Regaining the High Ground at Sea
Transforming the U.S. Navy’s Carrier Air Wing for
Great Power Competition
Study outline

• Key operational challenges for naval forces
• Naval strategy and posture
• New carrier air wing operational concepts
• Proposed aircraft and air wing composition
• Recommendations and implementation
Long-range sensors & weapons provide escalation dominance

NOTE: Range arcs are illustrative of possible threats rather than an actual force laydown.

Adversary able to mount attacks all along escalation ladder; U.S. and allies need to be survivable and effective at various scales to provide options
Threat inside 1000 nm may prevent effective CVW or air base operations

1 Day of PLAAF Air Raids
- 2 x JH-7A Fighter-Bomber Brigades (of 4 in PLAAF, 60/120 JH-7As as given in IISS)

Assumptions:
- Ranges measured from China coastline
- Assumes 4 hr turnaround time, 70% Ao, multiple crews
- Stairsteps represent switch to drop tanks
- Constant rate of fuel burn assumed
- No aerial refueling

Rocket Forces Conventional Missiles

<table>
<thead>
<tr>
<th>System</th>
<th>Range (nm)</th>
<th>Payload (lbs)</th>
<th>ASM Variant?</th>
<th>Missiles</th>
<th>Launchers</th>
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<tbody>
<tr>
<td>DF-11A</td>
<td>270</td>
<td>1,100</td>
<td>-</td>
<td>~890</td>
<td>108</td>
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<tr>
<td>DF-15B</td>
<td>430</td>
<td>1,100</td>
<td>Yes</td>
<td>~425</td>
<td>81</td>
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<tr>
<td>DF-16</td>
<td>540</td>
<td>?</td>
<td>-</td>
<td>~30</td>
<td>12</td>
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<tr>
<td>DF-21A</td>
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<td>1,320</td>
<td>-</td>
<td>~300</td>
<td>36</td>
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<td>DF-21C</td>
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<td>-</td>
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<td>DF-21D</td>
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<td>Yes</td>
<td>~30</td>
<td>18</td>
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<tr>
<td>DF-26</td>
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<td>?</td>
<td>Yes</td>
<td>~75</td>
<td>16</td>
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<td>DH-10</td>
<td>1,190</td>
<td>1,100</td>
<td>-</td>
<td>~375</td>
<td>54</td>
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</tbody>
</table>

Source: IHS Jane's (range, payload, CEP, variants), IISS (launchers), missile inventories estimated using DoD and Jane's information. DF-26 and DF-16 payloads assumed to be equal to DF-21 and DF-15, respectively, for illustrative purposes.

Beyond 1000-1200 nm, maximum PLA salvo lowers to ~600 1000 lb weapons
New air defenses could enable CSGs to counter aggression in contested areas

Could enable CSG to withstand a single PLA salvo at 1000 nm; goal is to cause PLA to wait for a better opportunity, creating a window for CVW operations
CVW ops focus on regional powers and periphery of great power conflict

CVW can support all operations against regional powers, and may be needed to deter opportunistic aggression.

CVW needs to be able to:
- Clear adversary forces around edge of conflict area (islands, ships)
- Conduct small-scale attacks on or near adversary territory

CSGs best suited for small-scale ops at long-range; large-scale ops at edge of great power confrontations; & full range of ops against regional powers.
Strategy and CVW Posture
CSBA architecture aligns with NDS posture of “contact” & “blunt” forces
Surface/sub forces for rapid, high-volume response; CVW sustains operations

CVW can deliver relatively large salvos multiple times a day, whereas Deterrence Forces can deliver a large salvo once before withdrawing to reload.
Evolution of the CVW
Battle of Midway—USS Yorktown (CV-5) in June 1942

79 Aircraft

36 x SBD Dauntless (2 sq)
16 x TBD Devastator (1 sq)
27 x F4F Wildcat (1 sq)

= Added to USS Yorktown after the Battle of the Coral Sea

- Attack – Strike
- Attack – Surface Warfare (SUW)
- Multi-role
- Air Defense - Fighter/Interceptor
- Electronic Warfare (EW)
- Airborne Early Warning (AEW)
- Anti-Submarine Warfare (ASW)
- Aerial Refueling
- Intelligence, Surveillance, Reconnaissance (ISR)

65.8%
34.1%

83 Aircraft

10 x A-3 Skywarriors (1 sq)
12 x A-1 Skyraiders (1 sq)
24 x A-4 Skyhawks (2 sq)
13 x F-6 Skyray (1 sq)
14 x F-8 Crusader (1 sq)
7 x A-1 AEW/ASW variants (1 det.)
3 x F-8 ISR variants (1 det.)

- **Attack – Strike**
- **Attack – Surface Warfare (SUW)**
- **Multi-role**
- **Air Defense - Fighter/Interceptor**
- **Electronic Warfare (EW)**

- **Airborne Early Warning (AEW)**
- **Anti-Submarine Warfare (ASW)**
- **Aerial Refueling**
- **Intelligence, Surveillance, Reconnaissance (ISR)**
**Vietnam War Era – USS Forrestal (CV-59) in 1972**

73 Aircraft

- 24 x A-7 Corsair IIs (2 sq)
- 8 x A-6 Intruders (1 sq)
- 4 x A-6 refueling variants (part of A-6 sq)
- 24 x F-4 Phantom IIs (1 sq)
- 7 x SH-3 Sea Kings (1 sq)
- 2 x A-3 EW/refueling variants (1 det.)
- 4 x E-2B Hawkeyes (1 sq)

![Diagram of aircraft types]

### Aircraft Types

- **Attack – Strike**: 43.8%
- **Multi-role**: 32.9%
- **Air Defense - Fighter/Interceptor**: 9.6%
- **Electronic Warfare (EW)**: 5.5%
- **Aerial Refueling**: 5.5%
- **Airborne Early Warning (AEW)**: 2.7%
- **Anti-Submarine Warfare (ASW)**: 1.6%
- **Intelligence, Surveillance, Reconnaissance (ISR)**: 0.8%
Late Cold War – USS Eisenhower (CVN-69) in 1988

73 Aircraft

20 x A-7 Corsair IIs (2 sq)
3 x EA-6B Prowlers (1 sq)
10 x A-6 Intruders (1 sq)
20 x F-14A Tomcats (2 sq)
7 x SH-3 Sea Kings (1 sq)
3 x E-2C Hawkeyes (1 sq)
3 x A-6 refueling variants (part of A-6 sq)
7 x S-3 Vikings (1 sq)

- Attack – Strike
- Attack – Surface Warfare (SUW)
- Multi-role
- Air Defense – Fighter/Interceptor
- Electronic Warfare (EW)
- Airborne Early Warning (AEW)
- Anti-Submarine Warfare (ASW)
- Aerial Refueling
- Intelligence, Surveillance, Reconnaissance (ISR)

41.1% Attack
27.4% Air Defense
19.2% ASW
4.1% AEW & C
4.1% Refueling
4.1% Multi-role
Current CVW - USS *Ronald Reagan* (CVN-76) in 2018

**69 Aircraft**

- 48 x F/A-18 E/F Super Hornets (4 sq)
- 5 x E-2D Hawkeyes (1 sq)
- 5 x EA-18G Growlers (1 sq)
- 6 x MH-60S Seahawks (1 sq)
- 5 x MH-60R Seahawks (1 sq)

**Roles and Aircraft Types**

- **Attack – Strike**: F/A-18 E/F Super Hornets
- **Attack – Surface Warfare (SUW)**: EA-18G Growlers
- **Multi-role**: E-2D Hawkeyes
- **Air Defense - Fighter/Interceptor**: MH-60R Seahawks
- **Electronic Warfare (EW)**

**Mission Roles**

- **Airborne Early Warning (AEW)**: E-2D Hawkeyes
- **Anti-Submarine Warfare (ASW)**: EA-18G Growlers
- **Aerial Refueling**: MH-60R and MH-60S Seahawks
- **Intelligence, Surveillance, Reconnaissance (ISR)**
- **Multi-role**
- **CSAR/MCM**

**Pie Chart**

- 70.6% Multi-role
- 7.4% Aerial Refueling
- 7.4% Airborne Early Warning (AEW)
- 5.9% Anti-Submarine Warfare (ASW)
- 8.8% Electronic Warfare (EW)
CVW Operational Concepts
21st Century Outer Air Battle uses distributed air defense at 800-1000 nm

- **ASCM CAPs** at 200 nm to engage ASCMs with SR AAM or laser.
- **ISR&T CAPs** direct counter-ASCM in inner layer.
- **DCA CAPs at 1000 w/ LR AAM** 300 nm orbits (X3 for 60 degree arc).
- **ISR&T CAPs** direct ground-launched SAMs to engage aircraft in other sectors.
- **ISR&T CAPs** direct ship-launched SAMs to engage aircraft in other sectors.
- **LHA/D** can provide additional ASCM CAP aircraft.
- **Shore base** defended by naval forces.
- **E-2D** to direct counter-ASCM in inner layer.
- **ISR&T CAP outer layer orbits** at 800-1000 nm of 300 nm diameter; FOV of 360 nm (X8 for 300 degree arc).
Future EMW relies on survivable platforms and expendable payloads

**Active IADS**
- S-band radar
- Expendable sensors find targets for strike platforms
- Collaborative weapons engage targets
- Long-range bombers or CVW attack aircraft strike targets
- Expendable EW missiles jam active IADS and decoy passive sensors
- CVW AEA aircraft jam enemy aircraft sensors and communication links

**Passive IADS**
- Decoys attract early warning radars

**Early warning radar and C2**
- CVW attack aircraft deploy expendables

**Future EMW**
- Relies on survivable platforms and expendable payloads
ASW uses distributed unmanned sensors and CVW pouncers

Distributed sensors could be deployed by CVW attack aircraft, unmanned surface or undersea vessels, or submarines
ASW efforts can succeed by suppressing sub ops, vice killing them

CVW attack aircraft could use inexpensive weapons to alert enemy submarine to that it was detected and compel it to break off operations and evade
SUW, ASW by surface combatants and CAPs; C3 & targeting by ISR&T CAPs

- ASW CAP
- USV w/LFA sonar
- DDG w/MFTA (w/ passive and LFA detection ranges)
- TRAPS sensors
- ASUW CAP
- ISR&T CAP outer layer orbits at 800-1000 nm (up to 8)
- ARG ships can host ASW CAP UAVs
- MAC UUV field
Today's CVW poorly suited for operating environment & U.S. strategy

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**Modern fighters and strike-fighters**
- F-4 Phantom
- F/A-18 E/F Super Hornet
- F/A-18 C/D Hornet
- F-14 Tomcat

**Attack aircraft**
- F-35C Lightning II
- A-6 Intruder
- A-7 Corsair II
- A-3 Skywarrior
- Future UCAV

**Early fighters and attack aircraft**
- A-1 Skyraider
- A-4 Skyhawk
- TBD Devastator
- F-6 Skyray
- F7F Hellcat
- F4F Wildcat
- TBM Avenger
- F3H Demon
- SBD Dauntless

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**Payload (lbs)**

**Range (nm)**
Proposed CVW Aircraft and Composition
New aircraft proposed for 2040 Navy CVWs

• **UCAV**
  - Survivable
  - 3000 nm range
  - UCAV AEA aircraft

• **Refueling Aircraft**
  - MQ-25 to start
  - Multi-mission capability needed
  - UCAV-based in future

• **FA-XX**
  - Derivative of existing aircraft
  - Survivable
  - Longer range than today’s strike-fighters
Proposed 2040 CVW

Three V(U)AE squadrons:
Each with 6 long-range, unmanned multi-mission attack aircraft (strike, SUW, ASW, EW)

One V(F)A squadron:
10 x F-35 aircraft

One VF squadron:
10 F/A-XX

One V(U)AQ squadron:
6 EMW UCAVs

One VAW squadron:
6 E-2D AEW/C2 aircraft

Two VRC squadrons:
Each with 6 unmanned multi-mission refueling aircraft

Two HSM/HSC squadrons:
11 MH-60R/S helicopters
2 MUX UAVs
Strike-fighter focused 2040 CVW

**One V(F)A squadron:**
8 F/A-18 E/F aircraft

**Two V(F)A squadrons:**
Each with 10 F-35C aircraft

**One VF squadron:**
10 FA-XX aircraft

**One VAQ squadron:**
6 E/A-18G aircraft

**One VAW squadron:**
6 E-2D AEW&C aircraft

**Two VRC detachments:**
Each with 6 unmanned utility/tanker aircraft

**Two HSM/HSC squadrons:**
11 MH-60R/S helicopters
Balance 2040 CVW

**One VF squadron:**
6 FA-XX or F/A-18 E/F aircraft

**Two V(U)AE squadrons:**
Each with 6 long-range, unmanned multi-mission attack aircraft (strike, SUW, ASW)

**Two VFA squadrons:**
Each with 10 x F-35C aircraft

**One VAQ squadron:**
6 E/A-18G aircraft

**One VAW squadron:**
6 E-2D AEW&C aircraft

**Two VRC squadrons:**
Each with 6 unmanned utility/tanker aircraft

**Two HSM/HSC squadrons:**
11 MH-60R/S helicopters
Capacity of CVWs decrease and diverge with increasing range

Analysis for strike mission using all strike-capable aircraft except 4 fighters that sweep for enemy air defense aircraft; attacks occur from 300 nm using standoff weapons, which allows external carriage.
Beyond 700 nm, all available F/A-18 E/Fs or FA-XX are needed for tanking. Analysis for offensive counterair (OCA) or destruction of enemy air defenses (DEAD) mission using all air warfare/strike-capable aircraft; attacks occur from 100 nm range, requiring internal weapons.

Although F/A-18 does not have internal weapons needed for this mission (yet), its use as a tanker enables CVWs to fully employ their stealthy strike capacity.
CVWs include more specialized aircraft when threat environment worsens.
Proposed CVW significantly increases strike efficiency

UCAV could provide longer range with similar payload to F-35C in a more efficient form factor; enables increases to CVW size without changing CVN
Implementation
Recommendations

• Sustain procurement of F/A-18 E/Fs as planned through 2023

• Sustain F-35C procurement as planned through 2024
  – First half of production, resulting in 10F-35C per CVW

• Develop the FA-XX fighter during 2020–2024
  – Derivative of an existing aircraft, with production starting in 2025

• Develop a low-observable UCAV attack aircraft during 2020–2024
  – Production starting in 2025

• Continue development of the MQ-25
  – Transition program to a UCAV-based refueling aircraft

• Retire E/A-18Gs as they reach their end of service life starting in the late 2020s
  – Replacing capability with UCAVs and UAV and missile-expendable EMW payloads

• Field a MALE rotary-wing UAV
  – In concert with the U.S. Marine Corps
  – Such as the Tactically Exploitable Reconnaissance Node (TERN)
Although the proposed CVW takes decades, it is a marked transformation.

About 1/3 of carrier fixed wing aviation is unmanned when the proposed CVW is implemented; significant implications for organization, personnel, & readiness.
Proposed CVW replaces strike-fighters with smaller number of UCAVs during first 10 years; other CVWs need to recapitalize manned aircraft during 2030s
Questions?