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The Soviet Attack Submarine Force and Western Sea Lines of Communication

An Intelligence Assessment

Information as of September 1978 has been used in preparing this report.

The author of this paper is
Office of Strategic Research. Comments and queries are welcome

This assessment has been coordinated with the Offices of Scientific Intelligence, Weapons Intelligence, and Economic Research.

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Foreword

The Director of Central Intelligence has reviewed this study and makes the following introductory comments.

There are two basic elements to the study. The first is: What are the Soviet intentions with respect to attempting sea denial in the North Atlantic? The second is: What are the Soviet capabilities to execute sea denial if they decided to do so?

With respect to intentions, I believe it is clear that planners on both the Warsaw Pact and NATO sides basically expect a short war. I therefore agree with the study that sea denial operations in the North Atlantic are not a high priority item for Soviet naval efforts in the initial stages of either a nuclear or conventional war between the Warsaw Pact and NATO. At the same time, in advance of both World War I and World War II, everyone expected that there would be a short war. In advance of each of these wars the Germans did not make explicit preparations for a war of sea denial and yet were forced into it by events. I therefore believe there is a high probability that if a war between the Warsaw Pact and NATO became an extended conventional conflict, the naval side of the war would turn into a protracted campaign of sea denial versus sea control in the North Atlantic. In short, there is reason to believe that this is not the Soviet intent today, but reason to be concerned that it may well become that intent if a war in which seaborne supply is a factor does evolve.

This means that the important part of the study is that concerning Soviet capabilities. Clearly if we establish that the Soviets do not have a substantial capability to conduct a sea denial campaign, this would have important implications. This study attempts to show Soviet capabilities given a wide range of assumptions governing the use of the USSR's submarines. It provides the reader with some indications of the sensitivity of various assumptions. There is work to be done, however, on assessing Soviet capabilities against varying assumptions about Western ASW and shipping strategies. In my view, the recent intelligence assessment that Soviet submarines carry substantially smaller loads of torpedoes than had previously been assumed is a major factor militating against a Soviet capability to exercise sea denial. The study assesses Soviet capabilities using as measures of effectiveness numbers of ships sunk and cargoes lost, percentage losses of NATO-flag ships over 6,000 GRT, and percentage losses of required economic and military cargoes. These measures suffer from imprecision and much more work remains to be done in this area, most of it by the Department of Defense, which has data on shipping requirements and availabilities.

With the cooperation and contribution of the Department of Defense, we plan soon to undertake an Interagency Intelligence Memorandum to assess on a broader basis the interdiction capabilities of the Soviet Navy against NATO sea lines of communication in wartime.

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The Soviet Attack Submarine Force and Western Sea Lines of Communication

Key Judgments

This study assesses the intention and the capability of the Soviets to disrupt the flow of Western military and economic shipping in a protracted conventional war with NATO by conducting submarine attacks on merchant ships at sea. We conclude that the Soviets would assign only a few attack submarines for use against shipping early in a war. They would probably assign more to interdiction if the conventional phase of a NATO-Pact war were prolonged and if the Soviets perceived that Western carriers, amphibious task forces, and submarines no longer posed any threat.

With their large fleet of general purpose submarines, the Soviets would have an inherent capability to threaten NATO's sea communications if they chose to concentrate their efforts on this task. But even if they realigned their priorities in favor of interdiction, several factors would constrain their ability to maintain a large submarine presence in the North Atlantic: the long transits, the small torpedo capacity of many of the submarines, the lack of replenishment opportunities outside home waters, the turnaround time between patrols, and combat attrition.

Important to the success of a Soviet interdiction campaign would be the ability to discriminate between ships loaded with vital military equipment and those carrying economic support cargoes. The Soviets' satellite-borne ocean surveillance systems might reduce the time their submarines would have to spend searching for targets. These systems are vulnerable to countermeasures, however, and in any case their data would be generally suitable only for locating ships at sea, not for identifying specific ships. As long as economic shipping continued—as it almost certainly would in a prolonged conflict—ships carrying economic cargoes would probably be intermixed with ships carrying military equipment. Unable to discriminate between them, the Soviets would have to attack ships chosen at random—further diluting their capability to interrupt the military resupply of NATO.

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Preface

Debate in the United States over naval strategy and the Navy's shipbuilding program has focused interest on the ability of the USSR's large fleet of attack submarines to interdict main Western sea lines of communication. Analysts in the US Intelligence Community have taken differing points of view on this issue and have formed markedly different judgments of the capabilities and intentions of the Soviet Navy in its potential employment of submarines for interdiction.

This assessment describes one view of the interdiction problem. After briefly placing interdiction in the broader context of Soviet naval policy, it focuses on Soviet capability to disrupt the resupply of NATO's Central Region by conducting submarine attacks on merchant shipping in the North Atlantic. Soviet capability to cut NATO's sea communications with Norway is outside the scope of this paper.

A model was used in the analysis of Soviet capabilities in several possible scenarios. The appendix describes the assumptions used in this model and the results obtained.

The paper makes several related assumptions: that Soviet submariners could not identify ships carrying war materiel in a stream of shipping, that NATO logistic managers would distribute those high-value ships among similar ships carrying less valuable economic cargoes, and that this shipping strategy would distribute losses at random among the total cargoes shipped. Our analysis did not include the beneficial effects of convoying, which could reduce losses to escorted merchant ships and increase losses to the submarines.

For this study, interdiction is defined as the disruption of merchant shipping (of military or commercial cargoes, or both) in the open ocean. The definition excludes warships, military logistic ships, and amphibious landing forces.

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The Soviet Attack Submarine Force and Western Sea Lines of Communication

The Soviet View of Interdiction

The Soviets hope to disrupt Western shipping by launching air and missile strikes against ports, conducting submarine attacks on merchant ships on the high seas, and mining heavily traveled waters. While we recognize that they could—and probably would—use all three forms of interdiction, this paper discusses only their capabilities to conduct submarine attacks on merchant ships in the North Atlantic.

The most effective way to disrupt shipping, the Soviets believe, is to attack the land-based facilities upon which it depends. Soviet criticism of Germany's failure in World War II to carry out "massed and systematic" strikes against British ports suggests that they would try to disrupt port operations in the conventional and limited nuclear phases of war as well as in a nuclear conflict. To be effective in a nonnuclear war, however, such attacks would require large-scale and repetitive bombing. The Pact probably would not make many bombers available for attacks on ports unless it had won the battle for air superiority and had destroyed NATO tactical nuclear strike forces.

The Soviets regard mining as useful in a conventional war because clearing minefields imposes an additional strain on enemy navies, and precautions against them lengthen the time that merchant ships must remain at sea, reducing their effectiveness and increasing their vulnerability to other forms of attack. Without air superiority in the areas to be mined, however, aircraft and surface ships would be unable to lay and replenish minefields effectively, and it would be inefficient to use submarines for dense mine-laying because of their small capacity, slow turnaround time, and insufficient numbers.

The third form of interdiction—attacking merchant ships at sea—probably would increase in importance for the Soviets if the conventional phase were prolonged and if they had first neutralized the threat from US carriers, amphibious task forces, and submarines. They acknowledge that this method would require a sustained effort by massed forces, principally attack submarines.

In their analyses, the Soviets distinguish between the interdiction of merchant shipping in the open ocean and the interruption of an enemy's military resupply effort in offshore waters adjacent to an area of active combat operations. They regard the interruption of NATO's close-in sea communications as an important aspect of the Navy's traditional role of supporting the ground forces. The operations involved would be concentrated in specific areas for brief periods of time, conducted mostly by combined air and surface forces, and directed against shipping with military cargoes. Their objective would be to isolate NATO troops on the Continent. The Soviets believe that the interruption of NATO's in-area sea communications under such conditions in a long war could make a direct contribution to a Pact victory on land.

Open-ocean interdiction alone, in the opinion of most Soviets who have written about the subject, could not determine the outcome of a war. Authoritative Soviet writers believe an open-ocean campaign should be carried out mainly by attack submarines, with a primary objective of causing the West to divert its forces to extensive antisubmarine warfare (ASW) operations far from the USSR. These authors believe that it is easier to attack than to defend merchant ships and hope that a few submarines committed to this task would tie up a disproportionate share of NATO assets by inducing NATO to scatter its naval forces over the sea lanes.

Some Soviets also believe that interdiction could make an important, though not decisive, contribution to the Soviet war effort, should a war be protracted. In their view, attacks on shipping could in time impose a strain

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on defending navies, erode enemy economies, and reduce enemy resources for military operations in distant areas. They believe that simply by operating in the sea lanes, Soviet submarines could force NATO shipping to adopt defensive measures (such as convoying, circuitous routing, and zigzag tactics) that would reduce its efficiency.

Most Soviet military planners, however, do not expect to have to fight a protracted war—the kind of war in which attacks against shipping would be significant. They believe or hope that the opening phases of war with NATO would be brief and decisive, perhaps culminating in a nuclear exchange—which, in any case, would destroy the ports upon which shipping depends. Holding this belief, they have relegated attrition-based strategies like interdiction at sea to a position of secondary importance. This view has strongly influenced their operational planning, training, force structure, and submarine design.

Most Soviet naval forces evidently are assigned to the wartime mission of controlling the seas near the USSR. Their exercises and training generally take place in the context of anticarrier or antisubmarine operations. For the most part, their submarines are designed for attacks on a limited number of high-value naval targets—such as aircraft carriers—rather than a large number of less valuable targets.

Competing Requirements for Submarines

The Soviets almost certainly do not have as many submarines, particularly modern nuclear-powered torpedo attack units (SSNs), as they deem necessary to perform the naval tasks most prominent in their operational planning. They probably plan on concentrating large forces in areas—such as the Mediterranean, Barents, and Norwegian Seas—where they feel that Western SSBNs, carriers, and amphibious task forces pose a threat to the USSR. These areas are far from the likely NATO sea lanes in the North Atlantic. We believe that the Soviets would release only a few torpedo attack submarines to raid NATO's sea communications as long as they felt threatened by Western naval forces.[1]

[1] Soviet capabilities for interrupting the resupply of NATO under different levels of effort are discussed in the appendix.

The Soviets' sea control operations in the Norwegian Sea and in the area of the Greenland–Iceland–United Kingdom (G-I-UK) gap probably would tie up a large part of their submarine force. They evidently regard the Norwegian Sea as a favored launch zone for Western naval strike forces, particularly aircraft carriers. Their exercise activity suggests that they also believe NATO might attempt amphibious landings on or near the Kola Peninsula, which could cause them to withhold some submarines in the Barents Sea.

In addition, the Soviets probably believe that NATO would send large numbers of attack submarines to the Norwegian Sea to threaten the D-class SSBNs patrolling there and the Y-class SSBNs en route to and from the North Atlantic. They probably believe that protection of these strategic submarines would be particularly important during the conventional and the limited nuclear phases of war, when these submarines would have to remain passively on station awaiting the transition to full nuclear war.

Soviet deployments would be affected by NATO's opening moves. If the Soviets concluded that NATO did not intend to send naval forces into or near the Norwegian Sea, they probably would release larger numbers of submarines for operations in the North Atlantic.

In any event, the Soviets almost certainly would conduct some sea denial operations south of the G-I-UK gap. These operations would be directed primarily against NATO fleets, however, and only secondarily against merchant shipping, because the Soviets believe that regardless of how a war may begin the major wartime objectives of their general purpose naval forces are to reduce Western nuclear capability and to protect their own SSBNs. We do not know exactly how the Soviets would apportion their forces between these tasks, but it seems likely that the requirements on their general purpose submarines to attack Western naval units south of Iceland would be demanding, even if none of them were committed to operations against merchant ships.

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Capability of Soviet Attack Submarines in the Atlantic Ocean And Contiguous Seas

Because the Soviets' naval strike aircraft have limited ranges [1] and their surface ships are vulnerable when operating out of Soviet-controlled waters, Soviet success in sinking merchant ships at sea would depend primarily on the availability and capability of the general purpose submarine force for this task.

The USSR currently maintains in its western fleets an active inventory of 173 attack submarines, most of which are based in the Northern Fleet (see table 1). Of this number, 126 are long-range units with enough endurance to operate in the major shipping lanes. Fifty-six of these long-range submarines are nuclear powered and have almost unlimited range. The other 70 are long-range diesel submarines capable of operating more than 15 days on station within a 2,400-nm radius. The remaining 47 submarines belong to the obsolescent medium-range R- and W-classes, which have an endurance of 20 days on station when operating within 1,200 nm of their bases in the USSR. To be effective against the major shipping lanes between the United States and Europe, they would require forward basing. After a war began, however, any of them in the North and Mediterranean Seas or the Atlantic Ocean would be unable to return to Soviet submarine bases in the Baltic and Black Seas and would have insufficient range to return to the Northern Fleet for replenishment.

The focus of a Soviet campaign against Western shipping would probably be the North Atlantic, and the main threat would be the 112 long-range attack submarines based in the Northern Fleet—the only fleet in the western USSR that would have access to the Atlantic sea lanes.

Because airlift could not meet the enormous logistic requirements of fighting a modern war with conventional weapons, NATO would have no choice but to use sealift to resupply its armies in Europe. Its long and vulnerable shipping routes could theoretically be severed at any point between the ports of embarkation in the United States and the ports of destination in Europe. Thus, the Northern Fleet submarine force poses an obvious threat to NATO's use of the North Atlantic in wartime.

On the other hand, the ability of that force to stem the flow of NATO shipping would be constrained by the submarines' low operational availability and limited torpedo capacity, the long transits they must make and the lack of replenishment opportunities while out of area, the turnaround time required between patrols, combat attrition (especially as the submarines funnel through geographic chokepoints to reach the sea lanes), and problems with weapons effectiveness and target acquisition.

Availability for Operations

The operational availability of Soviet attack submarines is low, and this would reduce their usefulness for interdiction. This limitation apparently stems primarily from poor quality control and from inefficiencies in the design, production, and maintenance of the submarines. The Soviets also may have expanded their nuclear submarine fleet faster than they have built the facilities and trained the personnel for repairing them.

On the basis of long-term observation of the force and other evidence, we judge that at any given time six out of every 10 Soviet attack submarines would be available—with varying degrees of effectiveness—for combat operations in distant waters. In wartime the Soviets would have difficulty sustaining the initial level of deployment, however, because of combat attrition and because the increased use could lead to more of the materiel failures that have characterized their peacetime operations. In peacetime, only about 10 percent of the Soviet submarine force is away from the USSR's coastal areas at a time.

[1] Soviet Naval Aviation is poorly suited for interdicting most of the Western sea lines of communication. Those aircraft that are equipped with antiship missiles have relatively short combat radii, which rule out their use over most of the major sea lanes in the North Atlantic. They have some capability near the United Kingdom and the Continent, but NATO's ground-based air defenses could make strikes there particularly hazardous.

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Table 1

Fleet Distribution of Soviet Attack Submarines, September 1978 [1]

		Range	Estimated Torpedo Loads [2]	Northern Fleet	Baltic Fleet	Black Sea Fleet		Pacific Fleet
Cruise Missile Submarines								
Nuclear-Powered (SSGN)								
Class	Missiles							
C-I	8 SS-N-7	long	12	9	0	0		2
C-II	8 SS-N-9	long	12	3	0	0		0
E-II	8 SS-N-3/12	long	8	15	0	0		14
P	10 possibly SS-N-9	long	Unknown	1	0	0		0
Total SSGNs				28				16
Diesel-Electric (SSG)								
Class	Missiles							
J	4 SS-N-3	long	6	12	0	0		4
W Long Bin	4 SS-N-3	medium	10	0	2	1		2
W twin cylinder	2 SS-N-3	medium	12	0	0	2		0
Total SSGs				12	2	3		6
Total Cruise Missile Submarines				**40**	**2**	**3**		**22**
Torpedo Attack Submarines								
Nuclear-Powered (SSN)								
A [3]		long	Unknown	2	0	0		0
E		long	8	0	0	0		5
N		long	20	8	0	0		4
V-I		long	16 [4]	12	0	0		3
V-II		long	16 [4]	6	0	0		0
Total SSNs				28				12
Diesel-Electric (SS)								
F		long	22	36	5	0		19
G		long	6	0	0	0		3
R		medium	14	10	0	2		0
T		long	22	5	0	4		0
W		medium	12	5	15	10		15
Z		long	22	3	4	1		5
Total SSs				59	24	17		42
Total Torpedo Attack Submarines				**87**	**24**	**17**		**54**
Total long-range attack submarines				112	9	5		59
Total medium-range attack submarines				15	17	15		17
Grand Total				**127**	**26**	**20**		**76**

[1] Numbers include submarines in repair and on sea trials, but not auxiliary, radar picket, coastal and reserve units. Two SSNs (an N and a V-I) have been inactive for many years and are here considered to be in reserve.

[2] Torpedo estimates assume that Soviet submarines are loaded with standard 21-inch torpedoes. It is possible that submarines which lack torpedo reloads, such as the J-class, could increase their loadings by carrying two small weapons in place of a large one.

[3] The Soviets have built five A-class SSNs. Of these, one has been dismantled, two are fitting out, and two are on sea trials.

[4] V-class submarines probably also carry [redacted] rocket-assisted nuclear depth bombs for use against other submarines.

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Torpedo Reloads

Another factor limiting the usefulness of many Soviet attack submarines for interdiction would be their apparently small capacity for carrying torpedoes. The cruise missile submarines evidently carry few or none beyond those already in the tubes. Thus, these submarines (the C-, E-II-, and J-classes, which together form nearly one-third of the USSR's fleet of long-range attack submarines) would be ill equipped for interdiction as a secondary task. We assume they would not use their missiles against merchant shipping. The long-range torpedo attack submarines, which are more likely to be committed to interdiction, have greater capacity (from 16 to 22 torpedoes each); but they are multipurpose submarines that ordinarily carry a variety of torpedoes, some of which are nuclear or for ASW and probably would not be used against cargo ships.

These weapon loads are consistent with a naval strategy that stresses the likelihood of a short, nuclear war and the primary importance of destroying a small number of high-value enemy naval ships. The relatively small torpedo loads would seriously constrain an effort to interrupt the resupply of NATO, however, because the interdiction of merchant shipping requires a large number of torpedoes.

Although they do not carry many torpedoes, the submarines generally have a high salvo capability: nearly all Soviet attack submarines have six forward torpedo tubes (most US nuclear-powered attack submarines have four).

Another indication that the Soviets are not concentrating on preparations for a long conventional war of attrition at sea is the composition of the torpedo loads. Recent evidence indicates that Soviet submarines may carry a fairly high ratio of nuclear to conventional weapons. In a conventional war, the salvo capability and the Soviets' preference for massing their forces against important targets like aircraft carriers would tend to offset the effect of the small weapons loads. The need for mass attack, however, would leave fewer submarines available for other tasks.

Time on Station

Several factors seriously limit the amount of time Soviet submarines could spend on station in the North Atlantic. These include the long transits they must make to reach operational waters, the lack of replenishment opportunities in those waters, and the need for time in port between patrols.

Long Transits. Soviet submarines would have to travel long distances to reach interdiction points on likely NATO shipping routes. Western shipping could be routed southward toward an area west of Spain, where one route could lead toward the Continent and southern England and another could enter the Mediterranean (see figure 1). We assume that the Soviets would give increased priority to interdiction if the conventional phase of a NATO-Pact war were prolonged and NATO succeeded in stopping the Pact's advance on the central front. In such a situation, NATO merchant ships could sail for many different ports, and the value to the Pact of any particular chokepoint near the Continent would be reduced. In addition, NATO's ASW capabilities probably would be greater near shore. Thus, the same circumstances that would make interdiction valuable to the Soviets could also force them to concentrate their interdiction forces farther out at sea and farther from the USSR.

Lack of Replenishment Opportunities. The Soviets would have to return their submarines to home waters to rearm them. They acknowledge in their writings that the maintenance of distant submarine operations requires logistic support dispersed over a wide area. Submarine tenders and missile support ships could transfer torpedoes at open anchorages and cruise missiles at sheltered anchorages or in port. If they left Soviet-controlled waters in wartime, however, these resupply ships would be vulnerable to attack, and the Soviets probably would not count on them for replenishment. Any Soviet merchant ships at sea when war began would probably soon be sunk or captured and would not be available to support Soviet submarine operations in the North Atlantic.

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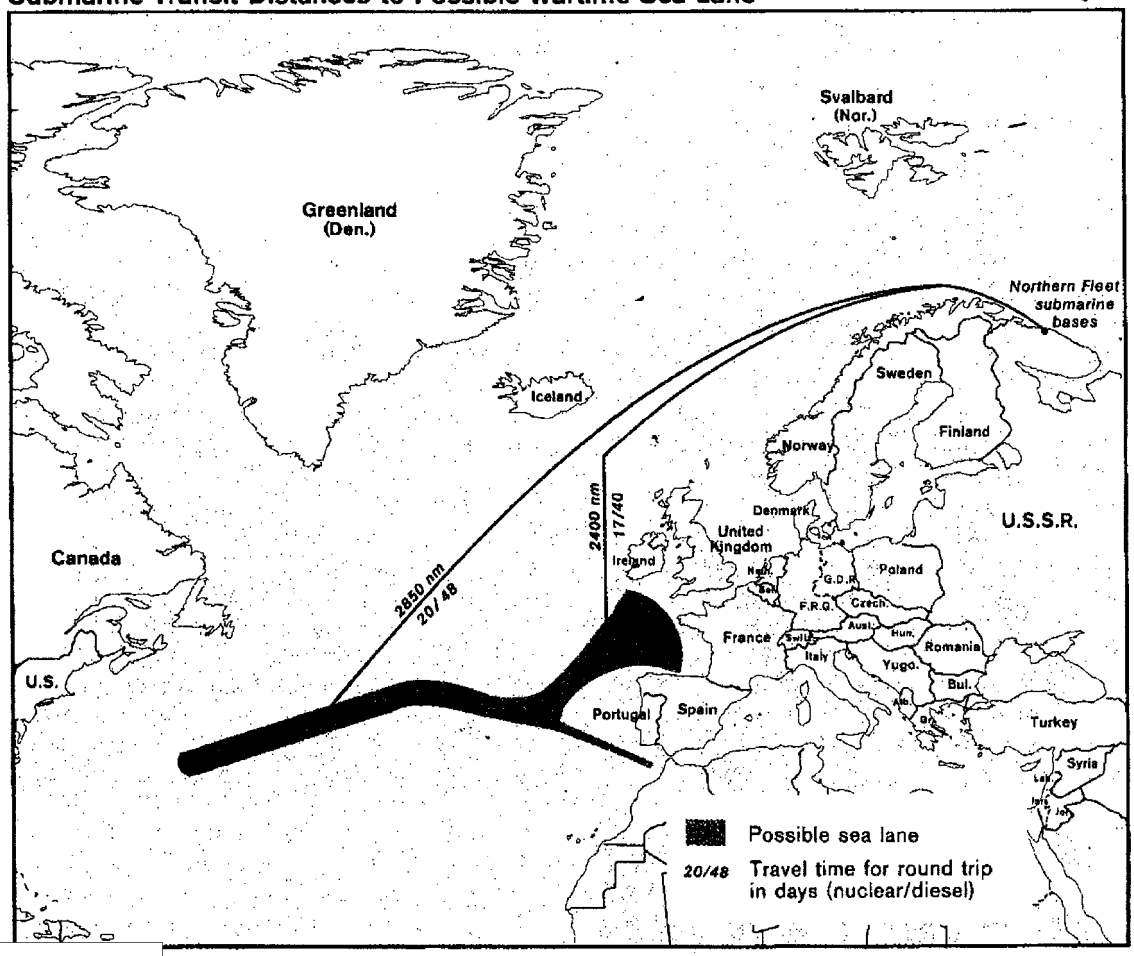
Submarine Transit Distances to Possible Wartime Sea Lane Figure 1



Turnaround Time. Submarines have to spend some time in port between patrols, and in a long campaign they need additional time for major repairs. In World War II, US and German submarines required some 25 days' turnaround time and required extensive repairs after seven or eight combat patrols.

Our observation of the Soviets' maintenance procedures suggests that they are unlikely to improve much on the World War II time for the turnaround of diesel submarines. They probably could not turn around a nuclear submarine after a patrol in significantly less time than the US Navy requires for its SSBNs—currently 32 days. A rough measure of efficiency is that the Soviet Navy requires some three years to overhaul and refuel a nuclear-powered submarine—more than twice as long as the US Navy.

Combat Attrition

This need to return to base for replenishment and refurbishment means repeated passage through such chokepoints as the G-I-UK gap, where the Soviet submarines would be especially vulnerable. Even on station, they would be continuously within range of NATO's land-based ASW aircraft, as well as other ASW platforms.

Weapons Effectiveness

The World War II history of US and German antiship attacks indicates that the number of torpedoes fired

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was much greater than the number of ships sunk. Although Soviet torpedoes appear to be technically reliable (about 85 percent), reliability is only one of several factors in the effectiveness of torpedo attacks, and other factors would tend to reduce that effectiveness. For example, we judge from some Soviet writings that the Soviets plan on firing their torpedoes from long ranges—a practice that would substantially reduce accuracy.

In Western navies, a single nonhoming torpedo has an even chance of hitting a straight-running surface ship at short range (2,000 yards or less). The odds against hitting a fast-moving, maneuvering target are longer. Accordingly, we estimate the Soviet hit rate in wartime at no better than about 25 percent for each torpedo fired (the 0.85 system reliability multiplied by an optimistic 0.30 probability of hitting the target).

The presence or absence of escorts among the merchant ships is another factor that would affect the Soviet weapons effectiveness against shipping. Soviet writings indicate that to reduce exposure to escorts Soviet submarines would use tactics that are likely to increase the ranges at which they would launch their torpedoes—and thus reduce their effectiveness. If they were diverted into firing some of their torpedoes against the escorts—fast, maneuverable, shallow-draft ships that would be difficult targets—they would have still fewer left to use against shipping.

Target Acquisition

In wartime, the Soviets probably would activate agents in North America to collect and communicate intelligence on shipments of war materiel to Europe. They probably would also launch ocean reconnaissance satellites to track the ships as they moved eastward.

Soviet ELINT-gathering ocean reconnaissance satellites (EORSATs) and radar ocean reconnaissance satellites (RORSATs), used in concert, can effectively collect intelligence against emitting US warships under normal operating conditions because the two space systems complement each other and because US naval ships of similar types carry similar radar suites. Both systems are vulnerable to countermeasures, however, and indicate that the RORSAT is not yet fully operational.

But even if the reconnaissance satellites worked well and the merchant ships continued to use their radars and radios, the Soviets almost certainly could not convert dockside or satellite-derived intelligence into targeting data adequate for submarine commanders to locate and attack specific merchant ships at sea. The data yielded would be too crude to enable the Soviet submariners to select the specific ships with military cargoes.

Furthermore, Soviet torpedo attack submarines (the strike forces most likely to be used against shipping) could receive satellite-derived target data only indirectly—primarily via the submarine broadcast from Moscow—and probably several hours after the satellite had passed over the target.

If the Western merchant ships practiced electronic emissions control, RORSAT would become the Soviets' primary satellite-borne ocean surveillance platform and simultaneously would become less effective because of losing the external tipoff data on which it is highly dependent for targeting. Even under optimum conditions (including receipt of tipoff information), a pair of RORSATs could detect a large surface ship in the aircraft carrier transit lanes of the North Atlantic only once a day, on the average, and during that time a fast merchant ship can travel some 500 nm.[3]

NATO logistic managers could reduce the value of a single ship by dispersing critical cargoes among many ships. They could complicate targeting by convoying ships loaded with economic goods together with ships carrying military cargoes. Alternatively, they could concentrate military cargoes in fast ships that would sail independently, at least in the open-water phase of their trips. The speed of these ships would sharply reduce the effectiveness of Soviet diesel submarines except at the terminal points of the voyage.

[3] This conclusion is based on a computer simulation

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NATO Sealift Resources

NATO is an alliance of maritime nations and has an extensive inventory of merchant ships.[4] Moreover, the construction of merchant ships—and thus the potential replenishment of the inventory—is high: *Lloyd's Register of Shipping* reported that in 1976 over 1,000 merchant ships, totaling nearly 30 million tons, were constructed in the Free World. This was down 4 million tons from the 1975 peak, and we expect further reductions as a result of overbuilding in the early 1970s, economic recession, and decreasing demand for new tankers. These figures nonetheless indicate considerable capability to replace losses in shipping even early in a conventional war.

US planning for the military resupply of NATO in a conventional war assumes a large amount of military support shipping that increases steadily during the war. Three or four hundred ships—or even more—could be en route to Europe within the first 30 days of hostilities, and during the next 30 days some 500 more could depart. More than 1,000 additional ships could sail later, making a total of 2,000 sailing with military cargoes in the first 90 to 120 days of war. Economic and military shipments together might total some 3,000 a month.[5] (C)

[4] There is disagreement within the US Government on how many ships would be available for sealift if necessary, but NATO clearly has more merchant ships than it is likely to need. According to *Lloyd's*, in 1976 there were over 9,000 NATO-flag merchant ships of over 1,000 gross register tons. A recent study concluded that over 5,000 of these would be suitable for sealift of supplies and materiel to Europe. Additional Western-owned merchant ships flying Panamanian and Liberian flags of convenience also probably would be available for sealift if needed. An older study estimated that about 11,500 merchant ships could be used for the resupply of NATO. The number used in this study—5,832—comes from *Lloyd's* but excludes ships of less than 6,000 gross register tons. This number is close to the estimate by the Naval Intelligence Support Center (NISC) on the size of the NATO-flag merchant fleet. NISC data show 5,565 NATO-owned merchant ships larger than 6,000 GRT. These figures understate the tonnage available, NISC believes, because the 6,000 GRT cutoff excludes many ships—especially those with a roll-on/roll-off capability—that could conduct trans-oceanic operations. If these ships and US-controlled foreign-flag ships were added to the NISC total, it would become 6,208.

Losses of military equipment probably would be more important than losses of ships, which probably could be replaced on a one-for-one basis during the war. To reduce appreciably (by, say, 25 percent) the number of military cargoes delivered to Europe, the Soviets would have to identify the ships carrying those cargoes and then maintain large strike forces in the sea lanes. If economic shipping dwindled during the war, Soviet efficiency in sinking military cargoes could increase.

The appendix contains an analysis of Soviet capabilities, using a computer simulation of a modern interdiction campaign in the North Atlantic and assuming long-range attack submarines in the Northern Fleet as strike forces. It addresses the effects of the above constraints, with various force levels, on the capability of the submarine force to interdict shipping. It shows that, regardless of the level of commitment, Soviet forces have little capability to disrupt the resupply of NATO by sinking merchant ships at sea.

Outlook

Contemporary Soviet writings, exercises, and naval force trends indicate that for the next decade or so there are unlikely to be any militarily significant increases either in Soviet willingness to allocate forces to interdiction or in the interdiction capabilities of the forces themselves. This judgment assumes that:

- The West continues to maintain and deploy strong offensive naval forces capable of attacking targets in the USSR with nuclear weapons—a threat that causes the Soviets to commit strong forces of their own in counteraction.

- NATO maintains strong air defenses which could and probably would deny Soviet aircraft free access to the sea lanes in wartime.

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A key element in deterring the Soviets from fully exploiting Western dependence on long sea lines of communication in wartime is the credibility of the NATO carrier and SSBN threats to the USSR. The specter of NATO carrier task groups in or near such areas as the Norwegian Sea and the eastern Mediterranean, for example, would almost certainly hold large Soviet forces in those areas—and well away from the major sea lanes. Even if the NATO carriers were more distant (in the North Atlantic west of the United Kingdom, for example), the Soviets probably would still regard them as a threat and keep a sizable submarine force available to counter them. Soviet submarines engaged in interdiction operations probably would be in waters farther south and could not be recalled to the Norwegian Sea in time to prevent Western carrier strike forces from penetrating into the Norwegian Sea and launching raids on Northern Fleet naval bases and other targets in the northwestern USSR.

If, on the other hand, the West stationed high-value targets like carriers on the major shipping routes, Soviet naval strike forces might be attracted to those targets and thus be in a position to threaten Western shipping as well.

To some extent, Soviet naval mission priorities are scenario driven. Thus, any reallocation of naval forces would depend on the outcome of the initial battles, at sea and on land. If NATO checked the Pact advance in Central Europe and the war became prolonged, Soviet interest in interdiction probably would increase, because cutting the sea lanes—particularly in waters adjacent to a theater of military operations—could then affect the outcome of the war. This would be particularly true if attrition or Western strategy reduced the carrier threat to the USSR, enabling the Soviets to free more forces to attack merchant ships.

If the war in Europe were stalemated and Western strike forces remained largely intact, however, the Soviets would face a hard choice: to try to interrupt the resupply of NATO or to concentrate their remaining naval forces against SSBNs and carriers. The Soviet tendency to assign higher priority to military targets suggests that under these circumstances they would continue their concentration against NATO's offensive naval forces. Should they elect to send most of their surviving attack submarines against merchant ships, they would leave Western naval strike and intervention forces free to attack important Pact ground and naval targets.

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Appendix

Analysis of Soviet Interdiction Capabilities

The analysis described in this appendix examines Soviet submarine capabilities against Western shipping in the North Atlantic. Using a computer-based model for convenience, it considers the ability of Soviet submarines to deliver torpedoes against US convoys to Europe. The analysis focuses on three scenarios, which postulate different Soviet commitments of attack submarines to interdiction. The first shows the effort we would expect the Soviets to make (giving priority to antifleet operations); the second scenario assumes roughly equal emphasis on antifleet and antishipping operations; and the third shows the Soviets using all their available long-range submarines against NATO shipping.

Assumptions used in our base study tend to "worst case" the situation for NATO and result in optimistic exchange ratios for the USSR. Key assumptions are:

- Submarines spend 15 days on station.
- Each submarine fires all its torpedoes (except two withheld for self-defense) against merchant ships in a target-rich environment; that is, each finds as many targets in 15 days as it has torpedoes.
- Turnaround time between patrols is 25 days (variations of the basic model were run with 15-day turnaround periods).
- Submarines suffer 20-percent attrition per patrol during transit and no attrition on station.
- Shipping travels a southern route. Submarines interdict merchant ships primarily in two areas—west of the Azores and west of the Bay of Biscay.
- The Soviets schedule their departures so as to maintain an almost continuous submarine presence in the shipping lanes.
- Soviet Northern Fleet bases are undamaged and continue to support submarine operations.
- The Soviets achieve a hit rate of about 25 percent for each torpedo fired (0.85 technical reliability multiplied by 0.3 for accuracy).
- A single hit sinks or disables a merchant ship.
- NATO air superiority prevents the Soviets from replenishing submarines from non-Warsaw Pact territory and forces the submarines to return to home waters for replenishment. (In an alternative World War II-like scenario, we simulated Soviet submarine deployments out of bases in France and southern Norway, which we assumed to have come under Pact control. From these forward bases, and targeted against shipping at points north and south of Ireland, Soviet submarines increase NATO ship losses by some 50 percent.)
- Torpedoes with nuclear warheads and cruise missiles are reserved for military targets; none are expended against merchant ships.
- Nuclear-powered submarines transit at speeds of advance (SOAs) of 12 knots, diesels at 5. (These approximate the speeds used by the Soviets and presume some minimal concern for NATO ASW capabilities during transit. We ran a variation of the model using SOAs of 15 and 8 knots, but they did not change the results significantly.)
- The Soviets know the general location of Western merchant ships (notwithstanding the difficulty of using space systems for targeting) but cannot specifically identify military shipping because economic shipping continues.

[a] The model, which is called Firearm and is unclassified, was developed by Science Applications, Incorporated, of Englewood, Colorado. It is described in a "User's Manual," SAI-77-143-DEN, dated 26 August 1977. Copies of the manual can be obtained from SAI.

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Table 2

NATO Losses in a 120-Day Interdiction Campaign: Three Scenarios

Scenario	Level of Soviet Effort Assigned to Interdiction	Soviet Submarines Participating in Interdiction Campaign	Total Western Ships Sunk or Disabled [1]	Losses as a Percentage of Total NATO-Flag Ships (rounded) [2]	Losses as a Percentage of Total Military and Economic Cargoes Shipped (rounded) [3]
1	The "anticipated level": 20% of available long-range torpedo attack submarines	5 F/T/Z-class SSs [4] 2 N-class SSNs	38	0.7	0.3-0.5
2	Intermediate level: all available long-range torpedo attack submarines except V-class	17 F/T/Z-class SSs [4] 5 N-class SSNs	115	2.0	1.0-1.4
3	Maximum level: all available long-range torpedo attack and cruise missile submarines [5]	7 C-class SSGNs 9 E-II-class SSGNs 7 J-class SSGs 5 N-class SSNs 12 V-class SSNs 27 F/T/Z-class SSs	277	4.7	2.3-3.5

[1] These numbers assume a Soviet hit probability of about 25 percent and that a single hit disables a target.
[2] Our calculations included only NATO-flag ships of 6,000 gross register tons or more. They excluded more than 3,000 comparable Liberian- and Panamanian-flag ships, some of which probably also would be used for sealift if needed.
[3] This assumes monthly sailings of 2,000 to 3,000 ships carrying military and economic cargoes.
[4] F-class submarines deployed to the Mediterranean are excluded from the strike forces in Scenarios 1 and 2.
[5] The Northern Fleet normally supplies about 10 attack submarines for the Soviet Mediterranean Squadron. Although it is unlikely, we assume for purposes of Scenario 3 that these forces would be available for operations against merchant ships in the North Atlantic.

Table 2 summarizes the results of the three levels of effort, all using these assumptions.

Scenario 1 (Anticipated Level of Effort)

This scenario assumes that the Soviets' main reason for attacking merchant ships in the open ocean is to create a diversion that will cause NATO to spread its forces over the sea lanes. This scenario represents the level of Soviet effort that we would consider likely in the early phases of a war, while Western SSBNs, aircraft carriers, and amphibious task forces posed a threat to the USSR.

In this scenario, under favorable conditions the submarines could sink or disable some 38 ships within 120 days. This number is less than 1 percent of the total ships available to NATO (see section on NATO sealift resources) and less than 1 percent of the combined military and economic cargoes shipped from the United States during that period.[7]

Scenario 2 (All Available Long-Range Torpedo Attack Submarines Except V-Class)

This scenario assumes that the conventional phase of war in Europe continues and the Soviet leaders risk sending all available long-range torpedo attack submarines in the Northern Fleet against merchant ships, with the exception of the 10 or so available V-class SSNs, which would be employed mainly in offensive and defensive ASW operations. The emphasis accorded interdiction would be approximately the same as that devoted to countering Western SSBNs, aircraft carriers, and amphibious task forces.

[7] Figure 2 shows the effect on ship losses of varying the number of submarines committed to interdiction in the three scenarios.

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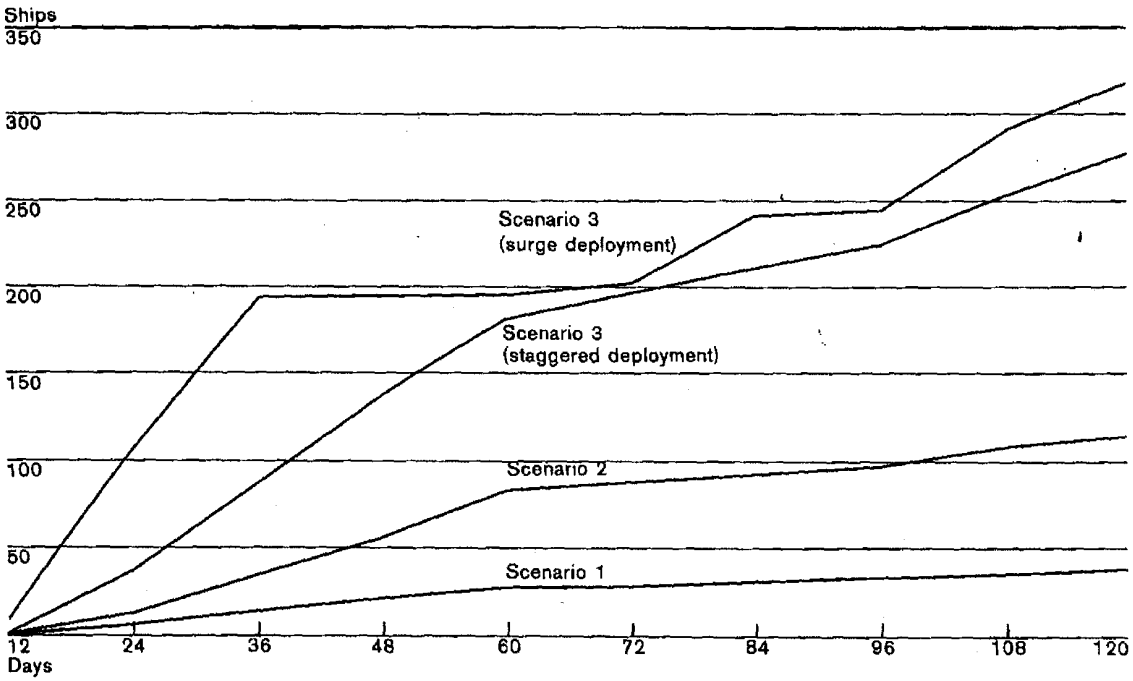
Cumulative Western Ship Losses Figure 2



Under favorable operating circumstances, this larger number of submarines could destroy or disable more than 100 merchant ships, constituting about 2 percent of the NATO-flag ships and 1.0 to 1.4 percent of the military and economic cargoes shipped.

Scenario 3 (Maximum Effort)

This scenario assumes that all available long-range torpedo attack and cruise missile submarines in the Northern Fleet and Mediterranean Squadron are sent against merchant ships in the North Atlantic, leaving no submarines to combat Western naval forces. This force could sink some 277 merchant ships, a level of attrition that would represent about 5 percent of NATO-flag ships of 6,000 gross register tons or greater and about 3 percent of cargoes shipped during a 120-day period.[8] Our analysis assumes that the Soviets stagger their submarine departures in order to maintain an approximately continuous presence in the sea lanes.

We have assumed that the C-, E-II-, and J-class submarines would use only their torpedoes, not their cruise missiles, against shipping. If we assumed that they had conventional warheads on half their cruise missiles and used them against merchant shipping, the number of Soviet weapons available for interdiction would increase by about 100. We have not made this assumption in our calculations of losses in Scenario 3; we have, however, weighted our calculations in the submarines' favor by assuming a higher proportion of

[8] Figure 3 shows the effect of attrition in Scenario 3 by comparing cargoes destroyed with cargoes delivered.

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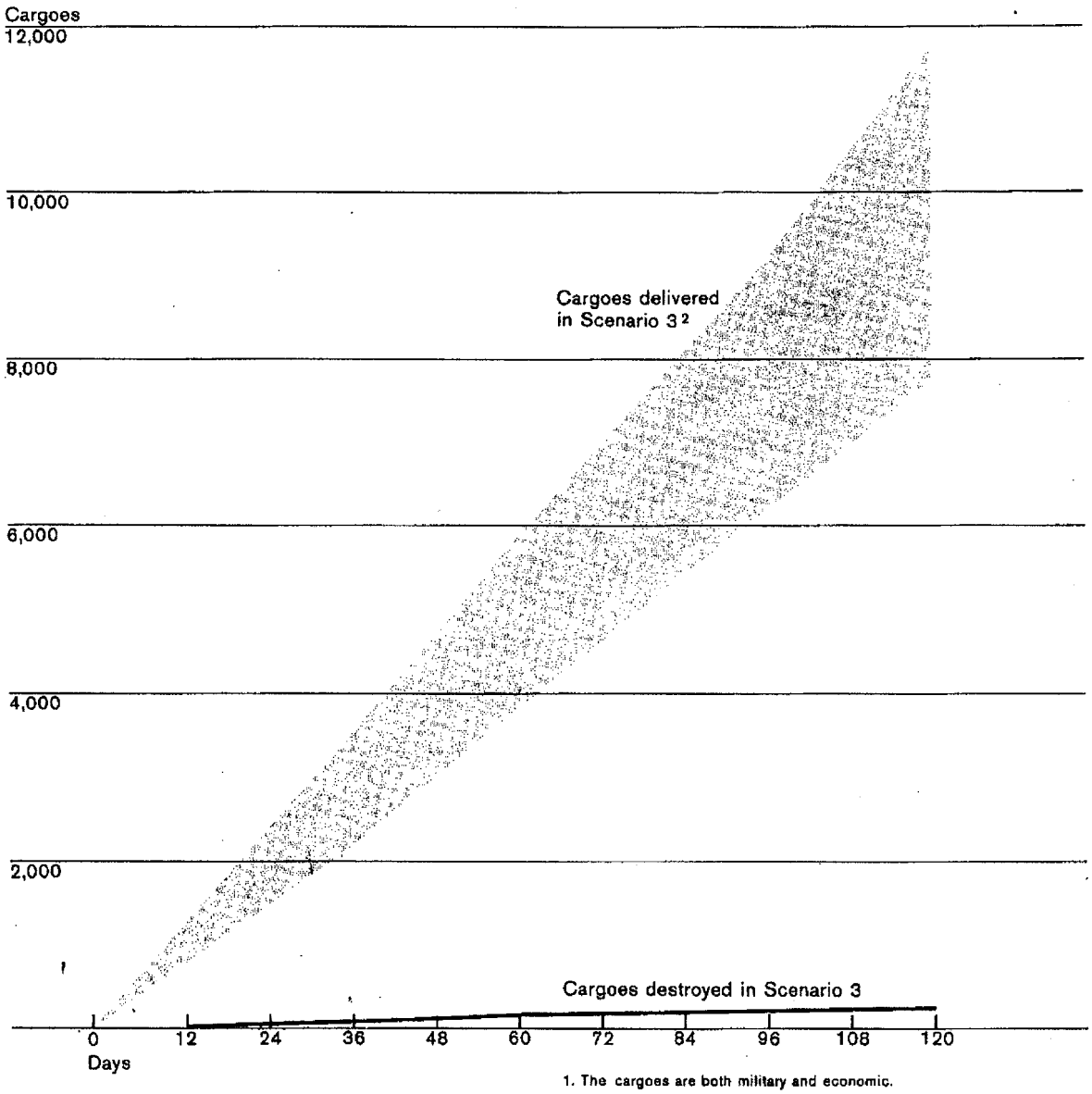
Cargoes Delivered and Cargoes Lost in a Hypothetical All-Out Interdiction Campaign[1] Figure 3



1. The cargoes are both military and economic.

2. Data on cargoes delivered reflect uncertainties regarding the number of economic shipments that would take place.

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antiship torpedoes (vs. ASW torpedoes) than the evidence would indicate. "Alert" submarines in peacetime evidently carry mixed weapon loads, including ASW and nuclear torpedoes. If they continued this loading pattern in wartime—as seems likely—they would have fewer torpedoes than we have postulated for them to expend against merchant ships and would sink fewer ships.

Other Considerations

Other, more realistic, operating conditions likely to prevail in wartime probably would make ship losses lower than those attained in the three scenarios of this analysis. Some hits, for example, might not disable or sink a ship—but we have assumed that they all would.

If NATO economic shipping continued, Soviet attempts to identify the ships carrying military cargoes could force the Soviet submarines to spend more time on station searching for targets (beyond the 15 days assumed in the model). This would increase their vulnerability and reduce the number of patrols over time.

Realistically, submarines would be subject to attrition during their entire patrols, not merely during transits. If submarine attrition were 0.3 to 0.5 per patrol (instead of 0.2 as assumed in this analysis), Soviet ability to sustain an at-sea interdiction campaign would be sharply reduced.

All of the scenarios we examined were constructed to the Soviets' advantage. If as an upper bound we assumed a torpedo hit rate which their submarines could achieve if all their attacks were made at short range against slow-moving, straight-running, undefended ships (about 0.5 accuracy), NATO losses in Scenario 3 would increase to about 11 percent of NATO-flag shipping and 6 to 8 percent of the cargoes shipped.

On the basis of the analysis, we consider it unlikely that the Soviets, even with a maximum effort, could destroy as much as 5 percent of NATO military and economic cargoes during the first 120 days of war by attacking merchant ships at sea.

Sensitivity Checks

Numerous variations of the basic model were run to check its sensitivity to changes in its basic assumptions. Table 3 summarizes the results obtained.

Rather than "pulsing" their submarines to maintain a nearly continuous presence in the shipping lanes, the Soviets could "surge" all those available when a war began.[9] Over time, surge deployment would sink about the same number of Western ships as staggered deployments, but it would leave periods when no submarines were operating in the sea lanes, leaving the North Atlantic safe for shipping (these periods show as plateaus in figure 2). In a 120-day campaign, surging Soviet submarines in Scenario 3 would increase NATO losses by about 15 percent (roughly 2.7 to 4 percent of the cargoes shipped).

Other variations include reducing the submarines' turnaround time and concentrating their attacks in the vicinity of the Bay of Biscay. Even with the most favorable combination of these variations, the model indicated a resulting loss of no higher than 6 percent of the NATO ships, or 4.3 percent of the cargoes shipped.

[9] Another alternative—predeploying all available submarines—could result temporarily in higher NATO casualties because it would eliminate wartime attrition on the submarines' first outbound trip and could increase time on station. We do not consider such an action likely, however, because in the Soviet view it probably would precipitate an unacceptable NATO response.

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Table 3

NATO Losses in a 120-Day Interdiction Campaign: Variations on the Basic Model

	Scenario 1			Scenario 2			Scenario 3		
	Total Ship Losses	Percentage of Total NATO		Total Ship Losses	Percentage of Total NATO		Total Ship Losses	Percentage of Total NATO	
		Ships	Cargoes [1]		Ships	Cargoes [1]		Ships	Cargoes [1]
Base Case [2]	38	0.7	.3-.5	115	2.0	1.0-1.4	277	4.7	2.3-3.5
Base Case Variations									
15-day turnaround time	44	0.8	.4-.6	133	2.3	1.1-1.7	303	5.1	2.5-3.7
Attacks concentrated in Bay of Biscay area	40	0.7	.3-.5	122	2.1	1.0-1.5	280	4.8	2.3-3.5
Biscay contact area plus 15-day turnaround	45	0.8	.4-.6	136	2.3	1.1-1.7	310	5.3	2.6-3.9
Attacks concentrated west of the Azores	36	0.6	.3-.5	109	1.8	.9-1.3	259	4.4	2.1-3.2
Azores contact area plus 15-day turnaround	40	0.7	.3-.5	121	2.0	1-1.5	283	4.8	2.3-3.5
Surge deployment	54	0.9	.5-.7	170	2.9	1.4-2.1	318	5.5	2.7-4.0
Surge deployment plus 15-day turnaround	60	1.0	.5-.8	188	3.2	1.6-2.3	341	5.8	2.8-4.3
Surge deployment plus Biscay contact area	57	1.0	.5-.7	179	3.0	1.5-2.2	318	5.4	2.6-3.9
Surge deployment plus Azores contact area	49	0.8	.4-.6	153	2.6	1.3-1.9	288	4.9	2.4-3.6
Surge deployment plus 15-day turnaround plus Biscay contact area	62	1.1	.5-.8	192	3.3	1.6-2.4	350	6.0	2.9-4.3
Surge deployment plus 15-day turnaround plus Azores contact area	60	1.0	.5-.8	188	3.2	1.6-2.3	341	5.8	2.8-4.2

[1] Cargo data reflect uncertainty as to the number of ships with economic cargoes that would sail for Europe. We assumed here that 2,000 to 3,000 ships with both military and economic cargoes sail each month.

[2] The basic assumptions are listed at the beginning of this appendix.

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