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Experience
of Daytime Submarine Torpedo Attacks

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The Main Naval Staff of the Soviet Navy, through the Department for Study and Generalization of War Experience, continues the publication of collections of materials on the experience of combat activity of the Soviet Navy.

The purpose of this collection is to inform the officer component of ship, aviation, artillery, infantry, special units, and formations of the VMF (voyenno-morskoy flot—the Soviet Navy); higher naval educational institutions; and central directorates of the VMF of the combat experience of the VMF in the Great Patriotic War.

The Main Naval Staff believes that in specific cases, the incompleteness of the existing materials may lead to an insufficiently complete examination of the issues under consideration, but at the same time does not consider it worthwhile to put off the study and generalization of the experience of combat activities until exhaustive data are collected.

The following issues are examined in this collection:

- Preparation, organization, conduct, and support of naval and joint operations with the Red Army;
- Combat activities of ship, aviation, artillery, infantry, and special units of the VMF;
- Command and control of operations and combat;
- The most important measures for organizational and logistical support of the Soviet Navy’s combat activities.

Thus, this collection generalizes the experience primarily of the operational employment and support of the VMF. Issues of tactics and combat training are examined in bulletins of the Directorate of Combat Training of the GMSh (glavnyy morskoy shtab—main naval staff) VMF, and equipment issues are contained in bulletins of corresponding special directorates of the NKVMF (narodnyy komissariat VMF—People’s Commissariat of the Soviet Navy).

A fundamental task of the collection is to examine issues of fleet (flotilla) combat activities **in order to extract the necessary lessons from immediate combat experience**, to show the causes that made possible or interfered with combat success, and to study the new methods of warfare that arose in the course of the war and proved themselves on the sea and in joint operations of the fleet with ground forces.

During this examination of separate operations and combat engagements, special attention will be given to coordinating forces and combat command and control, on which depends much of the success for accomplishing the combat mission.

Materials for these collections are taken from the following sources:

- Accounts of combat activities of fleets (flotillas) and major VMF commands, period and pertaining to specific operations, submitted to the Main Naval Staff.
- Main Naval Staff documents.
- Articles written by VMF officers.

This collection is intended to be used by: commanders of patrol and torpedo cutters in the fleets; commanders of aircraft crews in the air forces; commanders of shore defense batteries; commanders of naval infantry companies, their equivalents and superiors; professorial, instructor, and student components of the naval academy and higher special courses; chiefs of departments and higher in VMF central directorates and scientific research institutes; and all
officers who are instructors of military and political disciplines in other military naval academic institutions.

Articles and letters containing new data pertaining to the conclusions of earlier published works should be forwarded through classified channels of headquarters of major commands and institutions in accordance with established procedures to the following address: Moscow, Main Naval Staff VMF, Chief of the Department for Study and Generalization of War Experience.

Main Naval Staff, VMF
Department for Study and Generalization of War Experience
The work invested in the present collection, *Experience of Daytime Submarine Torpedo Attacks*, was accomplished by Captain First Rank A.V. Gomashevich by a tasking of the Main Naval Staff.

In the course of the Great Patriotic War, VMF submarines have revealed themselves as a powerful combat asset on the sea and mainly on enemy sea lines of communication.

During this period, an outstanding cadre of submarine officers has developed, and they have mastered their weapons to perfection. The improvement in the training of submarine commanders during combat operations and the implementation in the fleets of new methods of torpedo firing, directed by the People’s Commissariat of the VMF in Order No. 0219 1942, have done much to increase the effectiveness of submarine weapons.

People’s Commissariat of the VMF Order No. 0050 1943 exhaustively characterizes the positive and negative aspects of submarine utilization during the first 18 months of the war at sea. It also shows the specific share of the submarine fleet in this war and outlines the path toward more successful employment of submarines.

Despite the great success of our submarine fleet, fundamental tactical errors in the practice of submarine combat operations have occurred on individual seas. Since we lack a sufficiently well-regulated means to exchange combat experience from fleet to fleet, the same mistakes are often repeated in the different fleets.

On the other hand, for the same reasons, the positive combat experiences of the best submarine officers have not been sufficiently disseminated to the VMF or permanently recorded for use by all submarine commanders.

The work of Captain First Rank A.V. Tomashevich fills this void to some degree. In concrete calculations and examples, Tomashevich shows the superiority of the new method of torpedo firing (firing successive torpedoes with time intervals), exposes the positive experience of the best submarine commanders, investigates the most typical and harmful mistakes, and suggests the most effective methods for actions in various conditions of the situation.

Working on the enclosed material, the concluding words of the author come to mind:

> The stated positions, of course, may not apply in all combat situations, but just the same, submarine commanders must keep them in mind. Knowing these positions, a submarine commander can sometimes deviate from them. But it is important that commanders do this consciously, in accordance with the situation, and not in a mechanical, ill-advised maneuver.

The information in this collection is intended for submarine commanders, their deputies, and the officer component of antisubmarine defense vessels. It will without doubt be useful for fleet and major command staff officers, as well as for surface vessel commanders.

N. Ozarovskiy
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Editor-in-chief
Experience of Daytime Submarine Torpedo Attacks

An examination of the torpedo attacks conducted by our submarines during the Great Patriotic War has established that the success rate of torpedo engagements has grown significantly in this second half of the war. Along with this, it must be acknowledged that frequently torpedo attacks have been broken off because of improper actions by submarine crews.

The increase in firing success has been mainly due to the transition to a more effective firing method, that is, the firing of successive torpedoes with time intervals. Table 1 shows the rate of success of torpedo firing by periods corresponding to the firing methods employed by the submarines.

[Table 1 here in original text]

This table indicates that the firing of single torpedoes (conducted during the initial period of the war) on all seas yielded a relatively low success rate (37–44 percent, on average 41 percent across all fleets).

Northern Fleet submarines, which have begun employing the British firing method, have achieved a sharp increase in firing success—from 44 to 78 percent. Subsequently, with the transition to the firing method dictated by the People’s Commissariat of VMF Order No. 0219 1942, Northern Fleet submarines achieved an extremely high percentage of firing success for the year—96 percent.

The other fleets also experienced an improvement in their firing success when they changed to the new method: from 37 to 75 percent (double) in the Black Sea Fleet and from 43 to 50 percent in the Baltic. On average, the success rate has been 84 percent with the new method, a twofold increase in firing success when compared to the old method.¹

The reason submariners from the Black Sea Fleet, and especially the Baltic Fleet, have lagged behind Northern Fleet submariners is because not everyone in the Black Sea and Baltic Fleets has abandoned the old firing method. They are firing single torpedoes from significant ranges (single-torpedo firings comprise 50 percent of all firings in the KBF [krasnoznamennyy baltistkiy flot—Red Banner Baltic Fleet]), and they are firing two-torpedo salvos with the minimum technically permissible interval.

Commanders who fire single torpedoes believe that such a method is necessary to conserve torpedoes. For entirely understandable reasons, Baltic Fleet submarine commanders are particularly interested in conserving torpedoes.

In reviewing KBF submarine torpedo engagements in 1942, we see that of 46 cases of firing single torpedoes, only 15 hit the targets (33 percent success), that is, three torpedoes were required for a single exploded ship.

The Northern Fleet, having fired 81 torpedoes by the new method through May, hit 39 enemy ships, which calculates to 2.1 torpedoes for each exploded ship (98 percent success in attacks with torpedoes.

These figures thus indicate that the expenditure of torpedoes for one exploded ship is higher on the Baltic (where single torpedoes are fired) than in the north. At the same time, Northern Fleet submariners sank or damaged 98 percent of all the ships they attacked, while Baltic submariners, firing single torpedoes, sank or damaged only 33 percent.
The clearest example that shows how fallacious it is to fire single torpedoes is the attacks of the KBF submarine Shch-310. During the period from 28 September to 3 October 1942, this submarine fired eight single torpedoes and had only one hit.

The success rate of firing two and three torpedoes achieved by KBF submarines in the 1942 campaign was 72 percent, that is, a more than twofold increase in the success rate over single-torpedo firing.

The conservation of torpedoes during attacks has had enormously great significance for the KBF, even to the most recent time. With this, the question arises: how can torpedo expenditure be reasonably reduced using the existing method of firing, and must the single-torpedo method be abandoned entirely?

As is known, the number of torpedoes fired depends on the engagement range (for a given target length). The shorter the engagement range, the fewer torpedoes are required. Consequently, to conserve torpedoes, one must attempt to reduce the engagement range. Just the reverse situation has occurred on the Baltic. The average engagement range in the 1941 campaign was 1,000 yards\(^2\), and in the 1942 campaign, it has grown to 1,600 yards, at a time when 50 percent of the engagements were against ships that did not have escort and the average engagement range to them was 1,400 yards. Consequently, an increase in the engagement range cannot be explained by reinforced escort of enemy ships.

In an overwhelming majority of cases, the opportunity existed to reduce the engagement range, but submarine commanders did not take advantage of it. Thus, to conserve torpedoes, submarine commanders should, first of all, strive to engage from the closest possible range and not fire single torpedoes from great ranges.

Everyone understands that single torpedoes fired from a range of 1,600 to 2,200 yards have a very small chance of success, but 35 percent of the attacks of Baltic Fleet’s first echelon were of this type.

The firing of a two-torpedo salvo has frequently been practiced in the KBF and ChF (Chernomorskiy Flot—Black Sea Fleet). During attacks on more vulnerable ships (transports of less than 6,000–7,000 tons displacement), such firing would be understandable only when the serviceability of one’s own torpedoes was in doubt (if one failed, the second one would hit). There is no measurable increase in the probability of defeating an enemy with a torpedo fired in this manner. The following numbers illustrate this. If the speed of the target vessel is 10 knots, it traverses 10 meters in two seconds (the interval between shots in the salvo). With an engagement range of 1,600 yards (average for the KBF), the torpedo requires 67 seconds of running time to reach its target. Consequently, the second torpedo will cover an error in speed according to the following formula: \(\Delta V = 2 \times 10/67 = 0.3\) knots.

Thus, during the firing of a two-torpedo salvo, the permissible error in speed during which a hit can still be achieved is increased to only .3 knots. Such a miniscule increase, of course, does not have any practical significance.

Assertions that dispersion of torpedoes can increase the significance of \(\Delta V\) are completely baseless, because the dispersion of our 53/38 torpedoes is extremely minor (over a distance of 1,500–2,000 meters, it practically does not exceed those same 10–15 meters). In addition, deviation of a torpedo to one side or the other is equally possible, and if it is in the direction of the target’s movement, then it totally nullifies the influence of the time delay of the second shot.
It is completely obvious that one cannot base calculations on deviation that does not affect the result. Consequently, firing two-torpedo salvos at fairly vulnerable ships is still in great contradiction with the desire to conserve torpedoes.

It is typical that the KBF submarine Shch-406, firing three times by this method, achieved hits with both torpedoes in all three cases. Consequently, if the strike of a single torpedo was sufficient to sink a transport, then the second torpedoes in the salvos were unnecessary.

We will now examine when the firing of a single torpedo is permitted. The experience of the war has shown that the percentage of poorly running torpedoes of the 53/38 type is small (an average across all fleets of 1.5 percent). As a result, as has already been stated, the firing of a second torpedo is not required to compensate for malfunctioning torpedoes.

Therefore, the possibility of firing a single torpedo will be determined by the condition that the length of the target will cover the dispersion of the target’s position as a consequence of possible errors in determining its elements of movement. The range at which this condition is satisfied can be computed approximately according to the following formula:

\[ e = \frac{L}{2} \times \frac{V_m}{\Delta V_k} \]

where \( e \) is the desired torpedo track, \( L \) is the length of the target, \( V_m \) is the speed of the torpedo, and \( \Delta V_k \) is the permissible error in determining the speed of the target.

Having accepted the length of a moderately vulnerable target as 60 meters, a torpedo speed of 44 knots, a permissible error in determination of target speed in the area of four knots (which is approximately equal to an error in angle on the bow of ±10 degrees and ±2 knots in speed), we arrive at a torpedo track of 330 meters, or 360 yards, with an engagement angle on the order of 90 degrees. The engagement range against a slow-moving ship is thus on the order of 400 yards. Consequently, if there is no basis to assume large errors in determining the target’s elements of movement (it is not at night), it is permissible to fire a single torpedo.

In all of this, it should be noted that new transports of greater than 6,000–7,000 tons displacement have great survivability, and the strike of not less than two torpedoes is required for their destruction.

Thus, in all cases, the single reasonable measure for conserving torpedoes is to engage from the minimum possible range by consecutively firing the appropriate number of torpedoes with the required time intervals.

But when greater errors in determining the elements of movement are possible and when engaging swift targets, the number of torpedoes fired must be increased in order to broaden the sector of coverage.

We now examine the causes of disruption of torpedo attacks due to submarine crew errors. There are three principal factors:

- Incorrect maneuvering of the submarine during the attack.
- Unprepared or incorrectly prepared torpedoes.
- Poor control of the submarine for depth.

There have been more cases of improper maneuvering during the attack in recent times than in the initial period of the war.
Violations of the rules of maneuvering occur not because the commanders lack knowledge of these rules, but because they ignore them. The disregard of the rules is borne out of an absence of critical regard toward combat experience itself and from a perfunctory perception of facts.

Observation of the rules is particularly needed when the submarine commander is close to executing an attack or when the attack conditions are complicated.

When the submarine is at normal angles on the bow, errors in maneuver do not have decisive significance and violation of the rules of maneuver do not lead to disruption of the attack.

At another time, when the submarine is in a normal position relative to the target vessel, submarine commanders who have violated the rules of maneuver and yet successfully carried out their attacks conclude that adherence to existing rules of maneuver is hardly a requirement.

Oversimplification and improvisations are beginning to be observed. As long as the attacks are successful, they frequently are not analyzed by the command, and no one points out the incorrect maneuvering to the commander. The attack of the submarine M-118 on 7 August 1942 (figure 1) is an example of a completely improvised maneuver during an attack that concluded with the sinking of a transport.

At 1615, the submarine detected three transports and two barges 5 degrees off the port bow, escorted by a destroyer escort and seven patrol cutters. The range to the enemy was 14,000 yards, with an angle on the bow of 10 degrees to port.

The submarine remained on its previous course and continued moving for 44 minutes. It turned out that the enemy was on a zigzag course. The submarine determined the axis of his general course. The submarine’s course formed an angle of 25 degrees with the enemy’s general course and, obviously, was not arrived at by any kind of navigational intent. As can be seen from the sketch, the submarine’s subsequent maneuvering also bore an improvisational nature.

Just the same, the M-118 fired a salvo from a range of 1,600 yards with an impact angle of 110 degrees and achieved two torpedo strikes.

Since the commander had a target hit, he was not admonished for his incorrect maneuvering, and obviously he formed the opinion that he had carried out the attack in an acceptable fashion. In actuality, the success of the attack in this example was purely coincidental. By its maneuvering, the submarine by no means made the success of the attack possible. It could have attacked successfully by simply remaining in place.

The attack of the Shch-403 on 28 October 1942 (figure 2) is another example of improvisation that ended successfully. At 1015, the submarine detected two minesweepers 8–10 degrees off the starboard bow. The range to them was about 8,000 yards, the angles on the bow were about 30 degrees to port. The submarine continued to maneuver for 10 minutes on its previous course. The angle on the bow of the targets rapidly increased.

At 1025, the submarine came about 30 degrees to port and, after some time, an additional 10 degrees to port. The enemy also rapidly turned to the left. Behind the two targeted minesweepers were three additional ships of significant displacement. The commander decided to attack the just-detected minesweeper and, since its angle on the bow was small, selected stern tubes for the
attack. However, rather than come about to a withdrawing course perpendicular to the enemy’s course, the submarine turned to almost a reverse course. The impact angle thus was approximately 40 degrees. After eight minutes, the commander reduced the impact angle to 70 degrees and almost immediately after that to 110 degrees.

At 1050, two torpedoes were fired with an interval of eight seconds from a range of 2,400 yards. An explosion was heard in the submarine after one minute, 45 seconds.

Maneuvering in accordance with the rules, as soon as the direction of movement of the target ships became clear, the submarine should have turned to a course perpendicular to their bearing. After the enemy turned, the submarine should have turned to a course perpendicular to the enemy’s course to fire with stern tubes. Thus, the simplest maneuvering of the submarine was required, consisting of only two course changes. The impact angle of the torpedo with the target would be 90 degrees—the most desired angle.

In this particular case, we have a totally unwarranted improvisation, which extremely complicated all the submarine’s maneuvering. If the enemy had not turned to a new course, then the submarine’s initially improvised course would have led to a breaking off of the attack.

The attack of the submarine D-2 on 14 October 1942 (figure 3) is a good example of a submarine maneuvering during its attack on a ship proceeding on varying courses. As can be seen from the sketch, the submarine was maneuvering principally in accordance with existing rules. This permitted it to take up a good position for engaging from 0.4 nautical miles with an impact angle of 90 degrees. The result of the attack was the sinking of a transport.

When a submarine finds itself in one of the marginal situations (close to the limit of the permissible attack angle or close to the enemy’s course), violation of the rules of maneuver frequently leads to a disruption of the attack.

One of the most flagrant types of violation of the rules of maneuver is circumscribing a turn of 360 degrees during an attack.

Submarine D-3, conducting an attack on 27 February 1942, and wishing to maintain its position relative to the enemy’s course, began to conduct a 360-degree turn. As a result, while the submarine circled, the enemy ships sailed away and the attack was broken off.

Unfortunately, this is not the only case of a submarine turning 360 degrees while conducting a torpedo attack. The error of such a maneuver is totally obvious. During this type of turn, the submarine essentially loses its ability to observe the enemy and cannot react quickly to changes in the situation. The submarine is more or less prevented from attacking during its turn. Forced to conduct the turn at full speed, the submarine wastes electrical energy. In this example, the rules of maneuvering would stipulate a turn to a course opposite the enemy’s.

Coming about to a parallel course is also not correct if the situation does not require it, because it slows down the attack, increases the possibility of the submarine’s detection by the enemy, and leads to unnecessary expenditure of electrical energy.

A basic rule of attack is to execute it in the shortest possible time and with the minimum expenditure of electrical energy. Many of our submarine commanders, when they are being
subjected to prolonged pursuit, believe it is important to conserve more ampere hours toward the end of the attack. During attacks on slow moving ships, an incorrectly selected set of maneuvers may significantly prolong the attack and lead to the unnecessary expenditure of electrical energy.

The attack of the submarine *Shch*-*403* on 14 December 1942 (figure 4) is an example of such a prolonged attack. At 1210, the submarine detected two transports escorted by a patrol vessel and two patrol cutters. The range to the detected ships was about 7,000 yards; the angle on the bow of the target vessels was approximately 45–50 degrees to port. At 1215, the submarine commander turned his boat to an almost parallel course with the enemy. The turn was clearly incorrect, even if one considers that the commander could anticipate by the features of the shore a subsequent turning to port of the enemy ship. At 1220, the enemy ships turned to port. The angle on the bow of the target vessels was approximately 30–35 degrees to port. The submarine commander also turned, again to an almost parallel course. Only at 1237 did the submarine come about to an attack course and, at 1251, fired four torpedoes at the transport with an interval of 10 seconds from a range of 1,400 yards and an impact angle of 100 degrees. Explosions were heard after 52 seconds and one minute.

If the submarine had come about immediately to an attack course or to a course perpendicular to the bearing, the duration of the attack would have been reduced by a minimum of 10–12 minutes.

Along with this, frequently commanders try to conserve electrical energy by maneuvering at reduced speeds during the attack. Sometimes this leads to breaking off the attack, or it increases the engagement range.

So an attack will not be broken off due to the submarine’s slow speed, it should move at the greatest possible speed that it can maintain. It must be clearly understood that by having used great speed for some time at the beginning of the attack and, by doing so, having reduced the enemy’s angle on the bow, the submarine gains the ability to close with the enemy at reduced speed for a protracted time.

Conversely, not having attained full speed immediately and having permitted the enemy’s angle on the bow to increase, the submarine will subsequently be forced to attack at a continuous high speed. The attack of submarine *M*-36 on 21 August 1942 (figure 5) is an example of this.

At 1619, the submarine detected two transports escorted by two patrol vessels. The initial range to the target ships was 12,000–14,000 yards and the angle on the bow of the enemy at the moment of detection was about 40 degrees to port.

To close with the enemy, the submarine had to turn 110 degrees to starboard. The turn was conducted at slow speed, and the submarine had not increased its speed by the completion of the turn. Only nine minutes after the beginning of the attack did the commander order full ahead. During this time, the angle on the bow of the target increased by 12 degrees. With the submarine at full ahead, the bearing was changing rapidly by the bow, and the enemy passed the submarine’s bow at a range of 4,000–4,400 yards.

If full ahead had been given immediately upon detection of the enemy, the submarine would have closed with the target vessel to a range that would have permitted the firing of torpedoes.
Having given full ahead at the beginning of the attack and following a changing bearing, the commander can gradually reduce speed to reduce the angle on the bow and thus conserve electrical energy without the risk of breaking off the attack.

It is not difficult to determine if the submarine’s speed on the closing course is sufficient. If the bearing to the target ship remains constant, the speed is adequate. During this maneuver, one should initially reduce speed, remaining on a course perpendicular to the bearing. When it is clear that at six knots (for large submarines) or four knots (for small submarines) the bearing continues to change toward the submarine’s stern, one should adjust until the submarine achieves a constant bearing toward reducing the angle on the bow. This will ensure that the electrical energy is conserved to the greatest degree on a closing course.

It is advisable to come about to an attack course as early as possible, because this permits the submarine to reduce its speed more rapidly.

Movement on a closing course at reduced speed often occurs because the commander forgets to give the order to increase speed. During a correctly organized submarine engagement, the deputy should assist the commander during an attack and remind the commander to increase speed.

Now, some submarine commanders are setting attack courses without making computations according to the tables. This most frequently occurs when the submarine commander is not attempting to take up a specific firing position but will be satisfied with whatever he gets.

In this case, a risk always exists that the submarine will end up with a large engagement range, which will result in a miss or the fruitless expenditure of a large number of torpedoes. To avoid such errors, commanders must make their deputies monitor the tables for changing bearings, even if utilizing incomplete data. This will forestall the possibility of the commander making a large error and will permit him to determine the submarine’s actual minimum required movement speed. Thus, the submarine’s electrical energy can be rationally conserved without the risk of disrupting the attack.

Unfortunately, commanders are too often attracted to simplifying attacks and do not require their deputies to conduct the necessary computations. As a result, a portion of the attacks are broken off and a portion are conducted from positions significantly worse than the submarine could have attained.

On some seas, commanders have to attack principally in conditions of reduced visibility, which also contributes to their disregarding the rules of maneuver. During detection of the enemy in these conditions, the main factor that influences the possibility of attack is the speed of making the decision. If gross errors are not made in the decision, the attack is possible.

During detection of the enemy, if a submarine is already at or close to the maximum engagement parameters, maneuvering is not particularly significant for occupying a firing position. This has created the impression among commanders that special rules of maneuver are not required for conducting the attack.

By not analyzing in sufficient depth the conditions in which they had to attack, submarine commanders also have violated the rules of maneuver during attacks from great initial ranges, which also has led to breaking off attacks.
In the same vein, attacks have frequently been broken off because of poor observation in the periscope. The enemy has frequently been detected at close ranges, with an angle on the bow outside the parameters and attacks have been impossible. On a recent sortie of the Shch-406, the periscope was raised to inspect the horizon an average of every 50 minutes. During one of these periods, even a slow moving transport can move 16,000–18,000 yards. Consequently, even during good visibility, if a transport is passing at the limit of visibility of the submarine at the moment the periscope is raised, then during the subsequent raisings of the periscope it will be quite close to the submarine. For the most part, if the transport is not moving directly toward the submarine, an attack becomes impossible.

To guarantee timely detection of enemy ships, visibility must be considered in establishing the time periods between periscope inspections. Combat experience has shown that raising the periscope for an inspection of the horizon should be conducted during good and average visibility not less than every five minutes and more frequently during poor visibility.

War experience has also shown the enormous significance of well planned acoustic monitoring during periods of reduced visibility. In the Northern Fleet, there have been up to 30 attacks during which the enemy was detected by sonar operators. In a number of cases, a significant period of time passed from the moment the sonar operator detected the enemy until his visual detection in the periscope. Thus, on 11 May 1942, the M-172 maneuvered only by acoustic azimuth for 34 minutes (the M-173 for 49 minutes on 14 April 1942).

On 11 May 1942, the M-172, while observing for a change in bearing, was able to determine the enemy’s course by sonar bearing. When it was discovered that the enemy was approaching the lead angle and he was still not visible in the periscope, the commander reduced the impact angle. The commander quickly saw a transport in the periscope, escorted by three patrol vessels, at an approximate range of 2,000 yards. He fired two torpedoes at the transport from a range of 1,600 yards with an impact angle of 110 degrees. Two explosions were heard a minute later.

This and many other examples show that by taking up a firing position based on acoustic bearing, it is fully possible not only to detect the enemy with the sound-ranging equipment we now have on submarines but also to close with him for an attack. One must simply utilize the bearing provided by the sonar operator for the computation of maneuver, just the same as if it were received through visual bearings to the target ship.

During the 1942 campaign, the utilization of sonar for torpedo attacks significantly increased in the Baltic Fleet. Just the same, the majority of submarines still failed to use the sonar to its fullest extent.

In a number of cases, commanders, despite being in positions clearly unsuitable for engaging, nonetheless fired. Thus, on 20 July 1942, the submarine Shch-303 engaged a target from a range of 5,000–7,000 yards with an impact angle of 90 degrees. On 15 October 1941, the submarine M-171 fired from a range of 3,600–4,000 yards with an impact angle of 160 degrees. With the torpedoes set to maximum running speed, they could not reach the targets in such conditions.

The tendency to increase the engagement range up to 6,000 yards and greater appeared in the Northern Fleet. Examining this from a purely theoretical point of view, such an engagement range can be permitted with acute impact angles of the torpedo with the target.

But during submarine attacks, a large engagement range with an acute impact angle is unnatural, because the submarine can reduce the engagement range and simultaneously improve
the impact angle. In addition, it is impossible to equate a submarine’s firing in combat conditions with the theoretically allowed engagement range because it must always be considered that the commander may have made an error in judging the range to the enemy. If he estimates the range to be less than it actually is, then all the torpedoes he fires will not reach the target. It also must be considered that the air pressure in the torpedo may be below standard as a result of a leak, which has been observed on more than one occasion.

From these discussions, we have determined that **it is unconditionally prohibited to allow an engagement range greater than 4,000 yards.**

There have been many cases of torpedo firings with large impact angles. For example, on 3 October 1942, the submarine *S-13* engaged with an impact angle of 135 degrees. On 13 September 1942, the *Lembit* fired with an impact angle of 140 degrees; and on 15 November 1941, the *M-171* fired with an impact angle of 160 degrees. In all these and similar cases, the torpedoes missed the target.

When firing with such impact angles, commanders do not consider the significantly reduced projection of the target and that, during their approach, the torpedoes could be deflected from the ship by the backwash of its screws. When this does occur, a large impact angle can become still larger, and the torpedo’s strike on the ship is even more of a glancing blow. In the end, all this leads to misses.

**Based on the experiences of our submarines’ combat engagements, it can be firmly stated that torpedoes with contact fuses should not be fired with impact angles greater than 120 degrees.**

The number of cases of attacks being broken off due to torpedo tubes unprepared for firing has been significantly reduced. Submarines sailing with a portion of their tubes prepared for firing has brought an almost complete end to attacks disrupted for this reason.

A new cause of misses during torpedo firing in heavy seas has appeared. Attempting to maintain their ability to engage ships with reduced draft, commanders are setting torpedoes to run at shallow depths (1–2 meters). In heavy seas, torpedoes with such depth settings come out of the water and jump from wave to wave. This happened to the *Shch-310* several times on 21 September and 3 October 1942, to the *S-13* on 3 October 1942, and to the *S-33* on 24 October 1942.

To prevent this from happening, the torpedo’s depth setting should be consistent with the sea conditions, and consequently, **during high seas, torpedoes should not be fired at a ship with a shallow draft.**

Frequently, attacks are broken off due to submarines plunging downward immediately before firing torpedoes. Many such occurrences, particularly in the *KBF*, have been explained by the level of submarine combat training. The submarine *S-13* had 15 disrupted attacks during a sortie, principally because of its planesman’s poor ability to hold the boat steady at a depth. It clearly is pointless, indeed dangerous, to attempt an attack with a poorly trained planesman. Therefore, prior to beginning combat attacks, one must fully train the planesmen, even if on the combat sortie itself.

Since cases of submarines diving prior to firing have occurred fairly often as well on submarines with trained planesmen, it is interesting to examine the experience of Northern Fleet. Northern Fleet submariners employ the following method. If the submarine dives prior to the
shot, the crew brings it to an even keel and carries out the engagement based on time calculations. There have already been several cases of such engagements in the north, and all have been successful.

An example of this type of attack is the Shch-422’s experience on 23 August 1942. At 0411, three enemy transports under escort by three patrol vessels were detected on the lighter portion of the horizon in the periscope. The range to the enemy was about 10,000 yards. The commander began closing for the attack, but after 20 minutes the ships disappeared from his view. The commander came about to a course parallel to the coastline, and after 20 minutes he again detected the enemy vessels by the flickering of the escort vessels’ bridge lights. The enemy transports were proceeding in echelon and appeared as a continuous target. The commander made the computations for an attack on the lead transport. At 4 degrees before the target reached the lead angle, the horizontal planes jammed and the submarine dived. Not attempting to come up to periscope depth, the commander leveled the boat and 30–35 seconds from the moment the periscope submerged, he fired four torpedoes with a time interval of seven seconds, at neutral trim from a depth of 12 meters. The engagement range was about 2,200 yards. After 90 seconds, three explosions were heard at brief intervals.

Firing tables can be used when firing blind, but it is better to utilize a sonar bearing. From these discussions, in executing an attack, it is necessary for the sonar operator to provide sonar ranging to the target ship. This way, if the boat dives, he can immediately report a bearing to the target ship.

If the submarine cannot quickly be brought to an even keel, the commander must rapidly reduce the impact angle and thus gain time. During all of this, the submerged depth of the submarine should not exceed 15–16 meters, because our tubes and torpedoes are not configured for firing from greater submerged depths.

This same method of firing blind can be employed when the submarine cannot use its periscope as a result of a threat from the escort ships. We have had frequent cases of commanders refusing to attack and breaking off attacks because they believed that the submarine had been detected and the escort vessel had come about for an attack on them. In actuality the enemy ship’s turn is conditioned by his movement in a shallow zigzag. If the submarine commander finds himself in such a circumstance just before firing, he must use the sonar operator’s data or time computation to reach a firing solution. If there is still too much time before the shot and the sonar operator cannot give a bearing, the commander must reduce the impact angle in order to gain time and, when the threat is reduced, engage with torpedoes from periscope depth.

When firing blind, the number of torpedoes fired must be increased, since the target’s movement elements may have been imprecisely determined. Firing on acoustic bearing, it must be considered that the bearing is usually taken to a point close to the target’s stern, and that the resulting bearing is somewhat delayed in time. This requires some increase in the lead angle. With a target length of 100 meters, the supplement to the lead angle will be as follows:

<table>
<thead>
<tr>
<th>Engagement range in yards</th>
<th>Lead angle supplement in degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>400–800</td>
<td>+5</td>
</tr>
<tr>
<td>1,000–1,200</td>
<td>+3</td>
</tr>
<tr>
<td>1,400–1,600</td>
<td>+2</td>
</tr>
<tr>
<td>1,800 and greater</td>
<td>+1</td>
</tr>
</tbody>
</table>
The correction changes proportionally for other target lengths.

The actions of the submarine D-2 on 3 October 1942 serve as an example of an unwarranted refusal to attack when engagement would have been extremely simple. At 0957, having fired two torpedoes with an interval of nine seconds from a range of 1,200 yards, the submarine achieved a hit on one transport. After firing, the submarine initially came up to six meters and then dived to 28 meters. At 1025, when the commander inspected the horizon in the periscope, it turned out that one transport had already sunk and the second had stopped. Having decided to sink this transport as well, the commander began to close, but during a subsequent raising of the periscope he saw that one of the destroyer escorts was heading directly for his submarine. The commander dived his boat, thus breaking off the attack. There was no depth charging or pursuit of the submarine. In this case, it would have been fully possible to evade the destroyer escort and attack the transport.

The attacks of submarines M-13 on 4 November 1942, M-36 on 23 August 1942, and M-118 on 7 August 1942 are examples of persistent and successfully conducted attacks in extremely difficult conditions.

Operating in the shallow area in the northwestern portion of the Black Sea, these submarines were forced to ground temporarily on the sea bottom while conducting their attacks. During its maneuvering, the M-118 was even forced to work in reverse to get off a sand bar. Despite these difficulties, and the fact that the target ships had escorts, all three submarines managed to sink enemy transports.

The pointless maneuvering of some submarines after torpedo firing must be noted. The following are a commander’s tasks after firing torpedoes:

- Determine the results of the engagement.
- Conduct follow-on attacks if possible.
- Make the enemy’s pursuit of the submarine more difficult by its own maneuvering.

The majority of commanders automatically go deep after firing. This occurs even during attacks of unescorted ships, that is, in those cases when there is no one to pursue the submarine.

This has already become such a habit that sometimes, perhaps, the commander does not even intend to submerge, but the boatswain dives the submarine anyway. As a consequence, the commander cannot determine the results of the attack. Usually in such cases, the explosion of torpedoes is heard in the compartments after some time.

Of course, after the firing of torpedoes, everyone wants to hear explosions, and every similar sound that reaches the ears of those who are listening can resemble the explosion of a torpedo that has struck an enemy ship. A similar sound can be completely natural.

It is know, for example, that when British ships detect a torpedo fired at them by a submarine, they drop a special depth charge simultaneously with their evasive maneuver to confuse the submarine commander regarding the results of his attack. The employment of this method is known to the Germans, and it is possible that they are using it also.

From these discussions, the circumstances that “they heard explosions” on a submarine still cannot serve as proof that the torpedo struck the target. To a lesser degree, this can serve as an indicator of the destruction of an enemy ship. Even if the torpedo had struck the ship, then whether it sank depends on where precisely the torpedo struck.
The case of the submarine *D-2* on 19 October 1942 confirms the correctness of this proposition. Positioned along the line Sassnitz–Trelleborg, the *D-2* attacked two ferries escorted by an auxiliary cruiser and five patrol vessels, sailing in echelon. Two torpedoes were fired with an interval of 19 seconds from a range of 1,200 yards. Both ferries appeared as one continuous target at the moment of firing. Two powerful explosions were heard in the submarine. The commander believed that he had achieved hits in two ships or had sunk one. Later, it was established that only one torpedo had struck the German ferry *Deutschland*. The second ferry avoided the torpedo, but the *Deutschland*, having suffered great damage, was towed to Trelleborg for repair.

If the commander had observed the results of the attack, it is entirely possible that he would have sunk the *Deutschland* in a follow-on attack. Even though the escort ships dropped 16 depth charges after the torpedo detonation, they exploded far from the submarine. Therefore, the possibility to observe the results of the attack existed. Clearly, the depth charging was intended to intimidate the submarine and to deny it the ability to conduct a follow-on attack. Unfortunately, the Germans’ simple deception succeeded.

At times, it is vitally important to the command to know if an enemy ship was sunk or not. A good example in this regard is the attack of the submarine *Lembit* on 14 September 1942 (figure 6). Despite the forceful counter actions of the attacked ships, the commander observed the demise of two transports that he had torpedoed.

[Figure 6 here in original text.]

The periscope should be lowered immediately after firing from a great range. This reduces the possibility of the enemy detecting the attack (perhaps, having noted the periscope, he can evade). The periscope should be lowered enough that the attacked ship is not visible but that a small vessel can be detected in the submarine’s immediate vicinity to a range of 600–800 yards.

When there is an audible explosion, the periscope should be raised higher immediately. At this time, the danger of the enemy’s detection of the periscope is significantly reduced, because the explosion will initially distract the escort vessels’ attention.

If there is no explosion after the time it takes the torpedo to run to the target, the periscope should be raised and the horizon inspected to determine the situation.

No purpose is served by fully lowering the periscope immediately after firing. This places the submarine in a more restricted condition for raising the periscope to establish the results of the attack, because the enemy escort ship can end up too close to the submarine. By not fully lowering the periscope and continuing to observe the nearby surface area, the submarine protects itself from sudden attack.

[Figure 7 here in original text.]

Having established the results of the attack and the situation on the surface, the commander should evaluate whether a follow-on attack is possible. Unfortunately, the majority of our commanders do not focus on follow-on attacks.

Normally, the explosions of depth charges, even distant ones, that follow the torpedo detonations force submarine commanders to believe that they have been detected by the enemy. They refrain from ascending to periscope depth and, instead, maneuver to avoid pursuit.
At the same time, it is known with some certainty that the enemy utilizes preventive depth charging quite broadly, traversing the areas where the presence of our submarines is suspected.

There is no doubt that when the tracks of torpedoes are detected or the torpedoes explode, the enemy also uses depth charges to affect the psyche of our commanders. Unfortunately, this often succeeds. If the submarine commanders would act calmly and with good judgment, they could utilize the enemy’s dropping of depth charges to their own advantage.

When dropping depth charges, the enemy enables the submarine to determine where the enemy ship is relative to the submarine. If the depth charges are exploding far to the flank, it means the submarine has not been detected and, consequently, it can raise the periscope to inspect the horizon.

The sonar operator can be of great assistance in determining the location of the enemy ships. Many submarines have already confirmed this in practice.

We have several cases of successfully conducted follow-on attacks. On 12 November 1941, the submarine K-27 attacked two transports escorted by a patrol vessel, a cutter, and an aircraft (figure 7). The commander first attacked the lead transport; the torpedoes struck it and it began to sink. The second transport began to maneuver around the first.

Observing this in his periscope, the submarine commander utilized the favorable conditions and fired torpedoes at the second transport. The torpedoes struck the target and the second transport also sank.

Submarines Shch-205 (23 May 1942), M-62 (7 August 1942), and Shch-207 (7 September 1942) conducted follow-on attacks in the Black Sea.

**To guarantee for itself the possibility of conducting follow-on attack of ships proceeding in a single file, the submarine must select the appropriate target of its first attack.**

Frequently, commanders have selected the trailing ships for their attack. Of course, in such situations, no opportunity exists for a follow-on attack. As a rule, the lead ships should be selected for the first attack. When the enemy is proceeding in a tight formation, the opportunity may arise to engage several ships.

[Figure 8 here in original text.]

The attacks of the submarine S-12 can serve as examples of this. At 1755 on 21 October 1942 (figure 8), the submarine detected smoke, which, as it later became clear, belonged to three transports escorted by a minesweeper, a patrol vessel, and two patrol cutters. The commander decided to attack the lead transport, but before the target arrived at the lead angle, the submarine dived. When it came up to periscope depth, the transport had already passed through the lead angle. The commander decided to attack the second transport. At 1808, he fired a torpedo from a range of 2,600 yards and observed a hit in the bridge area. Shrouded by clouds of smoke, the transport began to sink, going down by the stern. The commander decided to attack the third transport, proceeding in echelon.

At 1812, having turned approximately 10 degrees to increase the impact angle, he fired a single torpedo at the third transport at a range of 3,200 yards. After the shot, the submarine dived, evading a patrol vessel heading toward it. The torpedo did not hit the target. The S-12 was not pursued earnestly. The enemy dropped one depth charge at 18 minutes and another 35 minutes after the attack.
While a good example of a follow-on attack, this submarine’s actions, at the same time, provide examples of what has already been stated: a missed first attack because the submarine dived, and misses due to single torpedoes being fired (true, the submarine did not have more stern torpedoes). The deficiency from the point of view of firing at several ships is that the submarine had to reduce the impact angle. It would have been better to attack the lead ship with a more obtuse angle and conduct firing at successive ships while the impact angle became more acute. Thus, the entire process of follow-on firing is hurried and, consequently, there will be more chances that the ships will not yet have initiated their evasive actions from the submarine.

At 1405 on 27 October 1942 (figure 9), the same submarine detected the smoke of five transports escorted by two minesweepers, two patrol cutters, and one patrol vessel. At 1435, the commander fired one torpedo at the lead transport from a range of 800 yards and with an impact angle of 100 degrees. One minute and eight seconds later, he fired another single torpedo at the second transport, proceeding in echelon. After the second shot, the submarine surfaced but rapidly resubmerged. Two explosions were heard. Pursuit of the submarine began immediately after the explosions, lasting one hour (40 depth charges were dropped). When the pursuit ceased, the S-12 inspected the attack site and observed the target steamer on the rocks in a semi-destroyed condition. Another ship lay on its side nearby.

On 7 November 1942, the submarine once again confirmed its sinking of two transports: one of them lay on the rocks on its side; only the masts of the second were visible nearby.

This time, the commander correctly planned his attack. The impact angle of 100 degrees permitted him to reduce the firing angle for the second ship. The commander did not manage to do this, because the second transport, proceeding in echelon, very quickly came into sight. Thanks to the close engagement range, the firing of single torpedoes did not have any negative consequences.

These attacks of the S-12, commanded by Captain-Lieutenant Turaev, show that it is possible to improve the effectiveness of submarine attacks by engaging several ships. Unfortunately, the majority of commanders fear changing to new methods of attack. Captain-Lieutenant Turaev’s great contribution is that he showed by example the complete possibility of such an engagement.

The submarine Shch-307, commanded by Captain Third Rank Travkin, conducted a similar attack on 2 October 1942. At 1407, three transports escorted by a minesweeper were detected. The range to the enemy ships was approximately 4,000 yards. The angle on the bow of the enemy ships was about 60 degrees to starboard. The transports were moving in echelon formation. At 1414, the commander fired at the lead transport and, turning the submarine toward the enemy’s movement, fired at the second transport 15 seconds later. The engagement was conducted from a range of 3,000 yards.

The minesweeper, positioned 1,000 yards from the submarine, turned toward it. Because of this, the submarine commander dived and took up a course to get away from the enemy. Two minutes after firing, two explosions at an interval of 15 seconds were heard in the submarine. The commander believed that he had sunk two transports. Some 11 minutes after firing, depth charging and pursuit of the submarine were initiated. Altogether, 11 depth charges were dropped.

In addition to those described, the following are examples of successful engagements of two ships:
In July 1942, the submarine *S-102* fired four torpedoes while turning (while evading depth charges) and hit two enemy ships.

On 15 March 1941, the *Shch-211* achieved torpedo strikes on two enemy ships sailing echeloned.

The attack of the *Lembit* on 14 September 1942 finished with the sinking of two enemy ships.

In all of these cases, the strikes on two ships bore a circumstantial nature, but the probability of strikes is increased if firing is conducted to hit two ships.

Very often, enemy transports conduct crossings in echeloned formations. Submarine commanders have observed this in all our naval wartime theaters. Such a method of movement has a fundamental deficiency, which should be utilized by our submarine commanders to increase their firing effectiveness.

During the movement of ships in echelon, it is possible to select an angle on the bow of the enemy ships by which the stern of the ship moving in front will merge with the bow of the ship following behind (figures 10 and 11).

If torpedoes are fired when such conditions are met by both submarine and target vessels, the probability of striking one of them grows significantly, because the beaten zone is the area NK₁MK₃.

In this circumstance, engagement of several ships is significantly simplified. There is no need for the submarine to alter its course, because the ships will arrive in its sights one after the other. The magnitude of the interval between torpedo firings will be equal to the time required for the ship to cross the distance equal to its actual length. For ships 100 meters in length proceeding at a speed of 10 knots, the interval of their arrival in the sight will be 20 seconds. This is already such a small interval of time that it hardly needs to be reduced by turning the submarine.

In carrying out their attacks, in several cases our submarines have fired torpedoes at a file of enemy transports in exactly those circumstances. But normally, the submarine finds itself in such a position only by coincidence.

In the first such attack conducted in wartime on the Black Sea, the submarine *Shch-211* fired at two large Romanian transports proceeding in echelon. At the moment of firing, the transports appeared as an almost continuous target. The stern of the lead transport slightly covered the bow portion of the second. Having fired two torpedoes, the submarine achieved hits on both ships. The sinking of both transports was confirmed by intelligence data.

The submarine *D-2* found itself in a similar situation on the Baltic Sea on 19 October 1942. This time, only the lead transport was destroyed by the torpedo. According to intelligence data, the second transport managed to evade the torpedo fired at it.

Submarines have met such conditions several times in the Northern Fleet. On 1 February 1942, the submarine *Shch-402* hit two transports in this manner. On 1 February 1943, the submarine *L-20* sank a transport and a patrol vessel in a similar situation. There could have been still more such cases if commanders had intentionally maneuvered to take up such an attack position.
When enemy ships are sailing in an echelon formation, inclined toward the submarine, it is better to attack with obtuse impact angles (without departing from permissible norms for impact angles). One must maneuver on a closing course with computations that will permit the bearing to change slowly toward the submarine’s bow. During turning to an attack course, the impact angle must initially be selected at about 110–120 degrees.

If the enemy vessels are proceeding in echelon formation inclined away from the submarine, they must be attacked with acute impact angles. One must try not to permit the angle on the bow of the lead ship to exceed 40–45 degrees (for slow-moving ships). During turning on an attack course, the initial impact angle selected must be 60 degrees.

Frequently, submarines are unable to attain the exact alignment of the sternpost of the lead ships with the bowpost of the following ships, but just the same, the engagement conditions will be more favorable than during attacks at other impact angles.

The experience of war requires us to reexamine one of our fundamental rules for submarine maneuver during a torpedo attack. We have discovered that when a submarine commander detects the smoke from or mast tops of enemy ships, he spends a lot of time maneuvering to determine the direction the enemy is moving. On average, nine minutes pass from the moment of detection until the submarine turns on a closing course. During this time, the bearing to the enemy can change by as much as 10 degrees. The question arises: does this maneuver have to be simplified or accelerated? Such a possibility exists.

When in position and observing the horizon, submarines, as a rule, are moving at slow ahead, normally at about two knots. At such a speed, even during observation to the flank, the lateral displacement of the submarine is so small that it has an insignificant influence on the change of bearing.

It is not difficult to figure the result if we determined the direction of target movement, remaining on the course that we were on at the moment of detection and proceeding with a speed of 2–2.5 knots. The following table shows under what enemy angles on the bow a submarine, observing him at various angles on the bow, will have a constant bearing.

<table>
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</table>

This table shows that under the most unfavorable conditions of observation, a constant bearing can be observed with a target angle on the bow of 15 degrees at 10 knots and 7 degrees at 20 knots of target speed.

At smaller angles on the bow, the lateral displacement of the target will be less than that of the submarine and, consequently, with converging courses, we can receive an incorrect impression of the enemy’s direction of movement. In this case, the bearing will change very slowly toward the submarine’s stern. But an attack is unquestionably possible for the submarine with these angles on the bow, and maneuver for closing with the target on a countercourse is the most favorable.

With converging courses, when the angle on the bow of the target is greater than indicated for this case in the table, the bearing will be changing toward the submarine’s bow, quite correctly orienting the commander concerning the target’s direction of movement.

When the courses are diverging, the bearing will rapidly change toward the submarine’s stern, also correctly orienting the commander concerning the target’s direction of movement.
Thus, the questionable case is only when the bearing change is slow toward the stern. What should be considered “slow”? With a speed of 2.5 knots, in two minutes a submarine covers 150 meters, or approximately 200 yards. With a range to the target of 12,000 yards, such displacement of the boat causes a change in bearing of one degree. With a greater range to the target, the change in bearing will be even less. Consequently, if the change in bearing to the submarine’s stern over two minutes does not exceed 1–2 degrees, this means that the angle on the bow of the target is small, and for closing with it, one should maintain a course equal to the bearing to the enemy (but this is a closing course and not a course for establishing the direction of the enemy’s movement). If the change in bearing has a different nature, the commander should immediately set a closing course, computing it by normal rules.

This method of determining the direction of the target’s movement has an advantage over the previous means. In this case, the watch commander, who is observing through the periscope, does not have to make any calculations for maneuver of the submarine. He should only take a bearing to the target, note the time, and call the commander to the periscope. Freed from superfluous turning of the submarine, we can accelerate the turn to the closing course and, since turning should be conducted at full ahead, considerably reduce the expenditure of electrical energy.

Some shortcomings exist in maneuvering submarines for breaking away from the enemy after an engagement. A single constantly present pattern in post-engagement maneuver would even be harmful. As war experience has shown, it is sometimes advantageous to depart from generally applied rules, but when doing this, there should be some logic in the maneuver.

If the commander has decided to break away from the enemy, he must actually break away. Therefore, a turn toward the enemy’s movement is without question harmful, because it delays the separation and permits escort ships not separating or only separating a bit from their charges to pursue the submarine.

The submarine breaks away from the enemy most rapidly by turning to a countercourse or close to it. At the same time, this complicates the actions of the escort vessels. If they are going to pursue the submarine, they must abandon their charges for a significant time. Clearly, during such a maneuver after an engagement, the duration of the pursuit of a submarine should be shorter. Not all commanders fully consider these factors.

Thus, for example, during attacks on 25 August 1942 (figure 12), 30 August 1942 (figure 13), and 12 September 1942 (figure 14), the commander of the submarine Shch-309 each time turned his boat toward the enemy vessels’ direction of movement.

In doing this, he twice executed turns of almost 270 degrees and, during the attack on 12 September, turned 180 degrees and then still 360 degrees.

The danger of such a maneuver is that with such a large turn, the submarine remains close to the point where it fired the salvo for a prolonged period of time. The enemy, orienting initially on the torpedo track, can easily find this point and, obviously, begin its pursuit of the submarine.
For the general case, it is more correct initially, after an engagement, to change course toward the enemy’s movement to an angle approaching 60 degrees, increasing it afterward to 120 degrees.

Having decided to break away, one must initially give full ahead, reducing speed on approach of enemy ships. If possible, one should avoid shallow depths, move to the opposite side of the target ships, or remain on the flank on which the enemy has fewer escort vessels.

We have examined only some basic precepts of the conduct of daytime submarine torpedo attacks.

The stated positions, of course, may not apply in all combat situations, but just the same, submarine commanders must keep them in mind.

Knowing these positions, a submarine commander can sometimes deviate from them. But it is important that commanders do this consciously, in accordance with the situation, and not in a mechanical, ill-advised maneuver.

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1 In arriving at this figure for the success rate of the new method, instances of firing single torpedoes have been excluded.
2 Data on the first two submarine echelons.