TONNAGE WAR SOLITAIRE RULES
VASSAL Module

1. Tonnage War Solitaire is a solitaire game simulating the great North Atlantic convoy battles of 1942-43. The player controls the anti-submarine escorts protecting a convoy of Allied merchantmen, while the German U-boats attacking the convoy are portrayed through the mechanics of the game system.

2. <u>Game Components</u>. The game uses the following components.

   2.1. The VASSAL window presents a Toolbar at the top that contains controls for major game functions in the form of clickable buttons. Key buttons other than standard Vassal module buttons are described below.

      2.1.1. "Day/Night" – Used to change daylight shading. This can be used to change the playing area shading from day to night and back again. Click this if the shading gets out of sync with the scenario time frame (typically at the start of a new scenario). Normally, the game mechanics will automatically change daylight shading with turn advancement.

      2.1.2. "Storm" – Used to turn the playing area storm shading on or off. Normally, the game mechanics will automatically change storm shading with turn advancement.

      2.1.3. "Game Units" – Used to select game units when creating a new scenario.

      2.1.4. "Notes" – Scenario notes provide details of the battle for the scenario selected plus play setup instructions.

      2.1.5. Game turn selector.

      2.1.6. "Reinforcements" – Holds reinforcement units available for each turn in the game. This tab also indicates scenario start and end times.

      2.1.7. "U-boat Reaction Tables" – These tables are used to determine U-boat reaction when escorts are attempting to detect U-boats.

      2.1.8. "1D6" – Used for one 6 sided die roll.

      2.1.9. "1D20" – Used for one 20 sided die roll.

      2.1.10. "Symbols" – Displays details of all the units used in the game.

      2.1.11. "Multi-Move Chart" – allows the player to roll for multiple events using a single die roll. Instructions for using the chart are provided at the bottom of the chart.

   2.2. Units representing U-boats and escorts used in the game. Details of each unit can be seen by clicking on the "Symbols" button on the Toolbar. Most actions for each unit type will be undertaken by right-clicking on the unit and choosing the appropriate action.

   2.3. The playing area represents the area of ocean containing a convoy and the seas around it. The playing area is divided into four concentric zones: the outer zone, the inner zone, the attack zone, and the convoy zone. The attack zone is divided into 5 attack sectors (Bow, Port Beam, Starboard Beam, Stern,

and Stragglers). U-boats attack the convoy from the convoy and attack zones. Other playing area details include the following:

2.3.1.   Victory points are indicated for both Allied and Axis sides, as well as a count of the total Allied merchant tonnage lost. For purposed of the game, each merchant ship lost counts as 5,000 tons.

2.3.2.   Day and time as well as sighting conditions are provided.

2.3.3.   "U-boats Entering" box – Place new U-boat reinforcements and U-boats forced out of the Outer Zone into this box.

2.3.4.   "U-boats Exiting" box – Place undamaged U-boats exiting the playing area here.

2.3.5.   "Aircraft Exiting" box – Place undamaged Aircraft exiting the playing area here.

2.3.6.   "Escorts Exiting" box – Place undamaged Surface Escorts exiting the playing area here.

2.3.7.   There are 3 special U-boat random draw boxes located on the playing area: the "U-boats Entering" box, the location directly below the "Outer Zone" label, and the location directly below the "Inner Zone" label. All U-boats moving inbound should be placed in these locations for ease of drawing.

2.3.8.   Below the Outer, Inner, and Attack Zones, values are placed in parenthesis, such as (S:8). The letter refers to the speed of the convoy, either slow (S) or fast (F). The number refers to the roll on a 1D20 required for a U-boat to advance to that zone.

2.3.9.   Below the 5 Attack Sectors, additional values are placed in parenthesis, such as (S:17-20 A:x1+4). The first letter refers to the speed of the convoy, either slow (S) or fast (F). The first set of numbers refers to the roll on a 1D20 required for a U-boat to move into that sector. The number following the A:x refers to the number of attack rolls a U-boat may make on the Convoy in that sector. If this number is followed by a "+", then the following number refers to the value the U-boat may add to its attack roll before making its 1D20 attack roll.

2.3.10.   The values indicated in the Convoy Zone, such as (S:12/8 A:x4+4), are slightly different meaning than those indicated in the other 3 Attack Zones. The first letter refers to the speed of the convoy, either slow (S) or fast (F). The first number refers to the roll on a 1D20 required for a U-boat to advance from the Bow Sector into the Convoy Zone. The second number refers to the roll on a 1D20 required for a U-boat to advance from the either the Port or Starboard Sector into the Convoy Zone. (Note: these values are only used if there are no escorts present with the U-boat. See section 9.8 for more information) The numbers following A:x have the same meaning as those provided in the Attack Sectors.

2.3.11.   Boxes for placing damaged or destroyed U-boats, Aircraft, and surface Escorts are provided at the bottom of the playing area.

2.4. A 20 sided die (1D20).

2.5. A 6 sided die (1D6).

2.6. The rules (of course).

3. <u>Preparing for Play</u>. First, the player selects a scenario to be played. Second, referring to the "Notes" and "Reinforcements" buttons on the Toolbar, the player selects and deploys escorts and U-boats. The player may also need to add stragglers to the convoy at this time.

4. <u>Game Length</u>. Play of a single game consists of 24 to 36 turns, as specified by the "Reinforcements" button on the Toolbar. Each turn represents a time period of 4 hours.

5. <u>Sequence of Play</u>. Each turn consists of a series of actions taken by the player. These actions should be taken in the following order:

5.1. Initial Phase.

5.1.1. Consult "Notes". Remove any escorts currently in play, if required. Check for other events and take action accordingly.

5.1.2. Check for "Reinforcements". Place reinforcement U-boats in the "U-boats Entering" box. Roll for availability of air escorts per "Notes" requirements. Place reinforcement air escorts in the inner or outer zone. Place reinforcement surface escorts in the convoy, attack, or inner zone.

5.1.3. For all U-boats that moved outbound to the inner or outer zone last turn due to evasion "EV" or an emergency dive "ED" that are not being followed by either a surface or air escort (the pursuing escort will be stacked with the U-boat), clear the settings from the U-boat and place it in the draw box of the associated inner or outer zone.

5.1.4. Maneuver the convoy evasively (section 12).

5.1.5. Post a decoy (section 10).

5.1.6. Illuminate the convoy (section 13).

5.2. First U-Boat Movement Phase.

5.2.1. Move U-boats from the "U-boats Entering" box to the outer zone. Place them directly beneath the "Outer Zone" label (section 9).

5.2.2. Move U-boats from the outer zone to the inner zone. Place them directly beneath the "Inner Zone" label (section 9).

5.2.3. Determine whether U-boats in the outer zone that previously fired torpedoes ("f" indicated) will exit the game or reenter the playing surface (section 15.6.3). Move them as appropriate.

5.2.4. Move outbound U-boats located in the outer, inner, and attack zones (section 15). Surface escorts making continuing attacks on the U-boat are moved with the U-boat and stacked on top of it (section 16.16).

5.3. Escort Movement Phase.

5.3.1. Escorts may move in or out 1 zone in each Escort Movement Phase. Surface escorts may enter any zone except the outer zone, although

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they may follow detected U-boats there in continuing attacks (section 16.16). Air escorts may only move into the outer or inner zone.

5.3.2. Select a rescue ship, if appropriate, at this time (section 11).

5.4. First Escort Attack Phase (section 16).

5.4.1. Air escorts may conduct continuing attacks against U-boats in the outer zone that defended against air attacks with flak "FL" in the previous turn. Stack the selected air escorts with the U-boat, determine the response of the U-boat, and resolve the detection attempts and attacks (section 16.12).

5.4.2. Air escorts may conduct initial attacks against U-boats in the inner and outer zones. Stack the selected air escorts with the U-boat, determine the response of the U-boat, and resolve the detection attempts and attacks (section 16.11).

5.4.3. Eligible surface escorts may conduct continuing attacks against U-boats in the inner and outer zones that were attacked by surface escorts in the previous turn. The escorts must be currently stacked with the U-boat. Resolve the detection attempts and attacks (section 16.16).

5.4.4. Surface escorts may conduct air cooperation attacks against U-boats in the inner zone that were detected by air escorts in the current turn. Stack the selected surface escorts with the U-boat, determine the response of the U-boat, and resolve the detection attempts and attacks (section 16.15).

5.4.5. Surface escorts may conduct HF/DF attacks against U-boats in the inner zone. Stack the selected surface escorts with the U-boat, determine the response of the U-boat, and resolve the detection attempts and attacks (section 16.14).

5.5. Second U-boat Movement Phase (section 9).

5.5.1. Move outbound U-boats located in the convoy zone (section 15). Surface escorts making continuing attacks on the U-boat are moved with the U-boat and stacked on top of it (section 16.16).

5.5.2. Move U-boats from the inner zone to the attack zone.

5.6. Second Escort Attack Phase.

5.6.1. Eligible surface escorts may conduct continuing attacks against U-boats in the attack zone that were attacked by surface escorts in the convoy zone in the previous turn. Stack the selected surface escorts with the U-boat and resolve the detection attempts and attacks (section 16.16).

5.6.2. Eligible surface escorts may conduct attacks against U-boats entering the attack zone from the inner zone. Determine the response of the U-boat, and resolve the detection attempts and attacks (section 16.13).

5.7. Third U-boat Movement Phase (section 9).

5.7.1.　Move eligible U-boats from the attack zone to the convoy zone (section 9.8).

5.8.　Third Escort Attack Phase.

5.8.1.　Eligible surface escorts in the convoy zone may conduct attacks against U-boats entering the convoy zone from the attack zone. Determine the response of the U-boat, and resolve the detection attempts and attacks (section 16.13).

5.9.　U-boat Attack Phase.

5.9.1.　Resolve U-boat attacks against the convoy (section 17.3).

5.10.　Advance the turn indicator.

6. <u>Object of the Game</u>. The player wins the game by preserving the convoy and his escort forces while sinking or damaging U-boats.

7. <u>Game Conventions</u>. The game requires the player to roll D20 or D6 and compare the result to values provided by the game rules or scenario cards. The rules also provide for cases in which those values are modified, either by adding to them or subtracting from them, or by halving them. When values are altered in this way, the additions or subtractions are always applied before any halving. They are added to the value, not to the die roll. In addition, all modifications are cumulative. Thus, if the rules call for a value to be halved twice, it is quartered. Finally, all fractions are rounded down, except that a value of more than 0 but less than 1 is rounded up to 1. In many cases, the game module will automatically calculate these additions or subtractions.

8. <u>Escort Placement and Movement</u>. The player moves escorts from the "Reinforcements" card and places them on the playing area during the Initial Phase. The escorts are moved in the Escort Movement Phase.

8.1.　The player may place each air escort in either the inner or outer zone. Air escorts are never placed in the attack or convoy zones. With an exception explained below, air escorts in the outer zone detect U-boats with reduced effectiveness.

8.2.　The player may place surface escorts freely in any sector of the attack zone. The player may place surface escorts on the line between two attack zone sectors, except for the straggler attack sector. Surface escorts positioned in this way may detect U-boats in both adjoining sectors, but with reduced effectiveness. The player may also place surface escorts in the convoy zone or the inner zone. As explained below, surface escorts in these zones and in the straggler sector of the attack zone are at certain disadvantages in their ability to detect U-boats.

8.3.　While surface escorts may only be placed in the convoy, attack, and inner zones, they may move to the outer zone during play.

8.4.　Once an escort is placed, the player may move it in or out 1 zone in each Escort Movement Phase.

9. <u>Inbound U-Boat Movement </u>. U-boats are placed on and move across the playing surface towards the convoy using the following rules.

9.1. The scenario "Notes" will specify the numbers of U-boats to be used in the battle. Some U-boats will start the game in the playing area, while others may start the game on the "Reinforcements" card and will be moved to the "U-boats Entering" box as reinforcements during the Initial Phase of a turn.

9.2. Each turn, the player rolls D20 to determine how many U-boats enter the playing area and move towards the convoy. To have a U-boat appear and close the convoy, the player must roll a result equal to or less than the number given on the playing surface.

9.3. The player rolls for U-boat appearance first, then for movement. U-boats appear in the outer zone (moved from the "U-boats Entering" box) of the playing area. They move then to the inner zone, the attack zone, and (possibly) the convoy zone.

9.4. U-boats can move through more than 1 zone in a turn. A U-boat entering the playing area could conceivably move all the way into the convoy zone with the right die rolls in each U-boat Movement Phase.

9.5. The player may use the D20 probability table to determine how many U-boats in a zone move into the next zone, without having to roll separately for each U-boat.

9.6. If there are U-boats in the outer zone and the inner zone, one U-boat will always attempt to remain in the inner zone. This is the "contact boat," which historically brought other U-boats to the convoy by radio reports. The contact boat may not be a U-boat that is evading or that has attacked and not yet returned to play. If there are no U-boats outside the inner zone, then the contact boat is free to attempt to move in to attack the convoy.

9.7. The attack zone has 5 sectors: bow, starboard beam, stern, port beam, and stragglers. When a U-boat reaches the attack zone, the player rolls D20 to determine to which of the 5 sectors the U-boat enters.

9.8. A U-boat in a bow or beam attack sector may move into the convoy zone in the Third U-Boat Movement Phase. If the U-boat is in an attack sector that could be searched that turn by an escort, but was not subject to a detection attempt during the Second Escort Attack Phase, the player rolls on the "0" column of the U-boat Reaction Table for surface escorts to determine if the U-boat enters the convoy zone or takes some other action. Otherwise, the player rolls D20 and consults the movement values on the playing surface to determine if the U-boat moves into the convoy zone. If the U-boat was subject to a detection attempt in the previous Escort Attack Phase, the player will have already rolled on the U-boat Reaction Table for that U-boat.

9.9. Daylight Submerged Attacks. In turns of high visibility, U-boats subtract 2 from the D20 number needed to move into the Attack or Convoy Zones, and add 2 to the number rolled to determine the Attack Sector they enter. This represents the U-boats making submerged attacks. These modifiers are automatically calculated by the module game system.

9.10. Straggler Attack Zone Sector. Depending on the D20 roll, a U-boat entering an attack zone may enter the straggler attack zone. While this attack zone

sector is shown as located in the inner zone, it is treated as another attack zone sector unless a specific rule says otherwise.

9.11. Contact Boats. If there is no contact boat the inner zone in the Initial Phase, the U-boats are not in contact with the convoy that turn. The contact boat may not be a U-boat that is evading or that has attacked and not yet returned to play. If there is no contact boat, halve the numbers needed for the U-boats to appear in the outer zone and move from the outer zone to the inner zone in the First U-boat Movement Phase. This adjustment is automatically calculated by the module game system.

10. Decoys. Convoy commanders sometimes posted a surface escort at a distance from the convoy and had it shoot flares in an attempt to draw off U-boats from the convoy. The player may allocate an escort (select "DC" on the surface escort) for this in the Initial Phase of any low visibility turn. If he does so, the escort may not detect or attack U-boats, but the numbers to be rolled for U-boats to appear in the outer zone and move inwards are reduced by 1 during that turn. The escort must begin the turn in the inner zone. This adjustment is automatically calculated by the module game system.

11. Rescue Ships. In some scenarios of the game, designated rescue ships are provided to rescue survivors from convoy merchant ships that have been sunk. When on duty, rescue ships decrease Axis victory points awarded for sinking merchant ships from 2 to 1. The rescue ship must be stationed in the Convoy Zone and designated "RS" in order to function as a rescue ship. If no "Rescue Ship" is provided with the reinforcements, the player may designate 1 surface escort to act as a rescue ship. The escort may not attack or make detection attempts while it is serving as a rescue ship. In order to act as a rescue ship, the escort must be moved to the Convoy Zone and designated as "RS".

12. Evasive Maneuvering. In the Initial Phase of any turn, the player may declare that the convoy is maneuvering evasively (select "EV" on the convoy unit). For that turn, the numbers needed by the U-boats to enter the playing area or advance through zones are halved. This adjustment is automatically calculated by the module game system. Upon declaring that a convoy is maneuvering evasively, the player rolls D6 and immediately adds this number of stragglers to the straggler sector. A convoy may only evade once each day.

13. Convoy Illumination. In the Initial Phase of any low visibility turn, the player may declare that he is illuminating the convoy. This has the effect of increasing by 2 the low visibility detection values of all escorts located in the attack and convoy zones. It also increases by 2 the D20 roll needed by U-boats to advance towards the convoy. These adjustments are automatically calculated by the module game system.

14. Example of Play: The player is escorting a slow convoy that is not evading or being illuminated. Visibility conditions are low. No escort is acting as a decoy. In the current turn, there is 1 contact U-boat in the inner zone and 6 U-boats waiting to enter. The player rolls 3 on D20. Consulting the D20 probability table for 6 chances of rolling 8 or less, he sees that 3 means that 4 of the U-boats enter. He then rolls again to see if any of these 4 boats progress to the inner zone. Two do. This ends the First U-boat Movement Phase. The player does not detect any of the U-boats in

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the inner zone. With 3 U-boats in the inner zone, the player checks to see whether 2 of them will enter the attack zone. Both do, in the Second U-boat Movement Phase. The player then determines which attack sector the boats enter. One enters the bow zone and the other the port beam zone. There is an escort in the port beam zone, which tries but fails to detect the U-boat. The player rolls on the U-boat Reaction Table for that U-boat and sees that it will move to the convoy zone. In the Third U-boat Movement Phase, the player applies the result from the U-boat's reaction roll by moving it to the convoy zone. The player then rolls to see if the other U-boat moves to the convoy zone, using the numbers shown on the playing surface. It does not.

15. <u>Outbound U-Boat Movement</u>. U-boats move away from the convoy using the following rules.

   15.1. After Attacking – On the turn after it attacks, a U-boat must move back through each zone to the outer zone, 1 zone at a time. U-boats that have attacked are indicated with an "f" in the lower right corner of the unit. U-boats that have attacked may not attack the convoy again until they leave and then return to the playing surface.

   15.2. After Evading – When a U-boat evades, it will not attack. It will not move farther inward during the turn in which it evades. It will move out 1 zone in the First U-boat Movement Phase of the following turn. U-boats that have evaded are indicated with an "EV" left side of the unit. U-boats cease evading at the end of the First U-boat Movement Phase in which they move out 1 zone, unless another rule (such as the rule for continuing attacks) provides otherwise.

   15.3. After Being Attacked by a Surface Escort – U-boats always make an emergency dive (ED) after being attacked by surface escorts. Treat an attacked U-boat that did not evade before the attack as making an emergency dive afterwards. It will move as an evading U-boat, and will not move farther inward in the turn that it is attacked.

   15.4. After Engaging an Air Escort – A U-boat engaging an air escort with flak will move out 1 zone in the following First U-Boat Movement Phase. It will not move farther inward in the turn in which it used flak.

   15.5. In all of these cases, the U-boat moves only 1 zone per turn. It does not move in the Second or Third U-boat Movement Phases of any turn in which it moves outward.

   15.6. U-boats continuing to move outbound after reaching the outer zone move off the playing surface in the following First U-boat Movement Phase.

      15.6.1. Damaged U-boats are permanently removed from play.

      15.6.2. U-boats that have not attacked since they last entered the playing surface are placed in the "U-boats Entering" box and restart the process of rolling to reenter the playing surface and moving back through the zones on the next game turn. Clear the settings on the U-boat before placing it in the "U-boats Entering" box.

      15.6.3. For U-boats that have attacked, the player rolls 1D6 (use the right-click menu on the unit). If the roll is equal to or less than the U-boat return value for the scenario, the U-boat is placed in the "U-boats

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Entering" box and restarts the process of rolling to reenter the playing surface and moving back through the zones. Otherwise, the U-boat is permanently removed from play. The game mechanics will automatically move the U-boat as appropriate.

15.6.4. When a U-boat moves from the convoy zone to an attack zone, the player rolls D20 to determine the attack zone sector to which it moves. A U-boat that rolls to enter the straggler sector should instead be placed in the stern attack sector.

15.6.5. A U-boat attacked in the attack zone after having attacked in the convoy zone still rolls on the appropriate reaction table, but treats any result calling for movement or an attack on the convoy as an "evade" result.

16. Escort Combat. In general, combat by escorts against U-boats is a two-step process. First, the escorts try to detect the U-boat. If the detection attempt succeeds, the escorts use their weapons to try to damage or sink the U-boat.

16.1. To detect a U-boat, the escorts must roll D20 at or below the applicable detection value, as modified.

16.2. An escort may attempt to detect and attack only 1 U-boat per turn.

16.3. To detect a U-boat in the attack zone, the escort must be in the same attack sector as the U-boat or on the border of an attack sector that contains the U-boat.

16.4. Escorts generally have several detection values (refer to "Symbols" button on Toolbar).

16.4.1. If an escort has a "Radar" detection value, it can use it to detect any U-boat on the surface. U-boats in attack or convoy zones in high visibility turns are considered to be submerged.

16.4.2. If an escort has a "High Vis" detection value, it can use it to detect any U-boat on the surface in high visibility turns. Again, those U-boats in the attack or convoy zones are considered to be submerged. "High Vis" detection values represent visual detection in good visibility conditions.

16.4.3. If an escort has a "Low Vis" detection value, it may use it to detect U-boats in low visibility turns. "Low Vis" detection values represent visual detection in poor visibility conditions.

16.4.4. An escort with a "Sonar" detection value can use it to detect a submerged U-boat in the attack or convoy zone in high visibility turns, to detect a U-boat that was detected and attacked in the previous turn and is now being searched for as described in 15.7 below, and to detect a U-boat that evaded when subject to an HF/DF attack in high visibility conditions. "Sonar" detection values represent detection by sonar, which is used to detect submerged U-boats.

16.4.5. See below for limits on the ability of a surface escort to detect U-boats in the Inner Zone or Outer Zone.

16.5. If more than 1 escort is attempting to detect a U-boat, each rolls separately.

16.6. Detection values may be modified by various circumstances.

16.6.1. In storm conditions, all escort detection values are reduced by 3 (This adjustment is made automatically by the module game system).

16.6.2. In poor sonar conditions, all escort Sonar detection values are reduced by 3.

16.6.3. When a convoy is illuminated, all "Low Vis" detection values of escorts in the attack zone (except the Straggler sector) and convoy zone are increased by 2 (This adjustment is made automatically by the module game system).

16.6.4. If the U-boat evades (EV) or makes an emergency dive (ED), the detection values of escorts attempting to detect it are halved.

16.6.5. If a surface escort is on a line between attack sectors, its final detection values to detect U-boats in either sector are halved.

16.6.6. If a surface escort is in the straggler sector, its final detection values are halved.

16.6.7. If a surface escort is in the convoy zone, its final "Radar" and "Sonar" detection values are halved.

16.6.8. If an air escort is in the outer zone, its detection values are halved unless it is conducting a continuing attack.

16.6.9. All modifications to detection values are cumulative (section 7).

16.7. All escorts have an Attack Value. The player rolls D20 against the Attack Value of each attacking escort. A roll of ½ or less of the value sinks the U-boat. A roll equal to or less than the value damages it.

16.8. Escorts may attack in three phases within each game turn. In the First Escort Attack Phase, escorts in the inner and outer zones attack. In the Second Escort Attack Phase, escorts in the attack zone attack. In the Third Escort Attack Phase, escorts in the convoy zone attack.

16.9. <u>Surface Escort First Attacks</u>. Special rules apply to the first attack by a surface escort in a turn against a surfaced U-boat in low visibility. On a D20 roll of 2, the U-boat is sunk by gunfire. On a D20 roll of 1, the U-boat is sunk by ramming and the attacking surface escort is damaged. This represents the U-boat being caught on the surface.

16.10. <u>Depletion</u>. A roll equal to or higher than the escort's depletion number means that the escort can no longer attack during the game – other than as described in 16.9. It can continue to detect U-boats. An escort that has depleted its weapons will display a "d" in the bottom right corner of the unit.

16.11. <u>Air Escorts versus U-Boats -- Initial Attacks</u>. Air escorts may attack U-boats in the inner and outer zones in the Escort Attack Phase. Air escorts in the outer zone have their detection values halved. Up to 3 air escorts may attempt to detect a U-boat, but only 1 may attack it in any turn. The sequence of an engagement is as follows.

16.11.1. The player rolls to determine the U-boat's action, based on the number of air escorts trying to detect it.

16.11.2. The air escort(s) attempts to detect the U-boat.

16.11.3. If any air escort detects the U-boat, the player selects 1 air escort to attack.

16.11.4. If the U-boat is not evading, it rolls against its Flak Value to shoot down or drive off the attacking air escort.

16.11.5. The air escort attacks the U-boat.

16.11.6. The U-boat and air escort attacks are resolved at the same time. Each can destroy or damage the other.

16.11.7. If the U-boat rolls against its Flak Value or evades, the U-boat moves out 1 zone in the First U-Boat Movement Phase following the attack. If the U-boat was attacked in the outer zone, it leaves the playing surface (section 15.6).

16.12. <u>Air Escorts versus U-Boats – Continuing Attacks</u>. Air escorts may engage in a continuing attack against a U-boat that was attacked by air escorts in the inner zone, but *only* if the U-boat responded to the previous turn's attack with a flak attack rather than by evading, and the U-boat was not damaged in the previous attack. If the U-boat evaded, the air escorts cannot attack it. Any air escort in the playing area may join in the continuing attack, up to a maximum of 3. As with initial attacks, only 1 air escort may attack, and the air escorts must attempt to detect the U-boat before attacking it. The U-boat first rolls for reaction to the continuing attack detection attempt. Detection values in continuing attacks are not halved for being made in the outer zone.

16.13. <u>Surface Escorts versus U-boats – Attack and Convoy Zones</u>. Surface escorts may attack U-boats in the attack zone in the Second Escort Attack Phase and in the convoy zone in the Third Escort Attack Phase. Up to 3 surface escorts may attempt to detect and attack a U-boat. The sequence of an engagement is as follows.

16.13.1. The player rolls to determine the U-boat's reaction, based on the number of surface escorts attempting to detect it.

16.13.2. The surface escort(s) attempts to detect the U-boat.

16.13.3. If any surface escort detects the U-boat, the player determines how many of the escorts attempting to detect the U-boat will attack it.

16.13.4. If the U-boat is attacking the escorts, that attack is resolved.

16.13.5. The surface escort(s) attacks the U-boat.

16.13.6. If the U-boat evades or is attacked, it is moved from the convoy zone to the attack zone, or from the attack zone to the inner zone in the First U-boat Movement Phase of the following turn.

16.13.7. Surface escorts may not roll to detect U-boats in the inner or outer zones unless they are making a continuing attack, making a HF/DF attack, or are cooperating with an air unit.

16.13.8. <u>Multiple U-boats in the Same Zone or Sector</u>. If multiple U-boats are located in the zone or sector where a detection attempt is made, the player randomly determines the U-boat on which each escort (or group of escorts searching together) will attempt detection. In making

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this determination, the player may still have each escort or group of escorts attempt to detect a different U-boat. This random determination may result in attempts to detect U-boats that have already attacked and are moving outbound from the convoy zone, even when there are U-boats that have yet to attack in the same zone or sector,

16.14. Surface Escorts versus U-Boats – HF/DF.

16.14.1. Surface escorts may attack U-boats by homing on the U-boats' radio transmissions, using HF/DF (high frequency direction finding) equipment. Surface escorts and Rescue Ships equipped with HF/DF are marked with "HD" on the upper right side of the unit.

16.14.2. Each turn, each escort with HF/DF still in play can home surface escorts on to 1 U-boat in the inner zone. Only surface escorts located in the inner zone can attack U-boats in this way. Up to 3 surface escorts may attempt to detect and attack each U-boat subjected to a HF/DF directed attack that turn.

16.14.3. Attempts to detect a U-boat in a HF/DF directed attack are subject to a minus modifier. This is the negative "HFDF modifier" shown on upper right of each surface escort's unit. This modifier is added to the appropriate detection value of the escort when detection rolls are made.

16.14.4. If the U-boat evades a HF/DF attack during a high visibility turn, it has submerged and must be detected using the sonar detection values of the escorts. Otherwise, the escort's Radar, High Vis, or Low Vis detection values are used.

16.15. Surface Escorts versus U-Boats – Air Cooperation. Air escorts can enable surface escorts to attack U-boats that the air escorts have detected in the inner zone. Only surface escorts located in the inner zone can attack U-boats in this way.

16.15.1. The cooperation attack takes place immediately after any air escort attack on the U-boat, in the same First Escort Attack Phase. Stack the surface escorts that will attempt an air cooperation attack on top of the U-boat under attack.

16.15.2. The attack is made in the usual way, with the player rolling for U-boat reaction based on the number of surface escorts attempting detection, then for surface escort detection, then for U-boat attack if called for by the U-boat reaction roll, followed by any surface escort attacks. If the U-boat evaded in response to the air attack, the surface escorts must use their Sonar detection values.

16.15.3. Attempts by surface escorts to detect a U-boat in an air cooperation attack is subject to a minus modifier. This is the negative "HFDF modifier" shown on upper right of each surface escort's unit.

16.16. Surface Escorts versus U-Boats – Continuing Attacks. Surface escorts may continue attacks in following turns on U-boats detected in the attack, convoy or inner zones in the previous turn. Up to 3 surface escorts can continue to

attack any 1 U-boat. At least 1 of the surface escorts must be an escort that detected or attacked the U-boat in the previous turn.

16.16.1. For attacks initially made in the convoy or attack zones, additional attacking surface escorts may be drawn from those located in the attack or convoy zones.

16.16.2. For attacks initially made in the inner zone, only those surface escorts making the initial attack may join in any continuing attack.

16.16.3. Signify that surface escorts are continuing an attack on a U-boat by stacking them on top of the U-boat as it moves outbound in the First U-boat Movement Phase.

16.16.4. Unless the player elects to break off the attack or fails to detect the U-boat, the surface escorts follow the U-boat as it moves out through the zones during the subsequent First U-boat Movement Phase. For example, a continuing attack against a U-boat previously attacked in the convoy zone would take place the next turn in the attack zone, and then potentially in the inner and outer zones in following turns.

16.16.5. If the attack is terminated, the escorts are considered to end the turn in the zone in which the last detection attempt against the U-boat took place.

16.16.6. In each turn's Escort Attack Phase, the escorts must attempt to detect the U-boat before attacking it. The escorts use their Sonar detection value for this. The U-boat always evades. If the escorts fail to detect the U-boat, the attack is over.

16.16.7. Detection values are not halved for continuing attacks conducted in the outer zone.

16.16.8. If the U-boat exits the outer zone, the attack is over. The escorts are then in the outer zone.

17. <u>U-boat Combat</u>. U-boats may use their attack values to attack surface escorts and convoys, and their flak values to attack air escorts. After using its attack value, a U-boat must move outward until it exits the playing area. A U-boat that uses its flak value in the previous turn move outward 1 zone.

17.1. <u>U-Boats versus Air Escorts</u>. A U-boat attacks an air escort with its flak value if it is attacked by the air escort and is not evading. It attacks at the same time as the air escort. A D20 roll equal to or less than the Flak Value damages the air escort; a D20 roll equal to or less than ½ of the value shoots the air escort down.

17.2. <u>U-Boats versus Surface Escorts</u>. A U-boat may attack surface escorts that are attempting to detect it. If the U-boat rolls a D20 calling for this action, an attack takes place.

17.2.1. If no surface escort detects the U-boat, it attacks 1 escort. A D20 roll equal to or less than ½ of the U-boat's attack value damages the escort. A D20 roll equal to or less than ¼ of the value sinks the escort.

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17.2.2. If the surface escort(s) does detect the U-boat, it still attacks 1 escort. The escort cannot be damaged, but a D20 roll of 1 sinks it.

17.2.3. The player randomly determines the escort that the U-boat will attack from among those attempting to detect it.

17.3. <u>U-Boats versus Convoys</u>. A U-boat in an attack sector or the convoy zone may attempt to attack ships in the convoy. Depending on the sector or zone it occupies, a U-boat may be able to make more than 1 attack on the convoy ships. The numbers of attacks and modifiers are noted on the playing area.

17.3.1. The player rolls 1 D20 for each attack. If the roll is less than or equal to the U-boat's adjusted attack value, 1 ship from the convoy is sunk. The player keeps a running tally of the number of ships sunk by the U-boats (This is done automatically by the module game system).

17.3.2. The straggler attack sector holds a limited number of ships, which the player tracks by incrementing the number of stragglers on the convoy or straggler unit. This number is set at the start of the game by the scenario "Notes". It increases as the convoy maneuvers evasively and decreases as ships in the straggler sector are sunk.

17.3.3. If the player rolls a 1 for any U-boat attack, the U-boat has sunk any scenario designated "Rescue Ship" sailing with the convoy. If no "Rescue Ship" is provided in the scenario, but a surface escort is serving as the rescue ship, then roll the D20 again. On a roll of 1 through 10, the surface escort designated as a rescue ship is sunk.

17.3.4. U-boat attack values, including flak, are reduced by 2 during storms.

18. <u>Damage</u>. Any U-boat that is damaged twice is sunk. Damaged U-boats may not attack, and are removed from play once they exit the playing area. Damaged escorts are immediately removed from play.

19. <u>Winning the Game</u>. The U-boats receive 1 point for each convoy ship sunk (2 points if no rescue ship was on duty at the time), 1 point for every escort damaged, 2 points for every escort destroyed (shot down or sunk), and 1 point for every 3 stragglers (or fraction thereof) at the end of the game. The player receives 3 points for every U-boat damaged and 6 points for every U-boat sunk. The player wins by scoring more points than the U-boats.

20. <u>Special Rules</u>.

20.1. <u>Storms</u>. For turns during stormy weather, subtract 3 from all detection values, subtract 2 from U-boat attack values, and halve U-boat flak values (but not to less than 1). Storm turns are not low visibility turns unless specifically designated low visibility.

20.2. <u>Bad Sonar Conditions</u>. For scenarios set in bad sonar conditions, subtract 3 from all S detection values.

20.3. <u>FAT</u>. Some scenarios may indicate that the U-boats have FAT torpedoes. FAT torpedoes could be set to run in patterns, increasing the chance of a hit when they were fired at convoys. These increase by 2 the hit numbers of the U-boats when they attack a convoy in any attack sector other than the straggler sector.

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20.4. <u>Zaunkönig</u>. Some scenarios may indicate that the U-boats have Zaunkönig torpedoes. These were acoustic homing torpedoes that were used against escorts. U-boats with Zaunkönig torpedoes attack surface escorts with their normal attack strength (A D20 roll equal to or less than the U-boat's attack value damages the escort. A D20 roll equal to or less than 1/2 of the value sinks the escort), regardless of whether the escorts have detected them. U-boats with Zaunkönig torpedoes will usually also have an increased chance of reacting to the presence of an escort by attacking it.

20.5. <u>Straggler Return</u>. In the Initial Phase of any turn in which there are ships and surface escorts in the straggler sector, the player rolls D6. On a 1, the player removes 1 ship from the straggler sector and returns it to the convoy.

21. <u>Abbreviations</u>. The units, playing area, and the scenario notes use abbreviations. Here is the key.

21.1. A: Attack value

21.2. AC: Attack Convoy

21.3. AE: Attack Escort

21.4. AT: Attack U-boat

21.5. AZ: Attack zone

21.6. CO: Corvette

21.7. CZ: Convoy zone

21.8. d: (Lower case "d") Escort is Depleted

21.9. DA: U-boat or Escort is Damaged

21.10. DC: Act as Decoy

21.11. DD: Destroyer

21.12. DE: Destroyer escort

21.13. DL: Destroyer leader

21.14. DT: Attempt to Detect U-boat

21.15. ED: Emergency Dive

21.16. EV: Evade Escort for U-boats, Evasive Maneuvers for Convoys

21.17. f: (Lower case "f") Torpedo Fired

21.18. F: Fast Convoy

21.19. FF: Frigate

21.20. FL: Flak Defence

21.21. H: HF/DF/air cooperation modifier

21.22. HD: HF/DF

21.23. IL: Illuminate Convoy

21.24. IZ: Inner zone

21.25. L: Low visibility detection value

21.26. MC: Move into Convoy

21.27. OZ: Outer Zone

21.28. R: For escorts, radar detection value

21.29. RS: Rescue Ship

21.30. S: Slow Convoy

21.31. SB: U-boat is Submerged

21.32. SD: Air Escort is Shot Down

21.33. SF: U-boat is Surfaced

21.34. SK: U-boat or Escort is Sunk

21.35. SL: Sloop

21.36. V: High visibility detection value

D20 Probability Table

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
2	1	2	4	6	7	9	10	12	13	14	15	16	17	18	18	19	19	**	**	**
	2				1	1	2	2	3	4	5	6	7	8	10	11	13	14	16	18
3	1	3	5	8	10	12	13	15	16	17	18	18	19	19	19	**	**	**	**	**
	2		1	1	2	3	4	6	7	9	10	11	13	14	16	17	18	19	19	**
	3						1	1	1	2	3	3	4	5	7	8	10	12	15	17
4	1	4	7	10	12	14	15	16	17	18	19	19	19	**	**	**	**	**	**	**
	2		1	2	4	5	7	9	10	12	14	15	16	17	18	19	19	**	**	**
	3				1	1	2	3	4	5	6	8	10	11	13	15	16	18	19	**
	4								1	1	1	2	3	4	5	6	8	10	13	16
5	1	5	8	11	13	15	17	18	18	19	19	19	**	**	**	**	**	**	**	**
	2		2	3	5	7	9	11	13	15	16	17	18	19	19	**	**	**	**	**
	3			1	1	2	3	5	6	8	10	12	14	15	17	18	19	19	**	**
	4						1	1	2	3	4	5	7	9	11	13	15	17	18	**
	5										1	1	2	2	3	5	7	9	12	15
6	1	5	9	12	15	16	18	18	19	19	**	**	**	**	**	**	**	**	**	**
	2	1	2	4	7	9	12	14	15	17	18	19	19	**	**	**	**	**	**	**
	3			1	2	3	5	7	9	11	13	15	16	18	19	19	**	**	**	**
	4					1	1	2	4	5	7	9	11	13	15	17	18	19	**	**
	5								1	1	2	3	5	6	8	11	13	16	18	19
	6											1	1	2	2	4	5	8	11	15
7	1	6	10	14	16	17	18	19	19	**	**	**	**	**	**	**	**	**	**	**
	2	1	3	6	8	11	13	15	17	18	19	19	**	**	**	**	**	**	**	**
	3		1	1	3	5	7	9	12	14	15	17	18	19	19	**	**	**	**	**
	4				1	1	3	4	6	8	10	12	14	16	17	19	19	**	**	**
	5						1	1	2	3	5	6	8	11	13	15	17	19	19	**
	6									1	1	2	3	5	7	9	12	14	17	19
	7												1	1	2	3	4	6	10	14
8	1	7	11	15	17	18	19	19	**	**	**	**	**	**	**	**	**	**	**	**
	2	1	4	7	10	13	15	17	18	19	19	**	**	**	**	**	**	**	**	**
	3		1	2	4	6	9	11	14	16	17	18	19	19	**	**	**	**	**	**
	4				1	2	4	6	8	10	13	15	17	18	19	19	**	**	**	**
	5					1	1	2	3	5	7	10	12	14	16	18	19	**	**	**
	6								1	1	2	3	4	6	9	11	14	16	18	19
	7										1	1	2	3	5	7	10	13	16	19
	8													1	1	2	3	5	9	13
9	1	7	12	15	17	18	19	**	**	**	**	**	**	**	**	**	**	**	**	**
	2	1	5	8	11	14	16	18	19	19	**	**	**	**	**	**	**	**	**	**
	3		1	3	5	8	11	13	15	17	18	19	19	**	**	**	**	**	**	**
	4			1	3	5	8	10	13	15	17	18	19	19	**	**	**	**	**	**
	5					1	2	3	5	8	10	12	15	17	18	19	**	**	**	**
	6							1	2	3	5	7	10	12	15	17	18	19	**	**
	7								1	1	2	3	5	7	9	12	15	17	19	**
	8											1	1	2	4	6	9	12	15	19
	9														1	2	3	5	8	13
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Top row is number or less to be rolled on D20 for success in one trial, left-most column is number of events, second left column is number of successes. Roll indicated number or less on D20 to score indicated number of successes based on number of trials and chance of success per trial. ** indicates automatic success for at least this many events. *Example: 6 U-boats requiring an 8 or less to move – on a D20 roll of 20, none move; on a 16 through 19, 1 moves; on a 10 through 15, two move; on a 5 through 9, three move; on a 2 through 4, four; on a 1, 5 move.*

Designer's Notes

In World War II, German submarines – U-boats – and Allied anti-submarine forces fought a series of great naval battles in the North Atlantic, battles unlike any fought before. These battles were fought in slow motion over days instead of hours. They were fought by very different opponents with different capabilities and different goals. They seesawed back and forth as they were fought, with the hunters becoming the hunted in a heartbeat.

They were fought under staggeringly bad conditions. In the past, darkness and low visibility had usually made naval battles less likely. For the submarine war in the North Atlantic, the Germans sought these conditions. That meant that the most active times for the submarine wars were the stormiest seasons of an inhospitable ocean: fall, winter and spring. The prospects for the crew of a torpedoed ship in the wintry North Atlantic were grim. But then, they were no grimmer than the likely fate of a U-boat brought to bay by Allied escort forces. "Lost with all hands" was a common refrain when the escorts scored a kill.

The Campaign. The principal goal of Hitler's U-boat war was very simple. In 1940, Britain and the Commonwealth nations stood alone against Germany. Britain was an island, dependent on ships to feed her people and stoke her industries. Sink the ships, and the island would die. The war in the Atlantic was a tonnage war: a war by the Germans against Allied merchant ship tonnage, and a war by the Allies to preserve it.

The Germans had, in a halting way, tried a similar strategy in the First World War. While it had ultimately been defeated by Allied countermeasures, and had played a major role in bringing the United States into the war, none of that was to stop Adolph Hitler from trying the same thing again. This time there would be no halfway measures, no nice regard for the rights of neutrals, and little compunction about the deaths of merchant seamen and the passengers in their charge. The Germans would fight as ruthless a submarine war as their resources would allow.

The start of the campaign saw both the Germans and the British struggling to build up their forces. Submarines had been forbidden to Germany after her defeat in World War I; only in 1934 had she begun to build again. By the start of the Second World War the Germans had less than 60 submarines in commission – a clearly inadequate number to cripple a British merchant marine of more than 4,000 ships. But the British also had building to do, as the Royal Navy had spent scarce inter-war defense funds on larger ships and not on building the massive numbers of small escort vessels needed to safeguard those 4,000 merchantmen.

From the start of the war, the Germans sent their submarines out into the Atlantic in search of prey. The principal British response was to sail more and more of their merchant shipping in convoys – groups of ships sailing together from port to port. Convoys had been effective in combating the submarine threat World War I, and they were to be effective again in World War II. Concentrating shipping in this way lessened the odds of the U-boats finding them, and increased the effectiveness of the anti-

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submarine forces escorting them. So effective were convoys compared to ships sailing alone that gradually, as the war went on, more and more ships were sailed in convoys and fewer and fewer sailed individually.

While U-boats waged war in waters as far away as the Indian Ocean, the focus of their efforts was on the North Atlantic. It was there that the great stream of shipping between the New World and the Old traveled, and it was there that the U-boats could break the back of the Allied merchant marine. Further, the North Atlantic was close by the U-boat bases. Once the Germans had established U-boat bases in France, U-boats could travel to the North Atlantic either north or south around the British Isles. While U-boats could venture further afield than the North Atlantic, this required elaborate refueling plans and resulted in a dilution of strength.

To combat the U-boat menace, the British allocated more and more escort ships and anti-submarine aircraft at more and more bases. At first, there were large gaps in both the escort protection and the air patrols directed at the U-boats – gaps that the Germans were quick to exploit. These gaps were closed in four ways. First, the British, Canadians and Americans acquired and developed more and more air and sea bases to support their war against the U-boat. Second, the Allies developed the ability to re-fuel and re-provision escorts at sea. This multiplied their effectiveness. Third, the Allies devoted more and more very long range aircraft against the U-boat threat, closing the gaps in their defenses still further. Finally, the Allies built a number of small aircraft carriers, which they used both to protect convoys and to search out U-boats.

Once the Allied defensive gaps were closed and enough Allied escorts were available to guard the convoys, the Germans had lost their tonnage war. Although the winter of 1942-43 was a grim time for the convoys, the tide turned decisively in the spring of 1943. By the end of that year the Germans were forced by the weight and effectiveness of Allied countermeasures to give up wolfpack tactics in favor of individual attacks on targets of opportunity. The Germans could never hope to win the tonnage war by such means.

By the end of the war, the Germans had lost 790 U-boats out of a total of 1,162 built – and more than 30,000 U-boat men had died. U-boats had sunk almost 2,500 ships totaling 13,000,000 tons, but it was not enough. The Allies built 42,000,000 tons of merchant shipping in World War II.

Tactics and Technology. Until the end of 1943, the standard German tactic for attacking Allied convoys was the wolfpack. The wolfpack was a loosely organized group of up to 20 or so U-boats that would patrol along the expected route of a convoy. When one of the wolfpack members spotted the convoy, it would maintain contact while calling in the other boats. These would attack independently, usually by mounting torpedo attacks while on the surface at night.

While the distinguishing characteristic of a submarine is, of course, its ability to submerge, submarines of the Second World War spent most of their time on the surface. Submerged, they were capable of only low speeds and limited endurance. To track

down convoys and maneuver to attack, U-boats needed to operate on the surface. At first, their ability to operate on the surface in the face of escort forces was quite good. A submarine presents a small visual target, particularly compared to a mass of ships making up a convoy. As time when on, however, the U-boats found the surface an increasingly perilous place.

The Allies countered wolfpack tactics with a combination of tactics and technology. Allied anti-submarine tactics at the start of the war called for the escort vessels to patrol around the convoy formation, trying to prevent the U-boats from closing to shoot. Primary emphasis was placed on stopping submerged attacks by detecting U-boats with sonar (or, in British parlance, asdic). Because asdic could not detect surfaced submarines, the Allies changed their tactics over time. They came to place more emphasis on detecting surfaced U-boats, and on attacking U-boats before they could close the convoy.

The Allies had important technological help in developing their tactics. While technology alone did not win the tonnage war, Allied technological dominance gave them an important edge and helped them bankrupt wolfpack tactics. Technology helped the Allies in a number of ways.

First, the Allies developed increasing effective radar and installed it in more and more escorts. Radar made it much more likely that a surfaced U-boat would be detected before it could attack. Effective radar also made aircraft much more effective U-boat killers. With radar, the aircraft could surprise the U-boats on the surface in bad visibility or at night. While the Germans did develop effective radar detectors over time, which U-boats could use as warning devices, they usually lagged well behind in their ability to detect the most current Allied radars.

Second, the Allies also developed and placed in their escorts extremely effective high frequency direction finding equipment (called "HF/DF") that permitted them to home in on U-boat radio transmissions. Because the Germans never believed that the Allies could develop this ability, they never enforced radio silence among the U-boats, and the Allies were continually able to run the boats down based on their radio transmissions. In particular, the Allies used HF/DF to pin down contact boats broadcasting convoy locations.

Third, the Allies developed increasingly effective ASW weapons as the war went on. Depth charges became more and more effective at deeper and deeper depths. Ahead-throwing weapons, which cut down on the U-boat's ability to escape an attack, were developed and perfected. Aircraft ASW weapons grew immensely in effectiveness. By contrast, German submarine weapons were relatively static. Perhaps the most radical new weapon used by the U-boats was the acoustic homing torpedo, introduced in numbers in 1943. This torpedo homed in on the noise made by the propellers of its target, and proved fairly effective against escorts. Beyond this, the Germans developed some torpedo types that could be programmed to turn in mid-course (in hopes of increasing the chances of a hit when fired into a convoy formation) and armed their U-boats with increasing number of anti-aircraft guns as the Allied air threat grew.

Finally, the Allies got tremendous help from their code-breaking efforts, which were fueled not just with intellectual effort but with some of the first computers. This, combined with other intelligence, often gave the Allies enough hard data simply to steer many convoys right around U-boat concentrations. Here though, the Germans had a counter. For while the Allies were reading the German naval codes, the Germans were also reading the Allied convoy codes. This occasionally led to situations in the Allied used their code-breaking information to alter a convoy's course around a wolfpack while the Germans used theirs to find the convoy again, with neither side suspecting that the other was reading its mail. By mid-1943, however, Allied code-breaking efforts had permanently outstripped those of the Germans.

Both Allied technology and Allied production combined to make Allied ASW efforts more and more effective. At first, too few Allied escorts were using inadequate means to detect U-boats and lacked the time, techniques and technology to have a good chance of killing the U-boats that they did detect. By mid-1943, larger number of escorts were able, through the use of HF/DF and excellent radar, to attack U-boats before they could close the convoys. These escorts could take the time to hunt down the U-boats they detected, and had the weapons and training needed to make them effective U-boat killers. Similarly, ASW aircraft grew immensely in effectiveness as the war went on. By mid-1943, there was no place in the North Atlantic where at least the longest-ranged of the Allied aircraft could not reach, and these aircraft had the radar and weapons needed to kill U-boats.

The Game. Two aspects of the convoy battles make them hard to simulate. First, obviously, are the aspects of limited intelligence. Even with efficient code-breaking and radio direction-finding, the Allied escorts could never be quite sure what they were facing or when the enemy would strike. On the German side, individual U-boat commanders would have only sketchy information on the convoys they were attacking, and could not even be sure of where their compatriots were. All of this limited knowledge made for a cat and mouse game in which the roles of cat and mouse could be reversed at any time.

Here's what some of the game concepts are meant to represent.

U-Boat Movement: The great problem for U-boats was to find and close the convoy, then stay close enough to it to make multiple attacks. Each boat was on its own; U-boats generally did not have the means to launch coordinated attacks. In part then, the game's U-boat movement system portrays individual boats trying to gain touch with the convoy. When U-boats move back out through the movement zone, however, the system is portraying not just U-boats withdrawing to reload their torpedo tubes and attack again. It also portrays the convoy moving away from the U-boats. Escorts strove to force U-boats under and hold them there. Even if the boats were not damaged or killed, they might lose so much ground that they could not again close the convoy.

The Contact Boat: In wolfpack tactics, the task of the first boat to spot a convoy was to call in the other boats to attack. It did this by broadcasting "beta-beta" homing signals.

Usually, it maintained its position while other boats attacked, although the role would switch between boats during a long battle.

U-boat Attacks: The different attack sectors take into account the varying effectiveness of a U-boat attack based on its position relative to its convoy target and the torpedoes being used. This also tends to concentrate escorts around the point of the greatest threat. Zaunkönig torpedoes were acoustic homing torpedoes that were relatively effective against escorts (until Allied countermeasures were introduced). FAT torpedoes were designed to run a set distance and then circle, theoretically increasing the chances of hitting ships in a convoy.

Evading: This simulates a U-boat abandoning any attack plans and attempting to evade escort attacks. During an initial escort attack round, it simulates a U-boat crash-diving or hauling off to avoid contact with an escort. In subsequent attack rounds, it simulates going deep and evading escort attacks.

Flak: During one period, U-boat doctrine called for the boats to repel Allied air attacks with gunfire, rather than crash-diving away. This was a more effective tactic than one might think, as the Allied bombers used against the U-boats tended to be large targets, and had to fly straight and low to make an effective attack.

Escort Attack: In the first round of an escort attack, this represents a combination of gunfire, ramming and shallow-set depth charge attacks. In the later rounds, it represents attacks by deep-set depth charges and ahead thrown weapons like Hedgehog and Squid. As Allied escorts became more numerous, more experienced and better trained, their ability to make multiple and persistent attacks grew.

HF/DF: HF/DF ("Huff-Duff" or high frequency direction finding) began the war as a shore-based technique, but HF/DF sets soon found their way on board escorts. Rated by escort commanders as being as crucial as radar, HF/DF permitted escorts to run down U-boats from their radio transmissions. As wolfpack tactics required considerable radio signaling, HF/DF gave escorts many chances to attack U-boats before the U-boats could close a convoy. This was particularly true for the contact boats, which had to broadcast frequently while remaining close to the convoy. The Germans never discovered the Allied use of this technology.

Air Escorts: With time, the aircraft became the most feared U-boat killer. Even at the outset of the war, aircraft were effective at scouting for U-boats and forcing them to submerge. The Germans responded by setting their U-boat operational areas in zones where Allied air cover was lacking or weak. The zones grew smaller and smaller as the war went on, while aircraft became more and more effective against the boats. The weak zones dwindled as the Allies used very long range aircraft and escort carriers to plug the gaps; the aircraft became more effective as they received radar and effective anti-submarine weapons.

Select Bibliography

There is of course an extensive literature on the U-boat war in the Atlantic. This bibliography lists only a small selection of these works, although I found these particularly helpful in the design of this game.

Blair, Clay. *Hitler's U-Boat War.* (2 vol.) New York, 1998. A massive, magisterial work. Blair's thesis is that the U-boat war did not pose the great danger to the Allies that others (including Winston Churchill) thought it posed. He makes his case ably.

Gardner, W. J. R. *Decoding History: The Battle of the Atlantic and Ultra.* Annapolis, 1999. Takes an operational approach to the influence of Ultra on the U-boat war, and provides a good analysis of the mechanics of the conflict.

Gretton, Vice-Admiral Sir Peter. *Crisis Convoy: the Story of HX231.* Annapolis, 1974. An excellent account of one of the climactic 1943 convoy battles, told by the escort force commander.

Keegan, John. *The Price of Admiralty: the Evolution of Naval Warfare.* New York, 1988. Contains a chapter on the Atlantic U-boat war giving a good overview.

Keegan, John. *Intelligence in War: Knowledge of the Enemy from Napoleon to al-Qaeda.* New York, 2003. Contains a chapter on the effect of intelligence (both Allied and German) on the Atlantic U-boat war.

Morison, Samuel Eliot. *History of United States Naval Operations in World War II.* (15 vols.) Boston, 1947-62. The "semi-official" history of the USN in World War II. Volumes I and X cover the Battle of the Atlantic from the US perspective.

Padfield, Peter. *War Beneath the Sea: Submarine Conflict During World War II.* New York, 1995. Covers British, US, and Japanese submarine operations as well as German, providing interesting contrasts in strategies and tactics.

Roskill, S. W. *The War at Sea.* London, 1954-61. (3 vols.) The British official history of the Royal Navy in World War II. Written before the Ultra secret was revealed, but still a good account of the strategies and tactics of the convoy battles.

Van der Vat, Dan. *The Atlantic Campaign: World War II's Great Struggle at Sea.* A good one-volume history of the whole battle, including German air and surfaces forces.