

TONNAGE WAR SOLITAIRE

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. Game Components. The game uses the following components.
 - 2.1. Wooden blocks representing U-boat and escorts. The blocks representing escorts have stickers affixed to them identify the particular escort represented by each block. The blocks representing U-boats are simply wooden blocks, without stickers.
 - 2.2. The playing area, which 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 attack sectors. U-boats attack the convoy from the convoy and attack zones.
 - 2.3. A 20 sided die (D20).
 - 2.4. A 6 sided die (D6).
 - 2.5. Scenario cards providing details of the battles that can be played in Tonnage War.
 - 2.6. The rules (of course).
3. Preparing for Play. First, the player selects a scenario to be played. Second, referring to the scenario description, the player selects and deploys escorts and U-boats.
4. Game Length. Play of a single game consists of 24 to 36 turns, as specified on the scenario card. Each turn represents a time period of 4 hours.
5. Turns. Each turn consists of a series of actions taken by the player. The player takes these actions in the following order:
 - 5.1. Initial Phase. Consults the scenario card to see if reinforcements are received or escorts in play must be removed, whether U-boats are eligible to enter, and whether other events occur. Determines whether U-boats that exited the playing surface will reenter. Determines whether to post a decoy, illuminate the convoy, and whether the convoy will maneuver evasively.
 - 5.2. First U-Boat Movement Phase. Places reentering U-boat blocks in the outer zone and moves U-boat blocks from the outer to the inner zone using the rules provided below. Moves outbound U-boats.
 - 5.3. Escort Placement and Movement Phase. Places reinforcement escort blocks in the convoy, attack, inner and outer zones. Only air escorts may be placed in an outer zone, although surface escorts may be moved there in continuing attacks against detected U-boats. Once placed, escorts may move in or out 1 zone in any subsequent Escort Placement and Movement Phase. Selects rescue ships, if appropriate, at this time.
 - 5.4. Second U-boat Movement Phase. Moves U-boats in the inner zone to the attack zone.

- 5.5. First Escort Attack Phase. Decides which escorts will detect and attack U-boats in the attack, inner, and outer zones, determines the responses of the U-boats, and resolves the detection attempts and attacks.
- 5.6. Third U-boat Movement Phase. Determines actions of U-boats in the convoy zone or the attack zone that were not the subject of detection attempts and moves U-boats from the attack zone to the convoy zone.
- 5.7. Second Escort Attack Phase. Decides which escorts will detect and attack U-boats in the convoy zone, determines the responses of the U-boats, and resolves detection attempts and attacks.
- 5.8. U-boat Attack Phase. Resolves U-boat attacks against the convoy.
6. Object of the Game. The player wins the game by preserving the convoy and his forces while sinking or damaging U-boats.
7. Game Conventions.
 - 7.1. 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.
 - 7.2. The player may use the following conventions for escort and U-boat units in play.
 - 7.2.1. Normally, escorts blocks are placed standing and facing the player.
 - 7.2.2. A escort that has depleted its weapons is flipped face-up on the playing surface.
 - 7.2.3. An air escort that can stay in play for 2 turns is placed standing, with the narrow edge of the standing block facing the escort player on its second turn in play.
 - 7.2.4. A U-boat block that is evading but has not attacked is placed standing, with the narrow edge of the standing block facing the escort player.
 - 7.2.5. A U-boat block that has attacked is placed flat on the playing surface.
 - 7.2.6. A U-boat block that has attacked and is evading is rotated so that it is positioned diagonally on the playing surface.
 - 7.2.7. All other U-boat blocks are placed standing, with the broad edge of the standing block facing the escort player.
8. Escort Placement and Movement. The player places and moves escorts in the Escort Placement and 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 Placement and Movement Phase.
9. Inbound U-Boat Movement. U-boats are placed on and move across the playing surface towards the convoy using the following rules.
 - 9.1. The scenario card will specify the numbers of U-boats to be used in the battle.
 - 9.2. The player then places the U-boat counters in the starting positions specified by the scenario card. Some U-boats may not start on the playing surface.
 - 9.3. 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.
 - 9.4. The player rolls for U-boat appearance first, then for movement. U-boats appear in the outer zone of the playing area. They move then to the inner zone, the attack zone, and (possibly) the convoy zone.
 - 9.5. 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
 - 9.6. 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.
 - 9.7. 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 an edge-on or a face-up block (that is, 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.
 - 9.8. 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.
 - 9.9. 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, 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 further. 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.

- 9.10. 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.
- 9.11. 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.
- 9.12. 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 an edge-on or a face-up block (that is, 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.
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 for this in the Initial Phase of any low visibility turn. If he does, 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. Place the escort allocated in the decoy box.
11. Evasive Maneuvering. In the Initial Phase of any turn, the player may declare that the convoy is maneuvering evasively. For that turn, the numbers needed by the U-boats to enter the playing area or advance through zones are halved. Upon declaring that a convoy is maneuvering evasively, the player rolls D6 and immediately adds this number of stragglers to the straggler sector. For that turn, place a block in the Evade box. A convoy may only evade once each day.
12. 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 L 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.
13. Example: *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 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.

14. Outbound U-Boat Movement. U-boats move away from the convoy using the following rules.
- 14.1.1. After Attacking. On the turn after it attacks, a U-boat will move back through each zone to the outer zone, 1 zone at a time. Flip the blocks of U-boats that have attacked face-up. U-boats that have attacked may not attack the convoy again until they leave and then return to the playing surface.
 - 14.1.2. 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. Turn the blocks of evading U-boats that have not attacked edge on to the escort player. Turn the blocks of evading U-boats that have attacked so that they are flat on the playing surface and diagonal. U-boats cease evading at the end of the First U-boat Movement Phase in which they moves out 1 zone, unless another rule (such as the rule for continuing attacks) provides otherwise.
 - 14.1.3. After Being Attacked. U-boats always evade after being attacked by surface escorts. Treat an attacked U-boat that did not evade before the attack as evading afterwards. It will move as an evading U-boat, and will not move farther inward in the turn that it is attacked.
 - 14.1.4. 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.
 - 14.1.5. 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.
 - 14.1.6. U-boats reaching the outer zone in outbound movement move off the playing surface in the following First U-boat Movement Phase.
 - 14.1.6.1. Damaged U-boats are permanently removed from play.
 - 14.1.6.2. U-boats that have not attacked since they last entered the playing surface are placed in the “U-boats to Enter” box and restart the process of rolling to reenter the playing surface and moving back through the zones on the next game turn..
 - 14.1.6.3. For U-boats that have attacked, the player rolls D6 in the Initial Phase of the next turn. 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 to Enter” box and restarts the process of rolling to reenter the playing surface and moving back through the zones on that game turn. Otherwise, the U-boat is permanently removed from play.
 - 14.1.7. 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 zone should instead be placed in the stern attack zone.

- 14.1.8. 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.
15. 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.
- 15.1.1. To detect a U-boat, the escorts must roll D20 at or below the applicable detection value, as modified.
- 15.1.2. An escort may attempt to detect and attack only 1 U-boat per turn.
- 15.1.3. 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.
- 15.1.4. Escorts generally have several detection values.
- 15.1.4.1. If an escort has a R detection value, it can use it to detect any U-boat except those in the attack or convoy zones in high visibility turns. U-boats in attack or convoy zones in high visibility turns are considered to be submerged. R detection values represent radar.
- 15.1.4.2. If an escort has a V detection value, it can use it to detect any U-boat in high visibility turns except U-boats in the attack or convoy zones. Again, those U-boats are considered to be submerged. V detection values represent visual detection in good visibility conditions.
- 15.1.4.3. If an escort has an L detection value, it may use it to detect U-boats in low visibility turns. L detection values represent visual detection in poor visibility conditions.
- 15.1.4.4. An escort with an S detection value can use it to detect a 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. S detection values represent detection by sonar, which is used to detect submerged U-boats.
- 15.1.4.5. See below for limits on the ability of a surface escort to detect U-boats in the Inner Zone or Outer Zone.
- 15.1.5. If more than 1 escort is attempting to detect a U-boat, each rolls separately.
- 15.1.6. Detection values may be modified by various circumstances.
- 15.1.6.1. In storm conditions, all escort detection values are reduced by 3.
- 15.1.6.2. In poor sonar conditions, all escort S detection values are reduced by 3.
- 15.1.6.3. When a convoy is illuminated, all L detection values of escorts in the attack zone (except the Straggler sector) and convoy zone are increased by 2

- 15.1.6.4. If the U-boat evades, the detection values of escorts attempting to detect it are halved. Turn the U-boat block edge on to the escort player.
- 15.1.6.5. If a surface escort is on a line between attack sectors, its final detection values to detect U-boats in either sector are halved.
- 15.1.6.6. If a surface escort is in the straggler sector, its final detection values are halved.
- 15.1.6.7. If a surface escort is in the convoy zone, its final R and S detection values are halved.
- 15.1.6.8. If an air escort is in the outer zone, its detection values are halved unless it is conducting a continuing attack.
- 15.1.6.9. All modifications to detection values are cumulative. See 7 above.
- 15.1.7. 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.
- 15.1.8. Escorts attack in two phases within each game turn. In the First Escort Attack Phase, escorts in the attack, inner, and outer zones attack. In the Second Escort Attack Phase, escorts in the convoy zone attack.
- 15.1.9. Surface Escort First Attacks. Special rules apply to the first attack by a surface escort in a turn against a 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.
- 15.1.10. Depletion. 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 15.1.9. It can continue to detect U-boats. Flip an escort block that has depleted its weapons face-up.
- 15.2. Air Escorts versus U-Boats -- Initial Attacks. 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.
 - 15.2.1. The player rolls to determine the U-boat's action, based on the number of air escorts trying to detect it.
 - 15.2.2. The air escort(s) attempt(s) to detect the U-boat.
 - 15.2.3. If any air escort detects the U-boat, the player selects 1 air escort to attack.
 - 15.2.4. If the U-boat is not evading, it rolls against its Flak Value to shoot down or drive off the attacking air escort.
 - 15.2.5. The air escort attacks the U-boat.
 - 15.2.6. The U-boat and air escort attacks are resolved at the same time. Each can destroy or damage the other.
 - 15.2.7. 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.

- 15.3. Air Escorts versus U-Boats - Continuing Attacks. 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. 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.
- 15.4. Surface Escorts versus U-boats - Attack and Convoy Zones. Surface escorts may attack U-boats in the attack zone in the First Escort Attack Phase and in the convoy zone in the Second 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.
 - 15.4.1. The player rolls to determine the U-boat's action, based on the number of surface escorts attempting to detect it.
 - 15.4.2. The surface escort(s) attempt to detect the U-boat.
 - 15.4.3. 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.
 - 15.4.4. If the U-boat is attacking the escorts, that attack is resolved.
 - 15.4.5. The surface escort(s) attack(s) the U-boat.
 - 15.4.6. 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. Turn the U-boat block edge-on to the player.
 - 15.4.7. Surface escorts may not roll to detect U-boats in the inner or outer zones unless they are making a continuing attack or a HF/DF attack, or are cooperating with an air unit.
 - 15.4.8. Multiple U-boats in the Same Zone or Sector. 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 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, even when there are U-boats that have yet to attack in the same zone or sector,
- 15.5. Surface Escorts versus U-Boats - HF/DF.
 - 15.5.1. Surface escorts may attack U-boats by homing on the U-boats' radio transmissions, using HF/DF (high frequency direction finding) equipment. The scenario card will specify the number of surface escorts equipped with HF/DF.
 - 15.5.2. Each turn, each escort with HF/DF still in play can home surface escorts on to 1 U-boat in the inner zone. Only escorts located in the

- inner zone can attack U-boats in this way. Up to 3 escorts may attempt to detect and attack each U-boat subjected to a HF/DF directed attack that turn.
- 15.5.3. Attempts to detect a U-boat in an HF/DF directed attack are subject to a minus modifier. This is the “H” modifier shown on each surface escort’s block. This modifier is added to the appropriate detection value of the escort when detection rolls are made.
- 15.5.4. 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 R, V, or L detection values are used.
- 15.6. 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.
- 15.6.1. The cooperation attack takes place immediately after any air escort attack in the U-boat, in the same Escort Attack Phase.
- 15.6.2. The attack is made in the usual way, with the player rolling for U-boat actions 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, then for any surface escort attacks. If the U-boat evaded in response to the air attack, the surface escorts must use their S detection values.
- 15.6.3. Attempts by surface escorts to detect a U-boat in an air cooperation attack is subject to a minus modifier. This is the “H” modifier shown on each surface escort’s block.
- 15.7. 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.
- 15.7.1. 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.
- 15.7.2. For attacks initially made in the inner zone, only those surface escorts making the initial attack may join in any continuing attack.
- 15.7.3. Signify that surface escorts are continuing an attack on a U-boat by placing them adjacent the U-boat. This is done at the end of the Escort Attack Phase in which the U-boat was first attacked.
- 15.7.4. 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 in following turn in the attack zone, and then potentially in the inner and outer zones in the following turns.

- 15.7.5. 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.
- 15.7.6. In each turn's Escort Attack Phase, the escorts must attempt to detect the U-boat before attacking it. The escorts use their S detection value for this. The U-boat always evades. If the escorts fail to detect the U-boat, the attack is over.
- 15.7.7. Detection values are not halved for continuing attacks conducted in the outer zone.
- 15.7.8. If the U-boat exits the outer zone, the attack is over. The escorts are then in the outer zone.
16. U-boat Combat. 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 surface. Once a U-boat has made an attack, flip it flat on the playing surface. A U-boat that uses its flak value in the inner zone is not required to move off the playing surface as a consequence.
- 16.1. U-Boats versus Air Escorts. 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 $\frac{1}{2}$ of the value shoots the air escort down.
- 16.2. U-Boats versus Surface Escorts. 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.
- 16.2.1. If no surface escort detects the U-boat, it attacks 1 escort. A D20 roll equal to or less than $\frac{1}{2}$ of the U-boat's attack value damages the escort. A D20 roll equal to or less than $\frac{1}{4}$ of the value sinks the escort.
- 16.2.2. If the surface escort(s) do detect the U-boat, it still attacks 1 escort. The escort cannot be damaged, but a D20 roll of 1 sinks it.
- 16.2.3. The player randomly determines the escort that the U-boat will attack from among those attempting to detect it.
- 16.3. U-Boats versus Convoys. 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.
- 16.3.1. 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.
- 16.3.2. The straggler attack sector holds a limited number of ships, which the player tracks by placing a number marker in the straggler box. This number set at the start of the game by the scenario card. It increases as the convoy maneuvers evasively and decreases as ships in the straggler sector are sunk.
- 16.3.3. If the player rolls a 1 for any U-boat attack, the U-boat has sunk any rescue ship sailing with the convoy. In the Initial Phase of each

subsequent turn, the player may designate 1 surface escort in the convoy or attack zone as the new rescue ship. The escort may not attack or make detection attempts while it is serving as a rescue ship. Put the escort in the Rescue ship box. On a subsequent 1 rolled in a U-boat attack on the convoy roll D20, roll the D20 again. On a roll of 1 through 10, the new rescue ship is sunk. The U-boats score more points for sinking merchant ships when the convoy has no rescue ship.

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

17. Damage. 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.

18. Winning. 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.

19. Special Rules.

19.1. Storms. 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.

19.2. Bad Sonar Conditions. For scenarios set in bad sonar conditions, subtract 3 from all S detection values.

19.3. FAT. 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.

19.4. Zaunkönig. 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, 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.

19.5. Straggler Return. 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.

19.6. Abbreviations. The playing area and the scenario cards use abbreviations. Here is the key.

19.6.1. AZ: Attack zone.

19.6.2. CZ: Convoy zone.

19.6.3. IZ: Inner zone.

19.6.4. OZ: Outer Zone

19.6.5. A: Attack value.

- 19.6.6. D: Depletion number.
- 19.6.7. HD: HF/DF.
- 19.6.8. H: HF/DF/air cooperation modifier.
- 19.6.9. V: High visibility detection value.
- 19.6.10. L: Low visibility detection value.
- 19.6.11. S: Sonar detection value.
- 19.6.12. R: For escorts, radar detection value.
- 19.6.13. CO: Corvette
- 19.6.14. DD: Destroyer
- 19.6.15. DE: Destroyer escort
- 19.6.16. DL: Destroyer leader
- 19.6.17. FF: Frigate
- 19.6.18. SL: Sloop

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	**	**	**	**	**	**	**	**	**
	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	2	3	5	8	10	13	15	17	18	19	19	**	**	**	**	**
	5					1	2	3	5	8	10	12	15	17	18	19	**	**	**	**
	6						1	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 seasawed 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-

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 went 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 increasingly 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.