</tbody>
</table>

Naval War Methodology

Our more limited analysis of the naval war was undertaken using both the JICM and Harpoon, a computer-based simulation of maritime warfare. Harpoon is widely considered the best commercially available depiction of modern maritime combat. It includes representations of submarine, surface, and air warfare.

This study also benefited from numerous discussions with area experts, analysts, and military officers in the United States and overseas. Particularly useful were the insights gathered on a trip to Taiwan, hosted by the ROC Ministry of National Defense (MND). The information gained in these exchanges helped shape the inputs to the analysis and was critical in helping us understand its results.

Caveats

This work explores only a very limited region of what is often referred to as the “scenario space.” We concentrated on one specific scenario involving one particular Chinese offensive strategy, and we selected the factors to vary based on our reading of the extant literature on the China-Taiwan balance as well as discussions with experts in the United States and elsewhere. We also focused our attention on what might be thought of as “reasonable” cases: those reflecting current capabilities, linear projections of current capabilities, and capabilities conceivably attainable within our limited time frame. To do otherwise would have required a level of effort well beyond the scope of this
project and one inconsistent with its goal of providing insights into U.S. options for improving Taiwan’s self-defense capabilities.

As such, we present these results as *illustrative* and *indicative*, meant to highlight and illuminate certain key points that emerged from our overall analysis. We ask the reader to bear this in mind throughout this report.

**ORDERS OF BATTLE**

Because five years is not a particularly long span of time in terms of military capabilities, much of the two sides’ respective arsenals in our scenario resides already in their inventories. So, the orders of battle we used consist mainly of familiar systems.

**Air, Air Defense, and Missile Forces**

Table 2.4 shows the composition of the ROCAF used in the analysis. It includes almost 350 modern combat aircraft (plus eight E-2Ts and 44 miscellaneous aircraft). As noted earlier, we varied the size and composition of the committed fraction of the PLAAF (as shown in

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-16A/B</td>
<td>162</td>
</tr>
<tr>
<td>Mirage 2000</td>
<td>54</td>
</tr>
<tr>
<td>Ching Kuo IDF</td>
<td>126</td>
</tr>
<tr>
<td>E-2T AWACS</td>
<td>8</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>44</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>394</strong></td>
</tr>
</tbody>
</table>


---

As of spring 2000, the ROCAF is experiencing continued difficulties integrating the F-16 into its force structure; the entire fleet has been grounded on several occasions. We assume that these teething problems will have been overcome by 2005.
Table 2.1) to reflect uncertainties in both the proportion of the PRC’s forces that would be engaged in an attack on Taiwan and the results of Beijing’s modernization efforts.

Table 2.5 lists the surface-to-air order of battle for Taiwan’s integrated air defense system (IADS).\textsuperscript{23} In the event of war, the radars and C\textsuperscript{2} elements for these systems would likely be high-priority targets for Chinese missiles and SOF. We have already discussed the numbers and kinds of SSMs employed by China in the scenario (Table 2.2 above).

**Naval Forces**

Tables 2.6 and 2.7 list the naval forces we used for each combatant.\textsuperscript{24} As with the air forces, the table shows only that portion of the PLAN that we assumed would be committed to the attack on Taiwan. Again, as with the air force, it includes the bulk of the navy’s modern combatants.

The tables show the ROCN to be outnumbered in terms of surface warships by 65 to 37. However, by and large, Taiwan’s navy holds a significant qualitative edge over the PLAN:

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of Batteries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patriot PAC-2</td>
<td>9 (6 quad launchers each)</td>
</tr>
<tr>
<td>Improved Hawk</td>
<td>36 (18 triple launchers each)</td>
</tr>
<tr>
<td>Tien Kung</td>
<td>6 (6 quad launchers each)</td>
</tr>
</tbody>
</table>

**Table 2.5**

Taiwan Surface-to-Air Order of Battle

---

\textsuperscript{23}The Tien Kung is a Taiwanese-produced Patriot-like SAM. We did not model Taiwan’s numerous low-level air defense systems, such as Chaparral and Avenger.

\textsuperscript{24}The size of the PLAN’s submarine fleet, and particularly the number of Kilos it could field by 2005, appears to be exaggerated in our order of battle. However, our assessment is that the results we saw in our naval combat simulations would not be particularly sensitive to the precise number of Chinese subs engaged; in any event the PLAN would field far too many for the ROC Navy (ROCN to effectively cope with.
Table 2.6
Taiwanese Naval Order of Battle

<table>
<thead>
<tr>
<th>Class</th>
<th>Type</th>
<th>Qty</th>
<th>SSM</th>
<th>SAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chien Yang</td>
<td>DDG</td>
<td>7</td>
<td>4 x Hsiung Feng II</td>
<td>10 x SM-1R</td>
</tr>
<tr>
<td>Fu Yang</td>
<td>DD</td>
<td>2</td>
<td>5 x Hsiung Feng I</td>
<td>4 x Sea Chaparral</td>
</tr>
<tr>
<td>Po Yang</td>
<td>DD</td>
<td>1</td>
<td>5 x Hsiung Feng I</td>
<td>—</td>
</tr>
<tr>
<td>Kun Yang</td>
<td>DD</td>
<td>3</td>
<td>5 x Hsiung Feng I</td>
<td>4 x Sea Chaparral</td>
</tr>
<tr>
<td>Cheng Kung</td>
<td>FFG</td>
<td>8</td>
<td>8 x Hsiung II</td>
<td>40 x SM-1R</td>
</tr>
<tr>
<td>Kang Ting</td>
<td>FFG</td>
<td>6</td>
<td>8 x Hsiung II</td>
<td>4 x Sea Chaparral</td>
</tr>
<tr>
<td>Chin Yang</td>
<td>FFG</td>
<td>10</td>
<td>4 x Harpoon</td>
<td>—</td>
</tr>
<tr>
<td>Hai Lung</td>
<td>SS</td>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>


Table 2.7
Chinese Naval Order of Battle

<table>
<thead>
<tr>
<th>Class</th>
<th>Type</th>
<th>Qty</th>
<th>SSM</th>
<th>SAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sovremenny</td>
<td>DDG</td>
<td>2</td>
<td>8 x SS-N-22</td>
<td>48 x SA-N-7</td>
</tr>
<tr>
<td>Luhai</td>
<td>DDG</td>
<td>2</td>
<td>16 x C-802</td>
<td>8 x Croatale</td>
</tr>
<tr>
<td>Luhu</td>
<td>DDG</td>
<td>2</td>
<td>8 x C-802</td>
<td>8 x Croatale</td>
</tr>
<tr>
<td>Luda III</td>
<td>DD</td>
<td>1</td>
<td>8 x C-801</td>
<td>—</td>
</tr>
<tr>
<td>Luda II</td>
<td>DDG</td>
<td>11</td>
<td>6 x C-201</td>
<td>8 x Croatale</td>
</tr>
<tr>
<td>Luda I</td>
<td>DDG</td>
<td>14</td>
<td>6 x C-201</td>
<td>8 x Croatale</td>
</tr>
<tr>
<td>Jiangwei</td>
<td>FFG</td>
<td>6</td>
<td>6 x C-802</td>
<td>6 x HQ-61</td>
</tr>
<tr>
<td>Jianghu</td>
<td>FF</td>
<td>27</td>
<td>4 x C-201</td>
<td>—</td>
</tr>
<tr>
<td>Han</td>
<td>SSN</td>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Type 93</td>
<td>SSN</td>
<td>2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Song</td>
<td>SS</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Kilo</td>
<td>SS</td>
<td>10</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Ming</td>
<td>SS</td>
<td>4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Romeo</td>
<td>SS</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>


- Taiwan’s 14 Cheng Kung and Kang Ting frigates—modified versions of the U.S. Oliver Hazard Perry and French Lafayette classes, respectively—are probably the most modern and well-balanced combatants available to either side.

- The PLAN’s two Russian-built Sovremennys carry the very dangerous SS-N-22 “Sunburn” sea-skimming antiship missile. However, it appears that the Chinese will only be acquiring two hulls
of this class, whose AAW and ASW capabilities are less impressive than those fitted to both the *Cheng Kung* or *Kang Ting.*

- In terms of antiship missile mounts, the PLAN holds a 366 to 210 edge. Almost half of the Chinese missiles are obsolescent C-201s; however, this missile is large, slow, and vulnerable to countermeasures and such close-in weapons systems as the Phalanx guns that equip nearly all ROCN combatants. Most of the ROCN missiles, meanwhile, are more-modern types, such as the Hsiung Feng II, which is broadly similar to the U.S. Harpoon.

- The *Cheng Kung* frigates along with the aging *Chien Yang* destroyers (former U.S. *Gearing* class) are equipped with the Standard SM-1 medium-range air defense system, which has significantly longer range and more capability than any SAM in the PLAN’s arsenal.

If the surface forces appear evenly matched, it is quite a different story beneath the waves. Beijing has applied enormous political pressure to prevent foreign suppliers from selling attack submarines (SS) to Taiwan, which has no indigenous submarine production capacity. So, the ROCN’s two *Hai Lung* boats (Dutch *Zwaardvis* class) are left to confront a much larger number (24 in our scenario) of PLAN submarines. Although many of the Chinese submarines are older and less capable, the *Kilo* and *Song* classes are fairly advanced, and the Type 93 SSN is expected to be similar to the Russian *Victor II* class in performance. Although not nearly in the class of the very latest U.S. or Russian SSNs, the Type 93 will nonetheless be by far the most capable sub ever deployed by the PRC. Combined with the acoustic qualities of the Taiwan Strait, which make it a nightmare for ASW operators, this disparity could have a telling impact on the battle for maritime control.

---

25In the long term, the Chinese may be able to adapt other surface combatants to fire the SS-N-22. However, we think it highly unlikely that they will be able to do so by 2005. Also, there are reports that Moscow has agreed to sell China two more ex-Russian Navy *Sovremennys.* See Novichkov, 2000.
Command and Control

The analysis required many assumptions and the problem frequently arose as to how much credit to give the protagonists for various capabilities. We decided to credit both sides with taking measures to increase their competence in critical areas. Because of these assumptions, our analysis is less a current net assessment of actual capabilities on the two sides than an assessment of reasonable potential capabilities with given orders of battle.

In particular, we credited the Chinese with more capability than they have demonstrated in conducting complex offensive operations. PLAAF training and exercises have not typically featured large numbers of aircraft engaged in coordinated activities, and there have been no recorded joint exercises that even approached the complexity of a Taiwan invasion scenario. Hence, we are probably being rather conservative (from a Taiwanese planner’s perspective) in crediting the mainland with the ability to execute such an intricately choreographed air and missile operation.26

We also assumed that Taiwan would be able to maintain the basic functionality of its C2 system even under the stress of a concerted PRC attack.27 To the extent that it relies on fixed surveillance radars and unhardened command posts, the ROC’s new “Strong Net” air-defense system will continue to be vulnerable to air, missile, and SOF attacks.

That said, given the small size of the battlespace and the large number of forces engaged, it seems reasonable to assume that each side’s combat jets and warships could “find the fight.” As explained in Appendix B, we constrained both sides’ aircraft in a manner we believe to be consistent with their likely performance in a “target-rich” combat environment under conditions of imperfect C2.

26The PLAAF last engaged in air-to-air combat during the 1958 Taiwan Strait crisis. The results were not encouraging for Beijing: the Chinese were unable to gain air superiority over the strait and, according to USAF statistics, suffered 32 combat losses to only three for the ROCAF. See Allen, Krumel, and Pollack, 1995, pp. 61–69.
27Including possible, but unmodeled, information warfare operations.
PLAYING OUT THE SCENARIO

Overview

Our analysis suggests that any near-term Chinese attempt to invade Taiwan will likely be a very bloody affair with a significant probability of failure. Leaving aside potentially crippling shortcomings that we assumed away—such as logistics and C² deficiencies that could derail an operation as complex as a “triphibious” attack on Taiwan—the PLA cannot be confident of its ability to win the air-to-air war, and its ships lack adequate antiair and antimissile defenses. Provided the ROC can keep its air bases operating under attack—a key proviso we discuss at length in Chapter Three—it stands a good chance of denying Beijing the air and sea superiority needed to transport a significant number of troops safely across the strait.

The War in the Air

Although we varied the particulars of the Chinese strategy across runs, the air battle was laid out roughly as follows:

- An initial barrage of Chinese tactical ballistic missiles (TBMs) aimed at early warning radars, SAM sites, and airfields.
- A wave of Chinese fighters performing a sweep over the strait and the island.
- A large, escorted strike package going after coastal defense, air defense, and airfield targets.
- A second fighter sweep approximately four hours later.
- A third sweep followed by a second wave of strikes four hours after that.²⁹

This pattern was repeated for four days.³⁰

______________
²⁸Amphibious, airborne, and air assault.
²⁹Given the known capabilities of the two sides, we constrained the air war to daylight only.
³⁰The four-day campaign length was arrived at experimentally—our preliminary model runs indicated that the air battle tended to resolve itself one way or another by that time. This should not be interpreted as suggesting that one or the other side is likely to
We scored the air war in each of our model runs using the PRC-ROC exchange ratio—the number of mainland Chinese aircraft shot down for every Taiwanese plane lost—as the measure of merit. While an imperfect indicator, it does provide some feel for the overall direction and dynamics of the air battle.

Each outcome was evaluated based on the opening ratio of the two sides’ committed air forces (679:394, or 1.72:1 in the base and advanced variants, 1,039:394, or 2.63:1 for the big threat case) and the total losses after four days of combat. Cases in which the ROC achieved an exchange ratio 50 percent greater than the opening force ratio (2.58:1 in the base and advanced cases and 3.95:1 in the big cases) were scored as “green” (which appears as black in the figures), meaning that Taiwanese forces could almost certainly deny the PRC a viable invasion opportunity. When the final exchange ratio was less than the “green” threshold but greater than the opening force ratio (1.72 or 2.63), we counted the outcome as “yellow” (medium gray), meaning that the ROC was at least holding its own and could probably deter or defeat a landing attempt. Any case in which the exchange ratio dropped below the “yellow” threshold was counted as “red” (light gray), meaning that the PRC could plausibly mount an invasion attempt.

Figure 2.1 shows how all the model runs scored out, broken out by the size and quality of the PRC air forces brought to bear. Almost 90 percent of the trials against the base PRC threat resulted in Taiwanese “victories”—that is, the outcome of the air war seemed likely to prevent a successful invasion attempt. Even when China was permitted to bring more of its airpower to bear, about 75 percent of
give up after a few days of pitched fighting. Indeed, if Taiwan were left to stand alone against the mainland, China would stand a relatively good chance of grinding down the ROC’s defenses in a protracted war of attrition. Our work does not address that potential course of events.

As RAND colleague Paul Davis reminds us, this calculation generates what is known as a “ratio of fractional loss rates,” which “determines who wins the battle in a deterministic drawdown” according to the Lanchester square law.

Note that we do not mean that a “red” outcome means that a Chinese invasion would succeed; only that the results of the air battle would not necessarily preclude a viable attempt.

“All runs” include those both with and without direct U.S. involvement. We will dissect the effects of that and other key factors here and in the next chapter.
the outcomes favored Taiwan. However, results were very different when the scenario pitted Taiwan against the more modernized “advanced” mainland force. Only about half of these runs resulted in defense-favorable outcomes.  

To make sensible recommendations for improving Taiwan’s defensive posture, we need to understand what drives the “bad” outcomes. Table 2.8 shows how our six experimental parameters contributed to each of the “red” cases reported in Figure 2.1. 

Against the most likely PRC force, the base case, we see that limited U.S. involvement is a factor in every bad case, and both Red BVR
superiority and suppressed ROC sortie generation play a role in 80 percent of the “red” outcomes. Put differently, we ran 288 simulations against the base threat in which “BVR parity” was maintained (neither or both sides having AA-12/AMRAAM); of these, only 13 (less than 5 percent) resulted in “red” outcomes. Of 192 cases in which the ROC was able to fly sorties unimpeded against the base threat, only 13 (about 7 percent) results were coded as bad for Taiwan.37

Against the big threat, limited U.S. involvement remains the best predictor of a bad outcome, and BVR parity is still critical as well, with less than 15 percent of cases in which either both or neither side had advanced AAMs producing “red” results. Less than 20 percent of the cases in which Taiwan had full sortie generation capability wound up in the “red” category.

As might be expected, the advanced threat produced the most diffuse results; the overall quality of the PLAAF force projected here makes it a much tougher adversary even absent any degradations being imposed on Taiwan. Nevertheless, we see that suppressed sortie generation and limited U.S. involvement are still implicated in more than 60 percent of the poor results.

All cases were characterized by extraordinarily high attrition rates, revealing an air war of great intensity and unprecedented attrition. The median loss rates for the two sides after four days of combat

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Base Case</th>
<th>Big Threat</th>
<th>Advanced Threat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited U.S. involvement</td>
<td>100%</td>
<td>81%</td>
<td>62%</td>
</tr>
<tr>
<td>PRC BVR superiority</td>
<td>80%</td>
<td>71%</td>
<td>51%</td>
</tr>
<tr>
<td>ROC sorties suppressed</td>
<td>80%</td>
<td>75%</td>
<td>64%</td>
</tr>
<tr>
<td>Poor ROC training</td>
<td>67%</td>
<td>65%</td>
<td>54%</td>
</tr>
<tr>
<td>More PRC TBMs</td>
<td>56%</td>
<td>52%</td>
<td>51%</td>
</tr>
<tr>
<td>More PRC PGMs</td>
<td>56%</td>
<td>54%</td>
<td>48%</td>
</tr>
</tbody>
</table>

37Remember that PRC missile and air attacks had an effect on Taiwanese sortie generation distinct from the exogenous reductions we imposed as an analytical parameter.
were about 75 and 45 percent for the PRC and ROC, respectively. With Chinese missiles and air strikes suppressing a significant proportion of Taiwan’s land-based air defenses, the overwhelming majority of these kills came in air-to-air encounters.

Over the four days, the Chinese sustained on average about a 30 percent per sortie attrition rate, while the ROCAF absorbed about 15 percent per sortie. Both numbers are extremely high by historical standards. On the second day of the 1973 Arab-Israeli war, for example, the Israeli Air Force (IAF) lost 22 aircraft in 488 sorties, a 4.5 percent loss rate. In the war as a whole—widely regarded as a catastrophe for the IAF—the Israelis lost 108 aircraft in 7,290 sorties, about a 1.5 percent attrition rate, a factor of 20 smaller than that inflicted on the Chinese in our simulation (Nordeen, 1990, p. 146).

Could these astonishing loss rates represent a reasonable characterization of a near-term China-Taiwan air battle? Perhaps the most instructive historical analog to the China-Taiwan clash we are analyzing would be the Battle of Britain. That campaign, like this one, was intended to pave the way for an invasion. Also like our fictional war over the strait, the Battle of Britain was largely fought in a confined space, over the English Channel and southeastern England. Finally, the general flow of the two battles are similar: the Germans and Chinese each launched large raids of bombers and fighters against which the defending side would mass as strong a challenge as it could.

Even the Battle of Britain, however, did not see losses of the scale we portray in the China-Taiwan air war. The most intense day of fighting in the Battle of Britain was probably August 15, 1940, when the Luftwaffe flew 1,786 sorties. Although losses on both sides were heavy—the British lost 35 aircraft and the Germans 76—the Luftwaffe’s per-sortie attrition rate amounted only to 4.2 percent (Terraine, 1985, pp. 186–187).

---

38 The median figures are quite close to the means: 12 percent for the ROC and 30 percent for the PLAAF.

39 Taiwan itself covers less than 36,000 square kilometers, which is a little smaller than Maryland and Delaware combined. Roughly double this figure to cover almost all of the strait, and the resulting area is about halfway between West Virginia and South Carolina in size (U.S. Central Intelligence Agency, 1999).
That having been said, it should be noted that there have been examples of extremely heavy attrition in air warfare. On August 17, 1943, 315 bombers from the U.S. Eighth Air Force (8th AF) set out from bases in England to attack the German ball-bearing factory at Schweinfurt; 60 (19 percent) did not return. In October of that year, the 8th AF flew 1,200 sorties in four raids over a period of seven days; 148 bombers were lost, a 12.4 percent attrition rate per sortie (McFarland and Newton, 1991, pp. 127–129). This number is beginning to look more comparable to those racked up in our analysis.

The Battle of Britain analogy may yet prove useful. Consider that battle, refought with modern sensors, aircraft, and weapons. In 1940, radar was in its infancy, and none of the aircraft in the battle had onboard sensors other than the pilot’s eyes. The main armament on each side were the .30-caliber and 7.62-mm machine guns, firing unguided projectiles with an effective range measured in hundreds of yards. There were no airborne warning and control (AWACS) aircraft and no data links to permit efficient target allocation. The Germans typically flew a single daily raid, while the Chinese in our campaign are mounting five waves each day. Clearly, a modern rendition of the Battle of Britain—with hundreds of radar-equipped jets engaging one another with long-range AAMs under the direction of both airborne and ground-based controllers—would very likely be a much more lethal environment than was the original.40 In this context, loss rates several times those recorded at the height of the struggle between the RAF and Luftwaffe may be quite credible.41

40The radar in the ROCAF Ching Kuo Indigenous Defense fighter (IDF) is credited with a search range of about 150 kilometers. Assuming it scans a 90-degree arc in front of the aircraft, a single aircraft can track targets over an area of about 18,000 square kilometers, or nearly one-quarter of the entire aerial battlefield. Given limitations on vertical scan, the proportion of the total volume surveyed would be significantly less, but each IDF pilot would still be looking at a considerable wedge of the total battle space. IDF data from Jackson (1998, p. 486).

41To the extent that our analysis overestimates Chinese capabilities—which it almost certainly does—it likely also overestimates both sides’ losses. To a lesser degree, we may also be giving the ROCADF more credit than it deserves, particularly for being able to sustain operations under attack. This too would result in exaggerated kill rates. Thus, we would not necessarily expect to see such extraordinary losses racked up in a real-world showdown between China and Taiwan. Nevertheless, for the reasons we describe, we would expect the air war between the two sides to feature much greater attrition, in terms of loss rates, than have been seen in perhaps any other air war.
The War at Sea

As our work progressed, it became clearer and clearer that the air war held the essential key to the scenario. Further, the analysis suggested that Taiwan could, if proper steps were taken, have a reasonable degree of confidence in its ability to defeat a Chinese air offensive and thereby prevent a successful invasion. So, our weight of effort gradually shifted to focus increasingly on understanding the air campaign, with commensurately less attention being invested in the naval war. Nonetheless, a few points of interest are worthy of note.

As in the air war, the naval contest in the strait would be very, very bloody. Each side’s navy has substantial weaknesses—the ROCN’s lack of submarines and the PLAN’s limited air defense capabilities—that quickly turn the constricted waters of the Taiwan Strait into a warship graveyard. Our analysis is not sufficiently exacting to support specific attrition estimates, but if the two navies were to meet head-on in the strait, neither could expect an easy victory, and the Chinese certainly cannot be confident of winning.

Our base case pitted the ROCN against the main battle units of the PLAN in an initial battle beginning on D day. After this has run its course, the invasion fleet, consisting of lightly escorted assault task groups screened by numerous small combatants and missile craft, begins to move across the strait. In this variant, PLAN submarines took a heavy toll of ROC surface combatants. As noted above, the strait is a terrible ASW environment. It is doubtful that Taiwan’s fixed- and rotary-wing ASW aircraft will be able to operate effectively in the midst of the air battle roaring around them. And, even the ROCN’s better ASW surface platforms, such as the modern Cheng Kung and Kang Ding frigates, may be overwhelmed by the combined air, surface, and subsurface threats.

Another major problem facing both sides will be targeting. Airborne surveillance platforms will be a prime target for the other side’s antiair operations, and both sides will likely employ heavy jamming and other electronic warfare techniques. Hence, weapons may not be employed at maximum standoff range, and fratricide will certainly be a concern. The side best able to keep a clear and coherent picture of the evolving battle will stand the better chance of prevailing.