A Fascinating Future-History Simulation Game

the time is: Tomorrow

Jaws of the Dragon

Modern War in the Pacific

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EVAN
2000

Rulebook

Jaws of the Dragon Rulebook

Powered By Evan's Wargaming Operational Kampaign System (EWOKS) v6.0
Semi-Rigid Kreigspiell Rules Written by Evan D'Alessandro © 2026[1]

A 0 on a d10 is a 10

Assumptions

1 turn = 1 day
1 hex (Operations Map) = 100 miles, which is 161 km or 87 nm
1 hex (Taiwan Map) = ~ 1/6th of a hex on the Operations map = ~ 17 miles = 30 km

Unit	Constituent Units	Missiles (25/salvo)[2]	Notes
CSG	1 carrier + 4-5 ships[3]	4 Atk., 12 Def. 7/13 Sqdn. Strikes	~400 VLS cells. NOTE: Subs for the purposes of this are not included as part of a CSG counter. US Carriers, 13 squadron strikes worth of munitions, other carriers 7 squadron strikes[4]
ESG	2 amphib + 4-5 ships	4 Atk., 12 Def.	1 embarked marine bn. landing team. ~400 VLS cells.
SAG	4-5 ships	6 Atk., 10 Def.	Roughly 400 VLS cells.
Missile Boats	6 Missile Boats[5]	1 Atk.	Any sort of ships using hit and run tactics (incl. corvettes, frigates)
Nuke Sub	1 submarine	1 Atk. (Seawolf only, LACM)	US subs (LA, Virginia) tend to have 12 LACM, Seawolfs carry 50 torpedoes/LACM
Diesel Sub	1 submarine		
SSGN	1 submarine	6 Atk. (LACM)	
Land Units	Brigade Size		Logistics, air defense, etc. abstracted. While frontages are quite wide here 2 units per hex on the Taiwan map would allow for a "continuous line" to be formed.[6]
MLR/MDTF	N/A	1 Atk.	For missile numbers see endnote
Air Units	Squadron		12-16 x 5th Gen aircraft, 16-18 all other gens per sqdn. Large aircraft (Tankers, AEW, transport) 9 aircraft/squadron (to match the amount of tarmac space taken up by small jets)
Bombers	US 6, Chi. Regiment		# based around 100 missiles, B-1's can carry 24, B-52's 20, B-2's 16,[7] HK-6's can carry 6 YJ-12

Movement

Unit	Movement	Notes
CSG, ESG, SAG, Missile Boat	6 hexes/day	Assuming speed of 25 knots max.
Nuclear Submarines	3/6* hexes/day	*Nukes can sprint 6, but more detectable (diesels may not sprint). Normal slow speed + need to get coms limits stealthy movement.
Deisel Submarines	2/3* hexes/day	*Diesels can sprint 3, but become more detectable.
Land Units (Rotating)*	0 [1] hexes/day	
Land Units (Cross Country)*	1 [5] hexes/day	
Land Units (Road)*	2 [11] hexes/day	TRADOC Pamphlet 350-14, September 1994, Heavy Opposing Force (OPFOR) Operation Art Handbook[8]
Land Units (Rail)*	5 [27] hexes/day	TRADOC Pamphlet 350-14, September 1994, Heavy Opposing Force (OPFOR) Operation Art Handbook[9]
(Dis)Embark Brigade on Ships	Load ½ Brig/day/port	Assumes simultaneous loading of all ships for the brigade, and that ships are ideal ships for such use[10]
Squadron changing Air Sectors	2 (US) / 3 days	Represents teeth element deployment, followed by supporting elements.[11]

Numbers in [#], are the numbers for use on the Taiwan map with its smaller hexes.

Weather[12]

Represents predominate weather conditions for each Air Sector.

Clear
- No Effects.

Rain/Heavy Clouds
- Tracking rolls have -2, all Air Strikes have a 30% chance to Abort.
- Sub detection -1
- Anphib Operations at -1 column shift.

Storms
- Tracking rolls have -4, 50% Air Strikes abort.
- Missile boats may not attack.
- -1 column shift on all Ground Unit Attacks
- Sub detection -4
- No anphib/air assaults
- No MCM actvivity
- Ship speed -1 hex

Optional Rigid Turn Sequence:
Detection/Tracking ▶ Cyber/Space/SOF ▶ Salvo Missile Fire ▶ Air ▶ Sea ▶ Land

Detection (d10)[13]

Approximate locations of units in hexes are always known (e.g. the unit block is in the hex), sea units can only be engaged however if they are detected.

Only detected units may be attacked.

Surface Ships (CSG, ESG, SAG):

- If inside the First Island Chain, on a d10 roll the # of hexes or higher to the nearest friendly country or carrier to detect.
- If outside the First Island Chain, roll a d10. On a 9 or 10 they are detected. +1 if the target is a carrier conducting flight operations.[14]
- If ships are in the same hex they are detected[15]
    - Exception: Submarines must roll a 10 to detect surface combatants in the same hex.[16]
    - Exception: Missile boats must roll 5+ to detect other ships).
- Ships in port are always detected.
- Ships defending a beachhead are always detected.
- Carriers detect all adjacent hexes, and may roll 1 dice per squadron to detect a hex in range of their aircraft, needing 4+ to detect.

Note that if multiple CSG, ESG, SAG are operating in a group together, roll once for each set of ships (CSG, ESG, SAG), if any are detected, the rest of the group is detected to.[17]

Submarines

- See the detection section of Undersea Combat.

Land Units and *Air Units* are always tracked.[18] Exception: MDTF's and MLR's must be tracked to be engaged by rolling a 9+.[19]

Sea Movement[20]

Unit	Movement	Notes
CSG, ESG, SAG	6 hexes/day	
Submarines (Nuke)	3/6 hexes/day	May sprint up to 6, but more detectable.
Submarines (Diesel)	2/3 hexes/day	May sprint 3, but more detectible. If not moving may bottom sit (not move) in water <250m deep[21] to decrease detectability.

Aircraft Carriers Munitions Storage

Carriers have the following amount of munitions stored onboard (separate from ammo on ammunition ships)

Carrier	*Squadron Strikes of Munitions**
US Carriers	13
All Others	7

*1 strike by 1 squadron consumes 1 squadron strike of munitions *(read that 5 times fast!)*.

Munitions and VLS can be fully refilled by spending 1 day in port.

Sea Combat (d10)[22]

Missile Ranges (***MUST HAVE DETECTED ENEMY TO SHOOT***)

Important Info		***Other Info***
Missile Type	**Range**	***Notes***
Chinese AShM	2⬣	*95 missiles/salvo. Assumed to be either YJ-12 (supersonic) or YJ-91 (sea skimming, supersonic), average range is about 200mi (2 hexes).*
Chinese Missle Boat	1⬣	*Assuming YJ-83 (max. 150 mi range), less range due to sea state or lower onboard targeting ability.*
US AShM	1⬣	*115 missiles/salvo Assumed to be sea skimming. Either SM-6, SLAM-ER, or Naval Strike Missile.*[23]
Sub AShM	1⬣	*# of missiles/salvo is dependent on nation. Have to have better targeting so must be in same hex.*
C Carrier J15	4⬣ (3⬣+1⬣)	*J-15 combat radius is 647 nautical miles, though at full combat load launching from a carrier it's going to be shorter due to the weight restrictions of the STOBAR system of Chinese Carriers.*[24] *(3⬣) firing YJ-83 (NOT YJ-12), so +1 hex of range. 24 missiles fired* [25]
US Carrier F-18	6⬣ (5⬣+1⬣)	*F-18 combat radius w/ drop tanks is ~450 nautical miles (5⬣).*[26] *Firing US ASHM, see note above.*
US Carrier F-35	6/8⬣ (6⬣+2⬣)	**8⬣ w/ LRASM Salvo Only.** *F-35 combat radius is 1000km*[27]*(600mi) (7⬣). Firing US ASHM, see note above.*
Chinese LACM	18⬣	*? missiles/salvo, ~30. Based on CJ-10 Range*[28]
US LACM	10⬣	*30ish missiles/salvo. Based on Block IV/V Tomahawk (900 nm range)*[29]

Roll type = Offensive missiles – ½ Defensive missiles* *(e.g. 2 defensive missiles salvos cover 1 offensive)*[30]

*If incoming misses are subsonic, it is 1 defensive missile is instead of 1/2.[31]

D10 Roll[32]	- 1 -	- 2 -	- 3 -	- 4 -	- 5 -	- 6 -	- 7 -	- 8 -	- 9 -	- 10 -
If Defense is equal, + missiles left in magazine[33]	–	–	–	–	–	–	–	–	*1* ☠	*1* ☠
If Defense is equal	–	–	–	–	*1* ☠	*1* ☠	*1* ☠	*1* ☠	*2* ☠	*2* ☠
If Defense less than (roll once for each unit in the task force)	*1* ☠	*1* ☠	*2* ☠	*2* ☠	*3* ☠	*3* ☠	*3* ☠	*3* ☠	*3* ☠	*3* ☠

Excess damage carries over to other units in the same task force.

Type	1st Damage	2nd Damage[34]	3rd Damage[35]
SAG	• Loose half (1/2) missiles • ASW effectiveness decreased.	Sunk/Mission Kill[36]	-
CSG (Carrier)	• Loose half (1/2) missiles	• Lose remaining missiles • Speed one-half (1/2) • Half (1/2) sortie generation • ASW effectiveness decreased.	Sunk/Mission Kill
ESG (Amphib)	• Loose half (1/2) missiles • Carried units ¼ damaged	• Lose remaining missiles • Speed one-half (1/2) • Carried units ½ damaged • ASW effectiveness decreased	Sunk/Mission Kill
Missile Boat Squadron	• Loose half (1/2) missiles	Sunk/Mission Kill	-

Submarine Combat (d20)[37]

Movement and Stacking

MOVEMENT: Submarines may opt not to move but instead remain in place. Doing so they do not move but rather they gain movement that they can use on later turns. Turn them 90˚ to mark 1 turn of unused movement, and 180˚ 2 turns of unused movement. A sub may never store more than 2 turns of movement. When the submarine opts to move it can move using stored movement. However, if the sub moves into a hex where it might be detected, it must stop and end its movement there. If a sub with stored movement has detection attempts made against it, it immediately loses all stored movement and remains in the hex it was in.[38] **STACKING**: No more than 2 submarines of allied nations may be present in the same hex, not counting submarines operating with a ship group.[39]

Using the Detection Table

Action	Detection Type
The sub attempts to attack, provides cuing for a strike, or shadows a unit.	ASW table below.
For each enemy unit w/ detection capabilities (Sub, CSG, ESG, SAG) the sub is in the same ⬢ as, or if sub launches a missile attack in the same ⬢.	Roll a d20: on a 20 the sub has been detected.[40]
Per MPA unit operating in hex	Table column *ASW Fixed Wing.*[41]
The Sub is in a hex with an enemy port.	Table column *ASW Fixed Wing*
Chinese sub enters US hydrophone hex.	ASW table notes below.

Detection

Roll equal to or higher than the # on a d20 to detect the target. Modifiers for stacking advantage/disadvantage:[A]

- **Sub is sprinting** – advantage to detect sub.[42]
- **Ship moved more than 3 hexes** – disadvantage for ships detecting.[43]
- **Searching unit is damaged** – disadvantage for damaged units.
- **SSK is bottom sitting** – disadvantage to detect SSK.[44] (assume bottom sitting if the diesel did not move this turn and is in shallow water)
- **Shallow Water[45] (less than 250m)** – disadvantage to detect submarines
- **Storms in Area[46]** – disadvantage to detect submarines

ASW Table (d20)[47]

	Chinese*			US/Allies			Platforms	
Hunter ▸ Hunted ▾	Nuke Sub	Diesel Sub	SAG ESG CSG	Sub or SURTASS	SAG	CSG[48] or ESG	Counter fire	ASW Fixed Wing (1✈)[49]
Seawolf	17	16	18	–	–	–	16	20
Virginia	16	15	17	–	–	–	16	20
Los Ange	15	14	16	–	–	–	13	20
C Nuke	–	–	–	6	11	10	7	20
C Diesel	–	–	–	5	11	8	6	19
C SSBN	–	–	–	6	11	10	5	20
Sōryū	15	14	16	–	–	–	12	20
	US hydrophones detect on 7+ in the hex they are in[50] * If inside Chinese hydrophone line add +1						May attacked detected target.	

Attack Table[51]

- *The sub that rolled the lower number that successfully detected attacks first*[52]
- If sub is defending a *moving* surface target, the defending sub must be engaged first before the surface target can be engaged, unless the attacker is bottom sitting.[53] (only SSN's may defend moving targets this manner)[54]
- For Subs vs. Subs *and* ASW vs. Subs. If sub shoots at another sub that had not detected the attacker, use Counterfire to see if shooting sub is detected, and the attacked sub can fire in response.

D20 Roll	1 to 10	11 to 20
Atk. vs. Subs	*Sub Escapes, may not attack again this turn.*	*Sub Sunk*
Atk. vs. Surface	*No effect*	*1 Damage Caused to Surface Group*[55]

[A] Advantage = roll a second die and use the higher number. Disadvantage = roll a second die and use the lower number. *(Note that rolling twice on a d20 is approximately equivalent to +/-3.3)*

Air Movement

Unit	Movement	Notes
Squadron Switching Sectors (US)	2 days[56]	Represents teeth element deployment, followed by supporting elements. REQUIRES TANKERS OR BUDDY TANKING IF NOT CHINESE[57]
Squadron Switching Sectors	3 days[58]	
Taiwanese Aircraft Dispersal	2d4 days[59]	Dispersal of aircraft to civilian airports, highway sites, etc.
Reorganize	1 day	Merge two damaged units into 1.

Air Combat (d20, d12, d10, d8)[60]

Carrier Air uses a range system rather than sector system, see Sea Combat for details.

Squadrons[61] can take 3 hits[62] before being destroyed (e.g. on the 3rd attrition result the unit is destroyed).

Squadrons can be used to conduct one of the following missions[63] per turn in their Air Sector:[64]

Teeth Aircraft	***Support Aircraft***

• **Fight for Air Supremacy**[65] – All squadrons dedicated to fighting for air supremacy are paired up at random with Enemies and then roll on the Air-to-Air Table for resolution.
   o Squadrons that are unpaired 1:1 can be reassigned or can gang up in other fights (max 3:1, or if stealth 2:1)
• **Intercept Strikes**[66] – Can attack one strike and its escorts (EXCEPTION: Carrier air may intercept all strikes on their carrier[67]). Battles any escorting fighters as if Fighting for Air Supremacy. A maximum of 3 squadrons can engage each enemy squadron.[68]
   o *vs. Escorted* - If the Interceptors inflict a Damaged or Destroyed result on the escorting Squadron, roll on the Escorted Strike row.
   o *vs. Unescorted* – roll on the Unescorted Strike row.
• **Escort Strike**[69] – Select a strike to Escort. If strike is attacked, squadron battles intercepting fighters as if Fighting for Air Supremacy.
• **Conduct Strike**[70] – A squadron may conduct a strike on any unit in its air sector.
   o *Maritime Strike* – Attacking enemy naval unit(s). Air strikes carry 1 missile per squadron (or 4 per bomber flight).
   o *Air Support*[71] – if Strike makes it through, notify Land control. (#) indicates max number of squadron strikes vs. a brigade per day.[72]
      ▪ *Ground Support* (2) – 1d2 attrition (1 if sqdn. is damaged) on targeted unit.[73]
      ▪ *Interdiction* (4) – Inflicts 1 attrition (0 if sqdn. is damged) on unit if moving and reduces their movement by half.
   o *Ports/Air Bases* – Roll on tables in the Missile Rules.
• **SEAD**[74] – A sqdn. equipped to conduct a SEAD degrades IADS by 1 for one strike.[75]
	Support Squadron – 1 required per Air Sector to avoid *No AWACS* penalty.
	
	MPA – If air superiority+ in Air Sector, generates 2 ASW sweep tokens (1 if 2 dmg.) to be placed by Naval Control in a hex in that sector (each has a 5% chance to detect subs)[76]
	
	Tankers[77]
	• Allows 2 squadrons to conduct operations in adjacent areas
	• Allows 1 bomber sortie from offmap bases (or 2 Tanker sqdn. required if flying from CONUS).
	
	Losses: If Air Superiority, 1 on d20 = 1 damage. If Parity, 3- instead. +1 to roll if being escorted.

IADS[78]

For any enemy squadron operating in a sector with an IADS value, roll a d20. If the number is less than or equal to the IADS value, the squadron is damaged. *Exceptions*:

- Aircraft using standoff munitions for a strike reduce IADS value by 1.
- 5th Gen aircraft reduce IADS value by 1 against them, and B-2's reduce it by 2.[79]
- When ground attack aircraft conduct a strike, they add 1 to IADS value (even if IADS value is 0).[80]

Air-to-Air Table[81]

Air to Air = Aircraft squadron dice + modifiers.

Strike is attacked = If escort is beaten, the strike squadrons rolls their own dice to see the effect.

D10 Roll	- 1 -	- 2 -	- 3 -	- 4 -	- 5 -	- 6 -	- 7 -	- 8 -	- 9 -	- 10 -	- 11+ -
Air-to-Air	–	–	–	–	–	–	–	☠	☠	☠	☠☠
Escorted Strike (or Multirole Strike)[82]	⮌☠	⮌	☠	☠	–	–	–	–	–	–	–
Unescorted Strike	⮌☠☠	⮌☠	⮌☠	⮌☠	⮌☠	⮌☠	⮌☠	☠	☠	–	–

☠ = Strike damaged, ⮌ = Strike aborts *Multirole*: If multirole conducing strike are intercepted, they count as escorted even without a escort.

	5th Gn	4th Gn	3rd Gn	F-35 Support	Attacking 5th Gn	No AWACS	Sqdn. has 2 ☠
Dice/ Effect	d12	d10	d8	▲1 friendly sqdn. attacking same target in the air engagement 1/turn.[83]	▼Attacking Dice by 1	▼All Dice by 1[84]	▼ Die by 1

Promote (▲)/demote (▼) means to increase/decrease dice size by 1 (e.g. a promoted d8 would become a d10). Dice cannot be promoted beyond d12's, or below a d8 (except 3rd gen, which can be demoted to d6).

Land Movement

Unit	Movement (Op Map)[85]	Movement (Taiwan Map)	Notes
Land Units (Rotating)	0 hexes/day	1 hexes/day	
Land Units (Cross Country)	1 hexes/day	5 hexes/day	
Land Units (Road)	2 hexes/day	11 hexes/day	
Land Units (Rail)	5 hexes/day	27 hexes/day	Requires 1 day to load and 1 day to unload.
Helicopter Unit (Range/Move)	3 hexes/day	15 hexes/day	Must start+end at Airport/FARP (FARP available at Control discretion)
(Dis)Embark Brigade on Ships	½ Brig/day/port		Assumes simultaneous loading of all ships for the brigade, and that ships are good ships for such use[86]

Land Combat (d4, d6, d20)[87]

Land units can take points of damage up to their combat power.[88] Every 20 attrition[89] = 1 point of damage. 1 point of attrition can be removed every 2 days by rotating the unit off the front line (artillery/helicopters do not regenerate).[90] Each point of damage subtracts 1 from the unit's combat power. A unit with no combat power is destroyed.[91]

Procedure:
1. Pick units to attack, each unit may only attack 1 unit in an adjoining the hex.[92]
2. Determine Combat:
   a. Atk. vs. Defence Ratio Column = Sum Attacker Power vs. Sum Defender Power
      i. Unsupplied units halve combat power[93]
   b. Note any column shifts from other factors
   c. Then roll 1d4[94] for each side and shift that number of columns in each side's favor
3. If a unit forces a retreat on the enemy, it can attack another enemy in the sector at 1 unfavorable shift.

Attritional vs. Maneuver Combat[95]
When attacking decide if the attack is a attritional or maneuver attack. *Attritional* resolve as normal on the table below. If the attack is M*aneuver* when a result states that the unit was attritted, it takes d6 attrition (exploding dice, 5 or 6)[B] instead of just 1, and the other side takes the same amount rolled on the first dice -1.[96] All other attacking units involved in the maneuver combat take 1 attrition.[97] Helicopter units (not air assault) take 3x normal attrition, artillery 2x.[98]

Breakthroughs[99]
A breakthrough may be attempted on a maneuver attack. Roll a d20, on 19+ breakthrough occurs (DRM +11 for surprise, +2 for air superiority, +1 if successful air assault). On success enemy ⤿ + take ½ attrition of that inflicted, on failure all attacking units take an extra 2d6 attrition.

Ratio = Sum Attacker Power vs. Sum Defender Power
Then roll 1d4 (if Maneuver), or don't (Attrition)[100] for each side and shift that # of columns in each side's favor.

Atk vs. Def Ratio:[101]	1:4	1:3	1:2	1:1	2:1	3:1	4:1	5:1	6:1	7:1	8:1	9:1	10:1	11:1
Meeting Engagement	▲ ⚐	▲	☠	☠	☠	🛡	🛡	🛡	🛡	🛡 ⚐	🛡 ⚐	🛡 ⚐	🛡 ⚐⚐	🛡 ⤿ ⚐⚐
Preped Atk. vs. Preped Def	▲	▲	▲	▲	☠	☠	🛡	🛡	🛡	🛡	🛡 ⚐	🛡 ⚐	🛡 ⚐	🛡 ⤿ ⚐
Prepared Atk. vs. Breaching	▲▲ ⚐	▲▲ ⚐	▲▲	▲▲	▲▲	▲	☠	☠	🛡	🛡	🛡	🛡	🛡	🛡 ⚐

▲ = Attacker attritted, 🛡 = Defender attritted, ☠ = Attacker and Defender attritted. *Attrition is divided between units involved in the combat.*
⤿ = Number of hexes damaged unit must retreat (cannot be mitigated). If unit cannot retreat to friendly hex it is destroyed.
⚐ = Number of hexes damaged unit must retreat. A unit can choose not to retreat (or to retreat some) and is attritted for each ⚐ it chooses to ignore.[102] If unit must retreat and cannot retreat to friendly hex it is destroyed.

Factors	Column Shift	Other Effects
Infantry Only vs. Mech/Armor (Maneuver Attack Only)[103]	1 favorable shift for Armor	
Friendly Air Superiority/Supremacy	1 favorable shift[104]	
Light Urban/Rice Paddies/Hills (Rough)	1 favorable shifts for Defender[105]	
Mountains[106]/Heavy Urban[107] (V. Rough)	3 favorable shifts for Defender	May ignore 1 ⚐. Attacker takes ½ casualties.
Fortification (per lvl., max 2)[108]	1 favorable shift for Defender[109]	May ignore 1 ⚐ per fortification, Attacker takes 2x casualties.[110]
River Crossing[111]	1 favorable shift for Defender	+1d6 attrition if attack not successful
Amphibious Assault[112]	2 favorable shifts for Defender[113]	For each ⚐ Attacker takes a *Damage*.
Air Assault[114]	Use Infantry Only vs. Mech/Armor if applicable.	Unit takes losses equal to IADS Value + 1d3 x 10%.[115] Unit can't move this turn.
Naval Gunfire Support	1 favorable shift	
Unit can't do Brig. lvl. combined arms*	1 unfavorable shift *when attacking*[116]	
Surprise + Successful Deception[117]	4 favorable shifts *when attacking*	If defender attritted, attrited by 5x rolled amount.

* This applies to Taiwanese C-Level reserve units, and to PLA units during amphibious attack[118]

[B] E.g. if a 5 or 6 is rolled on the dice, roll again and add that to the total, if another 5 or 6 is rolled, roll again and add to the total, and so on…

Missile Rules (d10)[119]

Salvos described on the Missile Tracker sheet or on cards.

If over ½ range targeting Ships (e.g. moving targets), each salvo counts as ½ of a salvo (excluding hypersonics), if DF-26 or DF-27 at extreme range, each salvo counters as 1/3rd.[120]

Depending on the type and target of salvo, resolve as follows:

Target	Max # of Salvos vs. Target Per Turn	Effect
Ships	d8 per Task Force*	Roll on Sea Combat damage table (Land Attack missiles may attack ships in port, AShM may not[121]).
Ground Targets	d3-1 per brigade	Inflict 1 attrition. In exceptional circumstances, may instead be a 1 column shift.[122]
IADS	d2 per strike package	Roll a d10 and subtract the IADS value of the selected air zone, add 3 if the missiles are hypersonic or stealthy. On a 7+ IADS is reduced by 1 in the selected air zone for one turn for one mission or strike package.
Airbase/ Port	Any Number	See below.

* +1 if attacking weapon is hypersonic[123]

Vs. Airbases and Ports[124]

Reduce the functional number of salvos by 1 for:[125]

- Each THAAD battery defending
- Each squadron on Intercept Strikes at the area (vs. cruise missiles only).
- If the missiles are Stealthy or Hypersonic, ignore one THAAD battery or Squadron.[126]

Airbase

D10 Roll[127]		**- 1 -**	**- 2 -**	**- 3 -**	**- 4 -**	**- 5 -**	**- 6 -**	**- 7 -**	**- 8 -**	**- 9 -**	**- 10 -**	
Single Salvo	Attrition	–	–	–	–	–	–	1 x ☠ -parking	1 x ☠ -parking	2 x ☠ -parking	2 x ☠ -parking	Cluster Munition + no HAS = +1[128]
Single Salvo	Airbase Closed	–	–	–	–	–	–	–	–	1	d2	+1 if Bunker Buster[129]
2+ Salvos	Attrition (per salvo)	–	1 x ☠ -parking	1 x ☠ -parking	2 x ☠ -parking	2 x ☠ -parking	2 x ☠ -parking	2 x ☠ -parking	2 x ☠ -parking	2 x ☠ -parking	3 x ☠ -parking	Cluster Munition + no HAS = +1
2+ Salvos	Airbase Closed	–	–	–	1+	1+	d2+	d3+	d4+	d6+	d10+	+1 if Bunker Buster

\# x ☠ -parking = Inflict that number of attrition to aircraft at the base. Subtract the number of unused squadrons[130] of parking at the base from the total attrition (sum of all salvos).[131] If this result occurs, a minimum of 1 damage occurs even if subtracting parking reduces the value to 0 or less.

Airbase Closed (#) = Airbase and runway inoperable for that number of days. For each salvo over two, add 1 day for the 3rd salvo, and 2 days for each subsequent one (4th salvo onward):

Salvo	**3rd Salvo**	**4th Salvo**	**5th Onward**
Extra Cumulative Days of Closure	1	3	+2 etc.

If target is a dispersed airfield or civilian airfield, triple the closure time.

Ports[132]

D10 Roll		**- 1 -**	**- 2 -**	**- 3 -**	**- 4 -**	**- 5 -**	**- 6 -**	**- 7 -**	**- 8 -**	**- 9 -**	**- 10 -**
Single Salvo	Port Closed	–	–	–	–	–	–	–	–	–	1
2+ Salvos	Port Closed (1 roll per salvo)	–	–	–	–	–	1	1	d2	d2	d3

Port Closed (#) = Roll the dice in the brackets to determine how many days the port is not functional.

(If detail is needed on a 8+ per salvo each of the following is damaged: drydock, fuel farm, munitions storage.)

Mine Rules (d10)[133]

Minefields are placed at specific locations. These can either open water, or on specific landing beaches/ports.

Clearing Minefields

Each sweeper allocated to clear a minefield clears 1d6 mines per day[134] as long as sweeping is unimpeded by weather or shore fires, during which no sweeping can usualy occur. Each day there is a 1% chance of each minesweeper being sunk by a mine,[135] though this can be ignored for ease. Clearing an entire minefield requires sweeping all the mines, but clearing a lane requires clearing 10% of the mines.[136] Clearing a *maneuver zone for firepower support ships*, also requires clearing 10% of the mines, failure to clear prevents naval gunfire support.[137]

# of MCM Ships	1	2	3	4	5	6	7	8	9	10	15	20	30	40	50
Avg. Mines Swept	3.5	7	10.5	14	17.5	21	24.5	28	31.5	35	52.5	70	105	140	175

Need to clear areas for anphib assault – Washburn 2007 pg.7, anphib assault + logistics area O'Flanaity, pg. 71

Transiting Uncleared/Semi-Cleared Minefields[138]

Ships will not willingly enter areas where there are known to be mines, if they do by order or unknowingly, roll a d10 and consult the table below:

Target	CSG, ESG, SAG	Sub	Civ Ship
Damage on:	1-4	1-3	1-6

Mod:	Partially Cleared	Dense Minefield (Beach minefield min. -1)	High-Tech Mines (All but Quickstrike)	Taiwan Strait
	+1, +2 etc.	-1, -2, -3, etc.	-1	-1???

Amphibious landings through mines check once for each point of combat power using the transport type.

SOF Rules (d20, d10)[139]

As a general rule, nations are limited to conduct as many missions as they have Tier 1 units (see table below).[140] Tier 2 SF, Psychological Warfare units (if Information Warfare module is not being sued), et. al. can be employed in addition as desired at adjudicator discretion.

Country	#	***Tier 1(ish) Units***
Australia	1	SASR
Canada	1	JTF 2
China[141]	13	Unless noted otherwise, units are brigades. *ETC* – Sharks, Thunderbolts, Dragons of the East Sea, *STC* – Sword of the South, ? Brigade, ? SF Bn. and Lion Coy, *NTC* – Falcons, *CTC* – Sacred Sword of the East, Whistling Arrows, Ferocious Tigers, *PLANMC* – Sea Dragons, *PLAAF* – Thunder Gods
France	4	Commandement des Opérations Spéciales (1er RPIMa – 13e RDP – Commandos Marine – CPA 10)
Japan	1	Special Forces Group
Philippines	2	Marine Special Operations Group – NAVSOCOM
Taiwan	2	Airborne Special Service Company – 101st Amphibious Reconnaissance Battalion
UK	2	SAS – SBS
US	6	Delta (Army) – Regimental Reconnaissance Company (Rangers) – SEALs (Navy) – SOG (CIA) – AFSOC (24th STS) – MARSOC (Marines)

Method:

1. Assign unit to conduct mission, determine how long it takes them to infiltrate
   a. For speed can roll d10 to determine number of days
2. Adjudicate mission
3. See if unit is lost[142]
4. Regeneration
   a. If unit is not lost, roll 1d10 and add the exfiltration time to determine when the unit will become available again.
   b. If unit is lost do the same as the above but roll 2d10

Lines of Effort[143]	***Adjudication (d10)***	***Chance of Losses (d20)***[144]
Battlefield Surveillance and Reconnaissance[145]	50% (11+) chance to Detect and Track one enemy ground unit in the given hex, or all air or naval units at a given base.	35% (14+)
Direct Action against Point Target	40% (13+) chance of 1 attrition to an enemy unit OR 10% chance (19+) of damaging enemy naval unit in port.	45% (12+)
Airfield Attack	30% chance (8+) of 1d6-3 damage against a squadron.[146]	45% (12+)
Attacks against Enemy Logistics	20% (17+) chance of enemy loosing 1 supply at random.	25% (16+)
Brigade Support*†[147]	5% (20+) chance of a favorable column shift on the Attack/Defense	N/A
Degrade IADS	30% (15+) chance of decrease IADS for one strike.	25% (16+)

*If a Chinese SOF brigade executes Brigade Support in support of an amphibious landing, the chance is instead 50% (11+) and chance of loss is 50% (11+)[148]

Inflil/Exfil Method	**Time**	**Notes**
On Foot[149]	4 days to move 1 hex (op map), 1 day to move 1 hex (Taiwan map)	
Submarine	SOF generates in same hex as sub.	Can use small boat or on foot methods in addition
Small Boat[150]	2 hexes in one day	Can only be used for one day. Can be combined with on foot methods or submarine methods.
Helicopter	Same day	50% risk of mission abort if IADS 1, 10% chance of loss. May not conduct at IADS 2 or higher.

†Infiltration/Exfiltration time for the Brigade Support mission is 0.

Tactical Nuke Rules

Naval Units (1 Nuke): Units may intercept incoming salvos, then roll a d10 for each nuke: [1-6] No damage, [7-10] Unit damaged.[151]
Naval Units (Multiple Nukes): Units may intercept incoming salvos, then roll a d10 for each nuke: [1-6] No damage, [7-10] Unit damaged.
Air Units: the unit is destroyed. [152]
Ground Units: If unit is a Battalion the unit's dispersion determines damage:[153]

Dispersion	Damage[154]	Example
Highly Dispersed	10%	Defending an area after dispersing due to nuclear threat.
Dispersed	30%	Defending an area.
Concentrated	40%	Conducting an attack.
Highly Concentrated	80%	Defending a key point (airfield, port), fighting in urban terrain.[155]

Pre-Generated Damage Reference[156]

Unit Cbt. Power	Damage			
	10%	30%	40%	80%
1	0 Damage, 1 Attrition	0 Damage, 2 Attrition	0 Damage, 2 Attrition	0 Damage, 4 Attrition
1.5	0 Damage, 1 Attrition	0 Damage, 3 Attrition	0 Damage, 3 Attrition	1 Damage, 1 Attrition
2	0 Damage, 1 Attrition	0 Damage, 3 Attrition	0 Damage, 4 Attrition	1 Damage, 3 Attrition
2.5	0 Damage, 2 Attrition	0 Damage, 4 Attrition	1 Damage, 0 Attrition	2 Damage, 0 Attrition
3	0 Damage, 2 Attrition	1 Damage, 0 Attrition	1 Damage, 1 Attrition	2 Damage, 2 Attrition
3.5	0 Damage, 2 Attrition	1 Damage, 1 Attrition	1 Damage, 2 Attrition	2 Damage, 4 Attrition
4	0 Damage, 2 Attrition	1 Damage, 1 Attrition	1 Damage, 3 Attrition	3 Damage, 1 Attrition
4.5	0 Damage, 3 Attrition	1 Damage, 2 Attrition	1 Damage, 4 Attrition	3 Damage, 3 Attrition
5	0 Damage, 3 Attrition	1 Damage, 3 Attrition	2 Damage, 0 Attrition	4 Damage, 0 Attrition
5.5	0 Damage, 3 Attrition	1 Damage, 4 Attrition	2 Damage, 1 Attrition	4 Damage, 2 Attrition
6	0 Damage, 3 Attrition	1 Damage, 4 Attrition	2 Damage, 2 Attrition	4 Damage, 4 Attrition
6.5	0 Damage, 4 Attrition	2 Damage, 0 Attrition	2 Damage, 3 Attrition	5 Damage, 1 Attrition
7	0 Damage, 4 Attrition	2 Damage, 1 Attrition	2 Damage, 4 Attrition	5 Damage, 3 Attrition
7.5	0 Damage, 4 Attrition	2 Damage, 2 Attrition	3 Damage, 0 Attrition	6 Damage, 0 Attrition
8	0 Damage, 4 Attrition	2 Damage, 2 Attrition	3 Damage, 1 Attrition	6 Damage, 2 Attrition
8.5	1 Damage, 0 Attrition	2 Damage, 3 Attrition	3 Damage, 2 Attrition	6 Damage, 4 Attrition
9	1 Damage, 0 Attrition	2 Damage, 4 Attrition	3 Damage, 3 Attrition	7 Damage, 1 Attrition
9.5	1 Damage, 0 Attrition	3 Damage, 0 Attrition	3 Damage, 4 Attrition	7 Damage, 3 Attrition
10	1 Damage, 0 Attrition	3 Damage, 0 Attrition	4 Damage, 0 Attrition	8 Damage, 0 Attrition
10.5	1 Damage, 1 Attrition	3 Damage, 1 Attrition	4 Damage, 1 Attrition	8 Damage, 2 Attrition
11	1 Damage, 1 Attrition	3 Damage, 2 Attrition	4 Damage, 2 Attrition	8 Damage, 4 Attrition

Strategic Nuclear Use Rules

Facilitator adjudicates as needed, OR cover the map in lighter fluid and light it on fire - everyone loses the game.

Space Rules

Facilitator adjudicates as needed OR use Space Module.

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Endnotes

[1] The Author wishes to thank RC, Maj. Tom Mouat, Thomas Danger, and Dr. Nick Bradbeer for their peer review of these rules.

Note that the author has also compared this game with CSIS's operational Taiwan wargame (Cancian and Heginbotham 2023) (having played a limited amount of the game, examined the rules, and talked with one of the designers), the Center for Army Analysis *C-WAM* v7 (July 29th, 2016) (Center for Army Analysis 2016) (reviewed the rules), and *A Balanced Fleet* (having played the game in several forms) as a rudimentary form of "literature review" for comparison of modeling. The *Operational Wargaming System* was also examined, but determined to be not easily comparable due to differences in modeling methods due to different purposes for the games. Similarity *Operational-Level Urbanised Campaigning (OPUC)* v0.3.250716 by David Burden was examined but direct comparison this was not possible due to different purposes for the game (OPUC being exclusively focused on the land campaign). Evaluation of CSIS's wargame, *C-WAM*, and (to a lesser extent, due to it's different purpose) *A Balanced Fleet* shows very similar decisions in terms of modeling methods and levels of abstraction that indicate that this game is not so massively different from these games as to invite the need for careful review of difference (e.g. the modeling of this game seems reasonable when compared to other similar professional wargame).

Throughout these rules an attempt is made to find for all cases simulation, historical data, and theory. Theory allows for the identification of the relevant elements of the system to be molded and allows the situation of the data, simulation usually provides the most recent information and shows ideal system outcomes, historical data provides evidence of what occurs with the friction of the real world. Using both simulation and historical data the outcomes and findings are then considered in the light of the specific scenario displayed here (and differences from the simulation and modeling) to best understand how to apply the evidence. In some cases only theory, simulation, or historical data can be found, in such cases best guesses must be made and further work remains to be done.

The following endnotes may be slightly incongruous, they have been written over the past 4 years at various points in time and at various levels of ever-increasing knowledge. The author apologizes for any inconstancies in style, tone, level of knowledge, thoroughness, or in reference to changed rules.

[2] 1/3 of missiles on a US destroyer are offensive missiles in peacetime, thus with 16 missile cubes of 25 missiles each this is 6/10. Players could of course opt to change the inventory of their reinforcement units who would have the time to change their loadouts as they see fit (or other units during the buildup to crisis). Ships at sea are stuck with their loadouts, though depending on the scenario the side with the initiative may opt to change their loadouts, while the side lacking initiative would not be able to. For the 1/3 number see (B. Clark 2017), pg. 16 and (Gunzinger and Clark 2016) pg. 7 and 75 , see also passing reference in a GAO report that "Notionally, one SSGN can carry as many Tomahawks [154] as three to four cruisers and/or destroyers … paired with a carrier group at the beginning of a conflict, an SSGN with maximum Tomahawk payload would provide about 44% of the total Tomahawks available to the group." (Fabey 2025) pg. 45, though note that Tomahawk is not the only offensive missile in a SAG's arsenal - complicated by the fact that certain missiles (SM-6 for example) are dual use, and land attack weapons are often different from anti-ship weapons, but this abstraction is made for simplicity.

[3] While US CSG's in peacetime do not always deploy with enough ships to provide 400 VLS cells of capacity, I make the assumption for two reasons: First: I suspect that in a war there would be a tendency to want to provide more magazine depth and sensor coverage than can be provided by a 3 ship configuration (1 Ticonderoga, and 2 96-cell Arleigh Burke's for example) to defend more vulnerable assets (see (Doyle and Herzinger 2022), pg. 33), without leading to over centralization making targeting easier (the current game system allows such putting together large numbers of units at the player's discretion which would make detection easier for the enemy). This makes it a player choice, not a designer choice on the value of concentration vs. dispersion of forces. Second: it limits the number of pieces on the board, making the game easier to play. Thus, all naval units (CSG, ESG, SAG) use the 400 VLS cell number as their benchmark. Note that this generally means 4-5 escorts, it may include more/less depending on the available number of VLS cells of ships and could be conceived to include additional elements like coast guard ships, USV's, or maritime militia ships. Of course this leads to problems in the external validity of the game when in real life ships may operate individually, opening themselves up to much small numbers of missiles (for example a

shore-based battery) than they would if defended by others in the same group, but for ease of play and time required to play a turn this is a sacrifice I view as having low consequence on the game as a whole.

Also assumed is an oiler with the group (or sufficient oiler support) and resupply as necessary so that cruising range is not a limiting factor and ships can sprint as desired. This is a large assumption but is made for playability.

[4] With 2 full loads of ammunition the carrier supported 771 strike sorties of 1,336 total "bombs" (Grant 1999). As a first order approximation, a carrier carries 668 munitions onboard (1,336/2). Each aircraft strike in these rules is 25 munitions (~4 munitions per aircraft for a carrier squadron of 12). Thus, the carrier has ~27 strikes before it has emptied its magazines. Other aircraft carriers are halved as they only have (approximately) half the strike aircraft of a US carrier. Munitions are the limiting factor here as each carrier has enough aviation fuel to sustain 16 days of round the clock aviation operations (U.S. Army Command and General Staff College 2000), section 12-7.

[5] The number of missile boats making up a squadron is taken from historical numbers of ships involved in Battle of Baltim (6 Israeli, 4 Egyptian), Battle of Latakia (5 Israeli, 4 Syrian), Second Battle of Latakia (various groupings of 2, 3, and 4), Operation Trident (3 Indian missile boats plus other ships). While the average of these historical numbers is 3-5, I choose to use 6 as: 1) missile defenses are better than they were historically necessitating more missiles fired, meaning more missile boats necessary for an effective punch, 2) historically smaller ships were being engaged by missile boats, necessitating less missiles than the larger combatants of the game, 3) Chinese missile boats operate in larger groups of 8 (see (Sutton 2021)) using 6 reduces the number of pieces on the board, making the game easier to play, 5) using groups of 6 tends to yield ~50 missiles per squadron, which is allows for two missile salvos per missile boat unit.

[6] See Ukrainian generals' comments in 2022 on Brigades holding 40km lines in (Magnuson 2022), note that this is under the conditions of low force densities on both sides on generally open terrain. This also appears to have been the case as per this source - "the 40th Naval Infantry Brigade's two battalions were stretched over tens of km of the front" (see (Rob Lee [@RALee85] 2022)). Dispersion of forces due to the nature of combat in Ukraine and lack of manpower has had at least one unit holding 27 km with 4 battalions, but units are also holding more depth than previously as well (e.g. units could stretch to hold further by reducing their depth) ((Watling and Reynolds 2025), pg. 9), also note that the ability to strike deep into the enemy rear is also forcing higher levels of dispersion than were previously done (pg. 17). Note this dispersion is key and high frontages were an issue early in the war when in the JFO area "brigade frontage at the start of the war was around 20 km. This left a limited reserve and depended on a manoeuvre defence to counterattack against breaches in the line" (Watling et al. 2024) pg. 13. This works well in the abstract and for larger hexes on the operations map, but on Taiwan 2 brigades per hex is relatively also consistent due to smaller frontages (on the Taiwan map this would mean each brigade holds a frontage of ~10km) due to the more difficult terrain. It is worth noting that in an urban environment the frontage of a brigade becomes 6-12 blocks, where 1 block is ~100m (('ATP 3-06, Urban Operations' 2022), section 4-42), but lines can be lengthened the lower the opponents force density is.

[7] (Hobbs 2025)

[8] As per (U.S. Army Training and Doctrine Command 1994), pg. 58 (3-3), this is a high bound (200 miles a day) but is possible. This assumes hard surface roads (reasonable as all countries here are modern countries with well-developed road infrastructure), and the given number is for divisions not brigades, brigades would likely be more efficient due to their smaller size. The source notes to add 10-20% distance for mountainous routes, which while a mild stretch, could fit within the high bound.

[9] As per (U.S. Army Training and Doctrine Command 1994), pg. 66 (3-11), gives the bound of 600-1000 km/day (including loading/unloading), so I take the middle (800km/day).

[10] (Military Surface Deployment and Distribution Command 2011), Load/Unload times: Table 6 on pg. 56. Assumes sufficient ships are available for use.

[11] If necessary limited operations can be conducted by a squadron's teeth element operating in a very expeditionary capacity, backed by one or two cargo planes/tankers as demonstrated by US exercises in the Pacific, then allowing the rest of the squadron's logistical and maintance element to flow in over several days (so operations can be conducted from the second day in a limited capacity). Alternatively, if there are already forces there, they are merely reinforcing existing squadrons and can leach off of their logistics for a

short period until the squadron's own full logistics set arrive. However, the main reason for this is to ease the amount of work Control has to do while running the game.

[12] **Weather**

Weather represents the predominate weather conditions in the area for that day. E.g. clear means the area is clear for most of the day or Storms mean that large storms are affecting operations in the area, not that the entire area is covered in storms.

Effects in this section is primarily based on an interview with Paul Kendal (Paul Kendal, 'Interview with Paul Kendal OBE', 2022, Online). Weather is split into 3 types (clear, rain/heavy clouds, storms), both for ease of understanding and playability, and also as it is consistent with US Army doctrine of no, moderate, and severe degradation groupings of weather effects, see (Department of the Army 1992).

Submarines

The sizing of the numbers here are not based on any hard data, but are attempting to account for the effects of weather. For explanations of what effects inclement weather has on ASW see (M. E. Glynn 2021), pg. 139, 141-142. Note that while some of the effect is on surface noise a large part of the effect of storms is on aircrew performance and thusly on recognition differential (see pg. 97-98 for an explanation of recognition differential).

Ground Combat

Effect on ground operations is mix of degradation of movement, ability to detect the enemy (both due to sensor degradation and grounding of reconnaissance assets), and personnel fatigue (for piles of detail, see (Department of the Army 1992))

Amphibious Operations

Based on analysis from (Balzo et al. 1999) pg. 68, with a conservatieve coding of factors as affecting assuming Rain/Clouds may lead to some increase in winds but not much. Note the weights here from (Balzo et al. 1999) are relative to the overall value of all assigned weights, and that "a factor might be the most critical factor for the most critical component and still not make it to the highest portion of the integrated list. Bottom clutter for MCM is such an example" (pg. 69).

Environmental Factor	Weight	Cumulative Weight	Rain/Clouds Effect	Storms Effect
Visibility	0.083	0.08	Yes	Yes
Topography (Land, Water)	0.073	0.16		
Reefs, Kelp, Land Vegetation	0.068	0.22		
Precipitation	0.067	0.29	Yes	Yes
Ambient Light	0.057	0.35	Yes	Yes
Clouds	0.056	0.4	Yes	Yes
Wind Speed & Direction	0.054	0.46	Possibly	Yes
Sea State/Swell & Direction	0.041	0.5	Possibly	Yes
Obstructions/Surface Clutter	0.041	0.54	Possibly	Yes
Particulate Matter	0.038	0.58	Unlikely	Possibly
Sun Glint/Glare	0.037	0.62	*Reduces*	*Reduces*
Air Temp/Humid/Press	0.037	0.65	Yes	Yes
Electromagnetic Conditions	0.027	0.68		Unlikely
Tides	0.027	0.71		
Depth Range	0.027	0.73		
Currents (Littoral, Ocean)	0.027	0.76		
Surf Conditions	0.025	0.79	Unlikely	Yes
Beach Characteristics	0.024	0.81		
Bottom Clutter	0.024	0.83		
Noise	0.021	0.86	Yes	Yes

Refractive Index	0.016	0.87		
Drainage	0.015	0.89	Possibly	Likely
Optical Properties (Turbidity/Visibility)	0.013	0.9	Unlikely	Yes
Scatterers (Optical, Acoustic)	0.012	0.91	Yes	Yes
Clutter (Acoustic & Magnetic)	0.012	0.92	Yes	Yes
Bioluminescence	0.011	0.93		
Bottom Roughness	0.01	0.94		
Water Temperature	0.01	0.96		Possibly**
Sediment Strength & Stability	0.009	0.96	Unlikely	Unlikely
Sediment Composition	0.008	0.97		
Salinity/Conductivity	0.008	0.98		Possibly**
Ambient Noise	0.007	0.99	Yes	Yes
Geoacoustic Properties	0.005	0.99		
Bubbles	0.004	1		Possibly**
Biofouling	0.003	1		
Sediment Gases	0	1		

*I am not preachy sure what this means in this context, or in what element of an amphibious operation it is being applied to. The initial report which would describe this information is not available online, so these are guesses.

** Due to wave-induced Ocean Mixing

Given that the values here are ranked with more important ones towards the top, the large cluster of effects in both categories high up indicates that they both have effects, though clearly Rain/Clouds have less effect.

13 Detection and Tracking

Overview

These rules represent the entire ISR system of the various combatants, from tactical means through to the national level. In this system, if a detection is made by blue, all Blue forces are assumed to have detected. Both these abstractions are made for simplicity, and could be reasonably expanded or changed (at cost of time in adjudication) if desired.

Tracking vs. Detection

This game uses the term detection to encompass both detection and tracking. Tracking is not just knowing where something is loosely, but knowing where it is more or less exactly in real time. Extremely loose tracks (i.e., the general location) in the game are more or less always known (e.g. players can see the presence of a counter, but not what the counter is, note that such a modeling abstraction is also done in (Center for Army Analysis 2016) pg. 27), but the ability to track a system in real time to strike it is much harder (e.g., "being detected" in game terms). As such, think about the chance of detection as Chance of finding the target x Chance of being able to maintain continuous track on the target = Detection (Finding and Track). This, for ease, also includes Identification, subsumed within. This is why a target like a CSG in the Pacific is more difficult to find. While you may get a glimpse of it (e.g., see its location on the board), you will have a hard time being able to get a track on it (flipping it face up).

Approximate Locations (Or Why You Can See the Units on the Board)

Approximate areas are always known for most units. In the case of land units and air units this is as they are easy detected by satellite, UAV, and aerial reconnaissance, or from HUMINT, OSINT, cyber sources, captured personal, etc. The other main reason is the massive complexity and increase in time involved if the game were designed to be fully double blind (though it can be done, typically I run it partly double blind by using blocks for the units).

Ships approximate position by long range over the horizon radar would be known, using ground based over the horizon radar out to 3000km with a CEP of 36-178km (22-110mi, basically the size of a hex, remembering that a CEP is a 50% chance to be in it, and the average of 22-100 is 60 or approximately ½ of a hex, so the 95% chance seems to fall roughly around a hex size for game purposes). (Majumdar and Wasif 2023) pg. 24 lists Chinese OTH Radars as having a range between 500-4,000km, it also states that a max detection range versus a destroyer for the OTH radar in the Spratly Islands is 250km active, 450km passive (note that larger ships and groups of ships will be more detectable than a single destroyer however). For a general overview of Chinese long range radars see (Wood et al. 2024), pg. 52-58 Space based options also extend coverage the Chinese had 18 passes a day in 2015, 3,500km coverage which has only gotten better see (Heginbotham 2015), pg. 157-159, particularly footnote 12.

Assets Represented in Detection

- OTH radars and SIGINT satellites would probably be used to cue other assets, such as EO/IR and SAR satellites (Heginbotham 2015), pg. 159-163, as well as SIGINT satellites (Day 2021) .
- Maritime patrol aircraft or drones.
    - A P-3's radar in the early 2000's could detect an aircraft carrier or tanker out to 350km, while a cruiser could be seen at 200km, a destroyer and 100, or trawler or surfaced submarine at 50km. A E-2 could spot a large ship at 180km, and aircraft surface search radars could reach perhaps 200km, and 100km if helicopter mounted (Dunnigan 2003), pg. 274. The Chinese KJ-2000 may range as far as 470km with older KJ-200's having a range of 300km (presumably tracking aircraft) (Pandey 2015). Capabilities have no doubt improved, and FLIR technology now offers a passive measure, though the advent of long range SAMs and AAM's will force back MPA's (less so attrittible drones). Drone's such as the MQ-4C can also be used for ISR, though their use is intensive. For a simple analysis see (Cropsey and McGrath 2019) pg. 20-27
- ELINT (ground and space based)
- HUMINT
- OSINT
- The (now famous) ISR balloons (used by both the US and China (Page 2024))
- USV's (Saildrones, etc.)
- Hydrophone networks
    - See (Ball and Tanter 2015) pg. 53, (Cote 2019) pg. 33-34, (Sutton 2018), (Trevithick 2018)
- Buoys (Fife and Chase 2023)
- UUV's
- Coast guard, maritime militia, and fisherman as ISR assets (Henley 2022), pg. 6.
- Cyber means

These can be defeated by strategic, operational, and tactical deception, PSYOPS, jamming, camouflage/concealment, dispersal, decoys (both physical and in the EM spectrum), looking unimportant, and degrading, destroying, and denying enemy sensors/ISR chain ((Heginbotham 2015) pg. 164-165, (Taylor 2024a), (Taylor 2024c), (Pyles and Revetta 2023) 22:30, (Doyle and Herzinger 2022) Chapter 5), and also by baiting the enemy (Lund 2024), etc.

Submarines additionally can be detected at longer ranges (25-75nm) by specialized ocean surveillance ships like the US's T-AGOS ships ((Heginbotham 2015), pg. 191), alongside the hydrophone networks and buoys. Of course, submarines are the necessary sacrifice of realism for playability in the game by both sides knowing the hex that they are in, but they still only represent a loose position in a 6,495 mi^2 hex.

The ability of all units to see (and strike) a unit once it has been detected is assumed both for ease, and to simulate C4ISR networking together all units' operating picture. Of course, if this bothers you the game can be run double blind or with some sort of additional C2, data sharing, or targeting rules if desired. However, given the difficult of assessing the ability of each sides ability to do this and for Blue to do so in coalition warfare, I have made an assumption of competence.

14 On OTH radar detection, and specificly carrier detectability from flight ops see (Heginbotham 2015) pg. 158, 165. In general on detection see also (Center for Army Analysis 2016) pg. 24 giving the following approximations: "The detection roll for a ship in mid-ocean is executed with a 1d12. Successful detection occurs on a roll of 10 or greater in calm/clear conditions, 11 or greater in cloudy/rough conditions and is not possible during storm/stormy conditions."

15 **Naval Detection**

For a concise overview of search theory see (Cares and Cowden 2021), pg. 34-45. For an analytical wargame abstraction see (Center for Army Analysis 2016) pg. 27-29. Specifically for this game, (Dunnigan 2003), pg. 227 gives the following surface search rates per hour for a task force of 10-12 ships:

- Task force – 2,000 km^2 per hour
- Task force using helicopters – 30,000 km^2 per hour
- Task force with fixed wing aircraft to scout – 100,000 km^2 per hour

Given that SAG's, ESG's, and CSG's, in this game are ½ to 1/3rd of the size as a task force (4-5 ships), I give the non-fixed wing categories only 45% of the rate given to them by Dunnigan, and given the turn time of days, convert this into a day rate and also give it in hexes (and multiples of hexes). Note when using helicopters with less aviation facilities than in a task force, and the need to potentially keep helicopters available for ASW, the rate of search may be even less in one of the games units.

Unit	km^2 per day	Hexes searched per day	Area 3 hexes across searched per day	Area 5 hexes across searched per day
Area Searched		16,822 km^2	151,402 km^2	420,562 km^2
Task Force	21,600 km^2	1.2 hexes/day	.14 megahexes/day	.05 maxhexes/day
Task Force Using Helicopters	324,000 km^2	19.2 hexes/day	2.14 megahexes/day	.77 maxhexes/day
Task Force with Fixed Wing Aircraft to Scout	2,400,000 km^2	142.2 hexes/day	15.9 megahexes/day	5.7 maxhexes/day

We can look at this in terms of how many sweeps per day are conducted across the area, giving us a revisit rate in hours that it takes to look at the given area. I'll also include an area 7 and hexes across here for illustration as I need it later:

	Hours per Full Sweep of Area				
Unit	**Area 1 hex across**	**Area 3 hexes across**	**Area 5 hexes across**	**Area 7 hexes across**	**Area 9 hexes across**
Task Force	20 hours	–	–	–	–
Task Force Using Helicopters	1.25 hours	11.2 hours	31 hours	–	–
Task Force with Fixed Wing Aircraft to Scout	.17 hours	1.5 hours	4.2 hours	8.27 hours	13.6 hours

SAG's will probably operate somewhere between the Task Force and the Task Force Using Helicopters, while ESG's with some more helicopter deck space to spare will probably operate as a Task Force Using Helicopters. CSG's will obviously operate as a Task Force with Aircraft.

From this, all ships have a very good chance to detect other units in their hex (with the small chance that they miss the enemy due to both sides being on high EMCON levels being negligible (I would guess perhaps 5% or so, so a 1 on a d20, but the chance of both sides missing each other is so low and would add a d20 to what is otherwise a simple d10 system, so is left out for playability). Beyond this, ESG's have a chance at detecting an enemy in an adjacent hex (I will say an 8+, or 30% chance). CSG's always detect in adjacent hexes, with a very good chance (4+, 70%) in the next ring, and a good chance (6+, 50%) in the next ring, and some chance in the final ring (8+, or 30% chance).

Of course the area search is not an ever expanding symmetric area in relation to the search ability of the forces, so making a smaller area is easier. (Dunnigan 2003), pg. 270 states that patrol aircraft from the aircraft carrier can spot ships out to ~400km (see discussion on Maritime patrol aircraft in earlier footnote), which given alter discussion (pg. 274), 200km+ seems reasonable. This means approximately a one hex radius around a carrier that is heavily scouted.

Auto detection of units in the same area (though smaller) is also done in (Center for Army Analysis 2016) pg. 28, providing some indication that this is a decent abstraction to make.

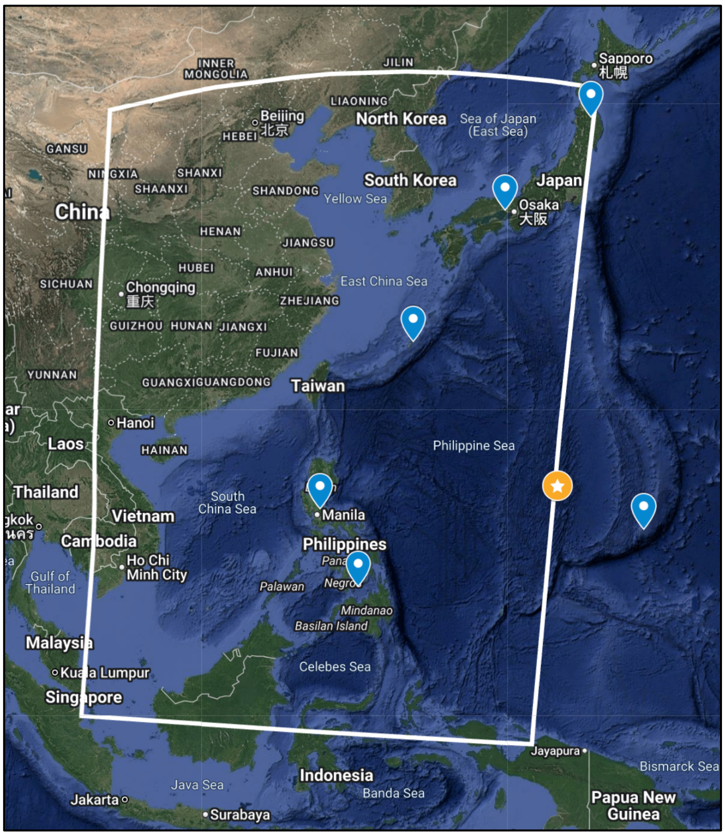
[16] (Center for Army Analysis 2016) pg. 28 assess the chance of an encounter between surface and subsurface asset as 50/50 in a 50Nm x 50Nm area. A hex is 87nm across, or an area of 12,733 Nm2, a 50 x 50 Nm square has an area of 2500 Nm, or 5 times smaller. If the probability of an encounter shrank linearly, this would result in a .1 chance of an encounter using the same probability of an encounter that (Center for Army Analysis 2016) gives. However, it likely does not shrink linearly, but at a more extreme rate as area increases and thus I reduce the probability of encounter to the lowest chance on the dice used in the section (keeping dice constant for ease), of a .05 (5%) chance. Note that (Center for Army Analysis 2016) is not the world's best source given the purpose of the game and the fact that it is publicly available, but lacking further data I use it.

[17] E.g. all it takes is one set of good detections to be able to cue other sensors to find the rest of the group operating together. This means that detection scales linearly as more and more units operate together.

[18] These units are large and have many means for being detected, and it makes the game easier to run. Via drone within 15km are able to be well tracked, and out to 40km deliberate reconnaissance is likely to be common (though note that this is dependent on satellite communications) and tactical SIGINT is passed to brigade level units (Watling and Reynolds 2025), pg. 15.

[19] Their small footprint inherently makes them stealthy as well as fact that they are designed to try to hide, but if you want a source (Freedberg Jr. 2019)

[20] The map was created from multiple smaller maps, trying to avoid as much as possible projection distortion around the ECS, Taiwan Strait, and SCS, letting issues with projection fall north of Japan and South Korea, and to the southeast as much as possible. When the game map is mapped onto the real world, it looks like the following:



The operations map is divided into 100 miles hexes as this provides a good resolution for movement and distances without becoming too fiddly.

Hexes were assigned their depth values based on their predominant depth using data from the Copernicus Marine Data Store. Water depths are classified as the following:

- Maximum depth for ground mines are 80 meters (O'Flaherty 2019) pg. 23, or 200 ft. (Washburn 2007) pg. 3 and (Lyons et al. 1993) pg. 3-5. Thus 80 meter's is the max depth for ground mine, so perhaps 60 m is "very shallow".
- 250m is depth where some submarines are constrained in maneuvering. This is about 200-300 meters, though in practice may be shallower.
- Max depth of Chinese rising mines is 2,000m - (Truver 2012), pg. 16. Older versions might have 1000ft capability (Lyons et al. 1993) pg. 5
- The rest of the map is then "deep"

Chinese networks were determined using OpenRailMap.

US hydrophone networks were from (Ball and Tanter 2015), the extent of Chinese hydrophone networks was guessed.

Chinese missile ranges were calculated from the coast based on open source range numbers.

[21] This may be a bit deep for some SSK's, but given how depths are split up and the fact that most <250m areas are closer to <200m, this is close enough.

[22] **Naval Combat (General)**

This section is *generally* informed by the following:

- (Hughes and Girrier 2018). Note I feel most comfortable in removing the qualitative factor of seamanship in surface combat after Hughes discussion on this (pg. 18-19).
- (Doyle and Herzinger 2022), specifically Chapters 3, 4, and 5
- *A Balanced Fleet,* by Dr. Nick Bradbeer (both tactical and operational varrients)
- *(Bradbeer 2023)*
- *Proceedings of the US Naval Institute* (perhaps starting from 2021 when I began reading them in earnest)
- (Dunnigan 2003) pg. 219-284
- Conversations with a serving Royal Navy Officer on work on the Indo-Pacific

[23] Range for all three of these is under 100 nautical miles (Cropsey and McGrath 2019), pg. 13.

[24] (Kadial 2023), pg. 22-27 (pg. 22)

[25] Assuming 12 x aircraft, each armed with 2 missiles (see (Kadial 2023), pg. 22-27 (pg. 22) for # of munitions carried, 2 AShM or air to surface missiles), this is 24 missiles, perhaps more/less depending on the size of the strike package and supporting assets.

[26] (*F/A-18E/F Super Hornet Aircraft (F/A-18E/F)* 2013)

[27] (Australian Air Force, n.d.)

[28] (Missile Threat, n.d.-a)

[29] [IV range] (Missile Threat, n.d.-b), [V range] (Larter 2020)

[30] With lower Pk's for interceptors, a shoot-shoot-look-shoot strategy, or the need to shoot 3 or more times, a ratio of 2:1 defensive to offensive missiles is roughly the minimum required to stop a given number of supersonic missiles. While it is unlikely that each of these (low Pk, S-S-L-S, 3+ engagements) would always be the case, overall, this ~2:1 rule is the best combination of being close to reality overall (at least for the purpose of modeling here) and being simple to use see (B. Clark 2017) pg. 17-18. Any minor problems arising from this can be fixed by the effects of point defense and ECM to increase the ratio of interceptors per incoming missile higher than two, the quadpacking of some interceptors into VLS cells, and assuming that the number of missiles in defensive and offensive salvos differ (e.g. 25 VLS cells worth of missiles is the rough number of missiles per salvo and used for ease, but in reality it's slightly less). This can produce the following:

Salvo Size in Terms of VLS Cells	***# of Missiles***	

	Incoming Salvo	Defensive Salvo	ECM + Pt. Def. Intercepts*	Ratio *(Interceptors per Incoming)*
AShM salvo size is 25 Interceptor salvo is 25	25	50	5	2.20
	75	150	7	2.09
	150	300	10	2.07
	Incoming Salvo	**Defensive Salvo**	**ECM + Pt. Def. Intercepts**	**Ratio** *(Interceptors per Incoming)*
AShM salvo size is 23 Interceptor salvo is 26	23	52	4.9	2.47
	46	104	5.8	2.39
	138	312	9.5	2.33
	Incoming Salvo	**Defensive Salvo**	**ECM + Pt. Def. Intercepts**	**Ratio** *(Interceptors per Incoming)*
AShM salvo size is 21 Interceptor salvo is 27	21	54	4.8	2.80
	42	108	5.7	2.71
	126	324	9	2.64

*Assuming 4 point defense intercepts of missiles, and 1 ECM defeat per 25 AShM (rounded to .1). Note that ECM is calculated before the defeat of incoming missiles by interceptors so is possibly overcounting, but at such a low Pk (though post-interceptor Pk it would thusly be much higher) it should not have to much of a bias on the system.

Note that offensive salvo size decrements by 2 missiles to allow 1 missile to be added to each defensive salvo (as two defensive salvos are shot per offensive salvo).

Thus with favorable defender assumptions if AShM salvo size is 23 and 6 salvos are fired (for 138 incoming AShM), and Interceptor salvos are 26 (and 12 salvos are fired in defense for a total of 312 interceptors), and each interceptor has a Pk of .7, and are employed in a S-S-L-S, in the initial S-S ~12 (12.42) incoming missiles would remain to be covered by 36 remaining interceptors (not counting ECM and point defenses).

With a little varying of assumptions, a attacker favorable tipping point for asumptions here would be AShM Salvo Size of 24, and Interceptor salvo sizes of 25.5, with interceptor Pk of .6, which ends with 6.7 incoming missiles for ECM and point defenses to defeat.

Of course if one begins to account for quadpacked additions to the interceptor salvos, we get the following:

	Incoming Salvo	Defensive Salvo	ECM + Pt. Def. Intercepts	Ratio *(Interceptors per Incoming)*
AShM salvo size is 25 Interceptor salvo is 31 *(25 VLS cells total, with 3 of them being quadpacked VLS cells)*	25	62	5.0	2.68
	75	186	7.0	2.57
	150	372	10.0	2.55

[31] Discussion with Dr. Nick Bradber.

[32] **Missile Combat Table**

This table is based on my own custom salvo combat model informed by:

- **Missile Hits**: (Hughes and Girrier 2018), (Cares and Cowden 2021) Note high variability in this damage table (e.g. randomness) has backing (pg. 18), (Smith 2010), (Cancian and Heginbotham 2023), pg. 30-32. Note I have some major disagreements with the overuse of historical numbers in this analysis and some assumptions made, it is worth noting that the outcomes are still relatively similar to those in my table. The systems analysis view used in the combat model of *A Balanced Fleet* by Dr. Nick Bradbeer has also been highly effectual on me to give me a high end bound of a systems model before it is degraded by friction.
- **Survivability:** My views on survivability are mostly informed by (Kok 2012a), pg. 1-94. I also conducted my own Historical Analysis in 2023 to determine survivability analysis of missile and bomb effects against military grade ships built after 1970 sunk/put OOA, and ships hit by missiles even if they were not sunk, I did an analysis of missile and bomb effects against military grade ships that I could find, which will no doubt be a undercount, but likely biased toward higher amounts of

damage as they would be more interesting and thus recorded. Ships damaged by mines were not included as they strike below the waterline. The given data may not account for advancements in damage control techniques and materials on newer ships. Full data and assumptions available upon request. Also of effect was *A Balanced Fleet* by Dr. Nick Bradbeer and discussion with David Manly (a specialist in ship survivability).

This table roughly assumes that 2-3 hits are required to kill or mission kill a ship, so a SAG would require 8-15 hits to kill while amphibs, carriers, etc. require more. See later footnotes for more of a discussion on this topic. Note also that this assume that all ships are roughly equivalent in terms of design for damage control and the effectiveness of damage control crews. This may not be the case with older Chinese ships whose design may be not as optimal for damage control (see (Kirchberger 2024) ~32:00).

[33] E.g. all incoming missiles have been covered off by 2 salvos of interceptors and there are spares for leakers to be covered.

[34] Naval units only start moving at half speed when they take a second damage as at the second damage the mission critical ships (carrier, amphib, etc..) have been damaged and are slowed. At lower levels of damage where only escorts are damaged, they will be left behind if necessary and will not affect the speed of the group in missions where it would become critical (e.g. at player direction). This is major concession to playability for the sake of some realis, but not all hits would necessary reduce the ships speed, and not all hits that would reduce ships speed would not be repairable.

A CSG and ESG only experience a decrease in ASW effectiveness when the flight decks start getting damaged or helicopters are lost as it limits the number of helicopters it can have active whereas with a SAG losing a ship seriously decreases the task force's ASW capabilities (both total ship sonars and helicopters aviable).

[35] The reason for a 3rd damage on CSG's and ESG's is due to the ability of larger combatants to 1) provide more ISR and (slightly) more defensive capacity, 2) to provide extra assistance (beyond what a SAG would provide) to other ships in the task force if damaged (extra damage control teams, helicopters, ability to take ships into tow, etc.), 3) to soak up a lot of damage as they are big. Dunnigan gives Nimitz-class carriers as requiring 10 hits to be mission killed, and a Wasp-class (as an example for Amphibs) as requiring 8 (see (Dunnigan 2003), pg. 240), (Center for Army Analysis 2016) pg. 34 gives 7 hits to put a carrier out of action, and LHD/LHD/LPD/LSD 4 hits.

With the larger combatants LPD, LHD, carriers, etc. (and carriers especially) it seems unlikely that a single AShM could sink them short of a very lucky series of events, ala Japanese carriers at Midway (which nowadays operations are conducted and ships designed in such a way to prevent), and that "sunk" here really represents a mission kill. For more on this, and the source that I draw my view of carrier battle damage from see (Doyle and Herzinger 2022), pg. 21-22.

These views have been double checked with David Manly (a specialist in ship survivability).

[36] It should be noted that a "sunk" result does not necessary mean that all ships are sunk, but rather that the unit (CSG, SAG, etc.) has lost so many ships, or sustained such damage that it is unable to continue operations and must return to repair yards for a long period of time, e.g. a mission kill. As major Blue repair yards not under massive kinetic threat from Chinese fires currently but are far away from the battle space, even moderate damage requiring repair can result in a mission kill at the operational level as ships must spend weeks in transit to the US (see (Trevor Prouty 2022), pg. 20). Note that Chinese threat to CONUS may be changing as the PLARF procures long and longer range weapons. Also consider also the US may not be able to repair surface combatants in any reasonable amount of time, meaning that even repairable damage can be an operational or strategic mission kill. In addition, as US forces do not have any destroyer tenders, repair ships, and or sufficient tug capability the number of mission kills that may have to be abandoned instead of taken under tow and repaired may be higher, see (Walton et al. 2019) pg. 62-63, 65-66. For the Chinese as their yards are within the area of operations, ships being repaired are likely to be struck again and damaged/destroyed, so the chance of a mission kill becoming a real kill is much higher for them.

[37] Submarine Combat (General Information)

The following pieces generally inform this section:

In General: (M. E. Glynn 2021), (Broadmeadow et al. 2008) pg. 39-48, (Nash 2000), (Heginbotham 2015) pg. 184-197, somewhat pg. 207-214, (Dunnigan 2003) pg. 255-269, (Aljilani 2018), (Mills et al. 2021), pg.

32-37, pg. 34-35 especially and the response to Mills et al. in (Noonan 2023), as well as *Undersea Warfare Magazine* (the US Submarine Forces Magazine, which was formally publicly available (magazines from 1998 to 2017)). **On Tactical Snippets**: (Eggman 2002), **On Hydrophone Detection:** (Cote 2019), **On the Ocean Environment:** (Gough 2011) and (M. E. Glynn 2021)

[38] This method of having submarines exist in a quantum state is slightly artificial but forces two things. One, it forces sweeping by ASW assets against subs to "lock them down". Two, it creates uncertainty as to where subs are at any given point. The movement storage maximum is only there due to piece considerations (information state on blocks is higher but limited), balance, and as it means that subs are localizable to a (very large) area, but not a specific area. This method was commented on as a good system both by Philip Sabin and by Dr. Nick Bradbeer.

[39] This is due to the fact that for submarine deconfliction, most will operate in a designated area, and that putting too many in raises the risk of a blue-on-blue or red-on-red occurring.

[40] This represents the chance of assets running into each other and cueing by theater ISR assets dedicated to the ASW fight. The ability of theater ISR (such as analyzing enemy operational patterns, SIGINT, hydrophones, etc. see (M. E. Glynn 2021) Chapter 10) is unknown and thus cannot be assessed. The chance of assets running into each other is not astronomical. (Center for Army Analysis 2016) pg. 28 assess the chance of an encounter between surface and subsurface asset as 50/50 in a 50Nm x 50Nm area. A hex is 87nm across, or an area of 12,733 Nm2, a 50 x 50 Nm square has an area of 2500 Nm, or 5 times smaller. If the probability of an encounter shrank linearly, this would result in a .1 chance of an encounter using the same probability of an encounter that (Center for Army Analysis 2016) gives. However, it likely does not shrink linearly, but at a more extreme rate as area increases and thus I reduce the probability of encounter to the lowest chance on the dice used in the section (keeping dice constant for ease), of a .05 (5%) chance. Note that (Center for Army Analysis 2016) is not the world's best source given the purpose of the game and the fact that it is publicly available, but lacking further data I use it. Chance of detection from a sub launching missiles represents datum cuing (M. E. Glynn 2021) pg. 164.

[41] This represents the ability to operate ASW aircraft for long periods required to persecute a contact. If superiority or supremacy are not present, there is a reasonable chance the aircraft will not fly the mission due to risk or will be driven off/shot down by enemy aircraft.

[42] Submarines moving at high speed are more likely to cavitate and just make much more noise in general, making them easier to detect. Based on discussion with Dr. Nick Bradbeer, a submarine design specialist, this also applies to SSK's as even though they are moving more slowly, the in detectability is not just from increased water flow speed, but also the need to snorkel after sprinting.

[43] Ships moving at high speeds are unable to deploy their towed arrays (the exact speed varies highly, this is an extreme average, based on a conversation with Dr. Nick Bradbeer in which I pushed him for a first order guesstimate, thus any mistake is on me not giving him the chance to come up with a proper answer.).

[44] This provides the benefit of bottom sitting (you are very, very quiet and hard to detect), but lack of mobility means that you can only cover that area (so there is no benefit to detection).

[45] Note that this is an extremely simplified view of a highly complex system, and the numbers here are based on conversation with Dr. Nick Bradbeer RCNC and a Royal Navy Lt. Cmdr. Exact numbers are pure guesses by the author as to effect. This simplification is especially true in the context of the South China Sea, see pg. 24 of (Torruella et al. 2022)– "high maritime traffic (especially in the South China Sea), marine life, industrial coastal infrastructure, currents and a complex seabed, temperature, and salinity profile, there is an inhomogeneous and noisy undersea environment. In many areas there is also a high sea bottom reverberation level. The result is an operating environment in which passive and active ship mounted sonars are challenged to meet ASW detection, classification, and target—tracking requirements". One key difference between shallow coastal waters and open ocean is the amount of maritime traffic leading to an increase in overall ambient noise to cover submarines (see (Tong Zhao 2018) pg. 27), though this is likely to change in a full scale war. Also note that shallow water is not only noisier, but limits passive sonar effects as well (Bradbeer 2023). Open ocean has less variation in the water column than shallow water, making sonar search generally more efficient, and is also generally quieter (both due to less shipping a less marine life). Additionally "long range acoustic arrival paths such as convergence zones and the Deep Sound Channel (DSC)" may be present. (M. E. Glynn 2021), pg. 8-9 (there is also discussion in (M. E. Glynn 2021) that shallow water is also nosier, but I have lost the page number and cannot be bothered to track it down).

[46] The sizing of the numbers here are not based on any hard data, but are attempting to account for the effects of weather. For explanations of what effects inclement weather has on ASW see (M. E. Glynn 2021), pg. 139, 141-142. Note that while some of the effect is on surface noise a large part of the effect of storms is on aircrew performance and thusly on recognition differential (see pg. 97-98 for an explanation of recognition differential).

[47] **ASW Table (General Information)**

While Chinese submarines are often discounted as being of extremely poor quality in some literature they have seemingly improved and "Blue subs are never sunk" is not a safe assumption to make when planning to fight. There do exist some cases of note that some might point to: In 2006 a Chinese Type 39 submarine got to within 5 miles of a carrier (though it is unclear to me how much ASW was being conducted by the CSG) (*CBS News* 2006), and in 2015 a Chinese submarine conducted a simulated missile attack on the USS Ronald Reagan (Gertz 2015). This is to say nothing of the litany of examples in NATO training of submarines managing to get kills on carriers or other surface combatants. In these cases however it is possible that the CSG or other ships could have killed the sub in a wartime environment before this had occurred. Many potential variables influenced these occurrences and they may not be representative of wartime outcomes for many reasons. The overall ability to detect (the numbers given here) are based upon the following sources:

- Expert analysis from CNA
- *(Heginbotham 2015)* pg. 186 (Figure 7.6), pg. 191 (Table 7.9), and light mind paid to pg. 194 (Table 7.10), somewhat pg. 213 (Figure 8.6) on the relative survivability of US submarines compared to a very heavy ASW screen (note the fact that these were primarily air kills as per pg. 223)
- From H.I. Sutton:
  - https://twitter.com/CovertShores/status/1554804240006238210 (2022)
  - http://www.hisutton.com/Chinese-Type-039C-Yuan-Class-Submarine.html (2021)
  - http://www.hisutton.com/Chinese-Navy-Type-093-Shang-Class-Submarine.html (2020)
- The availably and usefulness of various airframes for conducting ASW: (Noonan 2023), see especially the latter end of the section "So easy, a Harrier pilot can do it", and partly the problems presented in (Mills et al. 2021).
- (*Chinese Undersea Warfare: Development, Capabilities, Trends* 2023) for a look at Chinese submarine capabilities.
- (Torruella et al. 2022) for a look at Chinese ASW capabilities and the ASW environment of the Pacific. See figure pg. 23: of their escorts 88 (62%) are fully equipped for ASW, 8 (6%) are partly equipped, and 46 (32%) are not equipped (hulls only, ASW helicopters could be embarked). Notes on ASW helicopters on pg. 27. The overall lack of Chinese ASW assets (both fixed wing and rotary wing) at this time is also of interest here, though this problem will be remedied over time.
- To some degree (Tong Zhao 2018) particularly pg. 26-27, 36, though this report is about Chinese SSBN's. Notably I rate Type-94's as equivalent to Type 93's as "a Chinese 093-class SSN — which is believed to be considerably quieter than the 091-class SSN, and which may have a noise level similar to that of the 094-class SSBN" (pg. 36).
- (Kirchberger 2024)
- (Broadmeadow et al. 2008), especially pg. 39-48, 97-152 (pg. 129 especially), 180-183 (note I consider the various key assumptions and limitations to nullify each other when I use the data from this work, in part as it makes things easy (and I have no other data source to go to for some of these other factors to create a model) and in part as it wraps up a number of theater attrition factors that are not otherwise accounted for). Various bits of note follow, mostly so I don't have to go digging for them again when it becomes important:
  - On Kilo SSK's: "Its advanced MGK-400EM Sonar is capable of detecting surface ships at ranges greater than 40 miles and submarines at ranges beyond 10 miles" (pg. 44)
  - "In the modeling of other alternatives, the submarine speed is taken to be 5 knots. In this case its speed is taken as 10 knots, under the assumption that it will be less concerned with stealth

when outside the CSG OA. It can be reasonably assumed that the transiting submarine prior to entering the CSG OA will change its behavior to a stealthier, continually submerged mode." (pg. 118-119)

    - The probability of detection by a P-3 MPA defending a CSG over an 8 hour period, attempting to detect a SSK (surfacing 1 of every 6 hours) moving to attack a CSG is ~5%. (pg. 122).
    - Recognition a threshold for a sonobuoy is 20dB (pg. 126), background noise is on average 70dB, with detection values being 20dB for active and 10dB for passive sensors (pg. 108), a Kilo SSK gives off 10dB (pg. 106)

- (M. E. Glynn 2021), pg. 27-43
- In general values from (Center for Army Analysis 2016) pg. 28-29

On SURTASS specifically see (Heginbotham 2015), pg. 191 and (Center for Army Analysis 2016) pg. 28-29

[48] Data from baseline scenario in (Broadmeadow et al. 2008) pg. 129. Pk is .665 (65% chance) so 8+ on a d20. ESG and CSG grouped as both have access to large amounts of helicopters for ASW.

[49] Data from (Broadmeadow et al. 2008), especially pg. 122. The probability of detection by a P-3 MPA defending a CSG over an 8-hour period, attempting to detect a SSK (surfacing 1 of every 6 hours) moving to attack a CSG is ~5%. (pg. 122). Given that AIP submarines are becoming more common (so less/no surfacing) and only China's diesels are really noisy (though getting less so), I estimate a 5% chance for every sub, except Chinese Diesels (which are noisy, and a great number of which are not AIP). Japanese Diesels of which ~½ are currently not AIP are rated to be better because they are not as noisy as older Chinese boats.

[50] A sonobuoy array has a 57% chance of detecting a submarine (data from Figure 66, (Broadmeadow et al. 2008), pg. 129). A hydrophone network, more deliberately laid and not having to worry about drift of its sensors is probably better. Thus, I rate it as having a 70% chance of detecting the enemy (7+ on a d20). The author is aware that due to differences in the effectiveness of sensors and the underwater environment the barrier may be constructed differently, but assumes (as no better data is present) that if sensors are better/worse they will be placed further/closer to achieve the same effect as presented.

[51] **ASW Attack**

Estimating the Pk of a torpedo is difficult (see the section on "Kill Probability" in (Strachan 2022) for a brief overview). The Pk of a ASROC is ~.2, see (Valerio 2009) pg. 39-40. The paper takes as a given that the target has been detected (as per the detection table) and assumes that 3 shots are taken with a torpedo with a Pk of .2 against the sub (.512 chance of 3 misses, or .488 cumulative chance of a hit on the Sub), this choice of 3 attacks was vibe-checked by Dr. Nick Bradbeer (blame me if this is off, I ambushed him with the question!). I choose three shots in a given engagement as it makes good probabilities (it's ~50%) and seems a reasonable number to the author for the maximum number of torpedoes fired across a whole sub vs. sub or sub vs. ASW engagement which may go through several phases of attempting to localize and attack the sub over several hours in the 24-hour period which makes up one turn. Thus the 3 torpedoes may well be spread out over several minutes or several hours of time, but the aggregate over one turn is assumed to be 3 torpedos fired. E.g., approximately three is a reasonable number of possible engagements and at three the chance of a kill or mission kill is high enough to warrant rolling dice. In this context the Pk is almost the same as the Ph because hitting a submarine is either a) enough to kill it, or b) enough to make it loud enough due to the water flow to kill it with a follow-on attack shortly after. If the sub is attacked, but not killed it suffers a sort of "suppression" for the rest of the turn in that it needs to evade and reposition to carry on its mission. See (B. Clark 2017) pg. 25.

Note that as this is a 50/50 chance of kill, it would be easy to say "you sink the sub on an even number, you don't on an odd number", but for a number of hard to detect subs that significantly biases the chances of sinking them when detected (e.g. a sub only detected on a 18+ would only have a 1/3 chance of being sunk using the even/odd method) and is less thrilling that rolling to see if you escape (or sink a sub) once it has been detected.

It could be argued that the lower sprint speed of diesel boats, and more limited time that they can sustain that sprint speed ((Aljilani 2018), pg. 6) should increase the likelihood of them not escaping (perhaps a -1 or -2 on escaping), but I do not do this in favor of playability.

[52] Originally this used a "higher number rolled detects" – however if both sides detected this often meant that the Chinese submarine would detect first as it has to roll much higher to detect in the first place. This version of precedence used (lower number that detected) instead means that submarines with lower (thus better) detection number are both more likely to detect the enemy and more likely to attack first as a result of that detection. Thank you to Nick Bradbeer for recognizing this issue and suggesting this fix.

[53] Basically, with a sub sweeping in front of a group, the speed prevents an attacking sub from moving around into the baffles of the moving group and attacking, so a head on attack must be made forcing the attacker to kill the defending sweeping sub or attempt to slip by the sub with attempting to slip by being a very bad idea. (Discussion with RN Lt. Cmdr., May 17th, 2024). See also (Broadmeadow et al. 2008) pg. 45-46

[54] (Aljilani 2018) pg. 9

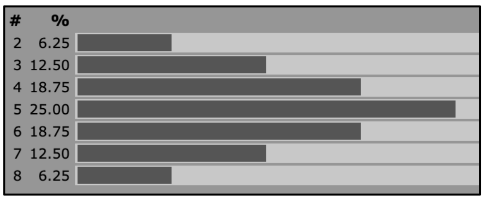
[55] Submarines can score max 1 damage (sinking/mission killing 1-2 ships) as they come under extreme risk by sticking around, and would tend not to try to attack multiple targets. See (M. E. Glynn 2021), pg. 12

[56] In Mobility Guardian 2023, units were able to deploy their maintainers and other supporting elements in 38-42 hours, with RAF forces able to get to the Pacific in 21 hours (Cohen 2023). If necessary limited operations can be conducted by a squadron's teeth element operating in a very expeditionary capacity, backed by one or two cargo planes/tankers as demonstrated by US exercises in the Pacific, then allowing the rest of the squadron to flow in over several days (so operations can be conducted from the first day in a limited capacity). Alternatively, if there are already forces there, they are merely reinforcing existing squadrons and can leach off of their logistics/maintainers for a short period until the squadron's own logistics and maintenance arrive. Assuming friction will make it worse than the real world to deploy than in the exercise, but that this more expeditionary limited operations can be employed. 2 days, (48 hours) seems a good number to go with. Additionally, having it only be two days makes it easier for Control.

[57] See (Walton and Clark 2021) pg. 34

[58] The US trains for rapid deployment and support of operations at a distance and on short notice. Other militaries do not do this to the same extent, and consequently, take longer to redeploy units.

[59] This is planned and trained for, but I cannot find a source on how long it takes precisely. Aircraft would be easier to move than support assets like ground crews, fuel, and munitions, but Taiwan is also not a large place and this is (supposedly at least) trained for. US document leaks show that the US assessed it would take at least a weak to ready the ROCAF to fight (Nakashima et al. 2023). Thus, I use a random number to represent the large number of factors at play. The distribution of 2d4 is as follows:



[60] **Air Combat (General Information)**

This section is generally informed by the following:

- ('Air Force Doctrine Publication 3-01, Counterair Operations' 2023), especially pg. 2-7.
- (Bronk et al. 2022). This work identifies three key elements: effectiveness of GBAD (mainly deconfliction and electronic warfare), the value of better technology (generally radar ability, missile range and missile seekers), and consequently to the value of better technology the effects of being forced to operate at low levels. These are represented thusly:
    - Effectiveness of GBAD: due to the high overmatch in numbers between the ROCAF and the PLAAF, I assume that Chinese GBAD in this case would rarely fire as Chinese aircraft would be the primary tool to engage threats for the Chinese IADS as Taiwanese aircraft would rarely be in range to be engaged by Chinese GBAD. Taiwan operates only medium

and short ranged GBAD systems, which would be a high priority target for the PLA. As I assume a general competence for all sides in a fight, I contend that there would be heavy suppression of such systems, but that numerous SHORAD and MANPADS would have effects due to volume on certain types of missions (as was seen in the first year of the War in Ukraine). As a consequence of assuming general competence, this means that deconfliction is assumed to be relatively effective, and where it is not, an equal rate of fratricides occurs, meaning that I can wrap up fratricides from deconfliction as part of the general attrition of squadrons. The ground-based EW talked about in the article will be less effective than in Ukraine due to the fact that there is a great deal of water that prevents the PLA from positioning ground-based EW platforms closer to Taiwanese air defenses. Air based EW from jamming pods is already assumed to be flying with strikes and therefore does not need to be addressed specifically as part of this. Also note that the discussion of the opening days of the war from pg. 6-17 (good summary on pg. 20) indicates that IADS values should possibly be lowered at the start of the game, and then raised back to normal later (e.g. IADS isn't static), but this is not done for simplicity and as deciding values is dependent on so many known unknowns and could end up with so many different results as to be worth a PhD dissertation.

  - Better technology: this is part of the attack and defense modifiers system for various generations of aircraft. 4.5th Gen aircraft are abstracted as being 4th Gen purely for easing the work of the air umpire (e.g. it is assumed that all sides have the same ratio of 4th to 4.5th Gen in their 4th Gen counters). It is assumed that Chinese and Western missiles and radar are of comparable quality for each generation given a lack of unclassified data on the subject and my general assumption for the purposes of this game is that all sides are generally competent, with this extending to their R&D sectors and military-industrial base unless otherwise known. Note though this should not be construed as an endorsement of this position. Given the fact that most sides have some 4th Gen and 4.5th Gen aircraft in the fray, mixing the effects of 4th and 4.5th Gen aircraft, and the higher level modeling employed by this game means that the affects can be abstracted and that no side has such a distinct advantage in 4.5th Gen fighters as to be worth modeling (note that this may be incorrect for someone like the US however). Some may disagree with this point, see (Lostumbo et al. 2016), pg. 38, the table on pg. 44, or pg. 44-45 for example. Furthermore this difference also becomes less important at the operational level where the system of warfare, enables, TTP's, force employment, and logistics become more determnitiative.
  - Low level operations:
    - This is also discussed in other sources: (Newdick 2022)
    - This is not accounted for in this game to avoid too much complexity, but if you want to add it a demotion to attack and a promotion to defense would one way to implement it.
    - PLAAF may have to do low level operations if they fail to suppress Taiwanese air defense as Ukrainian medium range air defense forced the Russians to abandon medium and high-altitude operations (RUSI, pg. 14). If this is the case in a Taiwan scenario, then any such effects of low-level operations would be a wash. However, later sources (see other sources above, and note that while the RUSI article and the Drive article were published a month apart, the RUSI article interviews are somewhat older than the publication date), indicate that Russia may be able to operate at higher altitudes and keep the Ukrainians low.
      - Note that in light of the analysis of (Lostumbo et al. 2016), I feel that the Taiwanese would not be able to project an air defense bubble over the island or their forces for a long period of time given competent Chinese SEAD/DEAD operations (again assuming Chinee competence here!).
- (Heginbotham 2015), particularly pg. 49-93

- (Lostumbo et al. 2016), particularly pg. 36-49, 53-54, 58, 60-62, 65-68, 97-121. Note that a good chunk of this report is looking at different structures for air defense for Taiwan and as such various models may have different assumptions from current Taiwanese air defense.
- (Bronk and Massicot 2023)
- (Bronk 2016). In general the whole report is of value, but I find the following quote (pg. 8) particularly encapsulating: "The US Red Flag exercises have consistently proven that the key determining factors in air-to air combat are situational awareness, persistence in terms of fuel and missile stores, and pilot experience. Aircraft kinematic performance is a secondary aspect that only becomes critically important in a post-merge situation – a dogfight – where opposing aircraft are in visual contact with each other and are aggressively manoeuvring to bring the other into their sights."
- On modern accounts from pilots, see (Newdick 2024) on US F-15's, and (Newdick 2025) on Ukrainian operations.
- On carrier airwings: (Eckstein 2022)
- On Ukrainian Operations: (Ax 2025)
- (Gunzinger et al. 2019)
- (Sillion 2015)
    - "Over the past two decades, the majority of aerial victories have been the result of BVR engagements where the victor almost always possessed advantages in sensor and weapon range and usually superior support from "offboard information sources" such as GCI radar operators or their airborne counterparts in Airborne Warning and Control Systems (AWACS) aircraft. This is significant, as it suggests the competition for SA is heavily influenced by the relative capabilities of the opponents' electronic sensors, electronic countermeasures (ECM), and network links between sensor, command and control (C2), and combat aircraft nodes." (pg. 24)

[61] **What is a Squadron (and a Discussion of Sortie Rates)?**

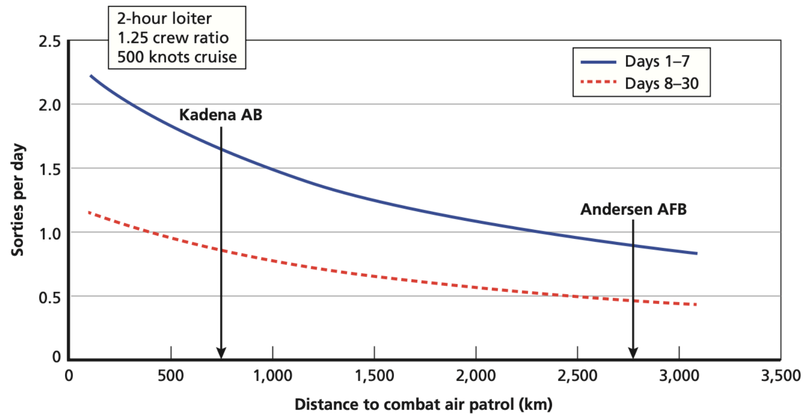
What is a Squadron?

While a "Squadron" is the unit used here (16-18 x 3rd or 4th Gen aircraft, or 12-16 x 5th Gen aircraft), given the turn length (1 day) the employment of a squadron in a sector doesn't necessary mean that all planes are up at once. A squadron indicates the capability of a squadron to conduct missions, and not all the aircraft are up in the air at any given time. This could mean no sorties or several sorties per day for each aircraft depending on the mission and tasking, but on average works out to 1 per day.

Sortie Rates in the Pacific Theater

A RAND report found that "assuming a 1.25 crew ratio with weekly and monthly restrictions in place for a mission with a two-hour on-station time. Flying from Kadena AB on Okinawa (roughly 770 km from the center line between Taiwan and the mainland), U.S. aircraft could fly 1.6 sorties per day for the first seven days and 0.9 sorties per day thereafter. From Andersen AFB on Guam (roughly 2,870 km from the center line), aircraft could achieve rates of 0.8 sorties per day for the first seven days and 0.5 thereafter." Given the model they present and the numbers they give for Chinese airbases, Chinese aircraft could fly between 2-2.5 sorties per day. See (Heginbotham 2015), pg. 79-80. Note that Western militaries likely would have an advantage in sortie generate due to higher force quality, but this would be offset by the fact that they are further from the areas of battle in many cases.

Figure 4.3
Sortie Rate as a Function of Distance



SOURCE: Air Force Instruction 11-202, Vol. 3, 2010.
RAND *RR392-4.3*

The reason for the shape of the lines on this graph is 1) increased time to transit to and from the target, and 2) increased maintenance time due to an increase in flight hours as a result of the longer transit. See (Stillion and Orletsky 1999), pg. 51, 81-84

Theoretical Sortie Rates

As a general rule of thumb for specific adjudication of things if specific numbers are needed at a specific point in time (any given hour for example): assume “1/3 of available airframes are in the fight; 1/3 preparing to launch or enroute; and 1/3 recovering, refueling and rearming” (Deptula and Penney 2022). For a deep discussion on sortie rates (a good assumption is ~2 per day in most generic cases, though see the discussion above for the Pacific), see (Stillion and Orletsky 1999), pg. 81-84

Higher Sortie Rates

Higher numbers of sorties (3-4 a day) in extreme circumstances for periods of time are possible, and would likely be flown, if possible, by outnumbered Taiwanese pilots to have some sort of presence in the air in the face of overwhelming Chinese numbers. This was seen in Ukraine at the start of the war: “Kryvonozhko said some pilots flew three to four sorties a day to engage Russian forces. They often skipped preflight checks and took off from shortened runways that had been bombed and then repaired overnight.” (Sonne et al. 2023), or pilots flying 2-3 sorites a night (Newdick 2025). In a system with poor maintenance provisions high initial sortie rates can collapse quickly however (see (Isby 1985) pg. 22, expected Soviet sortie rate was 4-5 in a surge, 2-3 a day in the first 3 days of operation, then decreasing to 1-2 sorties a day) though if this applies to the PLARF or a ROCAF degraded by fighting is unclear. For a discussion of PLA and some specifically on PLAAF maintenance see (Fleming et al. 2023).

[62] Damage here represents a combination of loss of airframes, decrease in sortie generation due to pilot and airframe fatigue, and other miscellaneous factors that decrease the overall effectiveness of the squadron. Thus, a Destroyed result does not mean that all aircraft have been destroyed, but that the squadron’s effective fighting power has been reduced to the point where it has a negligible impact on the ongoing fighting. Note a relative inherent brittleness to squadrons, as they likely only have 1-2 spare aircraft to begin with (Mattern 1993), pg. 3-3. Though of course, the higher the possible sortie rate the more a single aircraft can cover for another unavailable aircraft if trying to produce a given number of sorties from a squadron in a 24 hour period.

[63] While this does not act as validation of this model, note that a very similar system was arrived at by CSIS in (Cancian and Heginbotham 2023).

[64] Sectors are used in this system mostly for simplicity, and boundaries are based on my decisions, but match somewhat with long range SAM ranges.

[65] This approximately represents the “fighter sweeps” element of offensive counter air, but may also wrap up some degree of attack operations see (‘Air Force Doctrine Publication 3-01, Counterair Operations’ 2023) pg. 4-5.

[66] This represents the active air defense element of defensive counter air, see (‘Air Force Doctrine Publication 3-01, Counterair Operations’ 2023) pg. 6.

[67] This represents the fact that due to flying a continuous 24 hour CAP in the area of the carrier this CAP is able to react much more than another CAP flying far away from their base (and that might not even be flying at that point in the 24 hour period). E.g. the area needed to be covered by a CAP defending the CSG is much smaller than a squadron spread out to cover a large area.

[68] The number of squadrons here is a guess, but it is representing not having too many friendlies in the way such that it might cause problems in attacking the enemy.

[69] This represents the "Fighter Escort" element of offensive counter air. see ('Air Force Doctrine Publication 3-01, Counterair Operations' 2023) pg. 5.

[70] While Conducting and Escorting strikes are abstracted to squadron level in these rules, conducting a strike would likely involve some escort aircraft either from the same squadron or another, (for example a F-18 strike escorted by a small number of F-35's from another squadron) but due to level of abstraction, this sort of mixing is not represented here in that manner, but rather at the squadron level.

[71] Air Support here broadly represents what the USAF calls "Counterland Operations". The distinction between Ground Support and Interdiction functionally represents Close Air Support (both pre-planned and immediate) and Air Interdiction missions, though Ground Support is broader than just CAS missions (for example attrition of enemy forces away from FLOT is an Air Interdiction effect). See ('Air Force Doctrine Publication 3-03 Counterland Operation' 2024). Note that this assumes the ability of the PLAAF, PLAN, and PLAGF to conduct such missions as effectively as the US or other partners, which may be incorrect (though equal force quality is always assumed throughout these rules), on which see (Solen 2020) pg. 7.

[72] It is assumed that a maximum 24 aircraft may attack a target per 24 hours (assuming full ability to operate at night) can be conducted based on airspace limitations. This is approximately the strike component of 2 squadrons after accounting for some aircraft being unavailable and some flying escort or SEAD roles. This number is increased by an additional 24 aircraft if a unit is moving by road (Center for Army Analysis 2016) pg. 12, 36. It is unclear how CAA arrived at this number, but I suspect it is more due to the ability to detect targets to attack than airspace limitations.

[73] It is extremely difficult to tell how effective aircraft will be in inflicting damage in this war as its effectiveness is contingent on a great bevy of factors that vary greatly at various different points. Note that "ground support" in these rules does not just mean attacking frontline troops but also troops in the rear area when applicable (e.g. non-interdiction attritional attacks). This 1d2 attrition can therefore be argued over greatly (and should be changed depending on other circumstances, as always, these rules are not exhaustive). Given the potential effectiveness posed in (Lostumbo et al. 2016), particularly pg. 61, the 1d2 attrition falls close to the numbers from the RAND report.

74 This is a combination of standoff and non-standoff SEAD/DEAD missions both by kinetic and non-kinetic means. This also include the use of anti-radiation loitering munitions (Taiwanese NCSIST Chien Hsiang, Chinese ASN-301) and abstracts in the targeting of specific air defense assets with ground based long range precision fires or drones for SEAD as seen in Ukraine (though note that special forces attacks on air defense is covered in special forces missions and not abstracted in here). This overall represents localized suppression, and perhaps some non-localized suppression. Area of Responsibility (AOR) or Joint Operations Area (JOA) suppression is not explicitly modeled in this game both for ease and due to the high regeneration of most air defense assets for both sides (China via its number and landmass allowing it to reposition assets quickly, Blue assumed though the number of U.S. Patriots and other systems available for the initial part of the war). AOR or JOA suppression is somewhat accounted for in the ability of missile salvos to degrade IADS. See ('Air Force Doctrine Publication 3-01, Counterair Operations' 2023), pg. 5. For notes on current and future SEAD/DEAD, my thoughts are mostly shaped by commentary on the F-35's ability to support such operations from a variety of sources and more technical information from (Scott 2023b) and (Scott 2023a)

75 Reducing the IADS by 1 makes the most sense for playability (as the highest an IADS can usually be is 2). Note this reduction does not match roughly with effectives given for a 4 ship SEAD flight in Center for Army Analysis's C-WAM v7 (29th July, 2016), pg. 14 (1/4th risk reduction, compared to about 5% in this wargame).

[76] This model was independently arrived at, and is almost exactly same model of MPA's is used in Center for Army Analysis's C-WAM v7 (29th July, 2016), pg. 8 (though I am loath to state that this is "correct," it simply makes me somewhat more confident in the way the modeling works, though not the data itself, that

we both came to the same model). "MPA aircraft: The subsurface search capability of a command's MPA aircraft will be represented as a region of search coverage on the naval subsurface map. The MPA search region will be 100NM x 100NM (four contiguous squares on the standard scale subsurface map). The command will be given one such search region for every 4 MPA aircraft it has. Although MPA search regions must be assigned during the ISR turn the results of their activity is not determined until the naval white cell plots and executes the turn's subsurface movements. If a submarine moves through an MPA search region then a detection roll will take place and be adjudicated using the Naval Detection Table (shown in the Naval Combat Section)." Note each hex is Jaws is approximately 100nm x 100nm, and that a squadron of MPA which generates 2 searches is 9 aircraft (4.5 aircraft per search)

[77] Values drawn from (US Air Force 2018) Tables 11, 12, and 13, pg. 18-19. Assuming 17 4th or 5th generation aircraft need to be supported at a distance of ~1,000-2,000 miles of distance/time in the air, this means about ~3 tankers required per 18 aircraft, assuming a mission capable rate means only ~7 of 9 tankers are available, this means that 2 squadrons can be supported at a time by a tanker squadron.

[78] **IADS**

Here IADS represents both short, medium, and long-range air defense, as well as some number of interceptors (though to a limited degree, they are directly represent though the Intercept Strikes option), the degradation of forces due to IADS (e.g. increasingly attacking from standoff, difference in operations, etc.). See (Gunzinger et al. 2019) pg. 42-44. For details informing this section overall, the value of stealth, and IADS values on the map see (Heginbotham 2015), pg. 97-132.

On the evolving nature of IADS in the context of the Russia-Ukraine war (and the effect of persistent ISR on SHORAD), see (Watling and Reynolds 2025), pg. 18

[79] This means in most cases a 50% decrease in effectiveness against 5th Gen aircraft in most IADS areas, and a 100% decrease in effectiveness against the B-2. The B-2 is better here than a 5th Gen aircraft as it is both stealth and high flying which degrades the performance of radar and SAMs against it.

[80] Increasing by one, rather than doubling, or some other operation is based on my view that SHORAD is a relative static value in all cases here e.g. it is always present, but is not more effective in one case or another or depending on where you are as SHORAD occurs around where the target is, not as you are flying in, in the specific case of Taiwan. If this was Ukraine for example, the risk from SHORAD would increase the deeper you penetrate though enemy lines. As it is well integrated as part of an IADS with cueing (e.g., SPAAGs, short range SAM's, and MANPADs) it is a static value rather than something else.

Note that this fails to account for the ability of SHORAD to be outstripped by the maneuvering force it is supposed to support if not properly coordinated or if SHORAD is not available in enough numbers, as may well happen with Taiwan's limited SHORAD inventory, but given limited maneuver space on Taiwan I think the effective employment of SHORAD is a reasonable assumption to make. For some overview of what happens when SHORAD is outstripped by the maneuvering forces see the opening of the 2023 Ukrainian summer counteroffensive, as detailed in (Thomas Newdick and Tyler Rogoway 2023).

[81] **The Air Combat Table: Understanding the Lethality**

The rate of damage to squadrons here is heavily colored by (Withington 2022), particularly the point that in the 142 days after the invasion, Ukraine had lost 19% of its pre-war stockpiles (not including decreases in readiness rates due to mechanical fatigue which are not able to be documented), in a war seeing limited amounts of air power, which also generally stayed behind the respective side's forward line own troops (FLOT). Furthermore, air operations also took place over a piece of land, where pilots are easy to recover (especially as they were likely to be shot down close to, or behind their own FLOT), something made more difficult in the contested airspace and water (instead of land) that would characterize a war in the Pacific (not to mention a lack of long-range CSAR capabilities for the US, which for the US is limited to ~250nm (Hunter 2022b) without having to rely on boat or submarine pickup, of which there are few to be spared).

The accuracy of the lethality of the air-to-air table is up for debate but given analysis in (Heginbotham 2015), pg. 81, I feel that the given lethality of these rules is squarely within the bounds of probability. E.g., if a squadron of 16 aircraft can achieve a maximum of 32 kills as per the report, in an air-to-air engagement on this table, a 4th Gen fighter squadron (vs. 4th) will achieve on average 1.7 kills, and a maximum of 6 *if* it gets into an engagement, which may not happen. This is of course, assuming that the squadron is not damaged, in which case, it will perform more poorly. While I have not yet had time to crunch the data to provide comparison to the RAND information presented here, my view on air to air combat's exchange ratios is also shaped by Pournelle's model, and his discussion SWIFT data, which is also used in C-WAM (Pournelle 2024), and by the discussion in (Gunzinger et al. 2019).

Average Squadron Kills and Losses by Aircraft Generation (assuming full engagement)		
	Average Kills/Losses	Average Losses Taken/Inflicted Per Sortie
5th Gen vs. 4th Gen	3.3	19%
4th Gen vs. 4th gen (or 5th Gen vs. 5th Gen)	1.7	10%
3rd Gen vs. 3rd Gen (or 4th Gen vs. 5th Gen)	.71	4%

Also note that to some degree maintenance degradation and other mishaps taking out aircraft is also rolled up into this loss rate. Note that the above assuming that each squadron musters 17 aircraft sorties in a day and they all get into an air-to-air fight:

However, this is not entirely correct as not all squadrons are always fighting for air control. Assume that 50% are unavailable to get into a fight, either grounded (due to logistics/maintenance issues, or closure of the airbase runways/facilities due to enemy action), launch but don't find the enemy (or are escorting and do get into a fight), or are flying a strike or SEAD mission, or are degraded due to loss of enablers or aircraft in the squadron. We don't get a change in average Kills/Losses, but instead the individual lethality of aircraft engaged in air combat ticks up (to be more in line with (Heginbotham 2015), pg. 81), but across the theater as a whole, the overall daily attrition rate ticks down by half.

Effective Squadron Attrition Rate by Aircraft Generation Assuming a Variety of Missions		
	Effective Average Kills/Losses	Effective Average Losses Taken/Inflicted Per Sortie
5th Gen vs. 4th Gen	1.65	10%
4th Gen vs. 4th gen (or 5th Gen vs. 5th Gen)	0.85	5%
3rd Gen vs. 3rd Gen (or 4th Gen vs. 5th Gen)	0.35	2%

Based on player/control decisions from one run of the game, 50% may be an overshoot (though I didn't collect good enough data at the time to get a good answer to this, and Control recollection is slightly hazy).

Let us revisit my earlier comment "to some degree maintenance degradation and other mishaps are rolled up into this loss rate." What is the per sortie loss rate of aircraft to mishaps? For a competent military under the best possible conditions like in Gulf War 2, there were 15 non-combat losses (*CNN* 2001) out of 41,404 sorties flown (Dudney 2003), for a rate of .036% aircraft lost per sortie. This is functionally negligible but give us a floor to work off of. In the Pacific, at greater distance, with bases under attack, and less access to immediate reapply, this rate would inevitably be higher, though probably not massively so (even multiplying by 10 only gives .36%).

It is of course very difficult to estimate maintenance degradation, and the one source I found with direct numbers had those numbers redacted. A proxy can be found in not mission capable-supply rates, which are (first order approximation) 25% after 30 days of fighting (Mattern 1993). If each plane on average sorties ~1 time per day in the squadron for 30 days (480 sorties), and 25% become mission non-capable (4 aircraft), this is an maintenance attrition rate of .83% per sortie for the first 30 days. *Note this is very much a first order approximation,* and in reality this is not really linearly distributed – rater sortie rates can be surged in the first few days and then begin to drop off (Heginbotham 2015), pg. 79-80. Furthermore, many of these not true aircraft losses and can be repaired, though in practice accumulating wear means that an increasing number of aircraft will be unusable due to needing service.

Thus summatively gives us a .866% per sortie effective "loss rate" due to non-combat factors.

So, we can subtract out these losses per sortie (assuming again that there was 1 sortie per aircraft in the squadron TOE) to get the following:

Effective Squadron Attrition Rate from Combat by Aircraft Generation Assuming a Variety of Missions	
	Effective Average Losses Taken/Inflicted Per Sortie
5th Gen vs. 4th Gen	8.9%
4th Gen vs. 4th gen (or 5th Gen vs. 5th Gen)	4.1%
3rd Gen vs. 3rd Gen (or 4th Gen vs. 5th Gen)	1.2%

Is this realistic? This assumes 17 aircraft-sorties per day (e.g. each squadron generates 17 aircraft to fly a sortie at various points in the day), and that only 50% of sorties get into a fight. The numbers will change if you change the assumptions.

Second, let us gut check the numbers. Stealth aircraft are taking very low losses per sortie, with stealth doing very good against 4th Gen, and 4th Gen aircraft (lacking the defensive value of stealth) hitting each other pretty hard. Regardless of a specific quibble over the numbers (9% vs. 4% vs. 1%) these seem to fall within what could happen (we do not really have good numbers to compare to in the open source!).

Second, in (Cancian and Heginbotham 2023), it is stated that “historical attrition rate per sortie in most conflicts is less than 1 percent, and only 2 percent for the particularly intense Battle of Britain” (pg. 41). Why do my numbers differ? I think this is for two main reasons. First is that historical rates do not account for the very long range modern BVR combat and increased number of sensors in the air. Second, it does not account for modern IADS systems with their networked sensors and improved SAMs.

Difference from Historical Squadron Attrition Rate from Combat by Aircraft Generation				
	1% Attrition Difference		2% Attrition Difference	
	Average Kills	Average Losses	Average Kills	Average Losses
5th Gen vs. 5th Gen	0.6%	0.6%	-0.4%	-0.4%
5th Gen vs. 4th Gen	10.6%	0.6%	9.6%	-0.4%
4th Gen vs. 4th Gen	5.6%	5.6%	4.6%	4.6%
Avg. Attrition Difference	3.93%		2.93%	

Furthermore, higher loss rates per sortie are possible. In the Battle of Kursk, the Soviet Air Force from 5 July to 8 July made 11,235 sorties with combat losses of 556 aircraft meaning 4.95% losses per sortie (see https://en.wikipedia.org/wiki/Operation_Citadel accessed January 16th, 2024, citing G.A. Koltunov and B.G Solotiev, (Kurskaya Bitva, p. 366 16-ya Vozdusnye Sily v Volykoy Otechestvennoy Voyne p. 186), which I cannot find to read myself)

Note too that the numbers are per sortie, it does nto include the loss of aircraft on the gorund due to missile strikes.

[82] This is representing the fact that multirole aircraft are designed to be better able to conduct air-to-air missions than non-multirole aircraft and can defend themselves much better. For example see discussion in (Newdick 2024)

[83] The value here is drawn from a talk by a F-35 pilot about F-35 employment and tactics at Red Flag, which I cannot find the reference for. Also see (Sillion 2015) on the massive value of situational awareness in air combat (pg. 31-32 etc.). On quarterbacking see (Dahm 2025)and (Bronk 2016)

For an illustration of how it might work, see a good description of the Indian use of Su-30K’s in Cope India 2004 (Rogoway 2019),where one plane picks up information for the others then datalinks it to them allowing them to shoot, the inherent stealth of the F-35 makes it better for this than other aircraft. The point the pilot made was that the F-35 had a unique capability for data collection, fusion, and transmission. For further evidence of this sort of quarterbacking see (Trevithick 2023).

Note that both F-22's and J-20's seem to have datalinks, but the F-35's sensors + the datalink are the key reason this is a F-35 exclusive ability. As of 2022ish, F-22 Raptors also have datalinks ability as well with their new R1 upgrade (Hunter 2022a) though I have not seen an example of them doing this sort of "quarterbacking" (though this may well be due to me missing it), and it seems likely that the J-20 has a datalink (Chopra 2020). Given the lack of information on the abilities of the J-20 compared to Western 5th Gen aircraft, I do what I have done through the rules and rate it in these rules as being equivalent (see (Trevithick 2022) for further discussion on how good J-20's may be).

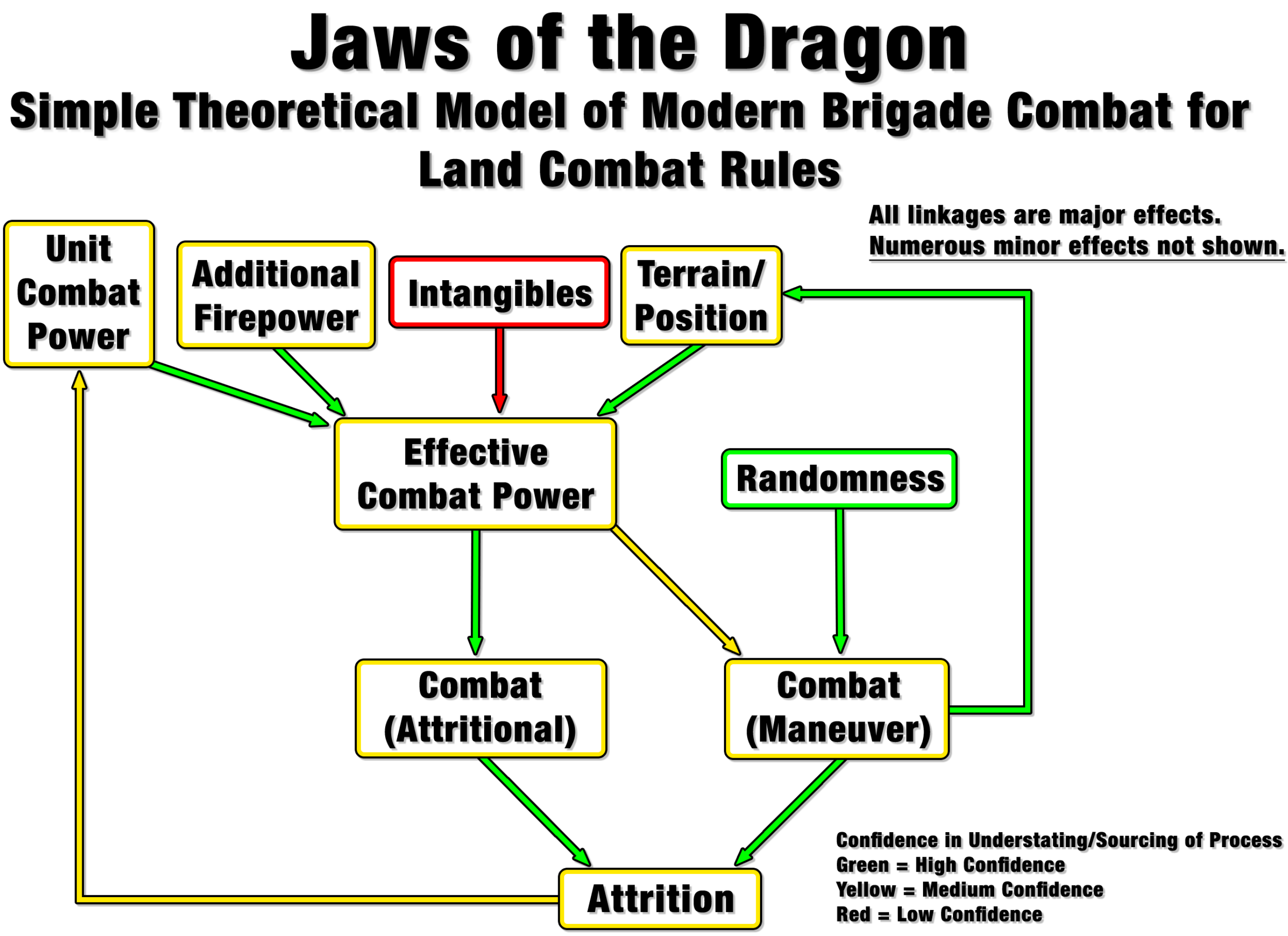
[84] On the value of AWACs against 4th generation fighters see (Sillion 2015) pg. 27-28

[85] Unit movement is based on numbers from (U.S. Army Training and Doctrine Command 1994), or if that does not provide the desired information numbers from Warfighter 2 Remote by Maj. Tom Mouat. Helicopter movement is 260 Nm/500 km based on (Center for Army Analysis 2016) pg. 38.

[86] (Military Surface Deployment and Distribution Command 2011). Load/Unload times: Table 6 on pg. 56. Assumes sufficient ships are available for use.

[87] Land Combat (General Information)

This is the general theoretical model of the land combat rules:



The central thesis of this model is that attrition taken by forces is the ultimate factor in land combat. This can be inflicted in a number of ways and is influence by a myriad of factors, but the loss of equipment, personal, and their summative system is the ultimate factor of the battlefield.

The best argument against this model is that the effect of morale, troop quality, and command and control is not well modeled in the system and is assumed to be equal between all forces. System destruction warfare or imposing psychological impact leading to the collapse of the enemy is not possible with this system, except by doing so to the human opponent playing.

The following pieces generally inform this section. Note while there are piles of stuff in here on the Russian Invasion of Ukraine, I am very careful in trying to understand where things would apply to the Taiwan fight and where they would not.

- Experts
    - Various Experts on the Russian Invasion of Ukraine – Particularly Michael Koffman, Rob Lee, Dara Massicot, RUSI (Jack Watling and Nick Reynolds), Konrad Muzyka, and Tatarigami (as well as a host of others).
    - On the theory of warfare (in no particular order or agreement with their positions): Franz-Stefan Gady, Amos Fox (with whom my philosophical disagreements are of great use in understanding my own ideas), and Jack Watling. Others: Michael Koffman, Mick Ryan, and Lawrence Freidman.
- **RUSI Papers on the Invasion of Ukraine:** (Watling and Reynolds 2023a), (Watling and Reynolds 2023b), (Watling et al. 2024), (Watling and Reynolds 2025), (Watling 2025)
    - For a good discussion on a specific example of the "Attrition in Depth" strategy described by (Watling and Reynolds 2025), see (Secretary of Defense Rock 2025)
- **RUSI Papers on Warfare**
    - On some general topics: (Watling 2019) on fires (this is the basis of his idea developed more in Arms of the Future and his work on Ukraine), (Reynolds 2023) on armored forces
    - On UAS see (Watling and Bronk 2024a) and (Watling and Bronk 2024b)
- Discussion from the National Training Center: (Fort Irwin Operations Group, n.d.) also see (Taylor 2024b) and (Taylor 2024c) (Taylor 2024a)
- **Operational Research (Historical Analysis):** (Rowland 2023), (Lawrence 2017), (Dupuy 1987), and to a lesser degree (Dupuy 1985)
- **Other Studies and Works:** The excellent discussion of breakpoints and attrition in (Clevenger 1997) pg. 16-25. For general work see *(Dunnigan 2003).* On ground combat in Ukraine (in 2022) see (Портал «Тиск» 2022) and (Sladden et al. 2024)

[88] **Combat Power**

There is no solid definition of combat power. The US Army's FM 100-5 Operations (1986 ed.) states simply that "Combat power is the ability to fight. It measures the effect created by combining maneuver, firepower, protection, and leadership in combat actions against an enemy in war" (U.S. Department of the Army 1986) pg. 11. ADP 3-0 Operations (2019) pg. 5-1 defines combat power as "the total means of destructive, constructive, and information capabilities that a military unit or formation can apply at a given time." This definition is also used by the 2016 ADP 3-0 Operations, and 2012 ADRP 3-0 Unified Land Operations. Christopehr Lawrence (head of the Dupuy Institute), thinking in terms of the Dupuyian model says that "in its most basic form, combat power is numbers x equipment x human factors x conditions of combat (including posture, terrain, weather, surprise, etc.)" (Lawrence 2022).

I have more simply defined combat power as "the ability to punch the enemy in the face. The force of which is a combination of material and intangible factors."

Combat power is calculated by using the Force Equivalent numbers from (the download takes some time to load properly) https://rdl.train.army.mil/catalog/view/100.ATSC/CE5F5937-49EC-44EF-83F3-FC25CB0CB942-1274110898250/aledc_ref/cas3_force_ratio_calc.xls which are based on CGSC ST 100-3, Back Cover, an alternative download can be found as the *CAS3 Force Ratio Calculation Worksheet* at https://rdl.train.army.mil/catalog-ws/view/100.ATSC/CE5F5937-49EC-44EF-83F3-FC25CB0CB942-1274110898250/aledc_ref/index.htm. I am unable to find any information on how these were calculated, and given that they are different to the 1999 numbers and were mad between 1997-2004, I suspect that they are some time between 2000-2004.

I make one change to the given numbers, which is that I treat the effectiveness of helicopters as 1/3rd of the given value. This is for the following reasons:

1. This is based on combat performance in Ukraine and the evolving trends against helicopters, see (Watling 2023), pg. 162-163. Helicopters can be very vulnerable, and when committed poorly can take high losses. For example see the 2003 attack on Karbala, though notably most of the helicopters were damaged and returned to base, not destroyed, (Watling and Bronk 2021) pg. 11. In Ukraine helicopters have seen effective use from the Russians with long range standoff ATGM's on the

defensive (see (Watling and Reynolds 2023b) pg. 17), and the Russians have seen some use with using them to break up attacks using lofted unguided rockets (see (Watling and Reynolds 2023a) pg. 22-23). The Ukrainians have also employed this lofting tactic, but to unknown effect. However, both Ukrainians and Russians have not to any large degree use helicopters in an standard "attack" role, even during more mobile phases of the war to my knowledge. This is, more or less because neither side has air superiority. If one has the ability to suppresses or destroy SHORAD and MRAD in volume, we can see helicopters being extremely effective (look back to the gulf war again). However, my assessment is that neither side will have sufficient air superiority to use helicopters at their maximum potential, as even if the Chinese are able to win air superiority over Taiwan, the number of MANPADs will still be a problem.

2. The vulnerability is not just confined to Ukraine, but also occurs in exercises. It is indicative that 72 hours is required for sufficient shaping for the effective employment of attack helicopters (Watling 2023), pg. 162-163.
3. The short range at which Chinese helicopters will need to be deployed to operate over Taiwan leaves them close to Taiwanese ISR and in a constrained area of China that is close enough to fly across the strait and loiter under combat load. This concretion makes them more vulnerable than if they were able to disperse across a wider and more distant area, and Chinese helicopters will have to carry lighter loads than if they could base closer or use a FARP to Taiwan. Inversely, Taiwanese helicopters also suffer from the same issue of concentration and having to fight from inside the enemies ISR area, as well as being inside the enemies are IADS.
4. Rotary wing aviation when engaged by ADA is reduced in effectiveness by 25% (Spurlin and Green 2017). Given evidence from Ukraine (everyone's helicopters stay well back from the front line) this is likely generously low, and as my general assumption is that there are going to be a lot of MANPADS about at a minimum, helicopters are probably going to be very consistently engaged. This seems to be the case in Ukraine (Watling 2023), pg. 162-163.
5. Also note that in this game there is no consideration made for the effects of weather on operations in relation to combat power. Limited visibility (rain, fog, etc...) would limit effectiveness by 25% (Spurlin and Green 2017), but given the already low-combat power and fragile nature of these units, (and I doubt that they would be highly committed in less than optimal conditions, mostly committed only if breakout was threated or break-in was required), it is to much effort and work control to apply the 25% reduction in combat power while running the game. Furthermore bad weather may result in missions not being flown and then reducing the overall combat power provided (e.g. if 1 day a week has bad enough weather to prevent sorties from occurring, the units combat power over the course of the week is reduced by $1/7^{th}$, though it's theoretical optimum combat power would not be).

For a discussion on the validity of the CGSC numbers see:

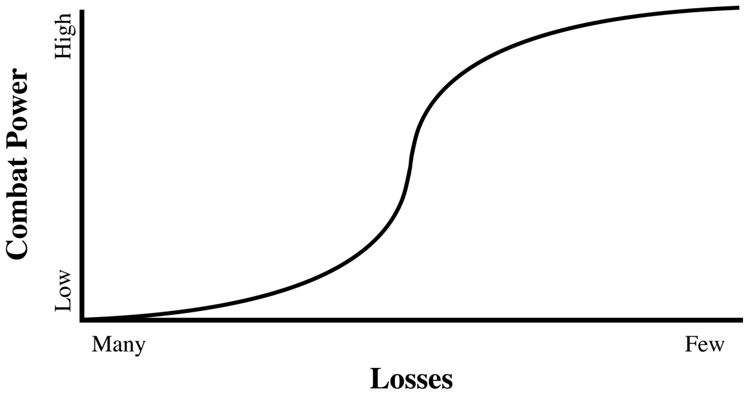
- (Spurlin and Green 2017), the second page directly talks about this available version (the old one, as opposed to the updated version), of which the main problem was that some forces were too outdated. Thankfully for us, the Taiwanese use lots of outdated equipment, and there is enough modern equipment to make it more or less work for us (and if anything, this results in assuming that Chinese equipment and forces are better than they likely are, which I am fine with (better to train against a strong enemy than an weak one)).
- (Woodford 2017). While this piece concludes that the combat power modeling is opaque and may be incorrect, lacking a better method to use than my own estimations I use the CGSC numbers (to see what the process of coming up with your own numbers looks like see: *Combat Power and Attrition Estimation (CPAE), Unit Combat Power Value Assessment*, Paul Works, Tyler Hitter, Michael Laquet, 15 June 2023, Presentation at Connections 2023, https://drive.google.com/file/d/1ZixTqnAT4nZJQSAcu_E3ibAZ4NjTktMa/view).
- (Christian 2019), pg. 28-30

Also note a key assumption of this game that the relationship between attrition and combat power is linear, and represented thusly in the rules, though a unit being "destroyed" by loss of all combat power is probably not the total wipe out of all people in a unit, but rather falling below the point of having any amount of combat power. This linear representation is probably incorrect as:

1. Units are a system, not individual summative packets of combat power. As losses occur the system breaks down rendering the overall whole less effective

2. Units take losses in their best troops, leaving more over time who are not as heroic.
    a. Note heroic performance may well extremely important in determining combat outcomes ((Rowland 2023) and that while the proportion of people who don't participate in infantry attacks at all starts at ~6% (and lessened participation a higher % of troops, varying by study examined) it grows over time as others get killed (for the 6% number and a very good overview of the research see (Rowland and Speight 2007), pg. 54-55). Note the data used by Rowland is WW2 data, and I suspect the numbers would be different in the categories of troop weapon use/activity compared to today and compared with volunteer armies. This may be seen to a certain degree in Cawkill's data looking at (presumably) the Falklands (pg. 57), though the comparison between the two datasets is imperfect (also due to the fact that the unit's sent to the Falklands were elite units).

I would theorize that this relationship between attrition and combat power probably looks like this. With the loss rate of combat power tapering off at the end as the system is already so broken that losing another piece has relatively little effect. The midpoint here is difficult to know, but one number for it is 37% losses in a unit (Dexter 2003), pg. 34-35.



Another proposed argument that matches the theoretical systems destruction one may be that entropy increases in the system due to casualties leads to this sort of combat power degradation. For this see work based on the ideas of Carvalho-Rodrigues:

- (Carvalho-Rodrigues 1989) see pg. 790 especially, (Carvalho-Rodrigues et al. 1991), (Dexter 2003) pg. 34-35

Why are Forces Assumed to be of Equal Quality/Effectiveness?

The other major assumption is that all forces are relatively equal in effectiveness of units and soldiers (e.g. one Taiwanese soldier is as effective as one US solider as is one Chinese soldier). This is a big assumption but is made for ease, as assessing differences is extremely difficult, and as I would rather have China be more competent adversary than a less competent one in this game. Note that there are many factors that can effect the combat value of troops, but generally this provides a value at maximum of one of your soldiers being worth 2 of the enemies. For more on this see: (Dupuy 1987) pg. 105-123 AND (Lawrence 2017) pg. 19-59.

Beyond even having quality soldiers the nature of their employment by their commanders might affect their relative effectiveness. For example Chinese brigades have 2 more battalions than a comparable US brigade, which might be over the regular span of command for a brigade commander and thus lead to elements of the brigade being employed less efficiently (Pierce 1991). Note beyond just troop quality matters, as well, as commander quality affects how forces are brought into battle, "The skill and personality of a strong commander represent a significant part of his unit's combat power" (Pierce 1991) pg. 21.

[89] **<u>What is Attrition?</u>**

Attrition is defined as "the depletion or destruction of an adversary's equipment, personnel and resources through a 'methodical use of battle or shaping operations' at a rate faster than the adversary can replace its loses" (Gady, Franz-Stefan. 2021. "*Manoeuvre Versus Attrition in US Military Operations*." Survival 63 (4): 131–48. doi:10.1080/00396338.2021.1956195., pg. 1). Here attrition can be considered a combination of KIA, WIA, morale, equipment losses, supply issues, C2 degradation, unit quality degradation, etc. (see (Wainstein 1986) specifically pg. 2 and pg. 11-12 for several of these attritional factors). Thus, small attritions (represented as attrition) add up to the point (represented as points of damage) where rotating the unit out of combat doesn't fix the problem without long periods to reconstitute combat power.

[90] This number is a guess, of which the only similar data is "default recovery rates are 2%/day for Blue and 1%/day for all others until the unit has returned to a maximum of 90% strength for light units and 80% for all others. Only units which have an available LOC to the rear area and are in supply may recover strength." (Center for Army Analysis 2016) pg. 47 . The inability to replace damage represents key, unreversible degradation of the unit due to losses (requiring regeneration), where attrition can be repaired as it is lower level and requires reorganization (≠ regeneration). For further details see ('ATP 3-94.4 Reconstitution Operations' 2021). Obviously, this is a loose rule of thumb and there are many exceptions to this where damage could be repaired, in such cases use professional judgement to come to a conclusion. The inability of artillery and helicopters to regenerate is due to their low number of systems and the specific role of the systems making them harder to replace (artillery and helicopter units), and the training required for personal being high (for pilots, and to some degree forward observers, etc..). This is more pertinent to helicopters than artillery, and Chinese forces could regenerate some of these losses from other units in non-engaged theater commands. If numbers are required the Chinese (and US *if* they have a good supply line into the area) can regenerate helicopters and artillery units: 7 days for artillery and 14 days for helicopters to remove 1 attrition, but these numbers are guesses on how long it would take to do the administration to ship the required pieces of equipment and crew and support personnel to the unit and integrate them into it.

While some have predicted the "death of the helicopter" as a result of the 2022 Russian invasion of Ukraine, I view this as not wholly correct. While helicopters may struggle against a well-constructed IADS, they can be effective against uncovered maneuvering forces as occurred during the 2023 Ukrainian Counteroffensive (see (Watling and Reynolds 2023b) pg. 17), and as discussed in a NTC anecdote (Taylor 2024c).

[91] **Why can Units be Ground all the Way Down in this Game?**

Exact percentages for units to become ineffective are not accurate (see (D. K. Clark 1954) pg. 3, 7-8). That said, abstractions and quantifications for the purpose of building a game model must be made.

This view of units remaining effective in combat even when ground down to a much lower number than classically assumed to make a unit "combat ineffective" is based on of (Wainstein 1986) as well as (D. K. Clark 1954). See also (Clevenger 1997) pg. 24, on the effects of a "combat ineffective" unit still being able to influence the battle.

These arguments seem to be at least somewhat borne out by descriptions of battalions in Ukraine still fighting at ~20% (40 of 200 TOE troops) or 35% strength (https://www.washingtonpost.com/world/2024/02/08/ukraine-soldiers-shortage-infantry-russia/), or a brigade at 40% infantry (https://www.pravda.com.ua/eng/articles/2024/09/17/7475408/). See also the excellent discussion of breakpoints and attrition in (Clevenger 1997), pg. 16-25.

Note variance in real world outcomes here is likely to a bevy of factors, as well as the non-inclusion of breakpoints in this discussion. Functionally, there is an importance difference between a unit's ability to attack which is exhausted before it's ability to defend is. (D. K. Clark 1954) defines these factors as follows:

1. Size of the unit (pg. 34)
2. Time over which the unit has take casualties (pg. 34)
3. Attrition – "Included may be growing awareness throughout the unit that casualties' have been heavy, accumulating memories of casualties witness by individual members of the unit, increasing apprehension among survivors as to their own fate, and accumulation of physical weariness and strain. One may also ask whether replacements represent a reinforcement in mental attitude, or whether they are instead very rapidly infected by the prevailing atmosphere of the unit, or if they in turn tend to degrade the effectiveness of the unit by their own inexperience and confusion." (pg. 16)
4. Ability of unit to take in new troops (e.g. number of old members of the unit remaining), (pg. 24)
5. Condition of troops at beginning of engagement (pg. 29-30) – this is comprised of:
6. Unusual environmental stress (pg. 30)
7. The imperative of the assigned mission (pg. 31)
8. Morale (pg. 31)
    - Troop mindset
    - Esprit-de-corps
9. Leadership (pg. 31)
10. Tactical plan (pg. 31)
11. Reconnaissance (either not knowing things important to planning or allowing the enemy to achieve surprise) (pg. 32)
12. Enemy opposition (pg. 32)
13. Fire support and reinforcement (pg. 32)
14. Logistical support (pg. 32-33)

- Starting strength of the unit
- Number of green troops
- Unit experience (intensity of combat)
- Unit experience (terrain)
- Nature of their combat experience
- Rest time before entering combat
- Unit training as special troops (paratroops, etc..)
- Training specific to the type of combat faced (e.g. river crossings)

15. Communications (both with subordinate and higher units). If communication is lost, leadership becomes more important. (pg. 33)

For a comparative look at what points a unit reaches combat ineffectiveness, given numbers are placed on the table below.

General Views		
Element	*Point of Unit Reaching Combat Ineffectiveness*	*Source*
US Army Views (pre-2000)	15-30% casualties (tend towards 30%)	(Clevenger 1997) pg. 17
Schwarzkopf	30% casualties (ineffective, for offensive), 50% casualties ("really combat ineffective", ineffective for both offense and defense)	(Clevenger 1997) pg. 21-22
Belarussian View (2011)	Unit maintains combat capability up to 20% personal + equipment losses, becomes partially combat capable at up to 50-60% if it maintains its C2, and has complete loss of capability at 50-60% losses and loss of C2.	(Grau and Reach 2021)
Artillery Views		
US Field Artillery Views	30% casualties in a short time span	(Clevenger 1997) *pg. 24*
Soviet Artillery Norms	30% casualties (ineffective for offensive), 50%-60% casualties (annihilation or destruction of unit)	(Clevenger 1997) *pg. 23*
Battalion		
Breakpoint Type I (Attack => Reorganization => Attack) - *General*	24.8% enlisted (12-38%), 21.5% (officers), casualties incurred over multiple days. Unit takes higher losses on day of breakpoint. One StDev from mean given in brackets. "The unit may be able to continue the attack after a few hours if more than half the losses are Incurred in a short time (no longer than 24 hours); otherwise it must revert to defense".	(D. K. Clark 1954) pg. 17, 19-20
Breakpoint Type I (Attack => Reorganization => Attack) – *within 2-4 days from entering combat*	13-34% casualties (range is based on 1 standard deviation from the mean)	(D. K. Clark 1954) pg. 34
Breakpoint Type I (Attack => Reorganization => Attack) – *within 6-11 days from entering combat*	20-30% enlisted, 27% of officers	(D. K. Clark 1954) pg. 34-35
Breakpoint Type I (Attack => Reorganization => Attack) – *within 16/18-22 days from entering combat*	Does not occur	(D. K. Clark 1954) pg. 35
Breakpoint Type II (Attack => Defense, forced to regenerate combat power) - *General*	27.6% enlisted (7-47%), 26% (officers), casualties incurred over multiple days, Unit takes higher losses across multiple days. One StDev from mean given in brackets.	(D. K. Clark 1954) pg. 17, 19
Breakpoint Type II (Attack => Defense, forced to	4-23% (range is based on 1 standard deviation from the mean)	(D. K. Clark 1954) pg. 34

regenerate combat power) – *within 2-4 days from entering combat*		
Breakpoint Type II (Attack => Defense, forced to regenerate combat power) – *within 6-11 days from entering combat*	20-30% enlisted, 27% of officers (includes replacements)	(D. K. Clark 1954) pg. 34-35
Breakpoint Type II (Attack => Defense, forced to regenerate combat power) – *within 16/18-22 days from entering combat*	No data given.	
Breakpoint Type III (Defense => Ordered to withdraw to secondary line) - *General*	52.3% enlisted (37-69%), 46.4% (officers), casualties incurred over multiple days, Unit takes higher losses across multiple days. One StDev from mean given in brackets.	(D. K. Clark 1954) pg. 19
Breakpoint Type III (Defense => Ordered to withdraw to secondary line) – *within 2-4 days from entering combat*	Does not occur	(D. K. Clark 1954) pg. 34
Breakpoint Type III (Defense => Ordered to withdraw to secondary line) – *within 6-11 days from entering combat*	42-71% enlisted, 29-63% officers (range is based on 1 standard deviation from the mean, includes replacements)	(D. K. Clark 1954) pg. 35
Breakpoint Type III (Defense => Ordered to withdraw to secondary line) – *within 16/18-22 days from entering combat*	8-17% enlisted, 5-11% officers (range is based on 1 standard deviation from the mean, these are <u>net</u> casualty rates (e.g. includes heavy replacements being added to the unit)	(D. K. Clark 1954) pg. 35
Soviet Belief (Battalion)	35% casualties (ineffective for offense), 50% casualties (ineffective for defense, capable of fighting retreat only)	(Clevenger 1997) *pg. 23*
Ukrainian Experience (2024)	Battalion still fighting at ~20% or 35% remaining strength (65-80%+ casualties)	(Khurshudyan and Galouchka 2024)
Ukrainian Experience (2024)	Battalion defending at around 10% strength	(Станко 2024)
Ukrainian Experience (2025)	Infantry battalions usually at 20–30% of full strength.	(Clavilier and Gjerstad 2025)
Russian Attack Usage (Nov. 2024, Jan. 2025).	Unit rotated out of frontline (units being used for continual small scale (section/platoon) infantry attack) at 30% casualties (e.g. unit has lost offensive potential and is swapped with a better unit). It is unclear if this belief is that the unit has loss offensive potential, or that diminishing marginal returns are beginning to occur however.	(Watling and Reynolds 2025)pg. 8 Note that while pg. 8 is unclear if it is Rgmt. or Bn. rotating, pg. 17 is clear that Rgmt's are rotating their battalions.
	Regiment	
Breakpoint: Attacker Forced into Defense Posture	4.3% casualties	(Clevenger 1997) *pg. 18*
Breakpoint: Defense Forced to Withdraw	14% casualties	(Clevenger 1997) *pg. 18*
	Brigade	
Soviet Belief (Brigade), Lt. Col. Yuri Demerenko	50% losses of main weapon systems (ineffective for attack and hasty defense), 60% losses (ineffective for prepared defense)	(Clevenger 1997) *pg. 23*
Center for Army Analysis (2016)	A unit* must be above 50% strength to conduct an attack, and above 30% strength	(Center for Army Analysis 2016) pg. 46-47

	to participate in defense. A unit at or below 30% strength is deemed combat ineffective In reservist-heavy formations, change to 70% strength for attack, and 50% for defense. Militia forces would be even higher. *CWAM uses brigades as it's standard unit	(Mahoney 2016)
Ukrainian Experience	Brigade still fighting at 40% strength (60% casualties)	(Kyrylenko 2024a)
Division		
Soviet Belief (Division), Lt. Col. Yuri Demerenko	35% losses (ineffective for attack or defense)*	(Clevenger 1997) *pg. 23*
Breakpoint: Attacker Forced into Defense Posture	4.8% casualties	(Clevenger 1997) *pg. 18*
Breakpoint: Defense Forced to Withdraw	37% casualties	(Clevenger 1997) *pg. 18*
Other		
Breakpoint: Defense Forced to Withdraw	42-71% enlisted and 29-63% officer casualties.	(Clevenger 1997) *pg. 17*
Army Level Defense	"A study of casualties has indicated that the effectiveness of an army reaches a critical level when the number of casualties lies between 25 and 35% of the number of combatants. Beyond this point all efforts, no matter how heroic, will not be able to avert defeat. That means that a parameter which is useful for measuring combat degradation due to casualties must peak at around these percentages.", the measure of entropy as a function of casualties measured in the study peaks at 37%, and reaches 60% of it's peak at 10%.	(Carvalho-Rodrigues 1989) pg. 790

* "This update to Soviet thought is due to the higher level of complexity associated with combined arms operations at the division level, and modern sustainment requirements for heavy armored and mechanized units"

[92] Eg. the units are conducting ground combat operations against each other between hexes. Artillery ranges for standard gun and rocket are also roughly this range on the Taiwan map hexes, assuming the artillery is staying back from the front line.

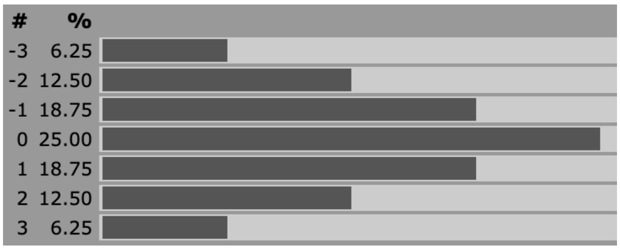
[93] This is both convenient (½ is easy to calculate) and also seems to be borne out somewhat by Chinese experience in Korea, where twice the effort was required to match a well-supplied opponent (e.g. the unsupplied Chinese were ½ as effective as the well supplied opponents). I know that there are multitudes of differences between the Chinese experience in Korea and today that muddy this comparison, but lacking other evidence currently, and with ½ being an easy number I use it here. See (Dunnigan 2003) pg. 500.

[94] **The Choice of d4's and Randomness**

I have not spent a long time thinking about the nature of dice, randomness, and what they represent in wargames. Thus, I would simply contend for now that they represent the following

a) Chance – the inherent randomness of opposed decisions and luck in fighting
b) Friction – the creation of mistakes and problems that are unavoidable. Friction is a functional negative (the best outcome of friction is no effect), while chance can be both a positive or negative, hence why I separate them.
c) Things not Modeled and Abstracted Away in this Model of Combat – there are physical and non-physical tools and effectors of war not present in the model of combat that could on occasion have significant effect on the outcomes of battle. These are below the level of representation of the game or abstract for playability, their effects are (as much as one can) felt here in the dice.
    a. Examples:
        i. Skilled leadership, Medical Treatment, Signaling, POW's

The use of a d4 here leads to some potential variability (+3/-3), though the use of two dice means that this is (approximately) a normal/Gaussian distribution. While some would argue about the accuracy of such variability in combat, I would note that combat is inherently complicated, confusing, and dependent upon a menagerie of different factors that make outcomes imprecise. Adding in such variability using the d4 system (a 62.5% chance of being inside the bounds of +1/-1, and an 87.5% chance of being inside the bounds of +2/-2), is less unrealistically “swingy” than might be initially presumed. Maj. Mouat also agreed with the use of a d4 for these rules as more realistic than a d6. The 1d4-1d4 distribution is as follows:



Variability of combat is somewhat informed by (Lawrence 2017), pg. 11-12.

[95] **<u>The Two Types of Combat: Attritional and Maneuver</u>**

This difference between attritional combat which slowly wears at units and maneuver combat which expends great numbers of men and material to achieve results (hence d6 as maneuver combat varies greatly in losses depending on distance, terrain, supply, and enemy resistance) allows for both types of warfare to be fought with these rules. Functionally I conceptualize attritional warfare, as slow moving where the objective is to inflict damage on the enemy, and maneuver warfare as an attempt to seize and hold ground. I am notably agnostic on the actions (and the philosophic centers of gravity they consequently target) taken to attempt to achieve these aims, I am solely interested in the descriptive differences between the two types of warfare.

For an indication of just how lethal maneuver warfare can be see Table 1, page 1 of (Duplessis 2017), though note as per (Rowland 2023), there is a 50-90% decrease in the effectiveness of weapons in real combat as opposed to exercises.

Note my views of attritional warfare (though attrition does not just mean soldier and material loses at this level but also the burning up of supplies, fatigue, and other intangibles, see (Wainstein 1986) (specifically pg. 2 and pg. 11-12 for several of these attritional factors) as the opposite of maneuver warfare is heavily colored by the Russo-Ukrainian War and World War II, nicely summed up by Michael Kofman’s repeated statement that “attrition enables maneuver” (see Making Attrition Work: A Viable Theory of Victory for Ukraine by Franz-Stefan Gady and Michael Kofman, February–March, https://doi.org/10.1080/00396338.2024.2309068). Also interesting on this point is *Maneuver Warfare is not Dead, but it Must Evolve*, Col. Pat Garrett (Ret.), Lt. Col. Frank Hoffman (Ret), Proceedings, November 2023, pg. 26-31 (pg. 28-29 is the most interesting, but I do not wholly agree with the whole piece.) Note that there are theorists who would wholly reject this characterization of maneuver vs. attritional warfare by changing/challenging the colloquial US army definitions and asserting “positional warfare” (‘*A Solution Looking for a Problem: Illuminating Misconceptions in Maneuver-warfare Doctrine*’, Amos C. Fox, Armor, Fall 2017, https://www.moore.army.mil/armor/eARMOR/content/issues/2017/Fall/ARMOR_Fall_2017_edition.pdf). However, I view “positional warfare” as an element of attritional and maneuver warfare, and reject the idea that attritional attacks employed in support of maneuver make that attempt maneuver warfare “attritional warfare” instead. Furthermore, if positional warfare is to be conducted in this game, it is conducted by the position of units on the map in relation to the terrain, and thusly does not need to be covered as a separate type of combat here (e.g. the nature of positional warfare is combat agnostic, with combats within positional warfare being maneuver or attritional in nature). Consequently, even if one does not buy my argument about the nature of maneuver, attritional, and positional warfare, this game does represent all three.

[96] This correlation between casualty rates can be seen in (Dupuy 1987), pg. 167-169, 175 (verity 3), 176 (verity 7). For example, see figure 13-1. For every 4% casualties taken by the loser of a combat, the winner takes 3% casualties. Thus I assume that the winner takes roughly 1 less than the loser. This is imperfect at best, but is the closet I can get with the way this system works. Furthermore given verity 8 and verity 12 (pg. 176, 177), and the nature of fighting on Taiwan (lots of prepared defenses, difficult terrain), I think in the

case of the defender in both cases, and the attacker in the case of verity 12 can help resolve some of the imperfection.

[97] This means that all units take some level of casualties, e.g. a successful defender or attacker always takes some attrition, and also that additional units committed to the attack also take higher casualties as target density increases (for some evidence of this see (Rowland 2023) pg. 80).

[98] This is due to the fact that each individual piece of equipment generates a much higher combat value than in a regular unit. E.g., losing one piece of artillery or a helicopter loses much more combat power a single tank, IFV, infantryman, or truck.

[99] Looking at factors that affect breakthroughs (Rowland and Speight 1996) pg. 9-10 found the following (note that we are mostly interested in "rapid breakthrough" as the game timescale is 1 day).

Affecting Values (in order of significance)	**Level of significance** (p-value)	**Description**
Initial Surprise	Less than .001	Surprise achieved on Day 1 of a campaign.
Subsequent Suprise	Less than .001	Surprise achieved post Day 1 of a campaign.
Shock	Less than .001	Appearance of paralysis or confusion in the defender
Commanders' intention	Less than .001	Attackers intent to break through as quickly as possible
Aggressive Attack Recce	Less than .001	Reconnaissance used boldly by attacker
Mobility	~.01	Mobility of attacker superior to that of defender
Attack air superiority	.05 to .01	Attacker had air superiority or supremacy
Attack Intelligence	.05 to .01	Attacker had good intelligence of the defense.

Depuy et. al. found the following elements were important: (*A Study Of Breakthrough Operations* by the Historical Evaluation and Research Organization, T. N. Depuy, Grace P. hayes, Paul Martell, Vivian E. Lyons, John A. C. Andrews, October 1976, https://www.generalstaff.org/BBOW/LOV-DUP/ADA036492_StudyBreakthruOps.pdf), pg. 1, pg. 7-8.

Element	**Found to be Important in Qualitative Assessment** (e.g. called out in text)	**Qualitative assessment** (# of times factor is decisive out of 14)	**Found to be Important in Quantitative Assessment**
Careful planning	X (most important factor)	2	
Well-organized, well trained, well led forces	X	7	
Combat effectiveness superiority (e.g. superior troop quality)			X
Forces massed at the point of attack	X	4	X
Ample reserves	X	3	
Mobility superiority	X	3	X
Air superiority	X	4	
Overwhelming air support			X
Surprise	X	5	X
Leadership		2	
Mass on narrow front		3	
Defender Fortifications		1	
Defender reserves		1	

Based on this sample of 14 cases, Depuy et. al. conclude that "In these 14 examples, all but one show an effective combat power superiority of 1.5 or more. … This suggests that it is necessary to have an effective combat power superiority of at least 1.5 in order to be able to achieve a successful breakthrough. Analysis's of other operations has demonstrated that a combat power advantage of 1.1 is enough to warrant a prediction of success in combat and that sustained advance not involving a breakthrough seems possible with an advantage of 1.3." (pg. 11)

We can compare all factors below, and how they are implemented into the model:

Important Elements	*Rowland, Speight, Keys*	*Depuy et. al. (Qual)*	*Depuy et. al. (Quant)*	*Model Implementation*
Massed Forces		X	X	Conducted by players moving units.
Ample Reserves		X		Assumed to exist within the brigade.
Initial Surprise	Extremely Significant	X	X	Die roll modifier assigned: + ?????
Subsequent Surprise	Extremely Significant			Assumed as element of breakthrough.†
Shock	Extremely Significant			Assumed as element of breakthrough.†
Commanders' intention	Extremely Significant			Player may decide to break through.
Careful planning		Most Important		Assumed as element of breakthrough.†
Aggressive Attack Recce	Extremely Significant			Die roll modifier assigned: + ?????
Mobility	Rather Significant	X	X	All unit assumed to have same mobility* but helicopter assault may help, therefore +???? if air assault involved.
Attack Air superiority	Significant	X	X	Die roll modifier assigned: + ?????
Attack Intelligence	Significant			Assumed as element of breakthrough attempt.†
Good Quality Force		X		Force quality is assumed to be equal in the game, except for some forces with suffer on the attack. Thusly the modeling of this element is not present in this model as it is present elsewhere.†
Superior Force Quality			X	As with Good Quality Force.†

*Given everything in modern combat (at least not in the third world) is at least motorized now this is more a question of 1) does the terrain affect mobility in some way?, and 2) can the attacker fix the defender in place (which is a question of ISR, strike, and as such ends up being a far larger and more viable question, best represented by the randomness of the dice).

† Variability of effectiveness represented in dice variation.

[100] Maneuver attacks carry risk, attrition attacks are squeezing out the enemy and attrition, so no randomness. The person who is in the more favorable position is able to inflict a disproportionate amount of attrition to the enemy compared to the amount of attrition they take. Thus, the net effect of attrition is the difference between the attrition taken by both sides, which is an outcome of the available combat power (unit combat values) and effects of the terrain etc. (the column shifts). In terms of determining the upper bound of the amount of attrition as a result of combat, see Table 1, page 1 of (Duplessis 2017), though note as per (Rowland 2023), there is a 50-90% decrease in the effectiveness of weapons in real combat as opposed to exercises. On lower bounds note that an attacking unit stops at around 5% casualties (Clevenger 1997) pg. 20), so even 1 or 2 attrition on a unit would be sufficient to stop its attack in most cases.

[101] **<u>The Construction of the CRT (Force Ratios and Outcomes)</u>**

Overall Construction

This combat results table is based on the DSTL Force Ratio Risk Table. Available at https://www.professionalwargaming.co.uk/Force%20Ratio%20Table%20with%20Numbers%20v0.1.png.

Some minor modifications based on https://dupuyinstitute.org/2018/04/25/u-s-army-force-ratios/ (noting that this is WW2 data, and thus I think the chances of penetration is rather lower today), and https://dupuyinstitute.org/2017/09/19/human-factors-in-warfare-diminishing-returns-in-combat/ (note I include more ratios here beyond the “necessary” stated by Depuy as the randomness in the table is done via dice rolled column shifts across the table, so having the columns to allow shifts is important to the functioning of the game. Those two Depuy Institute web pieces are the short versions. Read the books for more details.

Given the turn time of the game (1 turn = 1 day) I do not include hasty attacks as it would add another level of unnecessary complexity and uncertainty to adjudication and could cause players to argue if an umpire judged an attack to be hasty when players believed otherwise. Given the nature of fighting on Taiwan to include many dug-in positions, difficult terrain, and high force density around initial beachheads, I believe it likely that hasty attacks will not be especially efficient in taking ground and inflicting casualties (except perhaps on the attacker), thus meaning that they can be abstracted into prepared attacks that do have a larger effect on the battle without too much issue. Additionally, I am fine abstracting the difference between hasty defense (x1.3 effect on defender combat power) and prepared defense (x1.5 effect on defender combat power) as the difference here is relatively minor in the large scheme of all the other effectors.

Outcomes

On the topic of outcomes (e.g. the effects of combat) on the table, these are grouped from possible levels of risk in the DSTL Force Ratio Risk Table. In assigning effects to the type of outcomes to the types of risk I generally go with a few things:

1. The general outcomes of combat are relatively consistent beyond a certain point due the law of diminishing marginal returns (e.g. a 10:1 force ratio does not advance 10 times further or inflict 10 times more casualties than a 1:1 force ratio). This is why large numbers of force ratios result in the same outcome (e.g. in a Meeting Engagement a 3:1 though 6:1 force ratio all result in “Defender Attritted”). This is supported by (Dupuy 1987) pg. 125-147, 132 especially (combat outcomes) 154-157, 159-160 (advance rates), 177 (casualty rates). This is also tangentially discussed several times (mostly relating to casualties inflicted and force ratios and force ratios and rates of advance) in (Lawrence 2017).
2. All other factors being equal, the result of a 3:1 prepared attack against a prepared defense results in roughly equal chance of casualties on both sides (the actual amount of attrition is randomized as “equal casualties” represents the most likely outcome, but not the definite outcome). This means that attackers and defenders tend to take roughly the same number of casualties all other things being equal. This is roughly in line with the findings of (Lawrence 2017), pg. 19-59 (see the number of casualties, but also the number of cases where the attacker lost ewer soldiers than the defender being higher than might conventionally be considered.

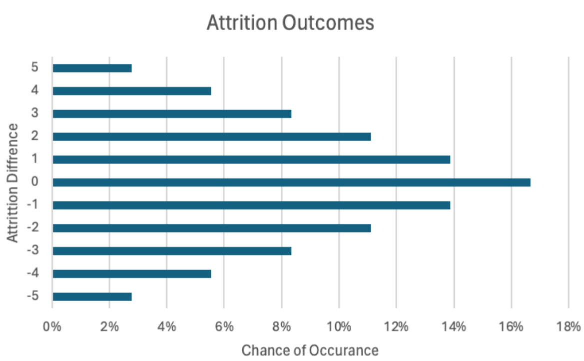


Figure 1 – Possible attrition outcomes from an exchange result between two units.

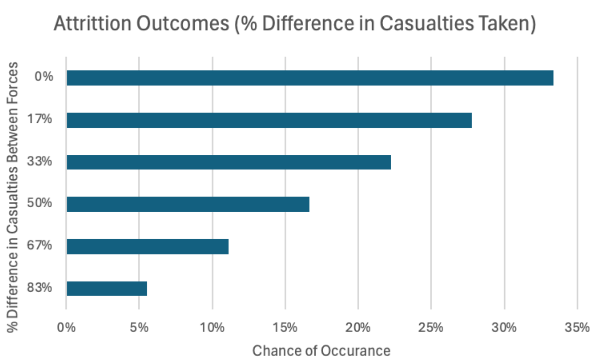


Figure 2 – Possible attrition outcomes as a % difference in casualties taken (between two units). This may seem rather high, but consider *Figure 3*.

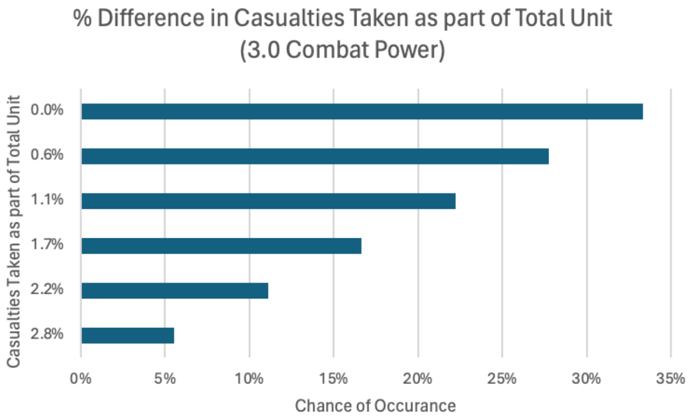


Figure 3 – Possible % differences in casualties taken as part of total unit combat power (assuming a 3.0 combat power) for a unit in an exchange result between two units. 3.0 is chosen as it's a good lower bound from most units in the game.

I then feel very comfortable anchoring "attacker attritted" at 1:1 force ratios due to the extremely low numbers given of successful attacks at less than 1:1 see (Lawrence 2017) pg. 19-59

3. Units take less damage before stopping the attack then expected (with the exception of breaching, where being caught in the breach can be deadly). See the breakpoint analysis section in (Clevenger 1997) pg. 18-20. More or less units take ~5% casualties before halting an attack. Note here that I am quite comfortable allowing units to attack each day (e.g. previous day's battle results don't affect willingness to attack) as identified in work on breakpoints, particularly as high losses on one day are more easily absorbed than sustained losses see (D. K. Clark 1954) pg. 17, 19-20. Note however, that after sustained time in combat rapid reorganization becomes much harder due to degradation across the force as opposed to heavy degradation of specific elements of the force. (pg. 23)
   - Note that (Lawrence 2017)'s numbers suggests the following (pg. 65, 67, see also 146-160 for lower level unit attrition). Type of attack outcomes from Depuy Institute Databases are matched to game combat outcomes via casualty numbers (pg. 60-71) and via advance rate (pg. 178)
   - WW2 Data (divisional and corps units):

Type of Attack	Limited	Failed	Advances	Penetrated
In Game	Attrition Combat	Attacker Attired Result	Exchange Result	Defender Attrited Result
Attacker % Casualties	.24	.80	2.98	1.20
Defender % Casualties	.20	.90	2.62	2.96

   - Post WW2 Data (up to 1991) for Battalion, Brigade, and Divisions, to be taken with a big grain of salt (the data is imperfect and limited in number)

Type of Attack	Limited	Failed	Advances	Penetrated
In Game	Attrition Combat	Attacker Attired Result	Exchange Result	Defender Attrited Result
Attacker % Casualties	.26	3.20	1.60	1.36
Defender % Casualties	.12	2.80	4.83	15.10

   - Dupuy stated Average casualty daily engagement rates for a Brigade/Regiment (of 3,000 troops) was 2.6%, or alternatively 3.6% (3.58%) (Lawrence 2017) pg. 147-148, footnote 4 on 356). He gives the numbers of 3% for the attacker and 2.5% for the defender in another work (Dupuy 1987) pg. 188, 194)
   - The current attrition rules create the following outcome (assuming 3.0 combat power). Note that these are not total force casualties as Lawrence's numbers are, but are effect on unit combat power.

Type of Attack	Limited	Failed	Advances	Penetrated
In Game	Attrition Combat	Attacker Attired Result	Exchange Result	Defender Attired Result
Winner	3.3	11.70	11.70	3.3
Loser	0	3.3	11.70	11.70

The differences here are for a few reasons:

1. Brigade combat produces more casualties than the divisional numbers as there are more troops in the "teeth" elements compared to the "tail" elements.
2. This is a 3.0 combat power unit. A unit with more combat power would take proportionally less casualties (as 6.0 unit would take ½ for example).
3. Modern combat is more lethal (I would wager by perhaps .2-.5 so) due to greater battlefield transparency at the tactical level
4. These numbers are not total force casualties. Given information collected above on levels of casualties before units become combat ineffective, we can take a number (say ~50% based on the above data and for ease) before a unit becomes combat ineffective (e.g. reaches 0 combat power). Thus, we would divide the values by 2, as that represents the casualties taken by the teeth force more accurately (roughly).
5. Attrition =/= casualties (in the context of this game). Rather attrition can be considered a combination of KIA, WIA, morale, equipment losses, supply issues, C2 degradation, unit quality degradation, etc.. See the footnote "What is Attrition" above. Thus the rate of attrition of a unit (e.g. ability to fight) is probably higher than it's losses in terms of personnel, as each person is a part of a larger system.

- My views on the determinates of success and degrees of success in attempted breaching of obstacles are heavily colored by information from the war in Ukraine (the Kherson and Summer offensives especially), see (Watling et al. 2024) and (Watling and Reynolds 2023b), also see (Magness 2003). This is also why breaching (and failed breaching) is substantially more lethal to units than Depuys 2:1 might suggest.

4. Higher force ratios take more damage from the enemy (contrary to some Dupuy work, for a short overview see https://dupuyinstitute.org/2018/12/14/comparing-force-ratios-to-casualty-exchange-ratios/, for a more through overview see (Lawrence 2017) pg. 72-78), <u>but not a lot more</u> (e.g. units that are rotated back from the line and given the chance to rest and regroup suffer substantially less ill effects). This is represented in game by having additional unis engaged in the combat take 1 attrition. I disagree with the Depuy Institute's view here because in the modern battle, the ability to bring in fires with more precision and from a longer distance is substantially different from even the 1990's (the data referenced). This is quite similar to Watling's zone of contestation idea, see (Watling 2023) pg. 95-104, or for an earlier view from Watling see (Watling 2019) pg. 37-42. That higher force ratios inflict some more damage, but not dramatically more is somewhat consistent with findings from (Rowland 2023). For example pg. 94 shows a roughly linear relationship based on force ratio, but with high variability. The general flatness of damage in the game (e.g. basically all results take dice of attrition regardless of the overall force ratio) is in line with (Lawrence 2017) pg. 72-78.
5. The chance of a breakthrough is very low in most instances (e.g. a forced withdrawal). For a short discussion on this, see the appropriate section in Stephen Biddle's piece here: https://warontherocks.com/2022/11/ukraine-and-the-future-of-offensive-maneuver/ ("Clean breakthroughs followed by exploitation and the decisive conquest of large theaters has long required a permissive opponent — that is, a defender who lacks depth, who has failed to withhold a meaningful reserve, who has failed to ensure cover and concealment at the front, and, often, whose troops lack the motivation to fight hard in the defense of those positions." This can be seen in Ukraine, where despite 6:1 ratios in some parts of the frontline, ((Watling and Reynolds 2025) pg. 5) Russia is unable to mount a breakthrough mostly due to lack of force quality (low troop skill and

ability to coordinate large offensive action) and a more transparent tactical battlefield allowing engagement at longer range (pg. 7-8).

6. Levels of attrition in relation to the overall force are *very roughly* in line with the findings of (Rowland 2023) pg. 79, the analysis of which I take with a rather large grain of salt mostly due to the data selection (and assumptions) for historical analysis and low(er) number of studies present for some of the factors. Also note that most units nowadays are mechanized infantry and tanks are ubiquitous when looking at Figure 3.12. Functionally, heavier units have higher combat power, and thusly represent the effect of casualties upon the force in proportion to losses taken (e.g. an infantry force takes more casualties, this is represented by the fact that each attrition is proportionally more of it's combat power than with a armored unit).
7. The use of a die to randomize attrition is roughly in line with the levels of randomness seen in Table 12.3 in (Lawrence 2017) pg. 148. E.g. a unit of over 2,500 people will take on average 12 casualties per day, but with a standard deviation of 20.

Force Ratios

On the topic of force ratios, there is much debate about their utility. I view much of the arguments laid against them to be of less teeth in the context in which they are used here (or in wargaming writ large). This is because 1) there are a multitude of factors (column shifts in this game, plus some other things) that affect the outcome beyond the basic force ratio, and 2) there is randomness injected via dice to cover anything not otherwise covered as well as to represent chance. For further discussion see:

- (Christian 2019)
  - The main effective criticism of force ratios is that they are historically unvalidated. The problem is there is no other method available other than expert adjudication (which has its own set of problems in accuracy) which would be equally viable. Lacking the ability to have SME's for every game (which I would still be highly wary of anyways), I default to using force ratios as the basis of the CRT.
  - See page 17 for what Depuy did to try to expand beyond force ratios and see their close comparison to what this wargame does. He 1) incorporated outside factors (e.g. column shifts and other effectors in this game), and 2) disclosed the sources and numbers (e.g. the footnotes in this game).
    - Note the conclusion of this piece is very anti-force ratios, but somewhat pro COFM. They key difference being that COFM includes intangibles in it.
    - Perhaps as Depuy says best himself "[historical examples] show why the 3-1 force ratio requirement for the attacker cannot be of *useful value* without some knowledge of the behavior and other combat variable factors involved." (emphasis added). (Dupuy 1985) pg. 11-12
  - Also note pg. 21-26, the discussion of concentration as a key determinate in relation to or opposition to the idea of strategic force ratios as determinate. Given the fact that concentration is becoming more difficult in Ukraine, I think this pushes the argument more in favor of force ratios as an useful explanatory tool, given that forces are more likely to be uniform at higher levels of abstraction like in this game (though not always). Given the way this wargame works (with units as brigade blocks, occasionally lower), it is thus difficult to represent specific concentration at lower than brigade level, except via injection of randomness (dice) and the ability of a commander to achieve concentration successfully. Thus in these rules it is assumed that effective concentration is achieved in line with what the underlying data assumes, but if you can't achieve that you have a column shift against your attack if you the capability to conduct brigade level combined arms attack (of which concentration at the decisive point is a key element). However, at above brigade level it is easy to represent concentration by putting multiple brigades together. Thus I am relatively happy with how this game models it, without having to unduly complicate the rules further.
- (Spurlin and Green 2017) again see the section on "The Need for Professional Judgment" to see what else they state are outside factors (which are represented as column shifts for the most part).
- On the 3:1 force ratio, on which the table is centered and which there is much debate:

- In the CRT for this game in a 3:1 attack (prepared attack vs. prepared defense, the "standard" combat in this game) the attacker is attritted 19% of the time, an exchange occurs 44% of the time, and the defender is attritted 38% of the time.
- Depuyian Work
  - Note that while I understand the historical numbers Depuy et. al. come up with (e.g. ~2:1 to ~3:1 for a successful attack (generally) with the number being closer to ~2:1, given the various in possible ratios, and the fact that a tactically transparent battlefield favors the defenders, I use 3:1 as the "standard attack ratio."
  - For a short overview of Depuy's work on the 3:1 Ratio see the following: https://dupuyinstitute.org/2016/07/11/trevor-dupuy-and-the-3-1-rule/. Note that 3-1 carries the attack 75% of the time according to Depuy's CHASE data. This is also the case in later looks at Depuy Institute data (74% of the time), see (Lawrence 2017) pg. 8
  - (Dupuy 1987) pg. 31-37
  - (Lawrence 2017) pg. 8-13
- An ancillary validation of the 3:1 rule in Figure 7.5 looking at tactical tank actions (Rowland 2023) pg. 183

Why the CRT Ends Where it Does

The table goes up to 11:1+ as I feel beyond a 10:1 force ratio the result is fairly known (going to 11:1 allows for the dice shifts of the randomness in the game better). This maximum of 10:1 is *very* loosely supported by a study on the value of surprise in tank battles, see (Rowland 2023) pg. 180-181. The bottom of the table is 1:4 as I feel any attack beyond that is stupid in the extreme, and the relative ratio of forces of any lower can be considered to be as stupid as attacking at 1 to 4 against. Furthermore, the defender's advantage beyond two to one in the defense is limited, and the extra 2 are both there as a stupidity as described previously and to allow to allow for column shifts and dice randomness. This is relatively validated by analysis in (Lawrence 2017) pg. 10 (Table 2.3), and specifically in the case of 2:1 and lower (Dupuy 1987) pg. 139

[102] ***Flag Results***

Flag here represent not a retreat in the classic wargame sense, but two possible things:

1. *Flags in Attacker Damaged in Breaching Attacks*: A unit has been damaged and lost cohesion to the point where the unit really should rotate off the line for a bit to regroup and regenerate otherwise it will have undue effects on the unit.
2. *Flags with Defender Attritted*: A representation of a unit screening the enemy while withdrawing (fall back in correspondence to the strength of enemy push) or choosing to stand and fight (in which case you trade casualties for holding your position). However, at very high force ratios one will be forced to pull out to avoid being enveloped and destroyed hence (⤷), while with breaching you can generally safely pull out hence no need for (⤷) as it represents a rapid need to disengage due to overwhelming speed of enemy movement due to high numbers of forces available to the enemy.

[103] ***Column Shift: Infantry Only vs. Mech/Armor***

Light infantry suffers disproportionality when faced with attacking a force with armor because of issues with mounting and dismounting and maneuvering forces forward (as well basic firepower disparity). This remains true in the modern day, even with more advanced ATGM's available to infantry. For a discussion on the modern effect see (Reynolds 2023) pg. 24-27, see also (King 2017). Note that this applies more in open environments, and less in more cluttered, but the issues still persists regardless ((Reynolds 2023) pg. 26), the data from NTC (relativity open terrain in terms of being desert (though rocky and rolling)) shows that it goes quite poorly.

[104] ***Column Shift: Friendly Air Superiority/Supremacy***

The effect of airpower here is a combination of the airstrike itself, and aftereffects on morale, unit dispersion, camouflage, and digging in to limit further airstrikes effect thus limiting combat capabilities temporarily. Note that effective air support in an attack could possibly reduce defense effectiveness by as much as 56% (see (Rowland 2023) pg. 204), though there are many caveats to this (see caveats on pg. 204, but also the fact that modern CAS is not dive bombing and strafing, so that the reasons for success of CAS on pg. 205 also do apply to modern CAS). For other quantitative work on air interdiction see (Clevenger 1997).

[105] ***Column Shift: Rough Terrain***

Dupuy gives the defensive value of flat terrain as a 1.1 combat power multiplier to the defender, mixed terrain such as the Ardenns and northeastern France is 1.3, and rough terrain as 1.5 (Dupuy 1987) pg. 96. In this case the light urban, rice paddies, mud flats, and low hills that make up Taiwan to me fall somewhere between mixed and rough (1.3 to 1.5 multiplier) on combat power. On a 3:1 attack this would be 3.9:1 to 4.5:1, or on average 4.2:1, though as with the urban discussion below I think this undersells the benefits, particularly as the tactical battlefield becomes more transparent for urban and especially rice paddies/mud flats/etc. where line of sight is extended by things like drones and movement is either canalized or slow. Thus, I set this as a 5:1, or 2 column shift.

[106] ***Mountains***

In terms of mountain warfare this is assumed to be the same as heavy urban, as this was a US army planning assumption in the 40's and 50's (Easton 2019) pg. 39. Also see (Rowland 2023), pg. 109-115

[107] **<u>Column Shift: Urban and Mountain Warfare</u>**

Majority of Footnote removed while I am working to turn it into a paper. Please contact me for footnoted information if desired.

Urban – Taiwanese Advantages

Another method to attempt to calibrate the effect of urban in the rules is to look not only at the general effect already discussed, but at the specifics of urban in a Taiwan contingency to determine if there is deviation from the baseline. All wars and battles are specific to their local factors, and in the case of an invasion of Taiwan there seem to be several situational advantages and disadvantages compared to an "generic" urban battle (if such a thing even exists):

1. *High Civilian Will to Defend Democracy* – As was seen in Kyiv, though thankfully the Molotov's people were making were never put to the test. This could provide combat power, local knowledge, obstacles and other fortification of preparation of the battlefield, and civilian based ISR.
2. *Building Construction* – This has occurred inadvertently by creating earthquake proof buildings which are highly defensible and hardened.
3. *Knowledge of the Local Terrain*
4. *Preparation of Urban Areas* – It is not known, but there may also have been preparation of urban areas for battle in advance. At the very least it seems that evacuation of civilians has been prepared for to some degree (Lilly 2022), pg. 154.
5. *Underground Infrastructure* – While likely a minor advantage, their will the ability to utilize underground infrastructure such as subway lines, car parks, and underground shopping malls. (Easton 2019), pg. 209. He cites a further article in a Taiwanese military journal, but I cannot find the journal article, (Lilly 2022) pg. 146-147
6. *PLA Urban Warfare Weakness*
    a. Note however this only holds if Taiwanese force quality is superior, and I have not yet come across an assessment of Taiwanese LSCO urban warfare training and preparation. pg. 146-147, (Kania and McCaslin 2022)

Disadvantages

1. If the Chinese are able to win air superiority (which they may well be able do for some time) then they will have advantages in:
    a. *Highly One-Sided Supporting Fires*
    b. *Dominant ISR Advantage*
2. *ROE restrictions* – I view it as unlikely that the Chinese will have any serious ROE restrictions of any kind for conventional weapons.

There are of course other factors are possible, but they are more situational

Now to compare these we must understand when they the various advantages and disadvantages will be present. The Chinese will likely employ their missile inventory to disrupt, degrade, and destroy US, Taiwanese, and allied airpower at the outset of a conflict. This effect could (depending upon assumptions) could last for up to a month or so, see (Grieco et al. 2024). At some point past the start of the conflict Chinese forces will hit the beachheads and sometime after that (if not thrown back into the sea) advance into urban terrain (assuming the Taiwanese are willing to fight in urban areas of course). Thus, the Chinese have some portion of time where their ability to surveil the urban environment via the air and deliver PGM's by the air will be at it's peak. However, this is a short window in the context of protracted conflict and will be shorter as the Chinese will likely conduct a joint firepower strike for some time before hitting the beach, and they may be delayed getting into urban areas to fight. Furthermore, the latter parts of their window of air supremacy/superiority will begin to become more and more contested (though of course air superiority over Taiwan could last for much longer than the supremacy their missile inventory will buy them for some time). Now, at a certain point in protracted war Taiwanese SAM stocks may begin to deplete and they will be forced to ration, become reliant upon ROCAF, US, or allied air cover, or have the US resupply them with SAMs. This will open some opportunity for air-based effects again.

So all of that said, if we assume a protracted conflict on Taiwan after the landing (which given the terrain, and Taiwanese will to fight, and assuming the US joins the war (both for airpower, and to keep the Taiwanese from surrendering if the US refuses to join), the Taiwanese will have some benefit (but given their type of advantages probably not a massive advantage) in urban warfare when Chinese air delivered effects (PGM's and ISR) are at a minimum, and Chinese advantages maximize when air supremacy/superiority is occurring. Projecting the air environment is incredibly difficult and frankly, I remain conflicted as to what is likely, given that an answer is extremely dependent on assumptions made. Thus, it is best (and also because I believe it is more or less correct) to assume that this is a wash and that on the whole no one side would have a distinct advantage in urban combat to such a degree that it necessitates changing the effect of urban combat in this game.

[108] ***Column Shift: Fortifications (Theory)***

Fortifications that have been built up extensively can be extremely effective in slowing the enemy and blunting the effects of mass. These are conceptually distinct from more immediately prepared obstacles (e.g. components of a prepared defense in this game, which is a simplification as not all prepared defenses have obstacles and may have them to highly varying degrees), hence the inclusion of "Fortifications" separately. See Russian losses in the battle of Avdiivka (666 vehicles lost compared to 57 Ukrainian, and 16-46,000 Russian casualties) (source https://twitter.com/MassDara/status/1760039863057846536). Fortifications here allow you to ignore flag results as you can fall back onto other pre-prepared defensive lines, negating the effect of being forced to withdraw from a position and offsetting casualties and personnel losses by fighting from fortified positions.

Depuy states the effect of fortification is a multiply factor of 1.6 ((Dupuy 1987) pg. 95-96), however I view this as lower than it should be. This is because fortifications are in large part comprised of obstacles. Obstacles are only effective when they are observed (otherwise they can be bypassed in relatively short order). As tactical ISR is more and more prevalent and the tactical fight becomes more and more transparent, obstacles (and therefore fortifications) become more and more effective as they are more continually and thoroughly observed by the defender.

[109] ***Column Shift: Fortifications (Effect)***

This is based on the differences in force ratios between European Theater of Operations attacks and Pacific Theater of Operation attacks (e.g. the difference between attacks on fortified Japanese positions and regular combat in the ETO is ~1 in the difference of force ratios), see (Lawrence 2017) pg. 10-11

[110] ***Column Shift: Fortifications (Special Effects)***

Fortifications increase attacker casualties by 1.65 in historical cases (Rowland 2023) pg. 77. Given increase in lethality and ability to monitor obstacles, I round this up to 2 both to be more accurate and for ease in calculating attrition taken.

[111] Generally informed by (Center for Army Lessons Learned 2020).

[112] Informing this section see:

- On determinates of success see (Malkasian 2002)

- In the Taiwanese context see:
  - On the planned beach defenses and PLA's ability to defeat obstacles in landing operations: (王禹景 (Wang Yujing) 2022)
- On Ukrainian amphibious operations at Krynky see (Kyrylenko 2024b)
  - This is of use in assessing the effect of pervasive ISR and sustainability of thin beachheads even at short distances, but also note the smaller scale and relative lack of equipment for the operation makes direct comparison unsuitable.
- On surf zone and very shallow water mining (in)effectiveness see (Eidson 2000). "This perspective is not intended to imply that there would be no personnel or equipment casualties. However, the number of casualties sustained during the assault would far exceed the number sustained by the effects of a VSW/SZ minefield." (pg. 8)

[113] ***Column Shift: Amphibious Assault***

It is extremely difficult to determine the force ratio difference from 3:1 an amphibious assault requires on average to be successful (Malkasian 2002) pg. 53-59). Given data from the same source (on pg. 55-56), it seems like past 5:1 the chance of an operational pause lessens dramatically, thus giving us a 2-column shift (3:1 -> 5:1).

[114] Informing this section see:

- On PLA air assault capabilities, Taiwanese defenses, and operations in the Taiwan context: (陳勝杰 (Chen Shengjie) 2024), see also to a lesser degree (林聖詠 (Lin Shengyong) and 余俊杰 (Yu Junjie) 2023) pg. 18-21
- On the attack on Hostomel/Anatov Airport (Sladden et al. 2024), pg. 17-21
- On the future of air assault see (Watling et al. 2026)

[115] So an IADS value of 2, would mean = 30-50% losses, a value of 1 = 20-40% losses, etc. This variability is dependent on how much can be destroyed on landing, as air assaults are very vulnerable in transit, but are extremely vulnerable to artillery attack on the landing zone (Watling 2023) pg. 162. I'm not quite sure about the sizing of a d3 vs. d4 vs. d6 vs. d8 vs. d10, as many brigade level such assaults are often battalion sized operations at first, followed by the rest of the brigade later (meaning that the whole of the force is not exposed to destruction during the assault). As such, if the initial battalion is destroyed, then the follow on forces would not arrive to be destroyed as well. If the battalion makes it, then the follow on forces could be destroyed, but are less at risk of doing so, and if both land, then there is a minimal amount destroyed. I go with 1d3 (10-50%), as that seems roughly correct and as "Modelling of aviation assault in modern high-intensity warfare has brought back an expected rate of attrition of 40% of the airframes employed" (Watling and Bronk 2021) pg. 26, though notably as per later discussion (on pg. 26) this is probably a high estimate on initial assault and in the Taiwan/Pacific context.

The base level of attrition (e.g. a minimum of 10%, because the minimum the dice can roll is a 1) is a <u>very first order approximation</u> calculated from attack on Antonov Airport, selected for recency, high competence of Russian forces, and relativity lower quality and quantity of Ukrainian air defense and defenders. This gives us the minimum number of casualties on a likely air assault. The defense had Igla's and at least one ZU-23. The initial attack was of ~34 helicopters and 200-300 VDV, and 2 helicopters were lost on the way into the target, with another 3 lost over the airfield, (for numbers used for this see (Sladden et al. 2024) pg. 17-21) and 1 written off after the attack (https://x.com/MarcinRogowsk14/status/1894474069807960218, I know a twitter/telegram source is suspect, but I feel it credible as it was added to the Oryx list). Counting the 2 shot down before reaching, possibly the one lost immediately after arriving at the airport that is 6%-9% of the force. This is therefore counted as the minimum attrition possible of an attacking air assault force (~10%), higher than the 6%-9% as casualties from landing in exposed positions are not accounted for in the Antonov data (Russian casualties are unknown), and as Stinger performs better than Igla. If facing a functioning IADS, losses would have been higher (e.g. IADS value inclusion), see RUSI work on how the Russians were able to effectively disrupt and discombobulate (resulting in functional suppression) Ukrainian air defense for the opening 24 hours of the war when the assault occurred, and both sites defending the Dnipro (the route to Hostemel) were destroyed see (Watling et al. 2024) pg. 24-25.

[116] ***Column Shift: Brigade Unable to do Brigade Level Combined Arms***

BLUF: This applies to Taiwanese C-Level reserve units, and to PLA units during amphibious attack (PLA amphibious units rarely practice above battalion (Blasko 2024) pg. 74-75). Inability to conduct brigade level combined arms has been noted repeatedly for Russian units, but also can be observed in Ukraine's 2023 counteroffensive which is worth understanding (see (Watling et al. 2024) pg. 31-32, and also (Watling and Reynolds 2023b) pg. 21-22). Stormbreak indicates that the two factors here are 1) lack of experienced staff, and 2) lack of good junior officers, both of which I view as potentiality being major problems for Taiwanese reserve units (junior officers especially, even with the new 150 permanent staff structure for new brigades, staff is likely less problem, but a problem still).

[117] ***Column Shift: Surprise***

This value is drawn mostly from (R. M. Clark and Mitchel 2019) pg. 6-7 (particularly Figure 1-1 and Figure 1-2). I argue this only applies when attacking as surprise and deception have substantially less effect on the defense (basically allowing for movement of troops/fires to affect correlation of forces, which the effect of such surprise/deception in that case is handled by other things in these rules beyond column shifts). Functionally, a surprised attacker takes damage and withdraws, while a surprised defender is overrun (this is of course overly simplistic, as a surprised attacker can be counterattacked and overrun).

For a deeper understanding of what constitutes "surprise" (Rowland et al. 1996) pg. 8 argues that surprise is comprised of 3 factors

> "a. The intention of (in most cases) the attacker to act in a way which, he believes, will not be expected by the defender.
>
> b. The confounding of expectations on the part of the defender, whether or not this was the intention of the attacker.
>
> c. The inability of the defender to respond appropriately, either through lack of time, poor appreciation, or because of his subjective reaction to this unexpected train of events (confusion or shock).
>
> Facet (a) does not guarantee (b), and (b) does not guarantee (c)."

For an historical analysis/operations research perspective on surprise see (Rowland 2023). On Tactical Surprise: pg. 176-184 (pg. 181-183 especially) and 199-203, on Operational Surprise pg. 210-214. Note the qualifier (pg. 176) that operational surprise had a much greater effect than tactical surprise (as studied on the following pages of the book). I however do not draw values for the game from this (beyond the general confirmation of the (R. M. Clark and Mitchel 2019) numbers) as reverse engineering the numbers into a usable format is beyond my limited statistical abilities. My thoughts are somewhat informed by (Lawrence 2017) pg. 121-145 (especially 128-132, 134-135, summary 137 and 140-141). However, I think the analysis and data (WW2, limited data) in the first part of Lawerence's chapter (pg. 121-131) obscures the importance of actively deceiving the enemy in modern combat (e.g. a more transparent battlefield gives (or perhaps forces) more agency to the deceiver to deceive as the enemy is less likely to have low information on you). Note the second major finding of Lawrence is that Surprise does not increase casualties, which contradicts the (R. M. Clark and Mitchel 2019) information. Again note that I do not draw values for the game from this (beyond the general confirmation of the (R. M. Clark and Mitchel 2019) numbers) as reverse engineering the numbers is beyond my statistical abilities.

For real world examples on surprise see:

- The Ukrainian attack into Kursk see (Boyer and Becker 2024) though not noted in the TRADOC piece, but discussed in some open sources was that it appeared higher Russian commanders ignored the tactical commanders on the ground warning of a Ukrainian buildup.
- Then also see the counterfactual in the 2023 Ukrainian Counteroffensive which was well known in advance by the Russians (Watling et al. 2024) pg. 30-31.

[118] PLA units have not been observed conducting brigade level amphibious training, and while to a certain degree this issue with force quality may be offset by the poorer quality of Taiwanese units defending the beach (see (王禹景 (Wang Yujing) 2022) pg. 85), the onus and difficulty is mostly on the PLA.

[119] **Missile Rules (General Information)**

For major sources informing this section see:

- On salvos and effects
  - (Grieco et al. 2024)
  - (Heginbotham 2015)
  - (Lostumbo et al. 2016) pg. xii-21
- For general overview (though more in the naval context) of the full detect to fire sequence and countermeasures see: (Doyle and Herzinger 2022)

A salvo of missiles (see missile cards) is noted by predominate type and that salvos in this case may in reality be mixed but represent the firing of a chunk of inventory of predominately the given type. Other mixed in odds and ends are expected to even out across the number of strikes in the game. This includes the use of high-low mixing, and is where OWA drones are represented in the game (as they are not otherwise represented).

For exact numbers of missile salvo sizes by characteristics see Missile Salvo Calculation Sheet.

- The basic assumption of the model is that a Pk of .5 needs to be achieved against 10 aimpoints, and that salvo size is the number of missiles required to do so. This is calculated by determining the single shot kill probability of each missile, assuming a target of 15 meters, CEP from open sources for each missile (15% increase in CEP is assumed if the weapon will have to go over a substantial distance of land where it could be jammed, this 15% is an assumption not based in any specific evidence), a reliability of each individual missile of 96.3% ((Cranny-Evans and Kaushal 2025) in 593 missiles that were not attempted to be intercepted 22 missiles failed to reach their targets), and the size of the warhead using data from (Laupa 1970), pg. 3, (BLU-67 discarded as it's a shaped charge) to derive a linear trendline for crater size for any given charge weight. Note that it would be better to use the Berezansky equation, (Sedláček et al. 2024) pg. 7, or a method from (Westine 1973) but I am not suitably a mathematician enough to do so. Note that if the warhead is a submunition warhead, and the dispersal area of the submunitions is larger than the unitary warhead the submunition area is used instead of the crater size.
- It is assumed that planners will expect 50% of their fired missiles to be defeated by some combination of: interception, electronic warfare/dazzling/other soft countermeasures, or decoys and deception. The number of incoming missiles defeated is then modified by:
  - If they are Low Observable/Stealthy – if yes, it reduces the number of effective intercepts by ½ (gut checked by PhD studying hypersonic missiles in the Pacific in an operational context)
  - Are the missiles maneuver in the terminal phase of attack – if yes it reduces the number of effective intercepts by 1/3. This is as per (Wang et al. 2022) pg. 4374 shows that the miss distance of random maneuvering was ~66% larger than no maneuvering, gut checked by above PhD student. For a simple general overview on the general value of maneuverability see (Trevithick 2025).
  - If the the missiles are hypersonic – if yes it reduces the number of effective intercepts by 1/3 (gut checked by above PhD student).
- A test to evaluate the accuracy of this calculation for Iskander ballistic missiles and Geran one way attack drones using salvo sizes from Ukraine was undertaken. Stated salvo sizes of a combined attack against an energy infrastructure target are ~60 Geran OWA-UAV and ~8 Iskander (Lee 2026) at 17:40 and 21:20. The outputs here are higher than given though within a reasonable range, though the real issue is that an unknown number of aimpoint hits are wanted here, the desired Pk is not known, and the predicted intercept rate is unknown. Also note that for Iskander penetration aids are not accounted for, but may be felt in the effect of maneuverability, see discussion in (Cranny-Evans and Kaushal 2022), and for Geran decoys are not accounted for as the calculator is attempting to find the number of munitions needed to get the needed number of hits only (increasing total number of drones in the salvo by 20-40% (Anokhin 2026) pg. 4). There is also a difference in expected salvo calculations between the war in Ukraine and a war in the pacific due to differences in weapons, defenses, ranges, and desired effects.

Name	Iskander	Geran

Missile CEP (m)	7	12.5
Jamming Expected?	Yes	Yes
Crater Size (ø ft)	50	18.5
Missiles needed for .5 Pk	1	1.55
vs. 10 Aimpoints	10	15.5
Low Observable/Stealthy?	No	No
Maneuverable?	Yes	No
Hypersonic	No	No
Final Anticipated Intercepts (as %)	10%	85%
Salvo Size	10.8	28.7*

*+20-40% to account for decoys would be the range of 34.4 to 40.1 as the salvo size.

Iskander data (CEP, maneuverability, warhead size to calculate crater size – assumed to be HE) were taken from (Cranny-Evans and Kaushal 2022). As energy infrastructure is usually unlikely to be defended by SAM's capable of ballistic missile interception, and the Russians can re-attack targets at their leisure, a low intercept rate from the bimodal distribution was picked, see (Cranny-Evans and Kaushal 2025). Information on Geran CEP from (Post 2023) and other information from (Anokhin 2026) pg. 5 (to ensure model and real world Ph were aligning), and pg. 11 for average intercept rate (assessed to be ~85% based on total launches and interceptions).

The final results here are as noted above are extremely sensitive to assumptions and without further data cannot be fully assumed to be including all relevant variables and to have the initial values of the variables correct. However, the fact that real-world salvo sizes are easily within the reasonable assumptions of the model shows at the very least that the calculator is not wildly off base in providing values.

120 Due to an increasing area of uncertainty due to flight time more missiles must be fired to get the same chance of kill. Potentially this also may represent the need to fire ballistic missiles on a flatter trajectory at longer range making them easier to intercept (Cranny-Evans and Kaushal 2025)

121 This has to do with the nature of the seeker heads employed and clutter in a port (Discussion with RN Lt. Cmdr., May 17th, 2024)

122 Occasionally one may get lucky and hit a command post, supply dump, or a grouping of enemy troops which could produce a column shift effect. For example there have been attacks on Ukrainian training grounds for example (*Wikipedia* 2026, '2025 Russian strikes on Ukrainian training grounds') producing large numbers of causalities or meetings of personal (Stern et al. 2023) that have lead to important losses of key personnel that would produce a larger attrition result or column shift, but these are few and far between.

However, in general missile strikes against ground units are relatively ineffective. As stated by Jack Watling on the Ukrainian 2023 counteroffesive: "Collectively, however, these strikes [SCALP/Storm Shadow] never reached the critical level of damage that would disorder the C2 or logistics system. Nor were the strikes themselves effectively synchronized with ground operations that would have caused pressure in tempo with disruption in the deep. This was partly because having effect in the land domain requires the simultaneous servicing of more targets than operations targeting naval forces. The damage to the Black Sea Fleet was absolute. Damaged command posts and bridges, by contrast, could be replaced and repaired." (Watling et al. 2024) pg. 23

123 As the possible area where a target grows is, the less likely commanders are to launch weapons at it because they are less likely to find and hit the enemy. As hypersonic weapons move from A to B very, very, quickly they have an advantage in the fact that more of them can be used to engage a fleeting target with less risk of them failing to find the target even at much longer ranges. Thusly as an end effects model hypersonics get an additional possible salvo against moving naval targets. They do not get this benefit against ground targets as the major limiter is the fact that such things can displace and hide as opposed to having a large possible area where they could be at sea that needs to be saturated with warheads.

124 *Assumption:* All airbases are defended by ~1 SAM battery (Patriot or similar), which will mitigate the effects of minor attacks (e.g. lower than "salvo" in this game) unless overwhelmed.

This section is heavily informed by:

- On Attack
    - Reports: (Grieco et al. 2024)*, (Heginbotham 2015)* pg. 58-68, 133-160, (Stillion and Orletsky 1999), pg. 61-80, to some degree (Lostumbo et al. 2016) pg. xii-21.
    - An author designed single shot kill probability (SSKP) equation model for airfield attack for a separate game.
- On Repair of Airfields: (Grieco et al. 2024), ('AFTTP 3-32.10, Introduction to RADR' 2024), (Gordon 2023), (Laupa 1970) note that current methods do not directly recycle the debris as fill as described in this paper, nor is airfield matting or fiberglass matting (to my understanding of unclear wording) usable on runways. See ('AFTTP 3-32.10, Introduction to RADR' 2024) pg. 12-15)
- Some very limited validation was attempted (though note due to a paucity of information, this is very tenuous at best) by comparing the rules to:
    - Individual Strikes
        - The 2017 Shayrat missile strike
        - The October 2024 Iranian strikes against Israel
    - Overall Campaigns
        - 12 Day War
        - 2026 Iran War

Note that a strike on an airbase includes attacks on air defense, radars, infrastructure (fuel farm, munitions storage, personal quarters, fire and repair units, and if not worried about war crimes possibly medical infrastructure), aircraft, and shelters, and cratering the runway and is assumed to have a mix of unitary and submunition warheads as it optimal.

This makes some assumptions about the availability of runway repair personnel and material (e.g. continual presence of personal, equipment, and fill material). For a discussion on these see (Grieco et al. 2024), pg. 26

[125] Note that while a THAAD battery is not so effective as to be able to shoot down massive waves of ballistic missiles by itself (and cannot to the author's knowledge properly engage cruise missiles), its presence represents a concentration of other air defense including Patriot batteries (or other similar air defense, for the effectiveness of Patriots in a favorable engagement see a Saudi engagement in 2019: (Osborne 2024) (2019), and in Ukraine see decreased effectiveness (Cranny-Evans and Kaushal 2025)) that can engage both cruise and ballistic missiles along with THAAD, decoys, and EW (for EW being able to affect PGM's, see *In a Jam*, Olivia Savage and Sunil JB Babu, Janes Defense Weekly, 5 July 2023), and even the occasional lucky MANPADS (against cruise missiles together helping to degrade incoming missile salvos. For a short overview on factors going into missile interception see (Lostumbo et al. 2016), pg. 12-13.

All this of course assumes that the defending batteries will be able to engage, but given the number of terrestrial sensors in the pacific, the number of space based sensors, and the flight time, it seems reasonable that batteries will be altered and ready to engage an incoming attack. On space based sensors, and especially the Theater Event System, see *(Air Command and Staff College 2023)*, pg. 107-110.

Aircraft CAP's shooting down cruise missiles is possible and effective at degrading salvos of missiles as seen in Ukraine (provided one has a look down radar), and as above represents the concentration of air defense systems and other efforts such as MILDEC and decoys that degrade the effectiveness of missiles. On decoys for airbase protection there are many types, including some large interesting ones, see (Stetson Payne 2023) and *(Easton 2019)* pg. 167-168 .

[126] If missiles are harder to detect, they consequently are engaged by defenses later, and are thus more likely to reach their target and have an effect on the target.

[127] Single salvos can be degraded by air defense at the airbase, and as such have less of a chance of having an effect on the enemy. At 2 or more salvos, the degradation of the missiles by air defense would have minimal effect in relation to the total salvo size that would hit and/or air defense is suppressed or damaged/destroyed due to the size of the salvo. This more binomial distribution has some evidence from Ukraine (Cranny-Evans and Kaushal 2025). Note however that interception of supersonic missiles is much more difficult (https://web.archive.org/web/20230310213624/https://twitter.com/MassDara/status/1634300311744438272,

which is something the rules do not yet fully account for in this section. Missile speed as subsonic, supersonic, or hypersonic is accounted for in other places in the rules, notably missile salvo size/sea combat, which means that this is partly accounted for but not fully accounted for.

Note a "no effect" result doesn't mean that no missiles got through or hit, but just that their impact was so minimal at the timescale and level of abstraction of the game as to not be worth representing.

[128] Cluster Munitions are devastating against aircraft parked in the open or in unprotected shelters due to their much hiver effective radius compared to a standard warhead.

[129] This represents the ability to defeat hardened aircraft shelters and buried infrastructure, as well as to damage runways more effectively.

[130] This represents the ability of larger airbases to disperse aircraft across them, so that aircraft are less at risk given the same number of munitions. For a discussion on this topic, see (Stillion and Orletsky 1999), pg. 35-38

[131] E.g. if 3 salvos inflict 6 attrition total to a base with 3 parking spaces occupied by 1 squadron (2 unused parking), inflict 4 attrition (6-2 = 4) to the aircraft at the base.

[132] This section pulls from the airbase table, but reflavors it to my understanding of ports (mostly that they substantially harder to damage by throwing missiles at them). Once again see (Heginbotham 2015) pg. 58-68, 133-160.

[133] Mine Rules (General Information)

Section generally informed by:

- For an exceedingly through look at all aspects of mine warfare see (O'Flaherty 2019)
- On mine warfare in the particulars of the Taiwan context see (Cancian 2022) and (Ying 2024). For more information on clearing mines close to shore see (王禹景 (Wang Yujing) 2022) pg. 78-79
- On modeling mine warfare see (Washburn 2007) and (Washburn and Kress 2009)
- Authors own shock force calculator (*Wikipedia* 2025, 'Shock factor'), though note that the bubble effect is also damaging (O'Flaherty 2019), pg. 23 and see other discussion on effective factors in and beyond shock force calculations on pg. 23-24.

Note that these rules assume that the correct type of mines for the given target and geographical conditions are being used. The final model used here is extremely inaccurate, but to produce a more representative model would require a substantially more complex game system, out of line with the rest of the ruleset. Thus the inaccuracy must be accepted as the price of playability in this context. As (Washburn 2007) states "[mine warfare] models are neither good nor bad in any absolute sense, but only for specific purposes" pg. 8

[134] The following are clearance rates for minesweepers:

Mines per Day Clearance Rates		
Example	Clearance Rate	Source
Corregidor 1945	On day 1 each sweeper on average clearing 1.3 mines and on day 2 clearing 5.23 mines per sweeper	(O'Flaherty 2019) pg. 73
Wonsan Harbor (1951)	.83 mines per day per minesweeper (225 mines over 15 days with 15 mineswepers)	(Cancian 2022) pg. 12
Iraq 2003 (US)	1.95 mines per MCM ship per day.	(Cancian 2022) pg. 12
Iraq 2003 (Coalition)	1.18 mines per MCM ship per day.	(Cancian 2022) pg. 12

Area per Day Clearance Rates		
Example	Clearance Rate	Source
Desert Storm (1991)	Planned staging/fire support area for the amphibious landing near Ash Shuaybah was planned to be 200 mi^2 with estimated possible clearance times as high as 40 days	(Lyons et al. 1993) pg. 6

Desert Storm (1991)	Planed staging area for a raid on Faylaka Island had a ~54 mi^2 with an estimated clearance time of six days	(Lyons et al. 1993) pg. 6
Rule of Thumb	"a typical minehunter should be able to clear approximately 1 square nautical mine [sic, should be mile] of a typical minefield every 24 hours, and sustain this rate for between five and ten days. A typical mechanical minesweeper should be able to clear between 4 to 6 square nautical miles of typical buoyant minefield per 24 hours and sustain this for up to five days. Most emerging remotely manned systems numerically emulate their minehunter or minesweeper predecessors"	(O'Flaherty 2019) pg. 45
C-WAM	A MCM vessel as able to clear 10km of lane per day (if this lane is 200m across (see (O'Flaherty 2019) pg. 45), this is 2 square km per day or .58 nm^2.	(Center for Army Analysis 2016) pg. 34

(Truver 2012) pg. 8 states that "the detection-to-neutralization process of a single mine-like contact can take several hours if conducted by MCM ships, longer if by other systems." There is also a difference in rate of clearance between mine hunting that occurs at 1-4 knots. and minesweeping 8 knots (O'Flaherty 2019) pg. 42-43. Note too that lower clearance than presented in some of the older historical rates (Corregidor, Wonsan) are more likely due to the higher degree of technical sophistication of US mines compared to historical examples (Cancian 2022) pg. 12.

Minesweeping also suffers from diminishing returns for search time put in (O'Flaherty 2019) pg. 39. This means the most reasonable approximation would be some sort of exponential decrease in efficiency with a cap on the high end of the asset searching what they could find and neutralize if the area was chocked with mines, and the low bound being 0. Determining those bounds and the exponential relationship is incredibly difficult and is revaluated constantly while sweeping, and the sweeper has no idea of the given relationship and what they are looking for precisely (O'Flaherty 2019) pg. 38-39.

[135] (Cancian 2022), pg. 12 looking at Wonson Harbor gives a 2/15 = 13.3% chance, though notes no losses in 2003. However (Washburn and Kress 2009), pg. 170 explicitly state that Wonson was an anomaly and the actual rate of loss for MCM vessels is much lower. Thus, I go with 1% per day.

[136] (Cancian 2022), pg. 13. While this is an imperfect model in many respects, this means that smaller minefields are easier to clear lanes through and thus is a usable approximation without having to deal with more complicated models (for more on such models see (Washburn and Kress 2009), pg. 162-163). While the model has a simplistic method of mining it does benefit from modeling minesweeper casualties (pg. 170-171), but does not model uncertainty over the minefield or multiple mine and sweeping types (pg. 172-173). If important the cleared lane is generically ~200m across, though this can change if required (O'Flaherty 2019) pg. 45)

[137] The number here (10%) is picked arbitrarily to match the number required to clear a lane. For more on this, see *Mine Warfare in a Cross-Strait Invasion*, Chapter 11, Thomas Shugart, in Study No. 8, Chinese Amphibious Warfare: Prospects for a Cross Strait Invasion, 11/8/2024 https://digital-commons.usnwc.edu/cgi/viewcontent.cgi?article=1000&context=cmsi-studies, pg. 221

[138] Based off of (Center for Army Analysis 2016) pg. 34. Note that as per (O'Flaherty 2019) pg. 48, a 5% risk to the first non-MCM ship transiting is typically achievable. The Taiwan strait is ideally suited for bottom mines due to it's shallow depth which are hard to detect making the strait a good place for mining (Ying 2024) pg. 14-15. However, the small nature of the strait means that minefields laid within it will likely be able to be intensely surveilled by one or both sides helping defeat minefields (Washburn 2007) pg. 6-7. However, as this is simply enough to know where, it will not defeat the benefits of the shallow nature, and given the concentration about to be discussed it not sufficient to prevent a -1 modifier. The noted bonus for beaches is due to the fact that one is to concentrating mines in an area that is known rather than having to spread them out to defend a larger area that the enemy might approach any of. Density is a typical characteristic of defensive minefields (O'Flaherty 2019) pg. 18.

[139] Modeling SOF is tremendously difficulty to do accuracy in a way that can be verified. This is not only due to a lack of data (the following discussion includes pretty much every source I can find that might provide hard numbers useful to constructing a model), but also because SOF works on a different timescale, in weird ways, and at high levels of abstraction at the theater level. Due to the high level of modeling (e.g. for an effect to be had it must be significant to rise to the point of being felt in this model), and the longer

duration of SOF activities, this game employs a relatively abstract end-effects models for SOF. It focused around using SOF to attempt to execute lines of effort that provide different effects.
The model of SOF in this game does a few critical things:

1. It aggregates SOF into lines of effort. Each SOF unit is here is not a team or detachment, but instead large unit (the whole of Delta Force, a Chinese SOF brigade) with their individual elements conducting missions that support that line of effort. In fact given the way SOF works, a "Delta Force" unit may also include 160th SOAR(A) with additional supporting assets from JSOC or other elements of the US armed forces a "Chinese SOF brigade" could include support from PLAN submarines and so on. This isn't true in any specific scenario (e.g. what each "unit" represents specifically in a given instance may vary), and scales oddly, but is the simplest method bar substantially more complex modeling.
2. The exact methods of infiltration/exfiltration are reduced in specific complexity and heavily averaged. This is because the level of aggregation is so high individual infiltration/exfiltration are too complex to do easily, and as large numbers of infiltration/exfiltration occurs, the most dominate form is assumed be average (and as the number of teams is high we can use an average with less issue for deviation from what is likely accurate).
3. Thusly the overall time for infiltration, exfiltration, and regeneration can be seen as representing the time required for multiple units to infiltration, execute the missions, and exfiltrate to support a line of effort to a sufficient enough degree that there is a chance it has large enough effect to be felt in this model.
4. Given that this ruleset is meant to cover at most the first few months of the war there are sufficient forces that if losses are taken the overall SOF forces of the nation are not lost. Thusly a nation don't loose the SOF unit if they take losses, rather they need to regenerate the capability (e.g. and regeneration when losses occur takes longer than just needing to readjust the line of effort). This may be due to the need to change mission planning, TTP's, re-order existing units, and an increase in caution leading to a longer time required to support the line of effort.
5. The overall chances of losses are very low again because the total combat power loss of a single unit being discovered is quite low because we are looking at large overall forces of SOF (e.g. if a 101st Amphibious Reconnaissance Battalion team is lost, it's not that large a part of the overall force).
6. Overall effects are also relatively low. It's assumed that a lot of SOF missions are having minimal effect (e.g. destroying up a single TEL, ambushing a trucks, etc.) which only minimally advances the line of effort or due to the difficulty of infiltration/exfiltration in this theater to get to some types targets are taking a long time to get the go ahead (thus slowing the line of effort) or are aborting the mission. This combined with the long time required to plan and infiltrate/exfiltrate makes the use of SOF much slower than other forces in having effects and thus means that they have a lower effect at the timescale used (e.g. due to the fact that SOF act slowly, their total effect is on a per-day basis is lower, even if they are having the same level of effect as an air strike for example).

[140] A functional limit is required and this does it well enough. Chinese SOF brigades are not SOF in the Teir 1 sense, but due to Chinese proximity to Taiwan and their method of employment (likely accepting a higher level of risk and attrition as they have SOF to spare (Chen and Wuthnow 2022)) meaning that they have more capability I'm fine use them here.

[141] Based upon locations in (Chen and Wuthnow 2022) pg. 7 and discussion on pg. 6, and partially on descriptions from https://twitter.com/nuwangzi/status/1656982424788639746 (2023)

[142] ***Detection***

Modeling infiltration/exfiltration and detection, limited sources are available. (Center for Army Analysis 2016) gives a 1/6 chance (16.7%) of detection by forces sweeping the area for them (or 1/3 chance, 33% if the unit directed fires last turn. At a even higher level of aggregation (Kraus 1986) pg. 14, also pg. 33 provides data that is "purely hypothetical and bears no resemblance to any actual scenario" (and lacks multiple scenarios to compare across to check the variance/order of magnitude), that has 12.5% of SOF missions not require exfiltration (unclear if this is due to loss of the team or they did not require exfiltration by air), but this data is not of sufficient quality to use.

(Willson 1995) did not model the chance of detection of the SOF unit, only the level of attrition if it is detected (by chance or by undertaking an direct action mission), a simple model with changes for force posture where at a certain level of losses the unit scrubs the mission could be used, but the real issue for these is detection, which the paper does not cover.

Notability maritime insertion of SOF by small craft is safer than other means (Watling 2023) pg. 185. This has seemingly been shown by a higher tempo of SOF actions conducted over water into Crimea than in land based areas in Ukraine during the calcification of the frontline (2023-2024), though determining the exact extent (or truth of this) is difficult.

In terms of modeling the insertion and exfiltration of units (Center for Army Analysis 2016) pg. 37 provides the following probabilities of success (table from original, modified from the dice values to give probabilities):

	Mission Risk			
	Low	*Medium*	*High*	*Extreme*
Clandestine Insert/Extraction	83%	67%	50%	33%
Extraction after DA Strike	75%	58%	42%	25%
-16.7% if enemy has superiority along aerial insert/extract route.				
-8.3% if enemy has superiority along maritime insert/extract route.				

There is no indication of how to prescribe the level of risk for a mission, other than a note that "SOF insertion into the middle of an enemy position is Extreme Risk." If a unit fails to succeed they are compromised.

(Lim 1995) modeling North Korean SOF calculates a detection modifier for modeling the chances of detection based on the size of the SOF unit, the terrain, and security level of the area (these are then modified by how long it takes the SOF unit to cross the area (in this case areas of multiple miles), and then this is stochastically processed to see if they are detected or not (pg. 27). For understanding of force sizes the following force to targets are given (pg. 38, 47-48):

SOF Force Size	Target (and # SOF Teams for Target*)
Small	Paldang Dam (1), Dongdu-Cheon Air Defence Radar (1)
Medium	Osan Air Base (5)
Large	Government Complex Gwacheon (8), Army CP I (6)
Unknown	Osan Air Force Command Post (4), Kimpo International Airport (2)

*Each SOF Team is 14 people (pg. 49)

Level of Security	Small Force			Medium Force			Large Force		
	Open	*Forest*	*Mountain*	*Open*	*Forest*	*Mountain*	*Open*	*Forest*	*Mountain*
Low	.2567	.1054	.2231	.4308	.2877	.3567	.6931	.5108	.5978
High	.4308	.2877	.3567	.5978	.4308	.5108	.9163	.6931	.7985

Note that the specifics of what constitutes types of terrain, level of security, and size of force are not given by Lim. This is difficult to understand, so it is normalized using the highest value as 100% so that each value can be understood as a percentage of the maximum chance of detection (large force, in the open, with high security). Note that SOF travels multiple legs in Lim's modeling, so this is not the overall chance, but a value for each leg.

Level of Security	Small Force			Medium Force			Large Force		
	Open	*Forest*	*Mountain*	*Open*	*Forest*	*Mountain*	*Open*	*Forest*	*Mountain*
Low	28%	12%	24%	47%	31%	39%	76%	56%	65%
High	47%	31%	39%	65%	47%	56%	***100%***	76%	87%

(Lim 1995) does not provide values for a force that is remaining in place, but does provide values for infiltrating against a target, taking a count of the size of the SOF unit, and the level of security. This is then normalized as above:

Level of Security	Force Size		
	Small	*Medium*	*Large*
Very Low	.21	.58	1.02
Low	.33	.86	1.38
Middle	.45	1.12	1.85

Level of Security	Force Size		
	Small	*Medium*	*Large*
Very Low	7%	18%	32%
Low	10%	27%	43%
Middle	14%	35%	57%

High	.57	1.47	2.4
Very High	.71	1.83	3.22

High	18%	46%	75%
Very High	22%	57%	***100%***

Outcomes of Compromise

When compromised (Center for Army Analysis 2016) gives a 50/50 chance of the SOF unit being killed. (Lim 1995) gives 20% attrition of the SOF unit if detected though states that this "is arbitrary" (pg. 24).

Another method to calculate this would be to use a proxy: how long do downed pilots manage to evade when shot down in enemy territory? This approximates somewhat as both SOF and aircrews are trained in SERE, are small groups or individuals, and when detected are aggressively searched for. The difference in fitness between SOF and aircrews is probably offset by a greater difference in size between individual pilots and small groups of SOF, meaning that aircrew numbers may present a better outcome that would occur for SOF. Furthermore the "discoverability" of a crashed pilot is lower, functionally the pilot was known to be downed in an approximate area, while if a SOF team is comprised its exact location is likely to be known (if compromised by enemy military forces, this may not be the case if they are compromised by civilians and then attempt to evade). This biases the data in favor of the aircrew again providing a higher overall bias towards a good outcome for the aircrew. (Kraus 1986) pg. 121 says that "99 percent of the crews to evade three days or less, which reasonably approximates historical data." Looking at historical data a RAND Report found the following (relevant conditions only were transcribed below) (Mouton et al. 2015) pg. 48. Note study methods and assumptions on pg. 7-8.

Condition (all assume ejection seats)	Recoverability % (Approximate)		
	Immediately After Aircraft Loss	2 Hours After Loss	12 Hours After Loss
Darkness, Terrain Good for Hiding	70%	52%	42%
Darkness, Terrain Not Good for Hiding	60%	44%	34%
Daylight, Terrain Good for Hiding	56%	36%	26%
Daylight, Terrain Not Good for Hiding	47%	28%	19%

Assuming SOF teams make use of the night for operations (assume 75% of operations occur at night), and they try to use terrain good for hiding (assume 75% of Terrain is Good for Hiding). Given day long turns in this game and the flattening out of the trend line after 12 hours (the slope is very minimal), we can assume that the "12 Hours After Loss" category represent pilots that escape successfully, about 36% of teams would evade detection. The problem of course is that in the data many pilots are dying immediately from crashes. Using data from pg. 13-21, we see that 241 of 441 individuals in the dataset were killed immediately, so only 45% of the total cases have a chance to escape and evade. Accounting for this, 66% of individuals who made it to the ground were still not captured or killed after 12 hours. As above this data is likely biased higher to be higher than for SOF teams, but such is the nature of using a proxy. With this caveat this data can then be used to determine what percentage of SOF teams might be able to evade after contact with the enemy (less than 66%) and how many are lost (greater than 44%).

(Willson 1995) calculated possible attritional outcomes of SOF direct action raids and meeting engagements against enemy forces of 3, 6, 12, and 24 enemy against 12 SOF (of which the meeting engagements are relevant here). The casualty rates for meeting engagments are as follows (note the last assumption on the list below is why no casualties are taken at night):

Time of Day	**Number of SOF KIA Taken**			
	3 Enemy	*6 Enemy*	*12 Enemy*	*24 Enemy*
Day	.15 (1%)	.75 (6%)	3.55 (30%)	4.15 (35%)
Night	0	0	0	0

%'s are total % of the force of 12 SOF.

Note some key assumptions of the work:

- Once the team moves out of the meeting engagements they are assumed to have evaded and are not reengaged (e.g. the study modeled only single engagements)
- JANUS (the modeling software used) only has KIA outcomes (e.g. individuals on either side cannot be wounded, only killed)

- The missions and scenario are against a low intensity threat (third world military) in support of conventional forces conducting contingency operations (pg. 14-5, 17)
- The work does not model attrition during infiltration/exfiltration (pg. 20)
- Issues with the model used and attempts to modify it for better fit (pg. 8-11)
- The enemy patrols only roads and major trails and conducts no aggressive patrolling (pg. 20)
- Night operations in the model are under quarter-moon illumination (pg. 8), and enemy forces did not have NVG's or other night sights (pg. 18)

It is now however sufficient to look at the loss rates from a unit being detected however. If they are conducted a direct action mission, the total attrition is going to be a combination of times they are compromised and casualties taken in conducting the mission itself.

Outcomes of Direct Action

SOF Casualties

(Lim 1995) also used Lanchester equations between defending forces and SOF giving SOF the benefit of aimed fire verses the defenders area fire Lanchester equations. This however was designed to be simple and does not elucidate the topic much further.

(Willson 1995) pg. 28-29 calculated possible attritional outcomes of SOF direction action raids, give numbers then calculate as proportion.

Time of Day	**Number of SOF KIA Taken**			
	3 Enemy	*6 Enemy*	*12 Enemy*	*24 Enemy*
Day	.35 (3%)	.5 (4%)	1.9 (16%)	7 (58%)
Night	0	0	.35 (3%)	2.15 (18%)

%'s are total % of the force of 12 SOF

SOF Mission Success Rate

(Lim 1995) computes the amount of damage to a target by using the value inversely proportional to the size of the SOF element remaining after combat (if it wins) – "for example, if the SOF has 70% of the force survive an engagement with the security force, 30% of the intended damage to the target is accomplished." (pg. 34). This seems counterintuitive but it is because it is (seemingly, to my understanding) that losses are incurred while damaging the target, and therefore each loss represents damage to the target (pg. 49-50), it may alternately have to do with the way that the simulation software used is designed.

An alternative to this system may come from analysis of the vulnerabilities of various targets to SOF action and how fast it can be recovered from if lost as described on pg. 19-20. This allows for a simple computation of how likely the target is to being damaged and if damaged how long will it take to get back to normal. This allows us to determine the chance of an successful operational effect on the target occurring.

Target	**Vulnerability Value**	**Vulnerability**	**Recuperability Value**	**Recuperability**
Power Pylons	5	SOF definitely has the means and expertise to attack.	3	Can be replaced in a relatively short time (months)
Runways	3	SOF may have the means and expertise to attack	1	Easily replaced in a short time (days)
Cables System	4	SOF probably has the means and expertise	4	Difficult to replace with long down time (<l yr)
Underground Cables	5	SOF definitely has the means and expertise to attack.	4	Difficult to replace with long down time (<l yr)
Observation Towers	5	SOF definitely has the means and expertise to attack.	3	Can be replaced in a relatively short time (months)
Command Post Building	4	SOF probably has the means and expertise	3	Can be replaced in a relatively short time (months)
Ships at Pier	5	SOF definitely has the means and expertise to attack.	5	Extremely difficult to replace. Long down time (>l yr)
Warehouses	5	SOF definitely has the means and expertise to attack.	3	Can be replaced in a relatively short time (months)
Road & Bridge	5	SOF definitely has the means and expertise to attack.	2	Easily replaced in a short time (weeks)
Mobile SAM Site	3	SOF may have the means and expertise to attack	3	Can be replaced in a relatively short time (months)
Fixed SAM site	3	SOF may have the means and expertise to attack	3	Can be replaced in a relatively short time (months)

Antenna Farm	5	SOF definitely has the means and expertise to attack.	3	Can be replaced in a relatively short time (months)
Personnel	1	SOF does not have much capability to attack	2	Easily replaced in a short time (weeks)

However this overall table is not sufficiently comprehensive to be used (and it also looking at North Korean special forces capabilities).

Unit Availability

(Kraus 1986) pg. 16 for his model provides data that again is "also bears no resemblance to real data" (and lacks multiple scenarios to compare across to check the variance/order of magnitude), that has a SOF team become available again 7 days after it is exfiltrated, but this data is not of sufficient quality to use.

143 SOF Rules (General Information)

The following table provides SOF missions (really mostly SF missions, e.g. SOF minus PSYOPS and Civil Affairs, abstraction in this game but represented in the *Only You Can Give Up* will to fight module) that various wargames allow SOF units to undertake, and if these activities have been undertaken by SOF in Ukraine (though note given the very covert and secretive nature of SOF that *absence of evidence is not evidence of absence*). The two most significant sources here are (Bezpalko and Oleniak 2025) who interview a very high level Ukrainian SOF commander, and (Danylyuk 2023) analyzing the effectiveness of Ukrainian partisans. For an overview of Ukrainian SOF see (Stringer and Vivdych 2025).

The purpose of this table is not only to determine what missions are being conducted in Ukraine (and thus an indication of what is possible and under what conditions), but also to see how various professional wargames and authors concerned with modeling SOF group the various missions conducted by SOF.

SOF Missions	***Wargames***	(Lim 1995)*	***SOF Conducted in Ukraine?†***	***Partisans Conducted in Ukraine?***	***Unclear if SOF or Partisans***
Operational/Strategic ISR Collection	Landpower, OWS	X	Pre-war: (Livermore 2025), 2023 (Borsari 2023), 2024 (Tucker 2024)	Likely	
Reconnaissance for Amphibious Operations			Russians (Watling et al. 2024) pg. 30, Ukraine at Snake Island (*BBC News Україна* 2022) and Krynky (Tucker 2024)		
Targeting for Fires	OWS, C-WAM		Early War: (Sladden et al. 2024), (Портал «Тиск» 2022), (Stringer and Vivdych 2025), 2023 (Borsari 2023), possibly later war (unclear) (Livermore 2025), later war (Livermore 2024), (Tucker 2024)	Early war: (Kramer 2022), (Schwirtz and Santora 2022), 2023 (Cotovio et al. 2023), "Most important function" of partisans in Ukraine (Danylyuk 2023)	
Destroy Infrastructure	Landpower				(Borsari 2023)
Direct Action			Ongoing limited amounts: "sabotage activities" (Портал «Тиск» 2022), (Boffey 2023), (Danylyuk 2023), "operations in the deep rear" (Bezpalko and Oleniak 2025), actions in Crimea (Tucker 2024), and in Kursk (Stringer and Vivdych 2025)	Early war occasionally supporting SOF: (Danylyuk 2023), likely minor amounts in 2026 (Taradiuk 2026)	
Direct Action (Assault/Ambush)	Landpower, C-WAM	X	Yes early war: (Портал «Тиск» 2022), (Sladden et al. 2024) pg. 37, in Kursk (Stringer and Vivdych 2025), later war small scale raids for prisoners or to retake key positions (sources: released combat footage from 2024-2026)		
Direction Action (General Infrastructure)	Landpower		(Boffey 2023), (Danylyuk 2023) "sabotage" (Bezpalko and Oleniak 2025)		
Direction Action (HQ)	OWS, C-WAM	X			
Direction Action (C2)		X	(Livermore 2024), (Stringer and Vivdych 2025)		
Direction Action (Aircraft Squadron)	OWS, C-WAM	X			
Direction Action (Sabotage Airfield)	OWS, C-WAM	X			

Direction Action (Missile Units)	OWS, C-WAM	(implied, attacking TELs)			
Direction Action (Radar)	OWS, C-WAM	X			
Direction Action (IADS)	C-WAM	X			
Direction Action (Sabotage Port)	OWS, C-WAM	Implied			
Direction Action (Sabotage Ship)	OWS, C-WAM (Implied)	X			
Direction Action (Sabotage Ammunition Dump)	OWS, C-WAM (Implied)	X			
Direction Action (POL)		X	(Livermore 2024), (Stringer and Vivdych 2025)		
Direction Action (Sabotage Bridge)	OWS	Implied			
Direction Action (Sabotage Rail)	OWS	Implied	(Danylyuk 2023), (Livermore 2024), (Stringer and Vivdych 2025)	(Kramer 2022), (Danylyuk 2023), (Daly 2024)	
Direction Action (Sabotage LOC)	C-WAM	Implied	(Danylyuk 2023), (Stringer and Vivdych 2025)		
Battlefield Support	OWS (bn level)		Brigade level early war (Sladden et al. 2024) pg. 37, support in Kursk operation (Livermore 2024), poor use in later war attritional fights (Bezpalko and Oleniak 2025)		
Partisan/Insurgent Training	C-WAM (Sensitive Actives teams only)		Pre-War: (Kramer 2022), (Danylyuk 2023), (Livermore 2025), cooperation with: (Stringer and Vivdych 2025)		
VBSS	C-WAM				
Attack Political Targets/Morale Boosting (leafleting, graffiti, attacking collaborators, or just conducting missions to show that anti-occupation activity is occurring)				Early war: (Kramer 2022), (Danylyuk 2023), (Borsari 2023), 2026 (Taradiuk 2026)	Attacking collaborators (Borsari 2023)

* Lim provides much more complex lists of targets (for example shelters and aircraft at an airfield), but I aggregate up here for clarity.

[†]Occurred in the sense of the use of on the ground operators conducting this mission, not SOF using drones in long range standoff from behind the FLOT.

Landpower (v. 7.4, November 2021) is a Divisional Level Wargame used by CGSC, *OWS* (v2.3, December 10, 2024) is an educational wargame used by the US Military and allies, *C-WAM* (v7, July 29th, 2016) is an analytical wargame used by the Center for Army Analysis (Center for Army Analysis 2016)

All rules SOF rules assume a maneuver environment and are looking at Teir 1 SoF or Tier 2 SoF who do the shooty-bang stuff. SOF obviously expands beyond that, but really these are SF rules. Notability lots of SOF units in Ukraine are now conducting missions as specialized deep strike drone units – this allows them to do many of the direction action mission they can't do in an attritional environment with a non-fluid battlespace (Khurshudyan et al. 2023) at range, though possibly less tacitly effective (in any given instance, the lack of a need to infil/exfil probably makes them much speedier and less likely to be lost overall so the operational effectiveness may well be higher). Furthermore the prevalence of long range strike reduces the need for SOF direct action (Danylyuk 2023). Overall this means that we do not need to model two distinct types of missions sets (for maneuver and attritional warfare) and the rule set out here should cover all instances. Whether or not this is rolled up into the overall capabilities of units or separated out is up to you.

Even in an attritional environment insertion/exfiltration by water seems to perform well (see Ukraine), allowing some degree of maneuver/infiltration/exfiltration.

[144] The chance of loss here is based off of values from (Center for Army Analysis 2016) pg. 37

[145] Ukrainian SOF have proved effective in this role (Livermore 2025). Ukrainian SOF can "reconnoitre 30 miles of coastline over a two-week period". This works out to about ~2 miles a day (Tucker 2024). Given that most sorts of these recce mission operate from a camouflaged observation post and want low emissions (no drones, no aggressive patrolling) then the ability to detect only one unit (or airbase) at a time.

[146] The first part of this section is a compilation of historical data, then followed by analysis and derivation of the number. It draws mostly from *Snakes in the Eagle's Nest: A History of Ground Attacks on Air Bases* (Vick 1995). This section will mostly look at penetrating attacks, defined as:

> "Penetrating attacks typically are done covertly by small teams who slip through the defensive perimeter and place bombs with time fuses (satchel charges) on aircraft and materiel." (pg. xv)

Penetrating Attacks against Airbases to Destroy Aircraft by Platoon or Smaller Elements (WW2)

Attack	Place, Year	Effect	Source
WW2 #9		Equipment Destroyed	*Snakes in the Eagle's Nest*
WW2 #10		1 destroyed	*Snakes in the Eagle's Nest*
WW2 #11		3 destroyed	*Snakes in the Eagle's Nest*
WW2 #12		1 destroyed	*Snakes in the Eagle's Nest*
WW2 #17		–	*Snakes in the Eagle's Nest*
WW2 #18		–	*Snakes in the Eagle's Nest*
WW2 #19		–	*Snakes in the Eagle's Nest*
WW2 #20		–	*Snakes in the Eagle's Nest*
WW2 #25		Trucks on road destroyed instead	*Snakes in the Eagle's Nest*
WW2 #26		–	*Snakes in the Eagle's Nest*
WW2 #27		24 destroyed	*Snakes in the Eagle's Nest*
WW2 #29		37 destroyed	*Snakes in the Eagle's Nest*
WW2 #31		–	*Snakes in the Eagle's Nest*
WW2 #32		27-30 destroyed + fuel dump destroyed + ground crews killed.	*Snakes in the Eagle's Nest*
WW2 #33		–	*Snakes in the Eagle's Nest*
WW2 #34		2 destroyed	*Snakes in the Eagle's Nest*
WW2 #36		–	*Snakes in the Eagle's Nest*
WW2 #37		–	*Snakes in the Eagle's Nest*
WW2 #38		15 destroyed	*Snakes in the Eagle's Nest*
WW2 #39		1 destroyed + trucks	*Snakes in the Eagle's Nest*
WW2 #40		–	*Snakes in the Eagle's Nest*
WW2 #41		5 destroyed	*Snakes in the Eagle's Nest*
WW2 #43		8 destroyed	*Snakes in the Eagle's Nest*
WW2 #44		–	*Snakes in the Eagle's Nest*
WW2 #45		–	*Snakes in the Eagle's Nest*
WW2 #46		21 destroyed	*Snakes in the Eagle's Nest*
WW2 #47		20 destroyed	*Snakes in the Eagle's Nest*
WW2 #48		11 destroyed	*Snakes in the Eagle's Nest*
WW2 #49		1 destroyed	*Snakes in the Eagle's Nest*
WW2 #50		–	*Snakes in the Eagle's Nest*
WW2 #51		Fuel dump	*Snakes in the Eagle's Nest*
WW2 #52		37 destroyed	*Snakes in the Eagle's Nest*
WW2 #53		15 destroyed	*Snakes in the Eagle's Nest*
WW2 #54		–	*Snakes in the Eagle's Nest*
WW2 #55		–	*Snakes in the Eagle's Nest*
WW2 #56		22 destroyed	*Snakes in the Eagle's Nest*
WW2 #57			*Snakes in the Eagle's Nest*
WW2 #58		–	*Snakes in the Eagle's Nest*
WW2 #59		–	*Snakes in the Eagle's Nest*
WW2 #60		–	*Snakes in the Eagle's Nest*
WW2 #61		40 destroyed	*Snakes in the Eagle's Nest*
WW2 #62		15 destroyed	*Snakes in the Eagle's Nest*
WW2 #63		–	*Snakes in the Eagle's Nest*
WW2 #65		10 destroyed	*Snakes in the Eagle's Nest*
WW2 #66		10 destroyed + fuel dump	*Snakes in the Eagle's Nest*
WW2 #67		32 destroyed/damaged	*Snakes in the Eagle's Nest*
WW2 #68		Unknown effect (effective, but quantity unknown)	*Snakes in the Eagle's Nest*
WW2 #78		–	*Snakes in the Eagle's Nest*
WW2 #79		–	*Snakes in the Eagle's Nest*
WW2 #80		–	*Snakes in the Eagle's Nest*
WW2 #81		5 destroyed	*Snakes in the Eagle's Nest*
WW2 #82		–	*Snakes in the Eagle's Nest*

WW2 #83		Fuel Dump	*Snakes in the Eagle's Nest*
WW2 #84		~5 destroyed	*Snakes in the Eagle's Nest*
WW2 #87		Unknown effect	*Snakes in the Eagle's Nest*

Penetrating Attacks against Airbases to Destroy Aircraft by Platoon or Smaller Elements (Korean War)

Attack	Place, Year	Effect	Source
Korea #1	Pohang, 1950	–	*Snakes in the Eagle's Nest*
Korea #3	Multiple Locations, 1950	–	*Snakes in the Eagle's Nest*

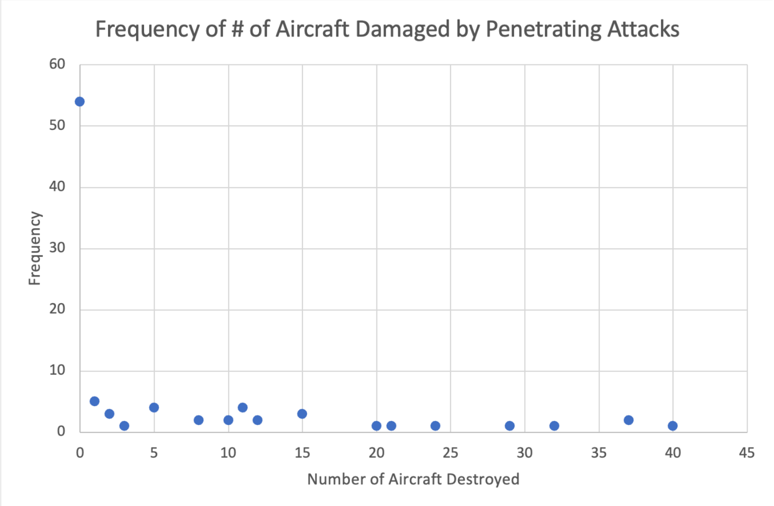
Penetrating Attacks against Airbases to Destroy Aircraft by Platoon or Smaller Elements (1960 to Today)

Attack	Place, Year	Effect	Source
Vietnam #16	Vietnam, 1966	20 damaged	*Snakes in the Eagle's Nest*
Vietnam #32	Vietnam, 1967	–	*Snakes in the Eagle's Nest*
Vietnam #53	Vietnam, 1968	–	*Snakes in the Eagle's Nest*
Vietnam #131	Vietnam, 1968	1 Hvy, 1 Moderate, 1 Lgt. Damage	*Snakes in the Eagle's Nest*
Vietnam #133	Vietnam, 1968	2 destroyed, 7 damaged	*Snakes in the Eagle's Nest*
Vietnam #166	Vietnam, 1968	–	*Snakes in the Eagle's Nest*
Vietnam #168	Vietnam, 1969	–	*Snakes in the Eagle's Nest*
Vietnam #192	Vietnam, 1969	–	*Snakes in the Eagle's Nest*
Vietnam #240	Vietnam, 1969	2 damaged	*Snakes in the Eagle's Nest*
Vietnam #276	Vietnam, 1970	–	*Snakes in the Eagle's Nest*
Vietnam #284	Vietnam, 1970	–	*Snakes in the Eagle's Nest*
Vietnam #297	Vietnam, 1970	–	*Snakes in the Eagle's Nest*
Vietnam #338	Vietnam, 1970	1 damaged	*Snakes in the Eagle's Nest*
Vietnam #386	Vietnam, 1971	–	*Snakes in the Eagle's Nest*
Vietnam #410	Vietnam, 1971	–	*Snakes in the Eagle's Nest*
Vietnam #422	Vietnam, 1971	–	*Snakes in the Eagle's Nest*
Vietnam #434	Vietnam, 1972	3 damaged	*Snakes in the Eagle's Nest*
Vietnam #435	Vietnam, 1972	Munitions destroyed	*Snakes in the Eagle's Nest*
Vietnam #456	Vietnam, 1972	–	*Snakes in the Eagle's Nest*
Muñiz Air National Guard Base	Puerto Rico, 1981	9 destroyed	156th Wing Information Page
Raid on Pebble Island	Falklands, 1982	11 destroyed/damaged	*Snakes in the Eagle's Nest,* OMCT #8
Battle of Ilopango Airport	El Salvador, 1982	11-28 destroyed	*https://time.com/archive/6699019/el-salvador-bombs-and-broadsides/*
Battle of Paitilla Airport	Panama, 1989	1 destroyed	Wikipedia
OMCT #14	El Salvador, 1990	1 damaged	*Snakes in the Eagle's Nest*
OMCT #17	Puerto Rico, 1991	1 damaged	*Snakes in the Eagle's Nest*
OMCT #18	Iraq, 1991	7 damaged	*Snakes in the Eagle's Nest*
Bandaranaike Airport attack	Sri Lanka, 2001	12 destroyed, 14 damaged	Wikipedia
Raid on Anuradhapura Air Force Base	Sri Lanka, 2007	8-15 Aircraft	Wikipedia
PNS Mehran attack	Pakistan, 2011	2 destroyed	Wikipedia
Raid on Camp Bastion	Afghanistan 2012	8 destroyed	Wikipedia
Camp Simba attack	Kenya, 2020	5 destroyed, 1 damaged	Wikipedia
Mianwali air base attack	Pakisan, 2023	3 damaged	Wikipedia

OMCT = Other Modern Conflicts and Terrorism

When using this data, I only selected entries I knew were direct action attacks by a small force (platoon or smaller) post 1960. Some datapoints were not marked clearly (*Snakes in the Eagles Nest* Vietnam #20, #30, #432, Other Modern Conflicts and Terrorism #3, #10,) or were not able to be disaggregated (*Snakes in the Eagles Nest* #165, #353, #397, #419). Other attacks that were not used as their intent to attack aircraft was uncertain or unlikely. Suspected biases in the data is that post 1995 data (data not from the *Snakes in the Eagle's Nest*) is biased towards successful attack, as there is little reporting of unsuccessful attacks. Such data is also biased by being attacks from terrorists or irregular forces.

From this data 34 of 88 attacks (38.6%) resulted in destruction of aircraft (damaged airframes, base infrastructure, equipment, or killed personal were not counted). There is no visible correlation or grouping of the number of airframes destroyed in attacks, other than numbers between 1-15 seem to be slightly more common than those in the 20-40 range.



However, if we look at attacks that managed to penetrate and destroy or damage aircraft or other things (infrastructure, equipment, or killed personal), the success rate of attacks is 50 in 88 or 56.8%. In 23 cases damage was also caused to aircraft or other things, in 16 of these cases no aircraft were destroyed, only other damage was caused.

However this isn't the full story. Chances of a successful attack may vary by time period. Looking at attack we know of WW2 (including Korea) attacks were effective in causing damage 33% of the time, in Vietnam 37%, and post-Vietnam 100% of the time. The post-Vietnam effect is due to sampling bias of a lack of inclusion.

The following factors need to be considered before arriving at a final discussion as historical data is not sufficient in and of itself, it must be taken in the context of difference between what has happened historically and how it is being applies. In this case factors decreasing effectiveness would be:

- Tyranny of distance in the Pacific theater makes infiltration/exfiltration more time consuming and risky.
- More pervasive sensors and more hostile territory than in the given data
- Base defenses are likely to be better than weak Italian/German and variable quality US base defenses in Vietnam and Thailand.

Factors increasing effectiveness:

- SF are better trained than forces in the historical data.
- Better night operational capability.
- Better indirect fire weapons and equipment (see for example FPV's https://www.airandspaceforces.com/air-force-special-ops-fpv-drones-backpack/).

Thus, I conclude that the factors moderately favor the defender, and thus the chance of a successful attack is 30%.

The possible outcomes of a successful attack are (very roughly) from a penetrating attack (based on the data above):

Outcome	No Effect	1-15 Aircraft Destroyed (1 squadron in game terms)	20+ Aircraft Destroyed (2 squadrons in game terms)
Chance of Occurrence	~60%	30%	10%

The risk of these should probably be rounded up however as these attacks don't include the use of indirect fire, which is more damaging (e.g. it is assumed that the SF will attempt to penetrate the perimeter and attack, but may well carry indirect fire weapons to support the penetrating or assault element). The exact value of indirect fire here varies heavily on how crowed the base is however:

> "At Tan Son Nhut – reportedly the most crowded of the bases – 1 aircraft was damaged for every 3 rounds fired. At Da Nang and Bien Hoa, both known for their severely crowded ramps, it took 4 and 6 rounds, respectively, to damage 1 aircraft. In contrast, on average it took 20 rounds to damage 1 aircraft at Phan Rang. Relatively few aircraft were destroyed per round; for example, only 1 aircraft was destroyed at Da Nang for every 50 rounds fired." (*Snakes in the Eagles Nest*, pg. 94)

The exact value of indirect fire here is difficult to tell. The following table includes Sapper attacks against US bases during the Vietnam War, but is overwhelmingly dominated by indirect fire. The average here is ~28.5% of attacks being successful, very similar to the 30% number selected above.

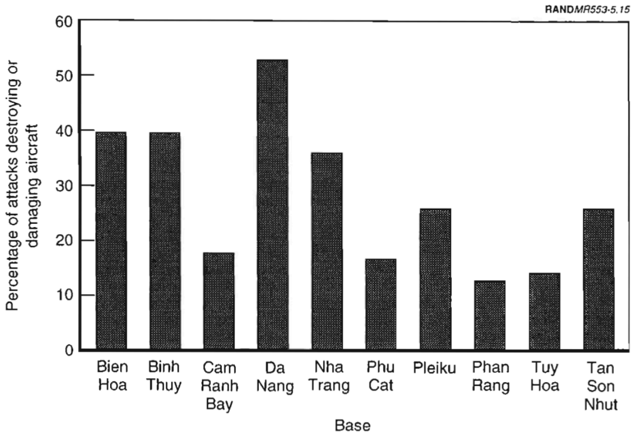


Figure 5.15—Attack Success Rate, by Base

Snakes in the Eagles Nest, pg. 96

The above is too general however, let us look at attrition in game terms and use that to guide the effects. Attrition in aircraft squadrons in the game is in units of 6 aircraft.

Group	No Effect	Damage, No Aircraft Destroyed	1-6 Destroyed	7-12 Destroyed	13-18 Destroyed	19-24 Destroyed	25-30 Destroyed	31-36 Destroyed	37-42 Destroyed
# of Instances	36	7/9*	13	10	4	5	1	0	3

* 7 instances of damage to airfield facilities with no damage to planes, and 9 instances of damage but no destruction of planes.

If we group the higher levels together where a squadron would be wiped out 13-24, and discount the outliers of the very high end (larger MG truck attacks from WW2 that would be difficult to carry out nowadays), and drop Damage, No Aircraft Destroyed (in most cases this was damage to one or two planes) the then we have the following table:

Group	No Effect	1-6 Destroyed	7-12 Destroyed	13-24 Destroyed
Game Effect	No attrition	1 attrition	2 attrition	3 attrition
# of Instances	36	13	10	9
% Chance	53%	19%	15%	13%

This can be easily mapped to a 1d6-3 roll (each roll being a 16.6% chance). This probably underrepresents the chance of a 1-6 destroyed, as attrition covers damage that incapacities 6 aircraft of combat power (e.g. damage that did not destroy aircraft may reduce combat power), but given these are covering ranges (e.g. 1 attrition would be likely 3-9 aircraft destroyed), including damage helps with this (e.g. covers for events when 1 or two aircraft are destroyed, but multiple other ones are damaged resulting in a mission kill of 6 aircraft).

[147] This represents the use of SOF to support brigades. While this may overlap with other missions (e.g. missions and/or targets may be the same even if not directed to support a brigade), this is the specific tasking and use of SOF in support of a brigade as opposed to tasking for other things and is often shorter duration in

nature (see (Spangenberg 2021) pg. 1). Note that this includes not just the physical output of the attacks but the psychological effect leading to degradation of combat power too. An example of this can be seen during the Kursk offensive operation in 2024 (Livermore 2024).

Note that I have this brigade support apply in both attritional fights where the SOF are likely providing specialized ISR support for fires, elite raiding troops to capture specific positions or enemy personal, or (less optimally) as elite assault troops or high quality infantry in critical areas of the defense or mobile reserve roles), or maneuver fights where they are providing more diverse effects more deeply into the enemy rear either in reconnaissance, direct action, or though desant detachments (in both attritional and maneuver events also having an effect through the provision of being able to call for and direct fires). While these call on different SOF mission sets, they are missions sets that SOF can provide in both instances (though the attritional missions are likely easier to plan for as they require less complex and time intensive planning and shaping) as seen in Ukraine and thusly the column shift is not limited to one either attritional or mauver only.

In other cases the value might be from supporting and stiffening non-national units by embedding with those forces and being able to call in fires in support of that unit, providing a liaison capability between the two nations forces (and being able to speak the language!), and providing advising and supporting training in the unit and it's staff. For example see (Johnson 1996) pg. 11-14 on the actives of 5th Special Forces Group in Desert Sheild/Storm.

The low chance of success is both due to the fact that SOF shaping the battlespace on it's own is often not sufficient, and also that they are often employed improperly by commanders who are not used to working with SOF.

148 This represents the use of SOF in much more direct roles and in large quantities than they might otherwise be used in support of a brigade (large scale and numerous desant detachments for example). See (Chen and Wuthnow 2022).

149 (Lim 1995) pg. 40 gives foot movement rates as 32 km/day in open terrain, 24 km/day in mountainous terrain, and 20km/day in forested terrain. This model assumes an average of 25 km/day as a result, making the assumption that SOF will stick to forested terrain for the most part due to the concealment it offers.

150 Speed based on Zodiac Milpro Futura Commando 470, assuming speed of 25 knots, for up to 6 hours of peak darkness at night. Chinese forces have been practicing SOF infiltration into Taiwan by this method (J. Glynn 2026) and it has been used by the Ukrainians for maritime raids on Crimea.

151 The nuke here is assumed to be 1MT (not really "tactical", but it is the best data I have as the evidence shows even a big nuke does not do all that well at sinking things). This is based on the example in (Jim Gifford 2023) slides 10, 11, and 12. Outcomes are: [1-6] a miss (given the large size of naval task forces and the small size of a nuke, this is a distinct possibility, the given example uses a 1MT weapon hit on the center of the task force (the carrier) and still only kills the carrier), [7-10] indicates the nuke hit on target and managed to take out a key element of the force (typically the amphibs or Carrier), there is no catastrophic loss (unit destroyed) as the nuke is too small to kill the entire task force at once. For a short look at what a (23 kt) nuke does to a ship, see (Kok 2012b) pg. 27-28.

Remember: *Close only counts in horseshoes, hand grenades, and atom bombs.*

152 This is based on the example in (Jim Gifford 2023) slides 13-16, 20.

153 The nuke here is assumed to be 1MT ground or airburst. This section is heavily based upon two pieces of work: the study (Curling 2016) and the presentation (James Gifford 2022). In (Curling 2016) it is assumed that the study's one light infantry battalion represents 30% of the combat power of a brigade, and that the study's dispersion of the battalion is considered to be a defensive posture. Thus a "Dispersed" posture resulting in 30% damage to the Brigade.

154 Damage against a fresh unit. Damage here is against the overall combat effectiveness of the unit not the whole brigade itself (a minor but important difference), and rear echelon units of the brigade would likely be less affected than combat units.

155 For an example of why this would be so devastating to a brigade in an urban environment the frontage of a brigade becomes 6-12 blocks, where 1 block is ~100m (see ('ATP 3-06, Urban Operations' 2022) section 4-42), putting the entire brigade inside the danger zone of a tactical nuclear weapon.

[156] Note that this sheet rounds up when forced to round.