SILENT SERVICE
Additional Notes (C64 cassette)

Due to the Fast Load on this game, the title screen will corrupt after a short time. This should not however affect the playability.

The game is completely loaded from Side 1. Side 2 is a back-up copy. The instructions should be ignored when it refers "Turn to Side 2."

Ships have to be identified with the correct identification instruction as this forms an integral part of the protection within the program. The game may not run properly if not adhered to.

When you have finished the Scenario, rewind the tape and re boot cassette.
Note:- F7 function is for disk version only.

The "Submariner's Hall of Fame" is not included in the cassette version.

Introduction

SILENT SERVICE is a detailed simulation of World War II submarine missions in the Pacific. It places you into the role of submarine captain, presents you with the same information, problems, and resources available to an actual sub captain. Included are numerous scenarios, options and play variations. Five detailed battle station screens, numerous commands, and realistic graphics and sound effects combine to provide a dramatic level of realism and playability.

As is detailed later, US submarines played a crucial role in stemming the tide of Japanese imperialism and winning the war in the Pacific. The primary mission of the American Silent Service was to take on the Japanese Navy in their home waters and to neutralise the Japanese Merchant Marine. As submarine commander in this elite force, you will be evaluated based on the number and types of ship which you sink.

The first group of scenarios recreate actual historical situations and require a variety of different tactics. They are useful for becoming acquainted with the mechanics of this simulation, practicing specific situations, or for quick games. The real test of a submariner's skill however, are the Patrol scenarios. Here you will encounter an almost infinite variety of situations as you seek out and attack enemy convoys. With a limited number of torpedoes and fuel, your goal is to sink a maximum tonnage of enemy shipping and bring your sub successfully back to base.

As an accurate simulation of a real-life situation, there are numerous details, subtleties, and features included in the simulation. The beginning player may safely defer the consideration of some of these factors until a few games are completed. The "Quick Start" section below is designed to allow experienced players to boot the program and play without reading the extensive documentation which follows. However, your enjoyment of this simulation will be enhanced by an understanding of the tactics, missions, equipment, and history of submarine combat as detailed in the remainder of this document.

Quick Start

SILENT SERVICE is sophisticated simulation which can be played at many difficulty levels. However, like most people you are probably anxious to load up this product and get started! We offer this "quick start" to get you going with what we call the JG perspective. The JG perspective is that of a new Lieutenant JG (Junior Grade), eager for battle, anxious to experience first-hand the challenge of submarine combat. When you decide to investigate this simulation in-depth, you will need to thoroughly review the contents of this operation manual. But, for you JG's grab your seabag, follow the short sea orders below, and let's go!

1. Locate your loading instruction and load the program into your computer.
2. Review the battle station screens explanation to understand the options available to you on each screen.
3. Review the joystick diagrams and keyboard commands so you can access the options available on each screen.
4. Choose Torpedo/Gun Practice or a Convoy Action scenario. Stick to scenarios 1 or 2 until you learn to manoeuver and attack with your submarine.
5. Choose difficult level1 (trainee).
6. Turn off all the reality level factors.
7. Good Luck!

Target Identification Practice

A vital skill which each sub captain must possess is the ability to recognise and identify enemy targets. If you select one of the dangerous Patrol Mission scenarios you will be given a chance to refresh your target identification skills. Look up the ship requested (example: Japanese "Type 1" Destroyer) in this Operation Manual. Determine which of the four ship silhouettes displayed on the screen matches the silhouette in the Operations Manual. Type the number of the matching silhouette (1, 2, 3, 4). If you correctly identify the ship you may proceed on your patrol. If you are incorrect, you will be re-assigned for further training and will proceed to Torpedo/Gun Practice at Midway Island.

Options

Upon loading, you will be allowed to select the scenario, options, and skill factors you wish to use.

Scenarios

There are three types of scenarios "Torpedo/Gun Practice" places you outside the American base at Midway Island. Four old cargo ships are anchored there as torpedo and gunnery practice targets. The second set of scenarios: "Convoy Actions" recreate various actual submarine attacks on a convoy. "War Patrols" allow you to command an entire patrol, beginning at the submarine bases at Midway, Brisbane, or Fremantle: continuing through a number of convoy actions; and concluding with a return to base.

Skill Levels

You may select from one of four skill levels: "MIDSHIPMAN", "LIEUTENANT", "COMMANDER", or "CAPTAIN". The skill level affects the accuracy of torpedo runs, damage sustained from depth charge attacks, the skill of enemy lookouts and sonar operators, as well as other factors. The "MIDSHIPMAN" level is designed to provide a challenge for beginning players. The "COMMANDER" level is designed to be historically accurate. The "CAPTAIN" level is intended for the expert sub driver. Press 1, 2, 3, or 4 to change the skill level.

Reality Levels

In addition, you may customize the simulation with various "reality levels". Each level introduces an element which makes the simulation both more realistic and more difficult. To select the reality level use the joystick to move the flashing asterisk and press the trigger to toggle the YES/NO indicator.

1) Limited Visibility

If this level is selected enemy ships which are beyond radar/sonar range will not appear on the map display. Enemy ships which were detected but have moved out of range will blink slowly at their last known position. If this level is not selected, all enemy ships appear on the map displays regardless of their range or location.

2) Convoy Zig-Zags

If this level is selected the enemy convoys will "zig-zag" (change course) at regular intervals. If this level is not selected, cargo ships will steam straight ahead unless they are attacked by torpedoes or encounter land masses.

3) Dud Torpedoes

If this level is selected some of your torpedoes may be duds, especially during the years 1942—1943. Dud torpedoes may hit the enemy but will not explode, only the splash will be seen.

4) Port Repairs Only

If this level is selected repairs will no longer be accomplished automatically while in battle or on patrol. Once an item of major equipment is damaged, it may not be repaired.

5) Expert Destroyers

If this level is selected certain enemy convoys will be escorted by "expert" destroyers. These escorts are more persistent and have better trained sonar operators.

6) Convoy Search

If this level is selected convoys will not always appear within radar range. You will need to search them out. Far off convoys are best sighted by performing a 360 degree periscope/binocular sweep of the horizon.

7) Angle-On-Bow Input

If this level is selected the computer will no longer calculate the "Angle on the Bow" for torpedo shots. You must enter the angle yourself based on periscope observations. Be sure you understand the workings of the Torpedo Data Computer before attempting this level. Recommended for experienced players only.

Difficulty Levels

The skill level and reality levels you select combine to produce an overall difficulty factor from 1 to 9. This difficulty factor and the tonnage which you sink will determine your ranking in the "Submariner's Hall of Fame" at the conclusion of your mission.

Once you are satisfied with the skill and reality level, press "F7" to load the remainder of the game and begin play.

Additional data may be loaded at this time. When loading is completed you will appear in the conning tower (or the Patrol Navigation Map if you selected a War Patrol scenario) and the action will begin!

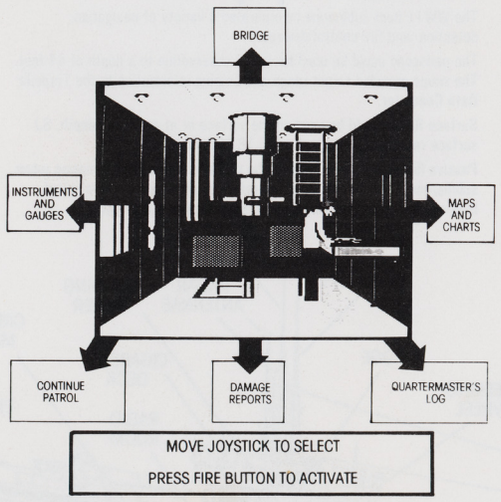
Battle Station Screens

SILENT SERVICE contains multiple Battle Station screens. On each screen different information is available and different commands can be entered. The battle stations represent the key locations which are used by the captain to manage the battle as his sub goes into action.

Battle Station: Conning Tower

The conning tower is the captain's primary station in battle. The conning tower contains the attack periscope, the map plot, critical gauges and instruments, and submarine controls. As the battle proceeds, the captain commands the sub from this nerve centre. The conning tower screen acts as menu screen — from this screen, you may select any of the five detailed battle station screens which are described below. Use the joystick to position the captain at the desired battle station and press the trigger. Centre — Periscope, Up — Bridge, Left — Instruments and Gauges, Right — Maps and Charts, Down — Damage Reports. To access the Binoculars battle station you must first go to the Bridge, then press the fire button again. You may return to the conning tower from these screens by pressing the fire button.

You may also select two special functions from this screen. If you selected a War Patrol scenario, the "Continue Patrol" function (joystick down and left) ends the current convoy battle and returns you to the patrolling screen. You will not be allowed to break off the engagement if you are being tracked by enemy escorts, have torpedoes active, or immediately after sinking an enemy ship. If you selected a Convoy Action scenario, the "End of Game" function (joystick down and left) will end your mission.



The "Quartermaster's Log" option (joystick down and right) is used to review your accomplishments so far in this patrol.

If you prefer, keystroke commands may be used to make these selections. (See the section on Keyboard Controls.) All other keyboard commands are ignored until you select a battle station.

When you are at the conning tower screen, the simulation is paused. Note that some selections are not available under certain conditions: i.e. the Bridge if you are under water, etc.

Battle Station: Patrol Navigation Map

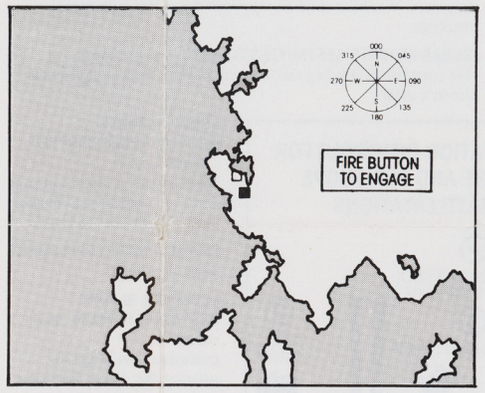
(War Patrol scenarios only)

The patrol screen simulates the time required to proceed to and from your base to enemy controlled waters as well as the patrolling activity between engagements. (A typical patrol lasted up to two months.) This screen displays a map of the Western Pacific Ocean. You are free to explore any area of the map. Use the joystick to move your submarine (black dot) to the areas which you wish to patrol. The screen border will change from light blue in the daytime to dark blue at night.

When a convoy is sighted, the screen border will turn red. You may engage the convoy by pressing the fire button, or you may continue patrolling. Note that enemy ships are generally found along the heavily travelled convoy routes (see centre insert map) and close to land. Valuable tanker and troop ship convoys are more likely to be found near Japan.

Battle Station: Maps and Charts

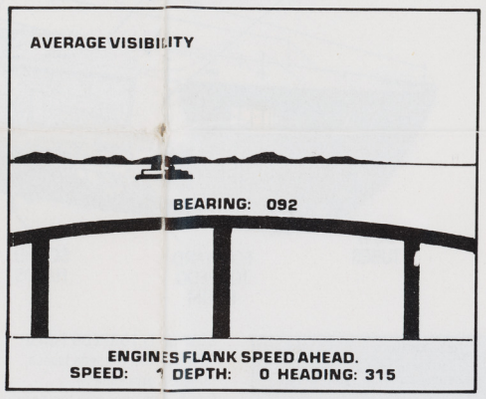
The maps and charts screen displays information available from the navigator and the tracking party. Map information, visual sightings, radar and sonar are combined in this screen to show the location of your submarine, torpedoes, and all known enemy ships. Your submarine is represented by a black dot, torpedoes and enemy ships are white dots, green areas represent land masses and islands. You may enlarge or shrink the map to any of four levels of detail (using the Z and X keys). The initial map shows the entire Western Pacific. The Patrol Area map shows a 500 by 300 mile area. Zoom again and you will see the Navigation Map which shows 60 by 40 miles. The most detailed map; the Attack Plot Map, shows an area of 8 miles by 5 miles. On the Attack Plot, ships are displayed with small "tails" which indicate the direction each ship is moving. If an enemy ship is no longer within sighting range, a dot will flash slowly at its last known position.



If more ships, torpedoes, etc. are active than the tracking party can handle, the most distant objects may be dropped from the map. As on most screens, the bottom of the screen displays messages from the crew and the sub's speed, depth, and course.

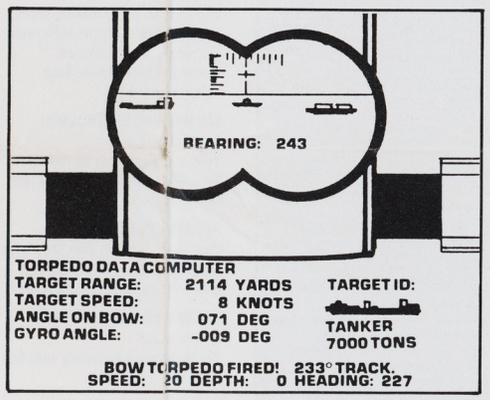
Battle Station: Bridge

The bridge screen provides a wide-angle view of nearby ships, islands, and coastline. This screen also displays the current visibility conditions (good, average, or poor). You may only select this screen if your sub is on the surface. To look to the left or right, press the joystick in that direction. Notice that the "Bearing" changes as you rotate. Bearing is the direction in which you are looking expressed in compass degrees. Bearing 000 indicates you are looking North, 090 is East, 180 is South and 270 is West. Holding down the joystick fire button will increase the speed of rotation. Note that the joystick does NOT change the heading of your submarine, only the direction in which you are LOOKING. Use the keyboard commands to control the sub while on the bridge.



Battle Station: Periscope/Binoculars

This screen displays the view through the attack periscope during daylight/dusk/dawn and the view from the bridge Target Bearing Transmitter binoculars at night (the attack periscope did not transmit enough light to be used at night). This screen shows an enlarged image of visible ships and land. The periscope may be rotated using the joystick (hold down the fire button for fast rotation). When the crosshairs turn white, the Torpedo Data Computer is activated and target tracking is displayed.



You may fire a torpedo by pressing "T", fire the deck gun by pressing "G", or request target information from the Identification party by pressing the "I" key.

The Torpedo Data Computer displays the range to the target, the target's speed and "angle on the bow", the computed gyro lead angle necessary to hit the ship, and the target's course. This last piece of information is not available if you have selected the "Enter Angle-on-Bow" reality level.

This screen may be selected when the sub is on the surface or at periscope depth in daylight (44 feet or less).

Instruments and Gauges

This screen displays vital status information. The straight up position for all gauges represents a zero value, with increasing values in the clockwise direction. The primary instruments and gauges are:

(A) BATTERY LEVEL — a gauge indicating the amount of electricity remaining in the battery. The battery is used for submerged cruising and is gradually recharged when on the surface. If your battery is exhausted you will be unable to move while underwater. A fully charged battery will allow one hour of high speed manoeuvering underwater, five or six hours at slow speeds.

(B) BATTERY CHARGE LIGHT — indicates the battery is being charged.

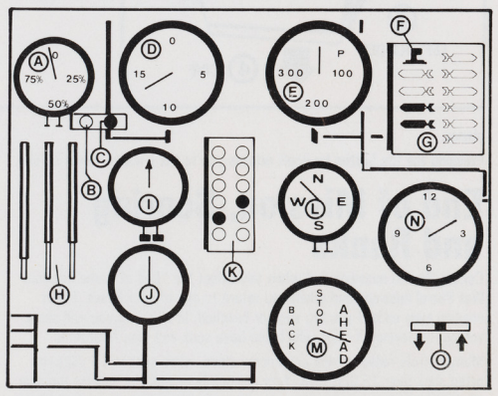
(C) BATTERY IN USE LIGHT — indicates the battery is being drained.

(D) SPEED — a gauge indicating the sub's speed through the water. Maximum surface speed is 20 knots, maximum submerged speed is 10 knots.

(E) DEPTH — a gauge showing the current depth below the surface. Periscope depth is 44 feet or less. Note that depth measured in feet below the surface; zero depth means the sub is on the surface.

(F) PERISCOPE INDICATOR — this indicator in the upper left of the torpedo status box is white if the periscope is raised, black if down.

(G) TORPEDO READY INDICATOR — a series of lights indicating which forward and aft torpedoes tubes are ready for firing. Green indicates ready, black indicates empty. Torpedo reloading is performed automatically and requires about 10 game minutes per tube. The green number under each column of torpedoes indicates how many bow/aft torpedoes remain in addition to those already in the tubes. The red number above the indicator indicates how many deck gun shells remain.



(H) FUEL LEVELS — three vertical tubes showing the diesel fuel levels in the three main tanks. The diesel fuel floats on top of the water. The tubes show the amount of fuel (black) and water (white) in each tank. Full tanks allowed for 50 to 60 days cruising.

(I) DEPTH UNDER THE KEEL — a gauge showing the depth from your sub to the ocean bottom. When this gauge reads zero you will run aground. Maximum reading on this gauge is 500 feet.

(J) WATER TEMPERATURE — a gauge showing the temperature of the water outside the submarine. A blue dial hand indicates that the submarine is below a thermal gradient layer.

(K) "CHRISTMAS TREE" — light indicating the status of all hull openings. Green light indicates closed, red light indicates open. Hull openings are closed automatically when you give the order to dive.

(L) COMPASS — indicates the direction the submarine is heading.

(M) THROTTLE 0—4 throttle settings. All stop ⅓, ⅔, full and flank speeds.

(N) CLOCK — shows the time of day. The sweep hand shows MINUTES and the number printed below is the HOUR (0—23) in 24 hour time. Dusk in the Pacific is from 7:00 PM (Hour 19) to 8:00 PM (Hour 20) dawn is from 5:00 AM to 6:00 AM.

(O) DIVE BUBBLE — a horizontal tube showing whether the submarine is diving or surfacing.

Damage Reports Screen

This screen indicates the nature of any damage to the submarine. Damage may be caused by depth charge attacks or enemy gunfire. Types of damage include:

Bow/Aft torpedo damage: these torpedo tube doors have been damaged. The torpedoes will not fire.

Periscope damage: the periscope housing has been damaged. The periscope cannot be lowered or raised.

Dive Plane damage: the bow and stern dive planes have been damaged. The submarine will only dive or surface at half its normal rate.

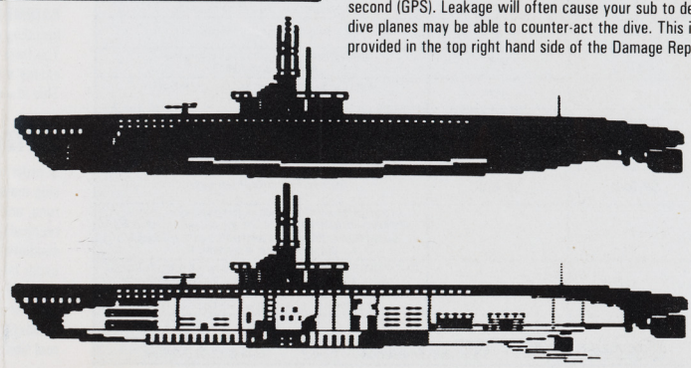
Fuel Leaking: the external fuel tanks are leaking. Fuel will be consumed at twice the normal rate. In addition, fuel rising to the surface will make the submarine easier to detect by enemy destroyers.

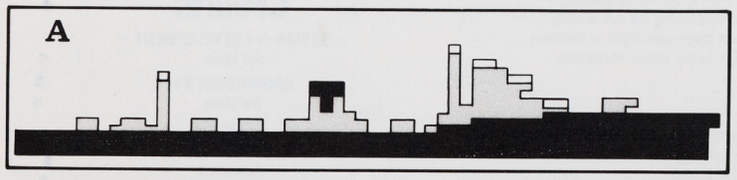
Engine Damage: the main diesel engines are damaged. Surface speeds are reduced by half.

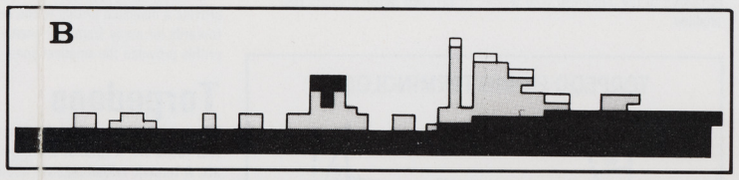
Machinery Damage: internal pumps and engines are damaged. The extra noise makes the enemy's sonar tracking easier.

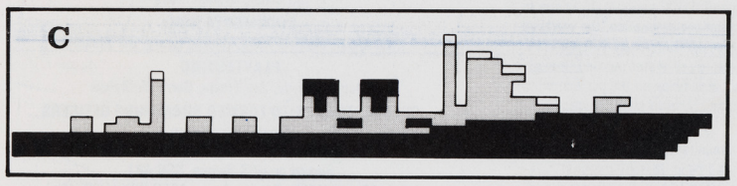
Battery Damage: batteries are used up at twice the normal rate when submerged. If the "Port Repair Only" reality level is not selected repairs are attempted by the crew automatically.

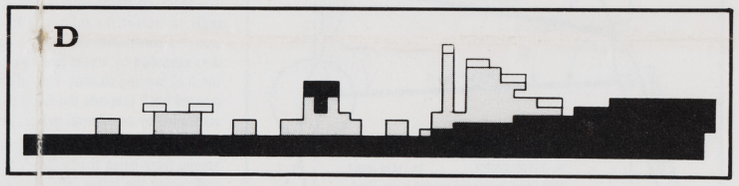
If your sub is taking on water, the leakage rate is indicated in gallons per second (GPS). Leakage will often cause your sub to descend, although the dive planes may be able to counter-act the dive. This information is provided in the top right hand side of the Damage Reports Screen.











Loading Instructions

COMMODORE 64/128 DISK

Before loading, be sure your joystick is installed in port 2, nearest the back of the computer.

If you have a Commodore 128, place the computer in C-64 mode by typing GO 64 followed by RETURN. (As directed by your hardware manual to establish the C-64 mode).

C-64 and 128: type LOAD "*", 8, 1 press RETURN.

You will be asked to select "Fast load" or "Normal load". Fast load is designed to reduce loading times from a 1541 disk drive. If your disk drive experiences any difficulty with the Fast load, try the Normal load option. Leave the game disk in the disk drive at all times.

The function keys "F1" through "F8" refer to the keys f1-f8 on the far right of the keyboard.

At some point, you may wish to clear the Submariner's Hall of Fame rankings. To do this; boot the machine, type LOAD "CLEAR", 8 followed by RETURN, when the computer responds with READY, type RUN followed by RETURN.

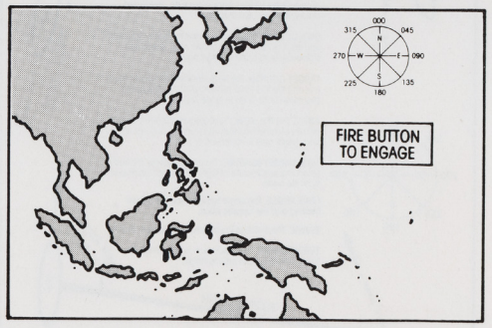
COMMODORE 64 CASSETTE

1. Insert side 1 of the cassette into datasette.
2. Hold down the SHIFT key and press RUN/.
3. Press PLAY on the datasette.
4. Once the game has loaded you will be presented with a series of options screens.
5. After making your selections you will be prompted to insert side 2. Rewind fully.
6. Press PLAY and hit any key.

ATARI

This program requires an ATARI 400/800/1200 XL/XE computer with at least 48K of memory and a disk drive. To load the program, remove all cartridges from the computer, insert the game disk in your disk drive, and power your system up. The joystick should be connected to the first joystick connector.

The function keys "F1" through "F8" refer to shift-1 (!) through shift-8 (@). The "F7" function may also be selected by pressing the START key.



The submarine bases at Midway Island, Fremantle, and Brisbane are indicated by flashing dots. When you have reached your base and the screen border turns green, you may end the patrol by pressing the fire button. If you get the urge to explore a particular area of the map, you may do so, even if no convoys have been sighted and you are not at your base. Simply press the fire button.

Sub Control Diagram and Status Area

The bottom two lines of most screens contain the sub control diagram and the status area. The sub control diagram on the left is a rear view of your sub with the current rudder, dive plane and throttle settings displayed. Left and right arrows indicate left/right rudder, up and down arrows indicate up/down dive planes, and a number 0–4 shows the throttle setting. The bottom line displays your current speed (in knots), depth (in feet) and heading (in degrees). The top line is used to keep you informed of status messages from the crew.

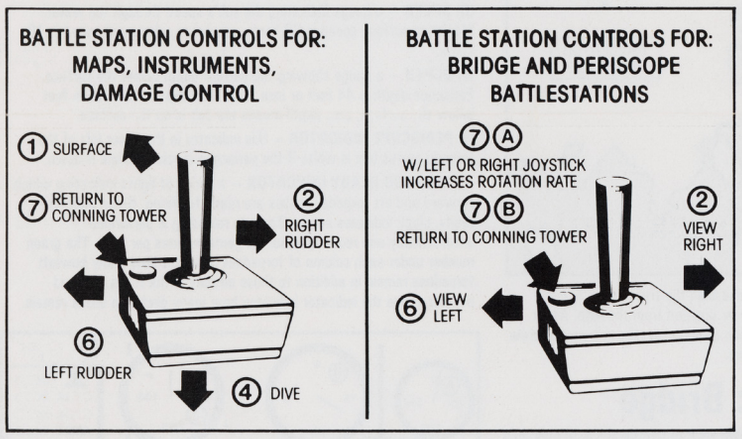
Using the Joystick

Many commands such as battle station selection or controlling the sub may be accomplished either via the joystick or through keyboard commands.

Holding the joystick right or left will rotate the periscope or bridge views and is used to aim your torpedoes and gun. You may accelerate this rotation by pressing the fire button.

On remaining screens you may control your sub using the joystick; hold the stick left or right to control the rudder, up or down to affect the dive planes.

Pressing the fire button by itself returns you to the conning tower screen.



End of Mission, Scoring and Ranks

Convoy Action missions end when you select the "End of Game" option. War Patrol missions end when you return to one of your bases. Either mission type ends if you are sunk or beached. In all cases you will see a screen displaying all ships which you have sunk and your final rank.

Many patrols failed to sink any enemy ships, while successful captains often sank over 15,000 tons. Your mission is to sink the highest tonnage of shipping without losing your sub. The simulation records your sinkings automatically. Your ranking will be based on tonnage sunk, difficulty level, and reality levels chosen.

The higher the levels, the more value your tonnage is given. All players will rank at least Ensign. Higher levels are Lieutenant JG, Lieutenant, Lieutenant Commander, Commander, Captain, Vice-Admiral, Admiral, Fleet Admiral, and ultimately WGSC (World's Greatest Submarine Captain)!

Press "F7" from this screen to embark on a new mission.

Submariner's Hall of Fame

If you have a successful cruise, you will be prompted to enter your name. This makes you eligible for the Submariner's Hall of Fame! The Hall of Fame records the best rankings achieved and also includes the real-life tonnages sunk by five submarines in actual war patrols.

Remember that your rank is computed based on both tonnage sunk and the difficulty factors used.

Messages and Sounds

You may receive messages at any time from various members of the crew. Rudder, throttle, and periscope commands will be acknowledged. You will also hear the sounds of your own engines, nearby ships, and torpedoes. In addition there are messages and sounds with special meanings:

SONAR REPORTS DESTROYERS CLOSING. ("ping" sound)
The sonarman is reporting that the submarine has been located by the enemy's sonar.

SONAR REPORTS DEPTH CHARGES DROPPED. ("splash" sound)
The sonarman is reporting that a destroyer overhead has dropped depth charges into the water.

DEPTH CHARGES EXPLODING! (explosion sounds)

LOOKOUTS REPORT DESTROYERS FIRING. (gun sound)
Lookouts on the bridge are reporting that enemy destroyers are in range and are firing at the sub.

SHELL HIT! SUB DAMAGED. (whistling explosion sound)
Your submarine has been hit by a destroyer's shell. Damage has been sustained.

BOW (AFT) TORPEDO FIRED! 135° TRACK. (torpedo launch, torpedo motor sounds)
One of your torpedoes has been launched in the direction indicated.

DECK GUN FIRED! (gun fire sound)
You have fired your deck gun in the direction indicated.

SONAR REPORTS DISTANT EXPLOSIONS. (Distant explosion sound)
The sonarman is reporting a torpedo or gun hit.

WARNING: TEST DEPTH EXCEEDED. (hull creaking sound)
You have exceeded the subs rated test depth, small leaks are starting. (Check the Damage Reports screen.)

WE HAVE RUN AGROUND! (grinding sound)
Your sub is scraping the bottom. You will be stopped until you rise off the bottom.

REPAIRS COMPLETED.
Work parties report that they have repaired a damaged component; check the damage reports screen.

BLOW EMERGENCY TANK! (alarm sound)
The emergency buoyancy tank has been emptied.

RAMMED BY ENEMY SHIP! (grinding sound)
You have been rammed by an enemy ship and will start to sink. This is usually fatal.

Time Scaling

In order to ensure accuracy, all ship movement, sightings, torpedo runs, and dive rates are recalculated every two seconds of simulated game time. However, under most conditions it is desirable to speed up the action somewhat. Normally the simulation proceeds at four times real time one minute of game time takes 15 seconds. If the "F" key is pressed, the time scale is doubled. Repeated pressing will continue to increase the time scale up to a maximum of 32 times real-time (i.e. one hour of game time will take 2 minutes at time scale 4). When the "N" command is entered, you are detected by the enemy or torpedoes are fired, the time scaling returns to normal.

SUB DETECTION TABLE (10 knots)

	DISTANCE IN YARDS	DAY	NIGHT
SURFACED			
Full Profile		20000	3000
Minimum Profile		8000	1000
PERISCOPE DEPTH			
Full Profile		6000	2000
Minimum Profile		2000	800
SUBMERGED*			
Full Profile		2000	2000
Minimum Profile		800	800

*if the submarine was under a temperature gradient layer, the sighting range was substantially less.

Capabilities

The US Fleet Submarine of the Second World War was an outstanding weapon. With 200 tons of diesel fuel and a cruising range of 12,000 miles, no area of the Pacific was safe for enemy shipping. Four diesel engines produced 6,400 horse-power for a maximum surface speed of 20 knots. Battery driven electric motors provided submerged propulsion at up to 10 knots for short periods. The rated test depth of the first submarines was 300 feet, while later craft were rated for more than 400 feet. Both were capable of somewhat greater depths under emergency conditions.

Standard Equipment

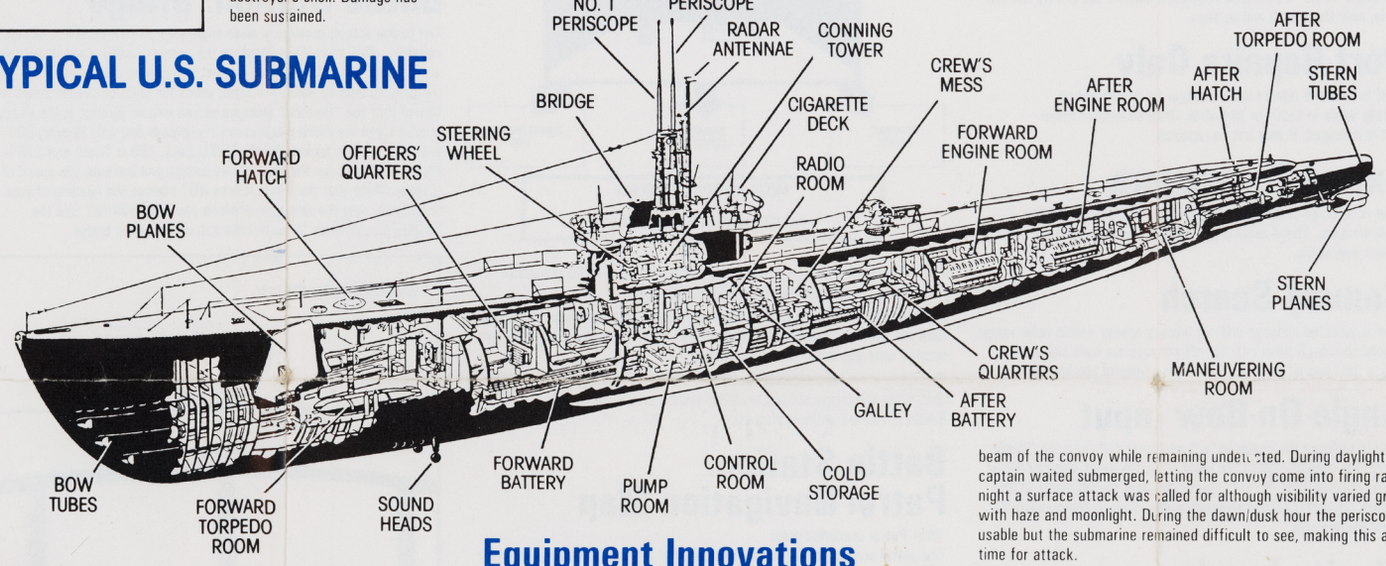
The WWII fleet submarine incorporated a variety of navigation, detection, and fire control devices.

The periscope could be used for visual observation to a depth of 44 feet. The scope provided target range and bearing information to the Torpedo Data Computer.

Surface Radar could be used on the surface or at periscope depth. SJ surface radar had a range of up to 16,000 yards.

Passive (listening) sonar became the primary source of information when submerged. Experienced sonar operators could determine ship speed, bearing, and estimated range up to a distance of 6,000 yards.

TYPICAL U.S. SUBMARINE



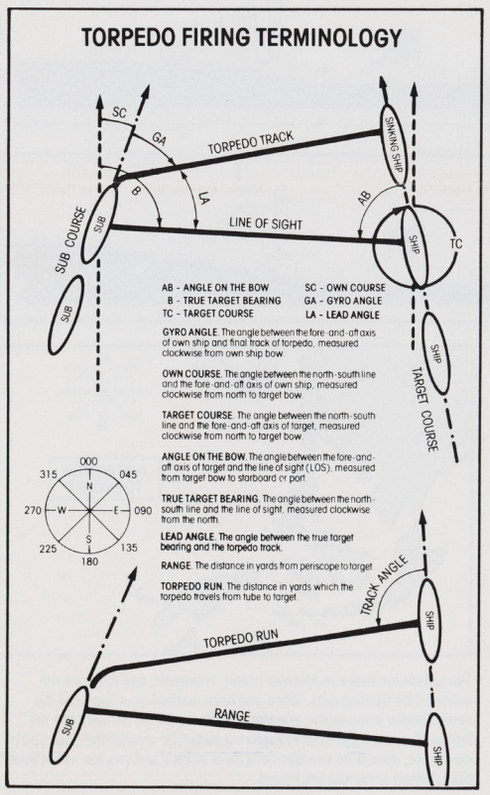
Equipment Innovations

At various times during the war, significant new equipment and tactics were introduced.

November 1942: US submarines were equipped with surface radar. This allowed enemy ships to be detected at ranges of up to 16,000 yards. Prior to this time, visual sightings and sonar were the only means of detecting enemy ships.

April 1943: The Japanese increase the escort strength for their vital tanker and troop ship convoys. All such convoys now contain at least one escort.

August 1943: A new stronger pressure hull on US submarines increases the maximum safe depth from 300 to almost 425 feet. This change was unknown to the Japanese who tended to set their depth charges too shallow.



September 1943: An improved detonator is fitted onto American torpedoes, greatly reducing the incidence of "dud" torpedoes.

January 1944: Mark 20 Electric torpedoes are introduced. These "wakeless" torpedoes no longer pinpoint the location of a submarine firing torpedoes. But their relatively slow 30 knot speed requires a good close-in attack position.

July 1944: The Japanese introduce radar on their escort vessels, making surface attacks much more difficult.

Submarine Tactics

A successful submarine attack was very much a team effort by the entire submarine crew, with the captain directing. The torpedomen and machinists mates maintained the torpedoes and engines. The soundman listened to the enemy ship through sensitive underwater hydrophones. By counting propeller revolutions and rotating the hydrophone, the soundman could estimate the enemy's speed and bearing. A radar party tracked the enemy on SJ surface radar. In the conning tower, the tracking party plotted the submarine's position and the position of enemy targets and escorts on the attack plot map. The identification party stood ready to identify enemy ship types as the captain called out his periscope observations. On the bridge, lookouts scanned the seas for enemy ships. As the submarine approached the enemy, tracking party fed the enemy's speed, course, range and bearing into the Torpedo Data Computer to calculate the correct gyro angles for torpedo firing.

At the focus of this activity, the captain made the crucial decisions which spelled the difference between success or failure. Carefully weighing the number of escorts, the types of ships, visibility, water depth, number of torpedoes remaining, battery charge, the convoy's course and speed he decided how, when and where to attack the enemy.

Within their low surface profile and ability to submerge, stealth and surprise were a vital ingredient in all submarine attacks. Once an enemy ship or convoy had been spotted a successful attack required a well thought out approach to within a few thousand yards of the enemy without being detected: quick and decisive torpedo aiming and firing: and the clever use of speed, depth and water temperature to evade the inevitable counterattack.

The Approach

The first priority upon sighting an enemy convoy was to determine its course and composition. At this point the decision to attack would be made. Next, the captain would direct his sub to a position ahead or on the beam of the convoy while remaining undetected. During daylight, the captain waited submerged, letting the convoy come into firing range. At night a surface attack was called for although visibility varied greatly with haze and moonlight. During the dawn/dusk hour the periscope was usable but the submarine remained difficult to see, making this an ideal time for attack.

The key to the approach phase was to achieve a favourable firing position without being detected by the enemy's escorts. As a result of the submarine's slow underwater speed, much of the manoeuvering during the approach has to be conducted on the surface, which made the sub vulnerable to detection. US radar could detect ships at a range of 16,000 yards (8 miles) or more. This generally gave the submarine the initiative as Japanese lookouts might see a sub at 10,000 yards during the day or 3,000 yards at night. When submerged, passive (listening) sonar could track Japanese ships at up to 6,000 yards, although this range lessened quickly if the sub was moving or at depth. Japanese sonar could detect a rapidly moving submerged submarine at up to 5,000 yards, although at maximum depth and rigged for silent running, they were very difficult to find. Both during approach and escape the captain would attempt to provide a minimum profile to the enemy by pointing the sub directly towards (or away from) the enemy. Even when submerged, a minimum profile provided the smallest sonar target to the enemy destroyers.

Torpedoes

Primary submarine armament consisted of six torpedo tubes forward and four tubes aft. A total of 24 torpedoes were carried: 14 forward and 10 aft. A torpedo reload required about 10 minutes.

The Mark 14 steam torpedo had a range of 4,500 yards at 46 knots. In order to protect the submarine from premature detonation, the warhead was not armed until the torpedo had travelled 450 yards. The Mark 14 was propelled by steam generated by a spray of water passing through a torch of burning alcohol. This left a trail of bubbles on the surface which pointed back towards the firing submarine. Torpedo steering was controlled by an internal gyroscope.

These complex devices suffered from a number of severe problems. Chief among them being the tendency to run too deep, thereby passing underneath the target, and the tendency of the Mark 6 exploder not to explode on contact with the target. Both of these problems were eventually corrected as the war progressed.

In late 1944 the Mark 18 electric torpedo was introduced. This weapon ran slower than the steam torpedo, 30 knots. However, it did not produce the tell-tale bubble stream of its predecessor. Sub commanders were no longer forced to escape after the first torpedo salvo. Under ideal conditions, ship after ship could be sunk as the escorts circled frantically searching for the unseen attacker.

Most torpedoes were therefore fired at a range of 1,000–3,000 yards. The best torpedo track was one which was perpendicular to the course of the target ship.

This provided the largest potential target area. Head-on shots or stern shots were unlikely to hit their target.

Torpedo Data Computer

Contrary to popular belief, the captain did not estimate an amount by which to "lead" the target. US submarines used a Torpedo Data Computer (TDC), an early-model analog device. The TDC, when fed with the target speed, range and course, automatically calculated the correct torpedo track. The TDC calculated and fed the gyro angle directly to the gyroscope which steered the torpedoes.

The gyro angle calculated by the TDC was based on the target's maintaining a constant course and speed. The captain would often aim slightly ahead or behind the target ship if he expected a particular change in course. Frequently a "spread" of torpedoes was fired by aiming one torpedo slightly ahead of the target, one torpedo directly at the target, and one torpedo slightly behind the target.

In this simulation the gyro lead angle is automatically added to your periscope bearing when the torpedoes are fired. Example: you have an enemy ship centred squarely in your crosshairs, bearing 090 degrees (due East). The target is on a course of 180 (South). The TDC calculates a gyro angle of 10 degrees. If you fire a torpedo it will assume a 100 degree track: (your 090 degree periscope bearing plus 10 degrees gyro angle) and should hit the target. In the same situation, if your periscope is pointed at 085 (slightly behind the target) your torpedo will assume an 095 track (85 + 10). This torpedo should pass behind the target but may hit if the target zigs or zags.

It was important to make the first set of torpedoes count. Once the torpedo tracks were spotted, the convoy would begin to zig-zag radically and the escorts would charge in on the sub's position.

The captain's role during the firing procedure was to call off range, bearing, and angle on the bow information which were input into the TDC and to select the moment to fire the torpedo(es).

Deck Gun

Most US subs were equipped with a 4-inch deck gun. This gun had a range of up to 8,000 yards and a fairly rapid rate of fire. Although infrequently used, the deck gun was effective in sinking badly damaged targets or to slow a ship down and force it to fall behind the convoy. The gun was also used as a last ditch measure by subs which had been forced to surface or had suffered too much damage to dive safely.

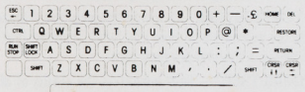
The gun may only be fired when your sub is on the surface. Use the crosshairs on the periscope/binocular screen to aim the gun. The range is automatically set to the TDC range of the target at which you are aiming. Use the "+" and "–" keys to add or subtract deflection from this range. Example: an 18 knot destroyer coming directly towards you from 4,000 yards away will move over 200 yards in the time it takes to shell the target. Therefore you should use the "–" key to select a deflection of –200 to –250 yards before firing the gun. At 2,000 yards the shell will only take half the time to reach the target, so a –100 yard deflection should be used. More than one shell may be in flight at any one time. You will see a splash of water when the shell lands. If the shell hits its target, you will see and hear the explosion. Your gun is supplied with 80 shells.

Escape

If detected by enemy escorts, escape became the sub's main objective. A submarine was no match for even a single destroyer in a gun and ramming duel. The usual tactic was to dive as deeply as possible and rig for silent running. The enemy escort would circle over the last known position of the submarine, hoping to pick up a sonar echo from the submarines hull. Maintaining a minimum profile and maximum running noise was especially important under these circumstances. A strong temperature gradient could also provide some protection from the enemy's sonar. Leaking fuel or machinery damage made the escort's job easier. Submarines gained some benefit from their tighter turning circle and ability to constantly track the escorts propeller noises. Under extreme circumstances, a sub might try to convince the attacking destroyers that it had been destroyed by releasing oil and debris which floated to the surface.

At night the sub's 20 knot surface speed was sometimes sufficient to outrun pursuing escorts.

Keyboard Commands



COMMAND	C-64	ATARI*	DESCRIPTION
MAP	F1	SHIFT 1	Select the Maps and Charts battle station screen. If you are already at the Maps and Charts, pressing this key will re-center the map on your sub.
BRIDGE	F3	SHIFT 2	Select the Bridge battle station screen. This is only possible when the sub is on the surface.
SCOPE	F5	SHIFT 3	Select the Periscope/Binocular battle station screen. This display is only available if the sub is at periscope depth or on the surface.
GAUGES	F7	SHIFT 4	Select the Gauges and Instruments battle station screen.
DAMAGE	F2	SHIFT 5	Select the Damage Reports battle station screen.
LOG	F4	SHIFT 6	Display the Quartermaster's Log for the current patrol.
PATROL/END	F8	SHIFT 8	Return to the Patrol Selection display to search for another convoy. This ends the game if you are playing a "Convoy Action" scenario.
ZOOM	Z	Z	Expand the situation map display. Used to take a closer look at nearby ships and terrain.
UNZOOM	X	X	Compress the situation map display. Used to get a wider view of ship locations and land areas.
THROTTLE	0–4	0–4	Throttle settings. All stop, 1/3, 2/3, Full, and Flank speeds.
DIVE	D	D	Causes your sub to dive to a deeper depth. When you have reached the desired depth, cancel this command by pressing Return.
SURFACE	S	S	Causes your sub to come up to a lesser depth. Cancel this command by pressing Return.
REVERSE	R	R	Reverse the engines. Note that the turning effect of the rudder is reversed if the sub is proceeding in reverse.
EMERGENCY	CONTROL E	CONTROL E	Blow emergency tanks. This will often halt an otherwise fatal dive. However, it will generally bring the sub to the surface. You may only perform this once per engagement.
PERISCOPE	P	P	Raise/Lower periscope. This command also sets the visual bearing to be the same as your sub's heading — you will be looking straight ahead.
ID	I	I	Identify target on scope.
TORPEDO	T	T	Fire torpedo. Bow or aft tubes will be selected automatically depending on which faces the target more directly. Note that four torpedoes or gun shells may be active at any one time. If a fifth torpedo is fired before the first completes its run, the first torpedo will end its run prematurely and the new torpedo will be launched.
GUN	G	G	Fire the 4-inch deck gun.
UP 25	+	>	Add 25 yards to the deck gun range deflection.
DOWN 25	-	<	Subtract 25 yards from the deck gun range deflection.
FASTER	F	F	Increase the time scale to cause the simulation to proceed more rapidly.
NORMAL	N	N	Return to normal time scale.
LEFT	↓↑	←*	Left Rudder. Press again for Full Left Rudder. To cancel press Return.
RIGHT	≒	→*	Right Rudder. Press again for Full Right Rudder. To cancel press Return.
CANCEL	RETURN	RETURN	Cancel turn and dive commands.
WAIT	W	W	Pause the simulation — press any key to continue. You may also pause by going to the Conning Tower screen.
CONNING TOWER	SP. BAR	SP. BAR	Return to the conning tower screen.
RELEASE DEBRIS	?	?	In a desperate situation, a sub might release debris and oil which would rise to the surface. The objective was to convince the escorts that the sub had been sunk. You may only use this ploy once per engagement.
AOB	A	A	Enter Angle-on-Bow estimate. Angle-on-Bow is entered in degrees by holding the joystick left or right. Press the fire button to enter the estimate. Use positive numbers for Port, negative numbers for Starboard, i.e., 45 degrees Starboard is -045.

*It is not necessary to press control key for Atari.

Credits

DESIGN and DEVELOPMENT
Sid Meier

COMMODORE 64:
Sid Meier

ATARI ST:
Silas Warner

GRAPHICS:
Sid Meier, Michael Haire

DOCUMENTATION:
Sid Meier, Michael Haire, George Geary, Bill Stealey

PLAYTESTING
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SPECIAL THANKS TO FORMER SUBMARINE OFFICERS
Frank Shakespeare
U.S. Naval Academy, Class of 1953
Served on USS Requin, SSR 481
Gold Medalist, U.S. Rowing Team, 1952 Olympic Games
Alan R. Thornton
U.S. Naval Academy, Class of 1967
Served on USS Robert E. Lee, SSBN 601

COVER ART:
David Phillips

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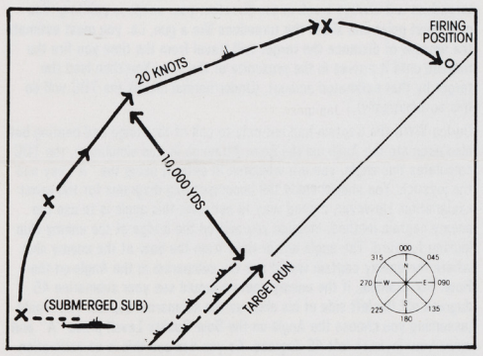
Tactical Situation Plots

The diagrams below will provide some sense of the combat situations faced by submarine captains. These are by no means all of the potential situations which you will encounter. They are presented here as examples of real-life submarine tactics and to assist you in surviving the myriad dangers of undersea combat.

Situation 1: End Around Attack

You are at periscope depth and have just sighted a 10-knot convoy bearing 090 degrees (due East). You determine the enemy's base course to be 045 (Northeast). It is around noon: seven hours of daylight remain. The convoy is escorted by at least one destroyer. Your torpedo tubes are full and your battery is fully charged. What is your plan?

This is a difficult situation: the convoy is steaming too fast for a submerged approach. A cautious skipper might leave this convoy alone and look for easier game. A foolhardy captain might charge in for a stern surface attack, but a surfaced submarine is no match for a destroyer during daylight.

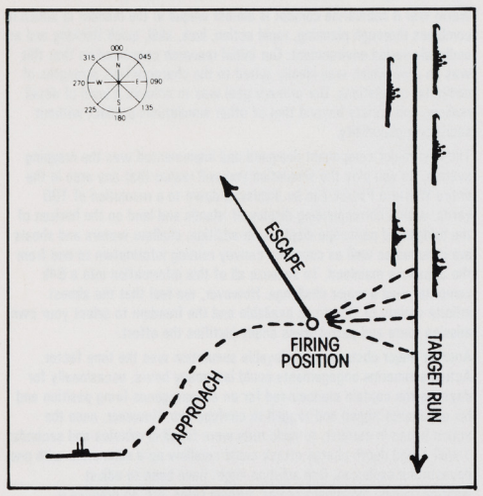


The experienced skipper would probably try the "end-around" tactic. Turn and proceed submerged away from the convoy until you are out of visual sighting range — about 10,000 yards depending on the visibility. Now surface and use maximum speed to achieve position ahead of the convoy, taking care to stay out of visual sighting range. Track the convoy on radar as you proceed. If an escort leaves the convoy and heads in your direction, you have probably been sighted — dive immediately. It may take some time to carry out this manoeuvre, use the time scaling feature to speed up the simulation. Once you are in front of the convoy, go to periscope depth and wait for the convoy to come to you. Make your torpedoes count! (Note that this situation is similar to the USS SEARAVEN scenario).

Situation 2: Night/Surface Intercept

You are patrolling on the surface when radar picks up a convoy bearing 045 (Northeast). It is a dark and hazy night. Radar determines the enemy's base course to be 180 (South) at 8 knots. Two "kaibokan" escorts appear to be leading the convoy. What do you do?

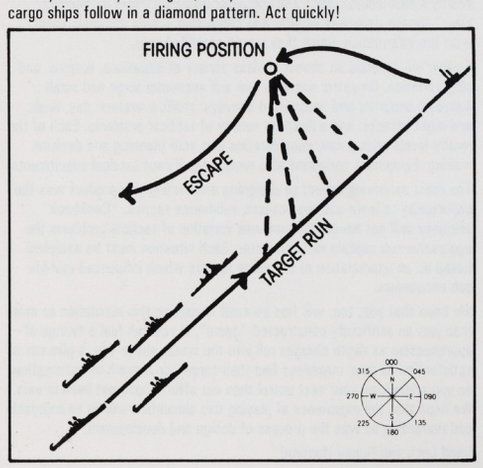
This is an excellent set up. You are ahead of the convoy and visibility is poor. Your primary consideration should be to avoid detection by the escorts as you approach the convoy. Use moderate speed and keep your bow pointed towards the escorts as much as possible. This provides only a small visual target for the enemy lookouts to detect.



You should be able to reach an ideal firing position off the convoy's beam at a range of 1,000-2,000 yards. If you time your approach when the escorts are busy on the other side of the convoy, you may be able to escape on the surface: the "kaibokan" can only turn 18 knots. Good Luck! (Note that this situation is similar to the USS HAMMERHEAD scenario).

Situation 3: Daylight/Submerged Attack

During a routine day periscope sweep you observe a convoy heading directly towards you: range 4,000 yards! An escort is in the lead and four cargo ships follow in a diamond pattern. Act quickly!

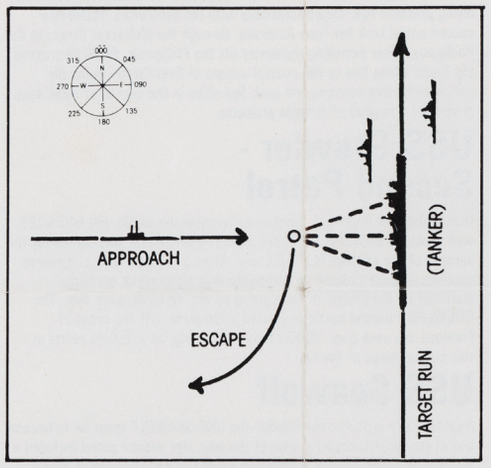


You should immediately head perpendicular to the convoy's track to put yourself into a favourable firing position for a broadside torpedo shot. Since you will be turning your broadside to the enemy you should dive to reduce the chance of sonar contact. Once in firing position, wait until the two middle ships give you an "overlapping" target.

Torpedoes which miss the closer ship then have a good chance of hitting the further ship.

Situation 4: Avoiding Enemy Escorts

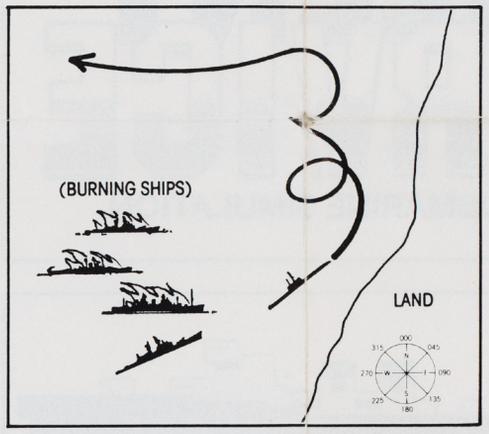
You have just loosed three steam torpedoes at a particularly juicy tanker. The two escorting destroyers have not detected your presence. You are at periscope depth during daylight.



It is extremely tempting to watch your torpedoes as they head towards the target. You will only do this once! As soon as your torpedoes reach their target, the bubble trails will point directly to your firing position. At 26 knots, the destroyers will be there quickly. You must get away immediately. Head away from the destroyers at maximum speed, dive as deeply as possible. If the destroyers get close, minimize your speed to reduce noise. Two escorts can be very dangerous, as it is usually impossible to present a minimum sonar profile to both ships.

Situation 5: Shallow Water Escape

You are in trouble! Behind you three cargo ships are burning from a well-planned torpedo salvo. But an angry escort is charging towards you. The constant pinging leaves no doubt that you have been detected. To make matters worse, you are close inshore in less than 100 feet of water! What now?



You are probably in for a long afternoon. At this depth, a depth charge attack might well be fatal. Your best bet is to use your sub's tight turning circle to prevent the escort from getting directly overhead.

Follow him on the attack plot map; try to anticipate his manoeuvres. Use maximum forward and reverse speeds to dodge him. Whenever you get a chance, head out towards deeper water — it is your only chance for escape.

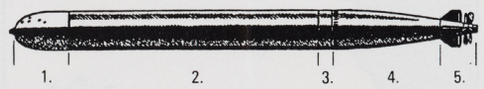
Submarine Warfare in the South Pacific

The American fleet submarine was a complex and formidable war machine ideally suited for the vast reaches of the Pacific and the far-flung Japanese convoy routes. American submariners developed an aggressive doctrine which frequently took them into the heavily travelled waters off the coast of Japan.

Sub skippers vied to surpass each other in ship and tonnages sunk. As the war progressed, US sub strength grew from a handful of antiquated craft to a powerful striking force of over two hundred vessels. The ranks of the sub commanders were also transformed as the pressures of undersea warfare weeded out the peacetime sailors and forged an elite cadre of young, aggressive, and skillful captains.

The history of submarine warfare in the Pacific is the story of these men and the highly trained crews they led. Each patrol, each attack was a personal confrontation between these men and a skillful and determined enemy. The Allied victory in the Pacific was in no small measure a consequence of their overwhelming success.

Typical Torpedo



1. War Head.
2. Air Flask (fuel water).
3. Midship Section (combustion flask igniter).
4. Afterbody (oil tank, turbines, depth engine, gyro steering engine, immersion mechanism, starting level, depth index).
5. Tail (exhaust manifold).

U.S. Submarines in the South Pacific

EMERGENCE OF THE U.S. SUBMARINE: Operational submarines date back to the time of the American Revolution, but it was not until the Second World War that the "Silent Service" came into its own as an essential part of the American armed forces.

Early efforts at submarine combat were beset with many problems. Submarines were deployed World War 1, but saw little action. The years that followed brought limited budgets, limited interests and U.S. sub development became a low priority item. The Japanese military, in contrast, had been constantly at war since the beginning of the 1930's. They enjoyed superior weapons and numbers, and their troops were battle-tested and combat ready. The Japanese sank a number of U.S. carriers and came close enough to the American West Coast to shell several targets there, including Los Angeles.

Japanese leaders were not infallible. Those leaders with first-hand knowledge of the vast industrial potential and internal resources of the U.S. were ignored by the majority of the Japanese military elite — a fatal lapse for a small island nation, heavily dependent on a vital shipping force. The Japanese also underestimated the strength and range of the 1930's vintage American subs, which were nearly a match for the Japanese I-boats at the beginning of the war. Compounding this shortsightedness was a deeply ingrained sense of racial superiority on the part of the Japanese. This arrogance would prove costly as the war progressed.

The early days of WWII undoubtedly reinforced the Japanese sense of superiority. The inexperienced American sub fleet got off to a lacklustre start, in large part due to uncertainty and disagreement over what their place in the war effort should be. As adjuncts to surface craft, subs were more active, but still were not encouraged toward independent action. Official policy at the time called for caution: sub captains were admonished not to be aggressive or to take chances. The lack of tangible success lowered crew morale and raised doubts about submarine effectiveness in the war effort.

DEVELOPING SUBMARINERS: Command inertia was not the only problem, it became clear that the special rigours of submarine service required a special captain and crew. The special situation of submarine service called for a different class of fighting man. Stern disciplinarians were not necessarily the best commanders: an aggressive and flexible kind of leader was needed to handle the myriad of situations a submarine faced. As for those of the crew, a more stoic, "get the job done" mentality proved more valuable in the tense conditions of sub warfare than cowboy bravado. An understanding of submarine psychology was a large step forward in improving submarine success.

TORPEDO TROUBLES: The lack of an effective and reliable torpedo plagued American forces throughout the war. Initially the poor showing of subs in the combat with the Japanese was attributed to human error. Some naval officials, as well as the Bureau of Ordnance, had fully supported the mark XIV torpedo and its Mark VI exploder. The Mark VI incorporated a magnetic detonator in addition to the conventional contact detonator in order to increase the torpedo's effectiveness against large heavily armoured craft. Laboratory testing proved very successful, but in actual combat situation, a chorus of complaints arose from sub commanders from across the fleet. An impasse arose with the torpedoes builders and backers on one side and the sub captains on the other. These captains claimed the torpedoes were running much deeper than they should, missing the target. When they did stay on course, the torpedoes often exploded prematurely or failed to explode at all. The Bureau of Ordnance continued to blame the performance of the sub crew for the problem, despite mounting evidence that something was indeed wrong with their torpedo. Once thorough testing was done, a faulty firing pin mechanism was discovered. When the torpedo had struck its target dead on, the firing pin was crushed in such a way that it could not trigger the explosion. Ironically, perfect sighting had usually resulted in a poor performance record for the submarine crew. Once the problem was conceded, the sub fleet was held in higher esteem by those in command. As performance levels rose, so did the morale of the submarine crews. Even so, the performance and scarcity of the torpedo hampered sub operations throughout the war.

THE BALANCE SHIFTS: By 1943, the balance of Pacific power was shifting to the Americans' favour. Broader combat experience and more effective subs and torpedoes were gradually putting the U.S. on the offensive for the first time. The Japanese remained a dangerous enemy — retaining an edge in experience and torpedo technology that they would keep throughout the war. Still, the lack of internal resources was taking its toll. Their earlier successful conquests had strung the Japanese forces on islands across the pacific, making their convoys of supplies even more important to Japanese success. The Americans recognized this vulnerability and successfully exploited it to defeat Japan.

Fully half of Japan's 6,000,000 tons of shipping were required just to sustain their civilian population. U.S. forces gradually closed in on Japan, choking off the supply arteries essential to the Japanese war effort. American subs sank nearly 3,000,000 tons of shipping, nearly half of what they had at the war's beginning. By the close of 1944, U.S. boats dominated the Pacific. With Army Air Corps bombers and carrier planes, U.S. subs could strike at will in nearly every corner of the Japanese empire.

The Japanese continued to suffer from a shrinking force of capable fighting men and morale was crippled by continued bombing of the Japanese homeland, something their warlords had promised would never come to pass. The Japanese forces were still dangerous, but their grip on the Pacific was irrevocably broken. The question in terms of time and lives yet lost remained, but American victory was now a certainty.

The war in the Pacific was the crucible which transformed the American submarine from a vague conception of uncertain worth into a full-fledged and eventually invaluable component of the American armed services.

Japanese Convoys

Japanese shipping generally travelled in small convoys of three to seven ships. Occasionally, cargo ships and warships might travel alone. As the war progressed and Japanese losses mounted, increasing numbers of escorts were assigned to these convoys. Convoys may consist of cargo ships, troop ships tankers, and destroyer escorts.

Tankers were the most important target class. The Japanese were critically dependent on the flow of oil to keep the Main Battle Fleet in operation. Troop ships were also important targets. These ships transported troops to and from their far-flung island conquests. You are more likely to find these valuable ships among the shipping lanes which lead directly to Japan.

Cargo ships represented the majority of Japanese shipping. They conveyed supplies and equipment to and from the Japanese homeland.

Escorts came in two classes; destroyers were often used for escort duty, especially in important convoys. The Japanese also constructed a special class of escort for anti-submarine defense: the "Kaibokan". Both destroyers and Kaibokan were armed with guns to engage submarines on the surface, sonar to detect submarines below the surface, and depth submarine on the surface could outrun a Kaibokan, which had to top speed of less than 20 knots. Destroyers could steam at close to 30 knots.

A twisting, speeding, shallow-draft escort was a very difficult torpedo target, although a single hit was generally sufficient to sink one.

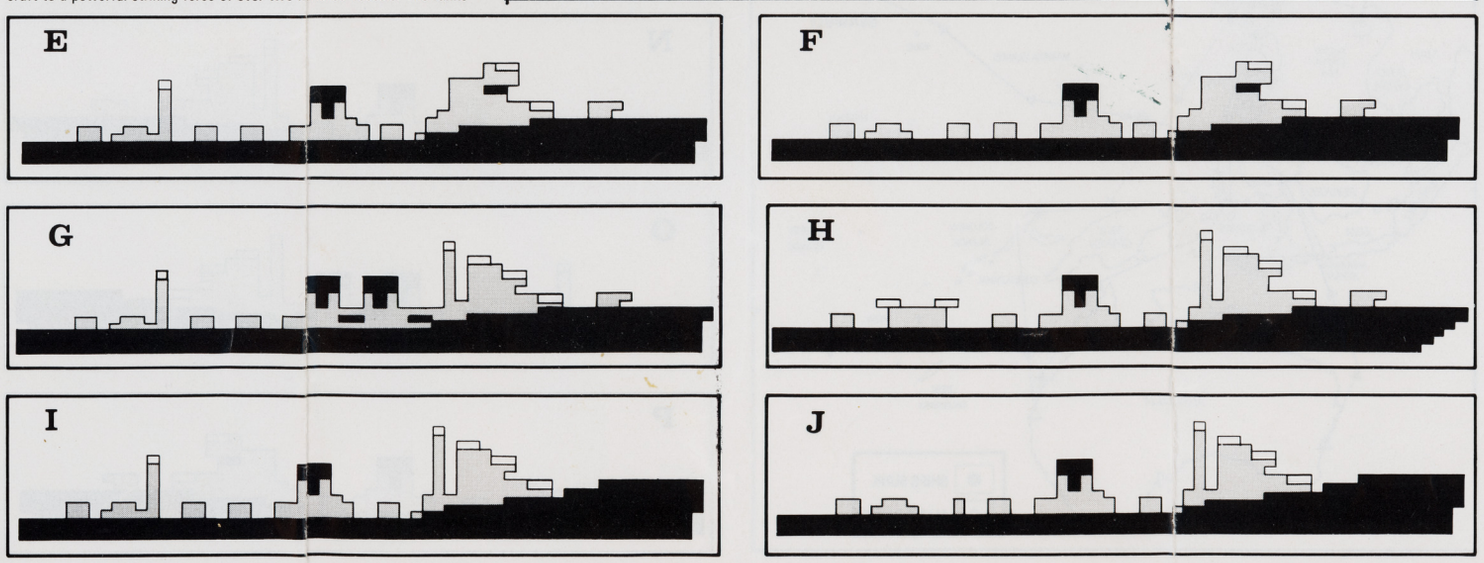
Japanese convoy traffic tended to concentrate along the route between major ports. Refer to convoy route map for details.

Japanese Tactics

Japanese escorts were formidable opponents. Their optical and sonar equipment were of excellent quality and Japanese gunnery was outstanding. The primary deficiencies were depth charges which tended to be set too shallow and the lack of surface radar until late in the war. This encouraged the night-surface attack and deep submergence as an evasion technique. The Japanese also had a tendency to give up the hunt once contact was lost, although some experienced escorts showed more persistence.

The goal of the escort was to sight an attacking submarine and to destroy or drive it deep before it approached torpedo firing range. As the escort swept back and forth across the path of the convoy, lookouts constantly scanned the seas and sonar operators searched under the water for the telltale silhouette, periscope feather, or sonar echo which betrayed the sub's presence. If a sub was sighted, all escorts charged the sub at maximum speed. An unwary sub might be caught near the surface and destroyed. A quicker adversary could still be forced to dive deep, removing it as a threat to the convoy. Once a sub had been driven under, the escorts circled the last sighting, hoping to establish sonar contact and conduct a depth charge attack.

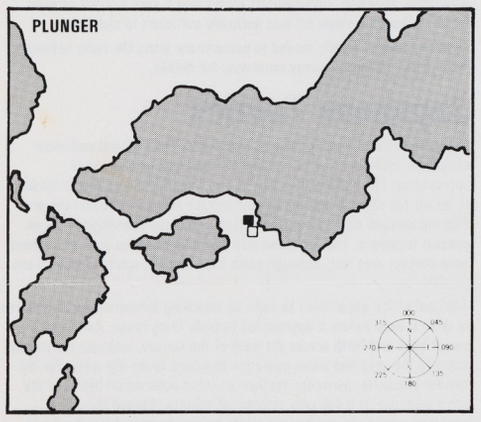
SUBMARINE LEADERS IN WWII — THE TOP 15		
SUBMARINE	TONNAGE SUNK	SHIPS SUNK
FLASHER	100,231	21
RASHER	99,901	18
BARB	96,628	17
TANG	93,824	24
SILVERSIDES	90,080	23
SPADEFISH	88,091	21
TRIGGER	86,552	18
DRUM	80,580	15
JACK	76,687	15
SNOOK	75,473	17
TAUTOG	72,606	26
SEAHORSE	72,529	20
GUARDFISH	72,424	19
SEAWOLF	71,609	18
GUDGEON	71,047	12



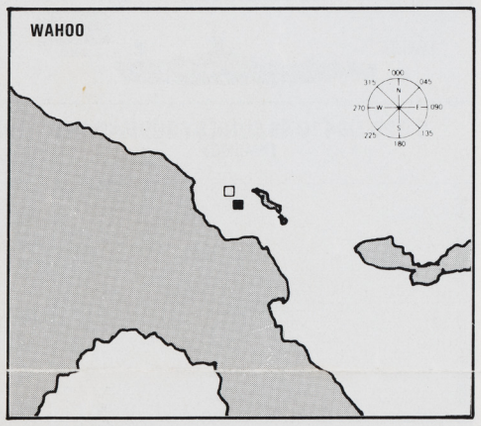
Convoy Action Scenarios

Convoy Action scenarios are shorter scenarios which place you in specific historical situations. They are useful for becoming acquainted with the features of this simulation, practicing specific tactics, or when time is short.

PLUNGER (Lt. Commander D. C. White)
Jan. 18, 1942 Day/Submerged
Latitude 33-30 N, Longitude 135-00 E.
The USS Plunger, patrolling off the southern coast of Japan, sights an escorted cargo ship steaming east at high speed. This scenario gives you the opportunity to set up a torpedo firing solution against a moving ship. Remember that even though the Torpedo Data Computer calculates the correct lead gyro angle to hit the target, it is often a good idea to fire a spread of torpedoes in case your target changes course unexpectedly.

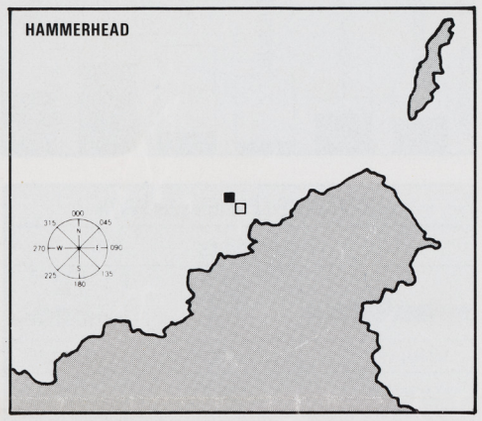


WAHOO (Lt. Commander "Mush" Morton)
Jan. 26, 1943 Day/Surface
Latitude 2-37 N, Longitude 139-42 E.
Off the New Guinea coast, USS Wahoo sights a small Japanese convoy. This situation is a submariner's dream: an unescorted convoy including a troop ship and a large oil tanker. However, the convoy has radioed for help and a destroyer is on the way!



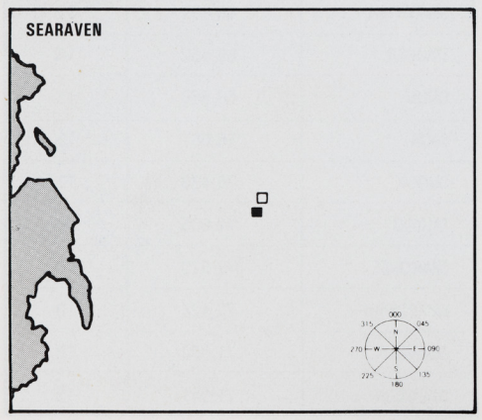
Your objective is to strike quickly and cause as much damage as possible. Be sure to use your aft torpedoes if your bow tubes are exhausted.

HAMMERHEAD (Commander J. C. Martin)
October 1, 1944 Night/Radar
Latitude 6-30 N, Longitude 116-11 E.
SJ radar picks up a large escorted convoy as the USS Hammerhead patrols the northern coast of Borneo. The tanker, one of Japan's dwindling handful remaining at this stage of the war, should be your primary target. This scenario introduces night combat against an escorted



convoy. You should take care to avoid being spotted as long as possible; use moderate speed, keep a minimum profile towards the escort, try to time your attack so that the escort is on the other side of the convoy.

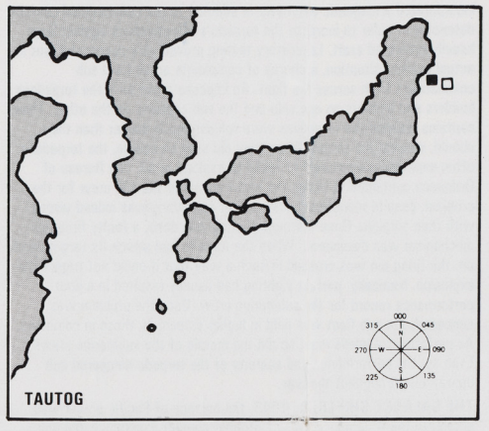
SEARAVEN (Commander H. Cassedy)
January 13, 1943 End around.
Latitude 9-12 N, Longitude 130-38 E.
Somewhere between the Philippine Islands and the Japanese naval base at Truk Lagoon, USS Searaven comes across a northbound convoy. You



are in a bad position: astern of the convoy in daylight. A careful "end-around" manoeuvre is recommended.

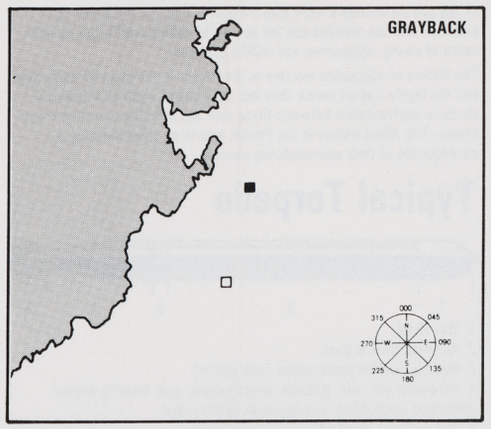
Be sure to use the time scaling feature to speed up your run around the convoy.

TAUTOG (Lt. Commander Sieglaff)
March 16, 1944 Radar/Visual Night
Latitude 42-25 N, Longitude 144-55 E.
Off the eastern coast of Japan, USS Tautog encounters a Japanese



convoy. Night attacks depended very much on the prevailing visibility conditions. During poor visibility, a low lying sub could safely close with its target on the surface. If visibility was good, however, somewhat more caution was required.

GRAYBACK (Lt. Commander J. A. Moore)
October 21, 1944 Submerged Radar
Latitude 26-48 N, Longitude 124-56 E.
A very difficult situation. Three radar-equipped escorts are guarding the convoy! Your best hope is a dawn or dusk periscope attack.



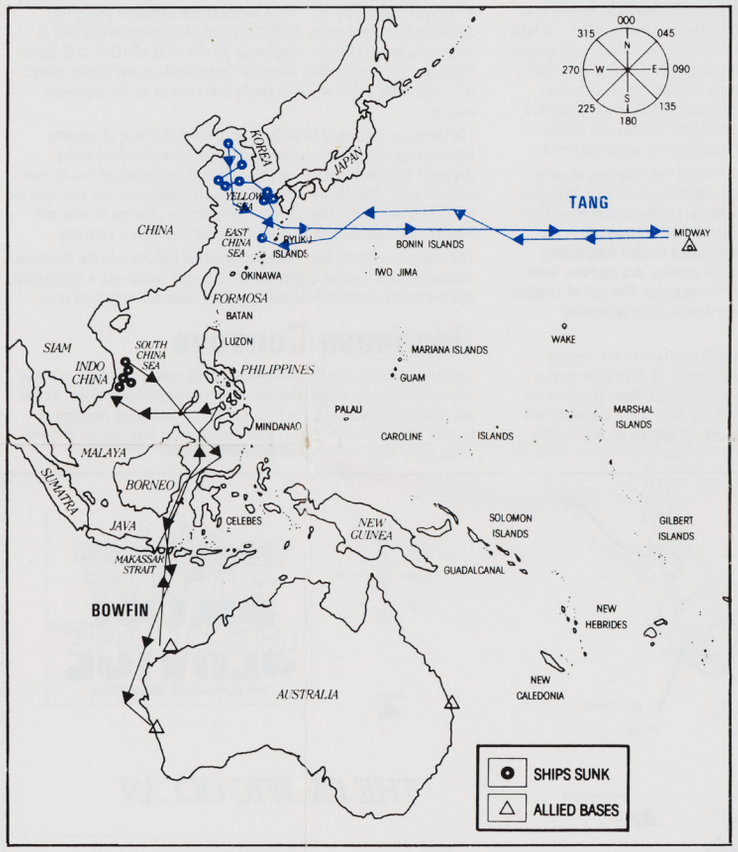
Equipment Summary

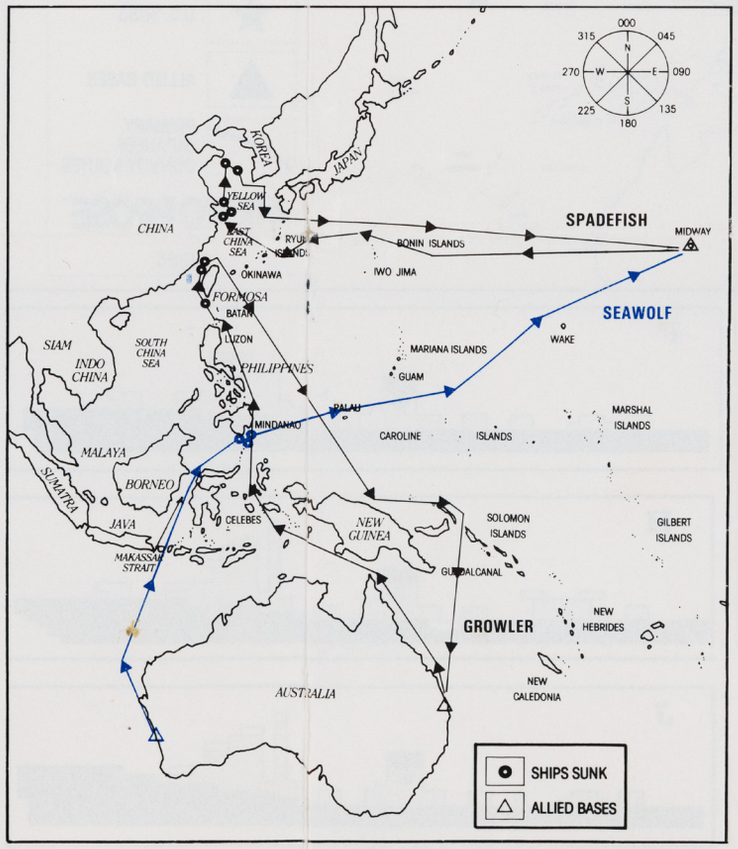
(CONVOY ACTIONS)

PLUNGER:	Radar, Steam Torpedoes.
WAHOO:	Radar, Steam Torpedoes 400+ft. hull.
HAMMERHEAD:	Radar, Steam Torpedoes 400+ft. hull.
SEARAVEN:	Radar, Steam Torpedoes.
TAUTOG:	Radar, Steam Torpedoes 400+ft. hull, improved detonator.
GRAYBACK:	Radar, Electric Torpedoes 400+ft. hull.

Patrol Scenarios

The Patrol Scenarios are the true test of a submariner's skill. Your mission is to scour the Japanese convoy lanes; to find, attack, and sink the maximum tonnage of enemy shipping. You will encounter a wide variety of situations, opportunities, and dangers. Note that each submarine is differently equipped, your tactics should take into account the strengths and weaknesses of your sub.





USS Tang - Midway Patrol

The USS TANG was the second leading submarine with 24 confirmed sinkings between Feb. 17, 1944 and Oct. 25, 1944. The TANG was equipped with surface radar, a deep diving pressure hull, electric torpedoes and improved detonators. TANG's third war patrol took her deep into the Japanese controlled Yellow Sea. In a span of only fourteen days, she sank 10 enemy cargo ships; including four in one day! This unsurpassed achievement earned her crew the Presidential Unit Citation.

USS Bowfin - Brisbane Patrol

The BOWFIN, based in Australia, sank 16 Japanese ships under four different skippers. The BOWFIN was equipped with surface radar, a deep diving pressure hull, steam torpedoes with old detonators. BOWFIN's second patrol took her from Australia, through the Makassar Strait, to the Phillipines. After patrolling fruitlessly off the Phillipines, BOWFIN crossed the South China Sea to the coastal waters of Indo-China. There she encountered two convoys and sank five ships in the course of three days in spite of a number of torpedo problems.

USS Growler - Second Patrol

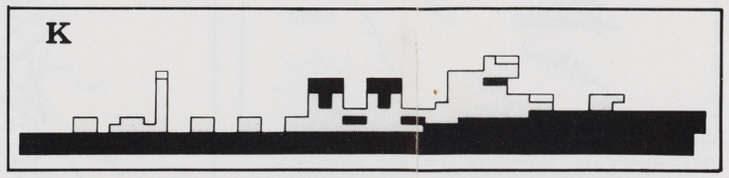
One of the first fleet-type submarines to enter the battle, the GROWLER was equipped with Surface Radar only. The GROWLER was famed for the heroism of her captain: H. W. Gilmore. After a collision with a Japanese gunboat, Gilmore ordered an immediate dive although he lay badly wounded on the bridge, thereby giving up his life to save his ship. The GROWLER's second patrol originated in Brisbane. Off the coast of Formosa she sank over 15,000 tons of shipping; an excellent patrol at this critical stage of the war.

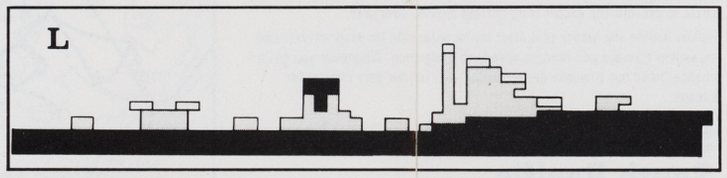
USS Seawolf

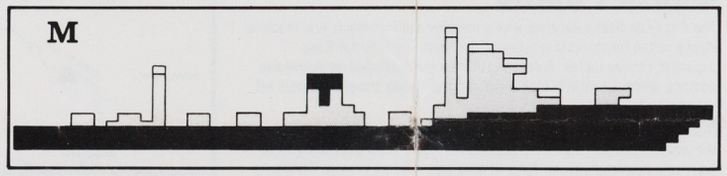
Another early arrival in the Pacific: the USS SEAWOLF went on to become one of the most successful subs of the war. Her second patrol included a memorable battle against a Japanese naval force off Christmas Island. The SEAWOLF was equipped with radar and early model steam torpedoes.

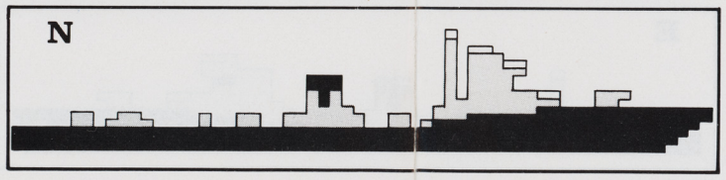
SILENT SERVICE

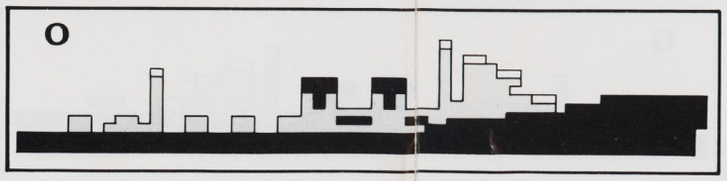
THE SUBMARINE SIMULATION

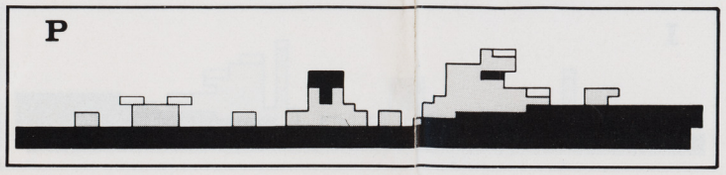












USS Spadefish

The SPADEFISH entered the war late in 1944. She was equipped with Surface radar, deep diving hull, and electric torpedoes with improved detonators. At this point in the war most Japanese escorts were equipped with radar. In spite of her late start, SPADEFISH sank 21 vessels for total of 88,000 tons. On her second patrol, two weeks out of Pearl Harbor, SPADEFISH happened upon a heavily escorted convoy in the East China Sea. After persistent tracking, SPADEFISH sunk the heart of the convoy: the 20,000 ton escort carrier Jinya.

Playing Tips

There are numerous books relating to World War II submarine warfare, many written by actual participants. Reading one or two of these should give the player an appreciation of what it was really like. This simulation has been designed to present you with the same types of situations and to let you use the same tactics you will read about.

Make sure you understand the role of the Torpedo Data Computer — most torpedo shots should be made with the periscope crosshairs directly on your target. If you really want TO LEAD the target, select the "Enter Angle-on-Bow" reality level and leave the gyro angle at zero. Now your torpedoes will always track in the direction your scope is pointing. You now must point and shoot the torpedoes like a gun, i.e. you must estimate the amount of distance the target will travel from the time you fire the torpedo until it arrives in the proximity of the ship. You then lead the target by that estimated amount. (Under normal modes the TDC will do this automatically).

During WWII the Captain had not only to call of the range and bearing but also estimate the Angle-on-the-Bow. Although in this simulation, the TDC calculates this angle, you are welcome to enter it using the "A" key and the joystick. You should study the accompanying diagrams for the exact explanation. However, a good way to estimate this angle is to use the enemy captain method. Imagine yourself on the bridge of the enemy ship looking forward. The angle left or right from the bow of the enemy ship where the enemy captain would see the submarine in the Angle-on-the-Bow. For example, if the enemy captain would see your submarine 45 degrees off the left side of his ship, as the submarine captain you would (assuming you choose the Angle-on-the-Bow Reality Level) press "A" and move your joystick left 45 degrees. As you can see this is an estimation procedure. By using this procedure, you are trying to solve the equation GYRO LEAD ANGLE = ArcSine (Target Speed × Sine (Angle-on-Bow)/Torpedo Speed) in your head. That's tough, but good luck if you want to try.

Make sure you understand the distinction between BEARING and HEADING. BEARING is the direction in which your scope/binoculars are looking. HEADING is the direction your sub is facing. Note that it is generally much faster and easier to aim your torpedoes and gun by rotating the scope (changing your BEARING) rather than by steering the sub (changing your HEADING).

In general, you should plan on making a submerged attack in daylight, and a surface attack at night. During dawn and dusk you can try both.

Submarines were not designed for extended gun duels and did not incorporate sophisticated range finding devices for their deck gun. Your best bet is to try to achieve a position directly to the side of your target which allows you to use no range deflection (the target is neither approaching nor receeding). If this is not possible, try a number of ranging shots at different range deflections. Once you hit the target with a ranging shot, commence rapid firing.

Most importantly, try to anticipate your opponent's manoeuvres and reactions. In general, you will know more about his location, course speed, etc. than he knows about you. Use this advantage to plan and execute the most destructive and least dangerous attack you can devise.

Designer's Notes

World War II submarine combat is almost unique in the manner in which it combines thorough planning, rapid action, luck, skill, quick thinking and an endlessly varied environment. Our initial research convinced us that this was an area which was ideally suited to the characteristic strengths of computer simulations. Our primary goal was to achieve a level of detail, realism, and variety beyond that of other simulations product without sacrificing playability.

The first major component designed and implemented was the mapping system. As you play the simulation you will realize that any area in the entire Western Pacific can be displayed down to a resolution of 100 yards, with a corresponding display of islands and land on the horizon of the bridge and periscope displays. In addition, shallow waters and shoals are included as well as complete convoy routing information to and from the Japanese mainland. To squeeze all of this information into a 64k computer was a major challenge. However, we feel that the almost infinite variety of situations available and the freedom to select your own mission route and patrol areas amply justifies the effort.

Another major obstacle to a playable simulation was the time factor. Actual submarine engagements could last many hours, occasionally for days, as the captain manoeuvred for an advantageous firing position and his opponents zigged and zagged to confuse him. However, once the action began in earnest, torpedo runs were timed in minutes and seconds: a well aimed depth charge attack could swallow up a submarine with one devastating explosion. One solution might have been to adjust sighting ranges, movement scales, turning rates, etc. to produce a "bathtub" simulation with continuous torpedo firing, depth charging, and frantic manoeuvering. However this would have negated many of the tactics and skill required of real submarine captains and defeated our initial design goals. Instead we implemented a time scaling system which allows the player to accelerate the progress of the simulation while manoeuvering for position and still continues to accurately track all activity.

This simulation actually maintains two distinct "points-of-view" as the situation develops. The computer continuously tracks all ships, torpedoes, and your sub. This information is then filtered to provide the player with the sub commander's "point-of-view": information which is not available to the sub commander is hidden (enemy ships which are out of range, the enemy's base course, etc.) The computer also constructs a "point-of-view" for the Japanese escorts and cargo ship — only providing them with the information which they would actually know.

Finally, we included an almost endless variety of situations, options, and play variation. On patrol missions you will encounter large and small convoys: escorted and unescorted convoys: shallow waters: day, dusk, and night attacks: and a limitless variety of tactical problems. Each of the reality levels adds a new consideration into your planning and decision making. Equipment variations also require significant tactical adjustments.

The most satisfying aspect of designing and testing this product was the opportunity to learn and use realistic submarine tactics. "Cookbook" solutions will not handle the immense variation of tactical problems the aggressive sub captain will encounter. Each situation must be analysed based on an appreciation of the same factors which influenced real-life sub encounters.

We hope that you, too, will find yourself accepting this simulation as more than just an artificially constructed "game". If you can feel a twinge of apprehension as depth charges roll into the water above you, a glimmer of satisfaction as your torpedoes find their target, or a spark of anticipation as you embark on your next patrol then our efforts have not been in vain. We hope that the experience of playing this simulation will be as enjoyable and rewarding as was the process of design and development.

Good Luck and Happy Hunting!