

A VISUAL GUIDE TO THE U.S. FLEET SUBMARINES PART THREE: SALMON & SARGO CLASSES 1936-1945

BY

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As the decade of the 1930's moved into its second half, submarine development in the United States Navy was rolling along at a brisk pace. The fits and starts of concept development and the limitations of an as yet under-developed technological base had been largely overcome by 1936. The *Salmon* and *Sargo* classes ultimately proved to be a solid step in the developmental ladder that led to the war winning *Gato*, *Balao*, and *Tench* class submarines. Although technological experimentation was still underway in some areas, the design process was maturing rapidly and the Navy and its contractors were learning with each succeeding boat.

The sixteen submarines of the *Salmon/Sargo*-class all have the same performance specifications and the same armament, and all of their names started with the letter S. As far as the Navy is concerned, all sixteen boats belong to the same class. However, they are actually made up of no less than five distinct groups, each with unique characteristics that separate them from the others. It must be remembered that at this point in USN submarine development (1936-38), designers were still tinkering with the fleet boat concept, trying to find the right combination of factors to optimize its performance. The civilian Electric Boat Company (EB) was particularly keen on maintaining its own in-house design capability separate from the Government's (based at Portsmouth Navy Yard) and thus numerous detail differences crept into their plans. The Navy tolerated these differences quite well as they understood the value of maintaining EB as a production source.

Most authors and historians will separate the boats into two groups, the *Salmons* (authorized in Fiscal Year-1936) and the *Sargos* (authorized in FY-37). However, the last four boats of the *Sargo* group (authorized in FY-38) had a completely different propulsion arrangement. The eminent author John D. Alden separated these boats into their own class, the *Seadragons*, and while this is technically correct, I will stick with the two class arrangement. The *Seadragons* were virtually identical to the *Sargos* in all other aspects and separating them into their own class can get a little cumbersome.

These boats were longer, heavier, and faster developments of the preceding *Porpoise*-class and the early units were quite similar to them in external appearance. However, internally the boats differed substantially from their forebears in the arrangement of the machinery spaces and with the addition of two more torpedo tubes aft, for a total of eight. Some members of the ongoing Submarine Officers Conference wanted two more tubes forward as well. Opposing members of the conference thought that this would prove to be too congested an arrangement and fire control tactics of the time did not support it. A six-tube forward nest would have to wait a few more years.

The first twelve boats of the *Salmon/Sargo* class introduced a new main propulsion arrangement. The all-electric drive of the *Porpoise*-class, while providing a high degree of flexibility in operation, lost about 360 horsepower in transmission through the electrical system. They also suffered from flashover on the main motors when under full load, limiting the maximum speed of

the boats. A fix for this problem was eventually found, but this experience temporarily soured the Bureau of Engineering on all-electric drive. The desire to reliably achieve higher sustained surface speed led the Bureau to re-evaluate this arrangement, the result being the so-called composite drive. In all-electric drive, all four engines drove only generators and were not directly coupled to the shafts. The generators in turn supplied electricity to the motors for propulsion and to the batteries for charging. In composite drive, only the forward pair of engines drove generators. The aft pair, sitting inboard of the shafts, were clutched to reduction gears, which were sited forward of the engines. Two electric motors for each shaft, one forward of the reduction gears and one aft and connected directly to the gears were sited outboard of the shafts. This complicated arrangement proved to be cramped and somewhat difficult to maintain, but in general performed satisfactorily. This arrangement also did not have a separate maneuvering room. An electrical control cubicle was placed in the forward end of the aft engine room. For the FY-38 boats (*Seadragon*, *Sealion*, *Searaven*, and *Seawolf*) the Bureau made a quick decision to revert to all-electric drive, spurred by rapid improvements in electro-motive technology which had largely mitigated the problems of the loss of horsepower and motor flashover. The cubicle remained in its previous location and a non-watertight bulkhead separated it from the rest of the engine room. All USN submarines from this point forward had all-electric drive, until the advent of nuclear propulsion in the 1950's.

As previously stated, the first three boats were virtually identical in external appearance to the preceding *Porpoises*. Starting with the Portsmouth built *Snapper* (SS-185), longer periscopes altered the arrangement of the periscope shears and from that point forward, the boats began to take on a more distinctive appearance. The numerous modifications made during wartime greatly altered the look of the boats, most to the point of being unrecognizable from the as-built appearance.

ORIGINAL CONFIGURATION

SALMON CLASS

A casual glance at the original as-built configuration of *Salmon*, *Seal*, or *Skipjack* (all built by Electric Boat) will show that EB chose to follow an external design path that they first established with *Cuttlefish* in 1933-34, then continued with their units of the *Porpoise*-class. The following two 1938 photos of sisters *Skipjack* and *Seal* (Figures 1 & 2) provide a good example of this group's configuration as completed.

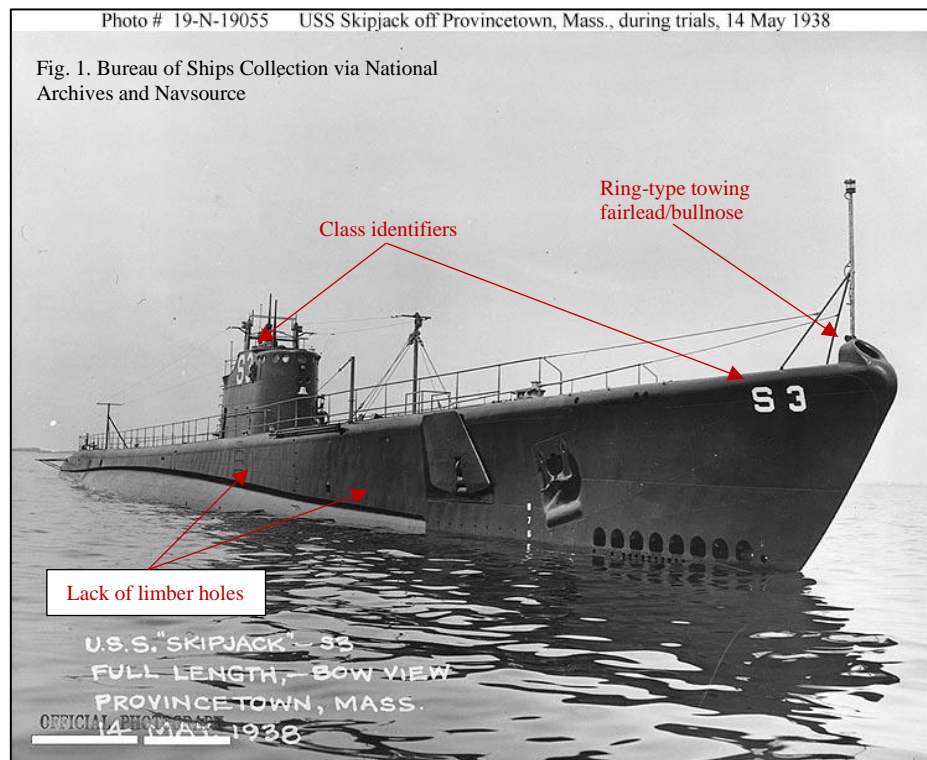


Photo # 19-N-19021 USS Seal off Provincetown, Mass., during trials, 5 March 1938

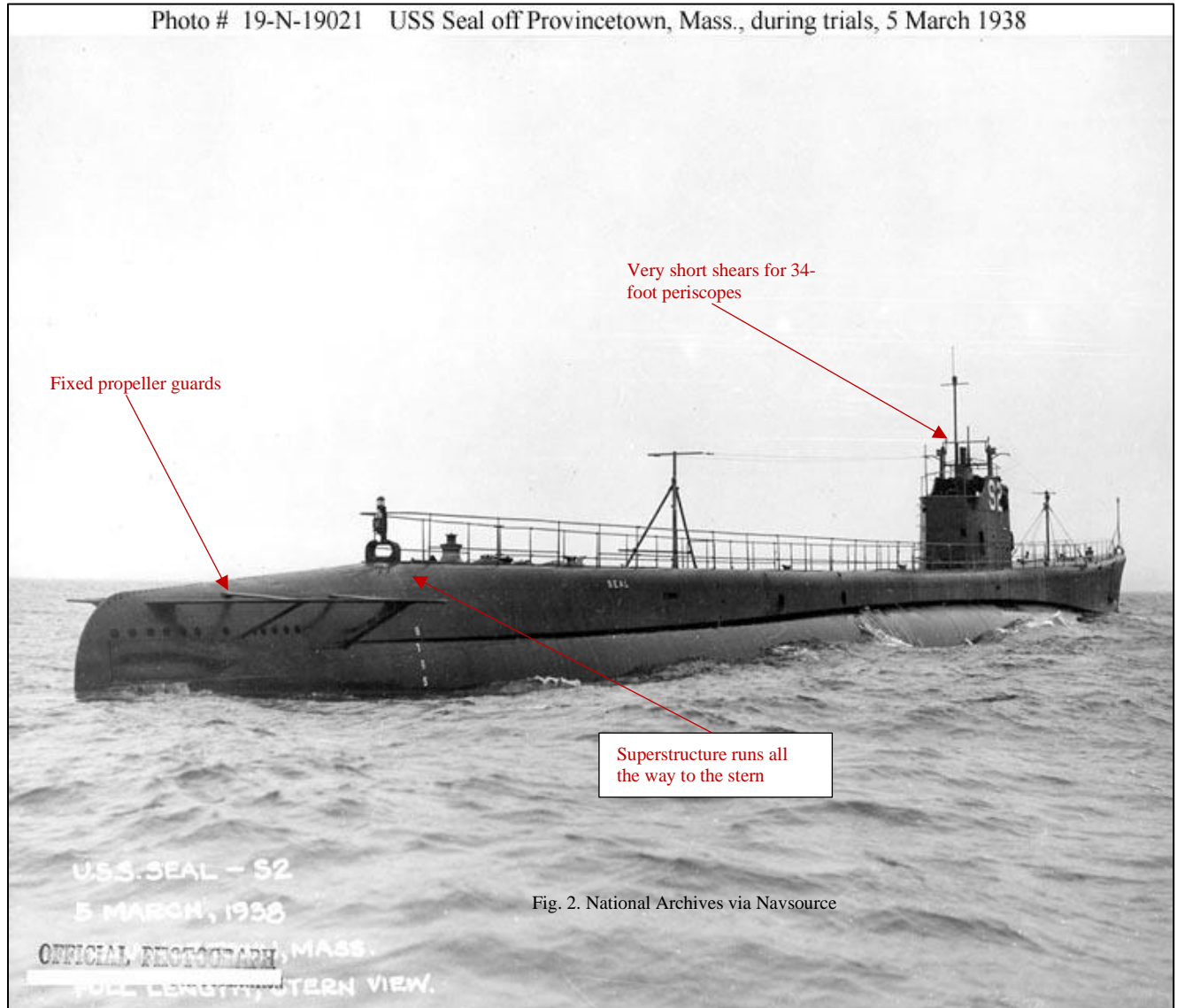
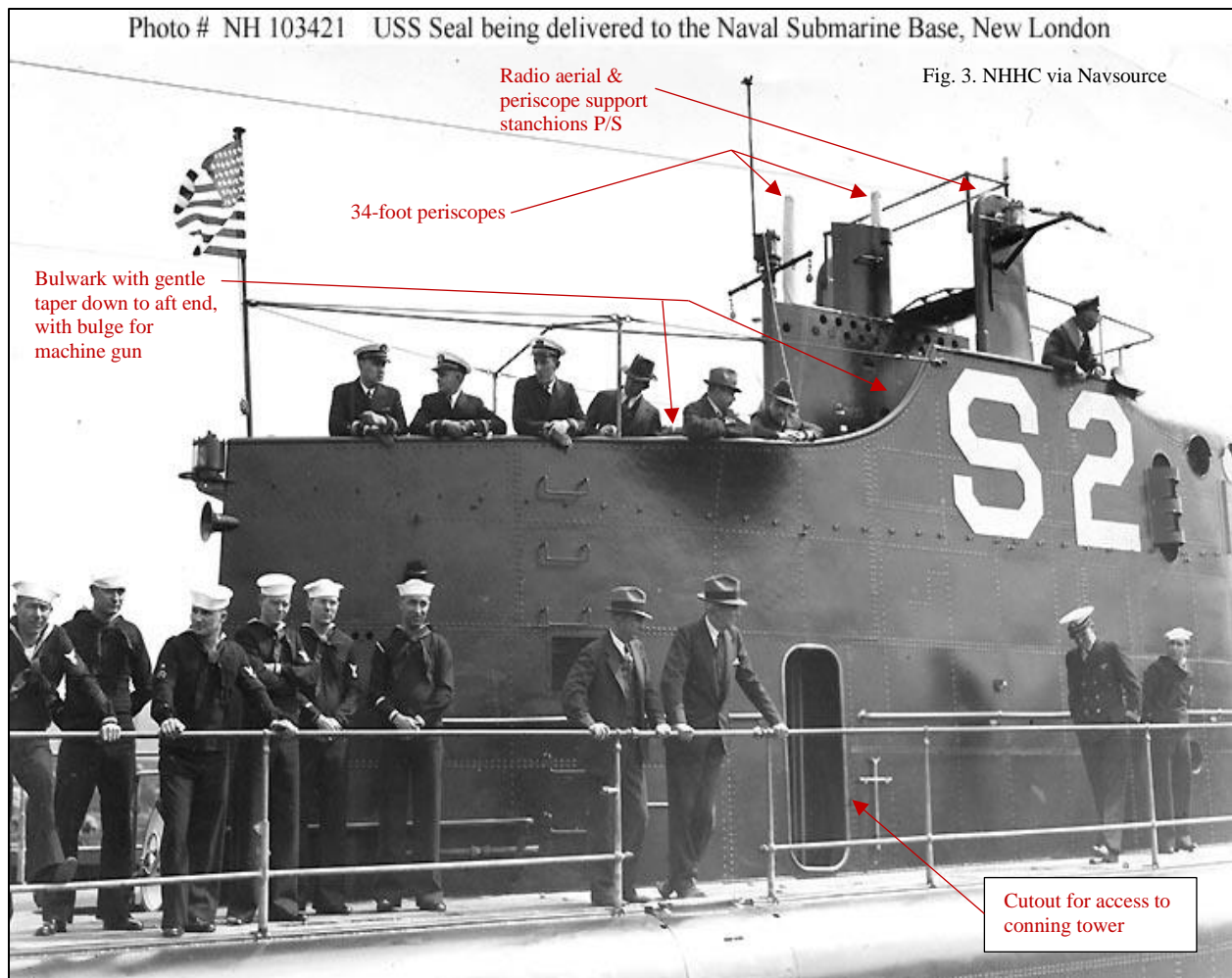


Fig. 2. National Archives via Navsource

These boats all had a prominent ring-type “bullnose” towing fairlead raised above the most forward tip the bow. Note the lack of free flooding limber holes for the superstructure aft of the bow planes. Operational doctrine of the time did not heavily emphasize quick diving times, thus the urgency to quickly flood the superstructure was absent. Limber holes for these three boats were not added until the war started, when the harsh reality of war provided a strong urgency to quickly reduce dive times. All of the *Salmon/Sargo* boats had two anchors on either side of the superstructure, forward of the bow planes. The aft superstructure ran all the way to the tip of the stern in a manner similar to the *Porpoises*. Note also the continuance of the class identifier symbols on the forward hull and fairwater. This began to cause confusion because many boats of the old S-class (i.e. *S-1*, *S-11*, etc.) were still in commission. Accordingly, the practice was halted with *Squalus* (S11, SS-192) and the identifiers were removed from all previous boats and replaced with hull numbers in 1939. The following photo of *Seal* (Figure 3) will give a good view of the details of the conning tower fairwater of this group.



Salmon, *Seal*, and *Skipjack* had two 34-foot periscopes when built and thus had very small shears. Two rounded top stanchions were placed on either side of the shears, providing an anchor point for the long radio aerials that ran all the way from a mast situated halfway up the forward deck to a mast halfway down the aft deck. These stanchions also acted as structural supports for the periscope shears. Just aft of the stanchions, the top edge of the fairwater curves gracefully downward about three feet and runs aft, forming the edges of the bulwark that surrounds the cigarette deck. This edge terminates at the aft end of the fairwater, which descends vertically down to the main deck, just forward of a hatch leading to the crew's berthing compartment. The rectangular opening in the side of the fairwater allows the gun crew access to the main deck after exiting the interior of the boat through a watertight door in the aft end of the conning tower.

The next three boats, *Snapper* and *Stingray* (built at Portsmouth), and *Sturgeon* (built at Mare Island) reflect some minor detail differences that were hallmarks of the Government design. Figures 4 & 5 illustrate the subtle differences between the Government and EB designs.

Photo # NH 99096 USS Snapper during the later 1930s

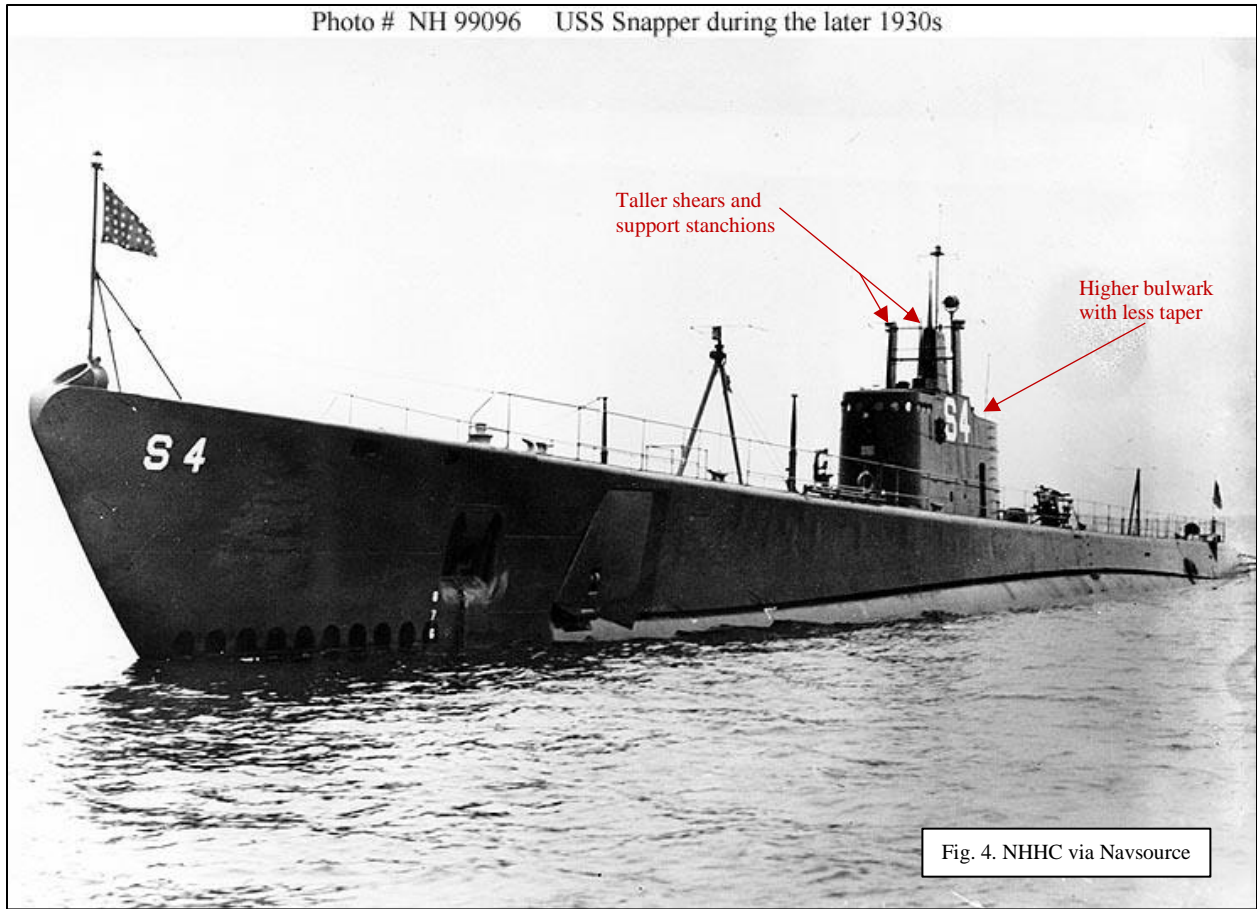


Fig. 4. NHHHC via Navsource

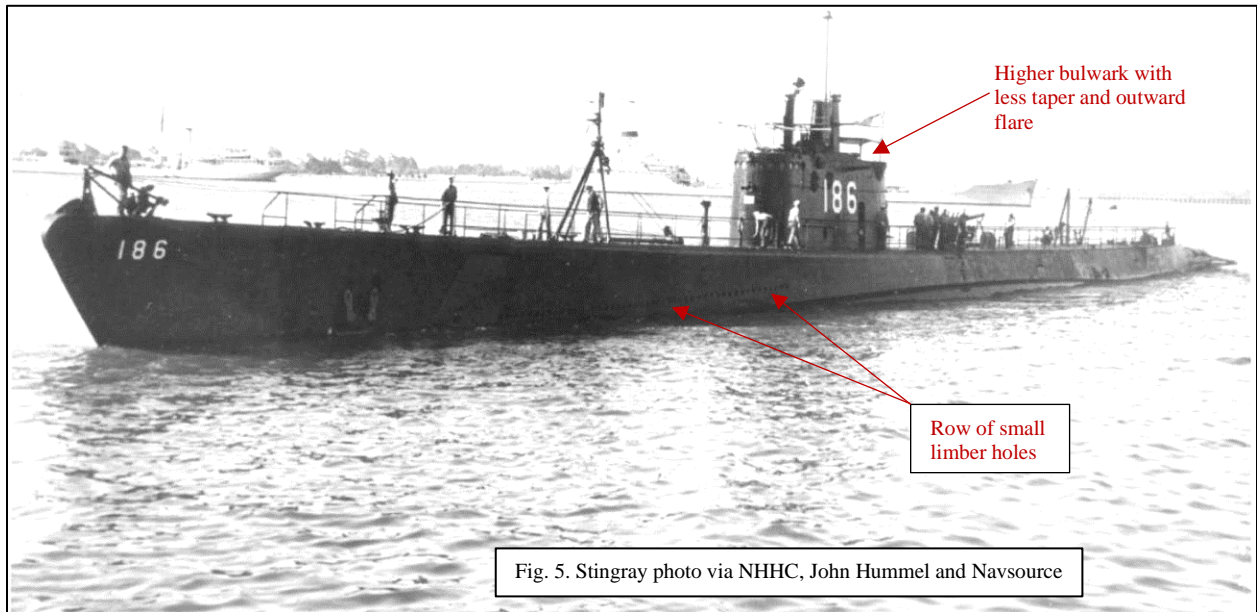


Fig. 5. Stingray photo via NHHHC, John Hummel and Navsource

The radio aerial masts on the forward and aft decks were of a bipod design, instead of the wire braced monopod of the earlier boats. The upper edges of the cigarette deck bulwark are slightly higher than the EB design. The hatch to the crew's quarters that was sited right at the aft end of the fairwater in the EB boats was located about six feet farther aft in the Government design. The single biggest change came from the replacement of one of the 34-foot periscopes with a 40-foot model, necessitating a taller and more substantial shear structure. Accordingly, the support stanchions on either side of the shears are taller as well. This feature makes these boats easy to spot. Continuing the practice of the three EB boats, as built these boats also lacked any limber

holes in the superstructure aft of the bow planes. However, sometime in 1940 one row of small limber holes was added to at least *Stingray*. These holes ran in a line parallel to the curvature of the bottom edge of the superstructure, about 18 inches above that bottom edge. It is quite possible that *Snapper* and *Sturgeon* had them added too. Note in the *Stingray* photo that she had a modification to edges of the cigarette deck bulwark. There was a portion of it flared outward on each side. This flare was to accommodate an improved field of fire for the M2 machine gun that was mounted there. This was a post-commissioning mod and all three boats received it.

SARGO CLASS

Technological development during the construction of the *Salmons* led to some changes for the six boats of the FY-37 building program. These changes did not substantially alter the external appearance of the boats, but subtle visual clues will enable separating these boats from the preceding *Salmons*.

Other than being two feet longer (an attempt to alleviate crowding in the aft engine room), most of the visual differences were centered on the conning tower fairwater. Vibration problems encountered with the longer 40-foot periscopes installed in the previous boats led to a redesign of the shears structure. Three heavy I-beams were attached to the main deck on either side of the conning tower. These beams ran vertically to the level of the bridge, then made a 90-degree turn inwards, where they attached to the periscope housings. Above this level, the housing was completely enclosed in metal sheathing. With the shorter 34-foot scope forward of the 40-footer, this gave these boat's shears a distinctive three step appearance.

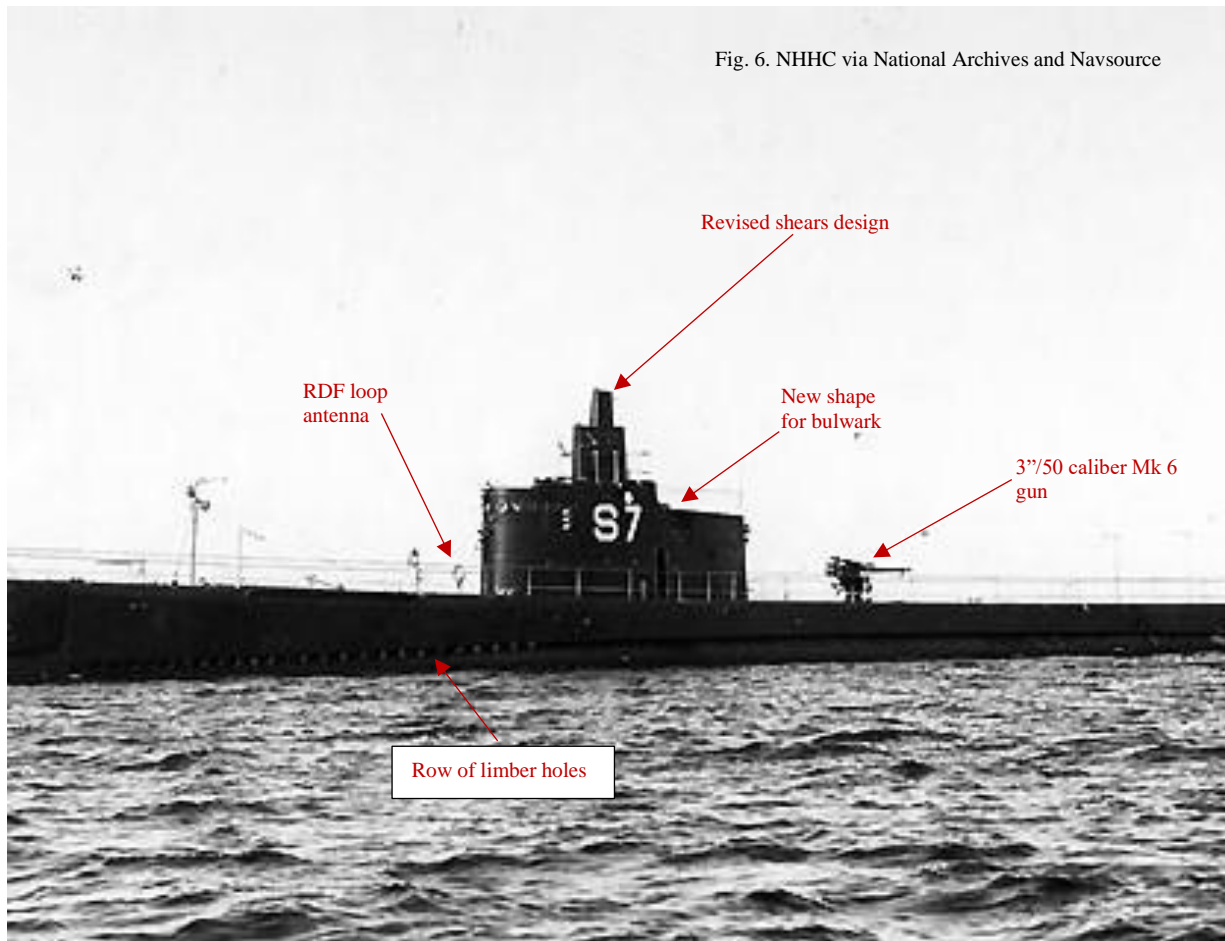
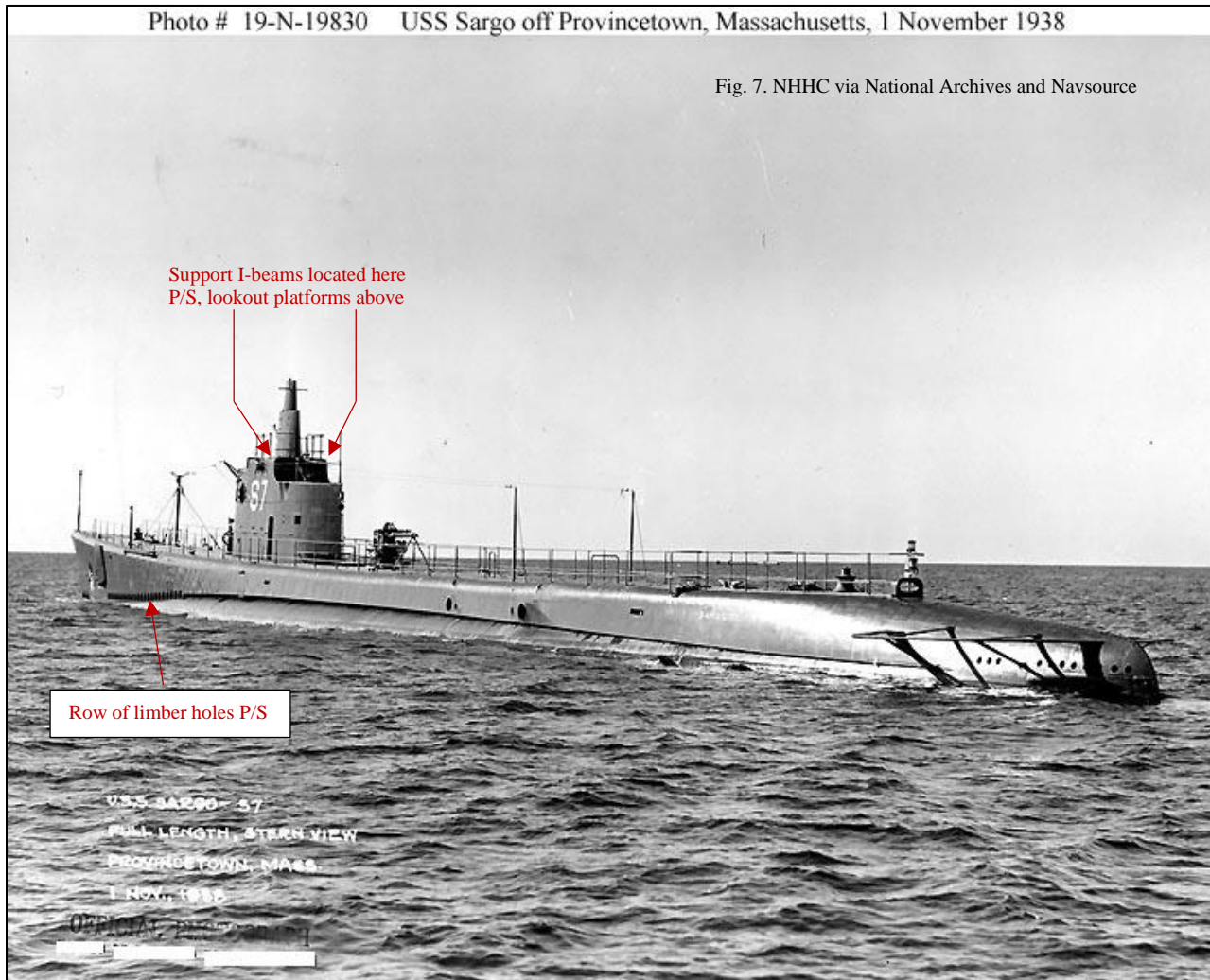
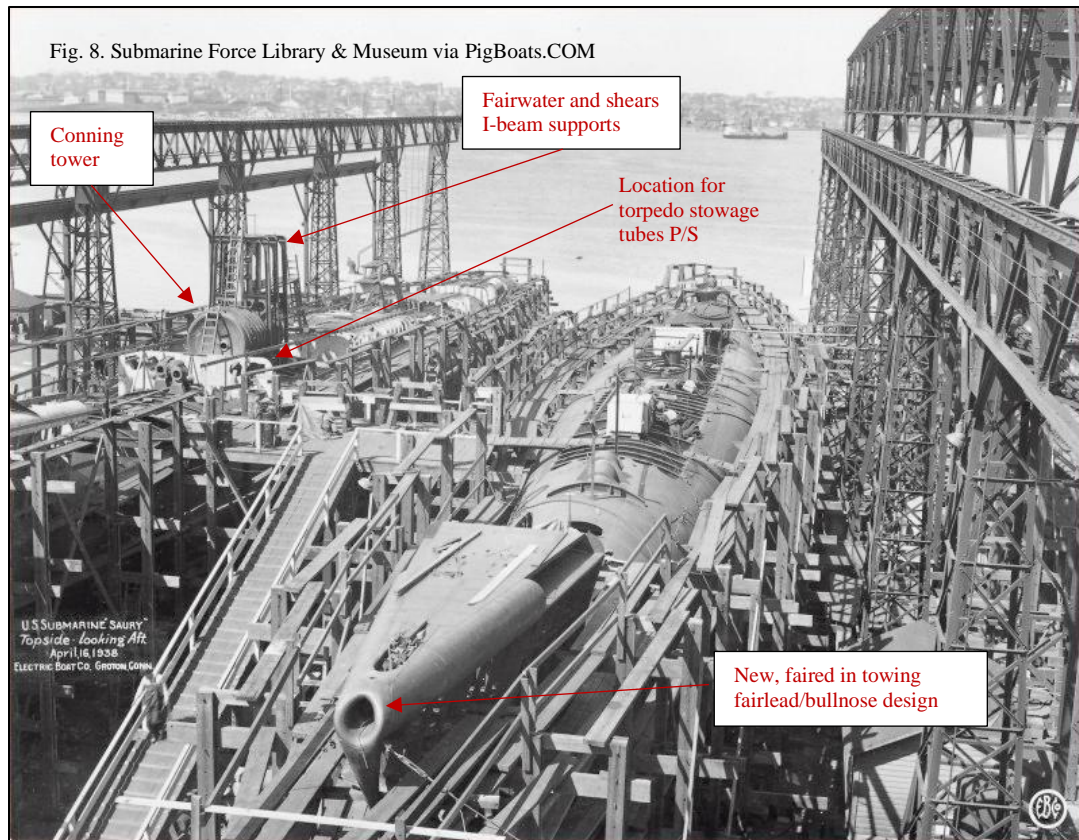


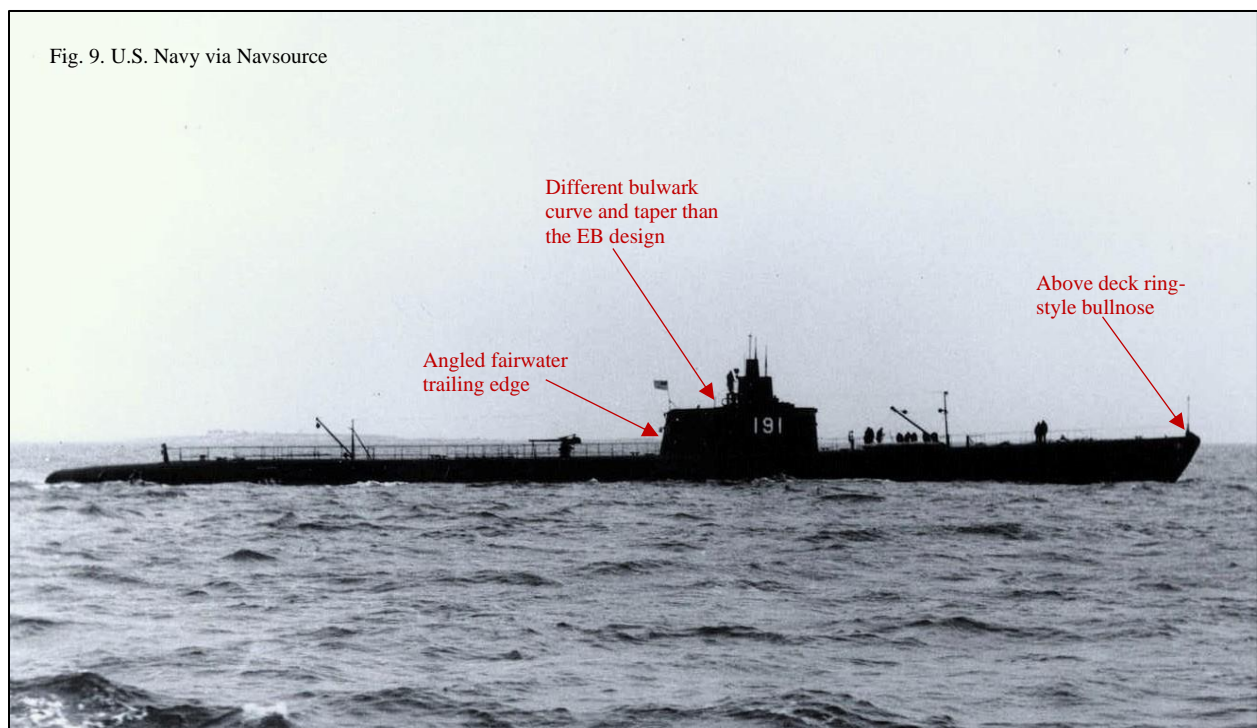
Figure 6 shows *Sargo* and gives a good view of the shears arrangement. The I-beams are not visible as they are covered by the fairwater plating. The shape of the fairwater itself is also distinctive. The EB built boats had the upper edge of the fairwater descend vertically directly aft of the shears, then curve sharply to the horizontal. Both the leading and trailing edges of the fairwater are vertical. A row of semi-circular limber holes were situated at the bottom edge of the superstructure, directly above the tank tops. These holes ran from the bow planes to the forward edge of the fairwater. The photo below of *Sargo*, (Figure 7) taken from the port quarter, will also show these features.



Note also how the I-beams on either side of the shears provided excellent lookout platforms. One other feature of the EB boats of this group was a new bullnose design. These three boats (*Sargo*, *Saury*, and *Spearfish*) had the bullnose faired into the bow buoyancy tank as shown in the construction photo below of *Saury*, Figure 8. Note also in this photo the conning tower and shears I-beam installation on the *Sargo* under construction on the right side of *Saury*. In a well-intentioned but ultimately misguided attempt to increase firepower, all of the *Salmon/Sargos* had four non-firing torpedo stowage tubes inside the superstructure, two each on either side of the conning tower. Although these tubes were not yet installed on either boat in the photo below, a general sense for where the tubes were mounted can be obtained. The procedure for removing these reload torpedoes from their tubes and getting them below to the forward torpedo room proved to be tedious and time consuming and executing this evolution in enemy held waters ultimately proved to be more dangerous than what it was worth. The stowage tubes were removed from all boats early in the war.



The next three boats were built at Government yards (*Sculpin* and *Squalus* at Portsmouth, *Swordfish* at Mare Island) and predictably they displayed minor visual differences. Internally they were nearly identical to the EB boats, sharing their redesigned tank and compartment arrangement.



The photo above of *Sculpin* (Figure 9) shows the different shape of the upper edge of the cigarette deck bulwark, substituting the sharply curved/horizontal configuration with one that is more gradually tapered. Also, the trailing edge of the fairwater tapers at an angle to the main deck, as

opposed to straight down in the EB design. The Government design boats retained the ring type above-the-deck bullnose of the previous *Salmons*.

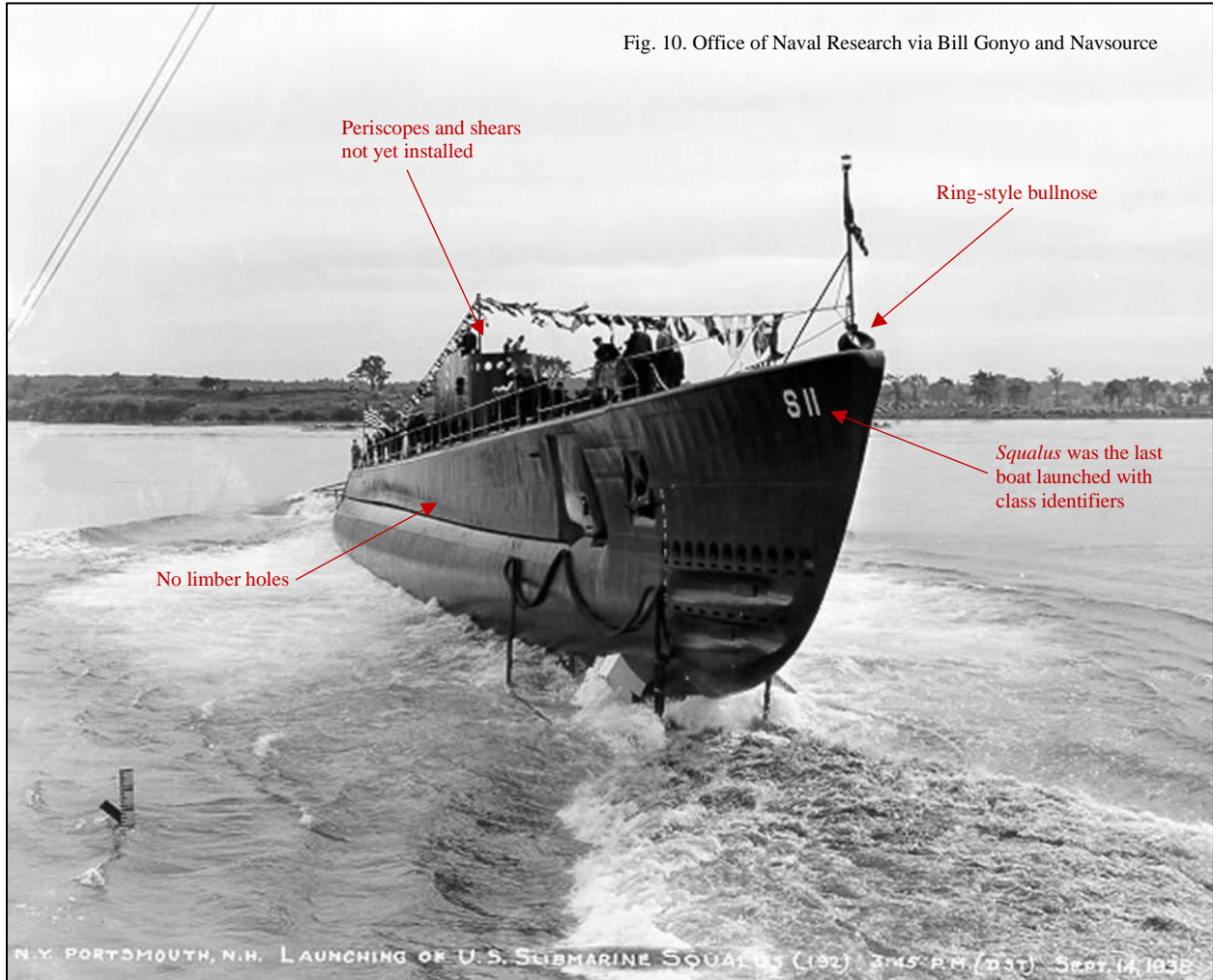


Figure 10 is a launch day shot of the ill-fated *Squalus* and it shows the ring bullnose at the bow. It also illustrates that the Government boats lacked the limber holes at the bottom edge of the superstructure. The EB designers were leading the way at this time with some new and innovative design elements, the faired bullnose and limber holes being just two examples. The efficacy of the EB features eventually won over the more conservative Bureau designers and these features were eventually retrofitted into the Government boats or incorporated into the plans for new boats. Two other items are of note in this photo. *Squalus* was the last boat launched with the class identifiers (S11) on her hull instead of the hull number (192), and she slid down the ways without her periscopes and shears, a common practice at Portsmouth at the time. They were installed in the post launching fitting out phase.

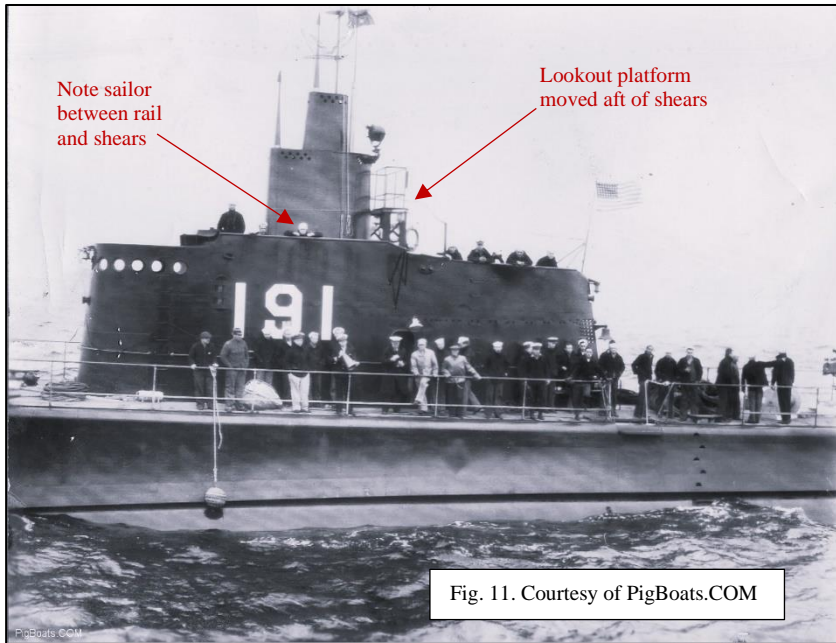
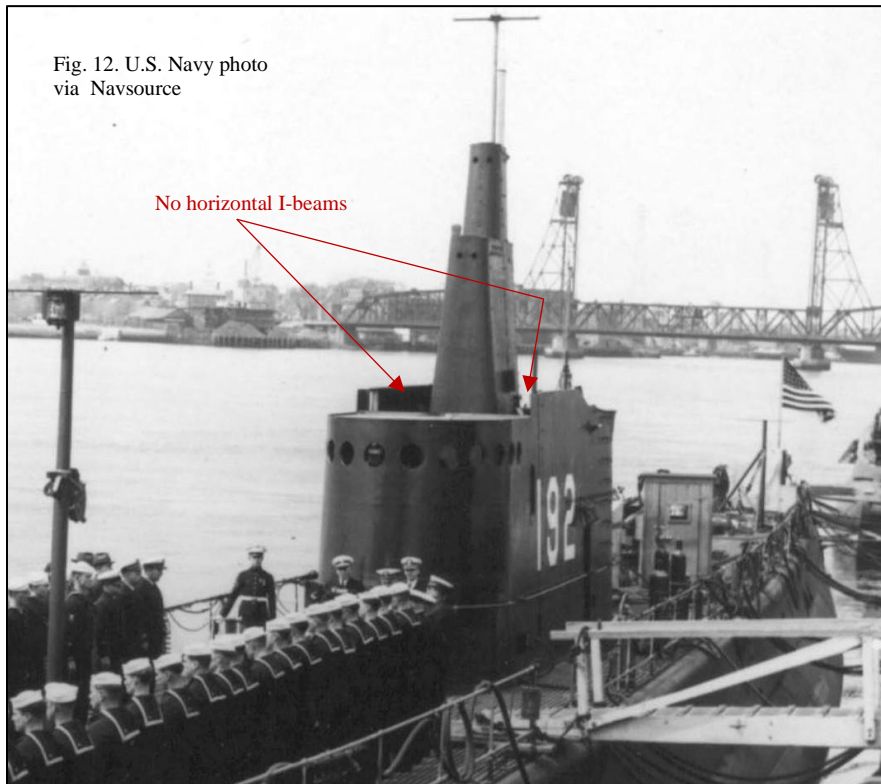


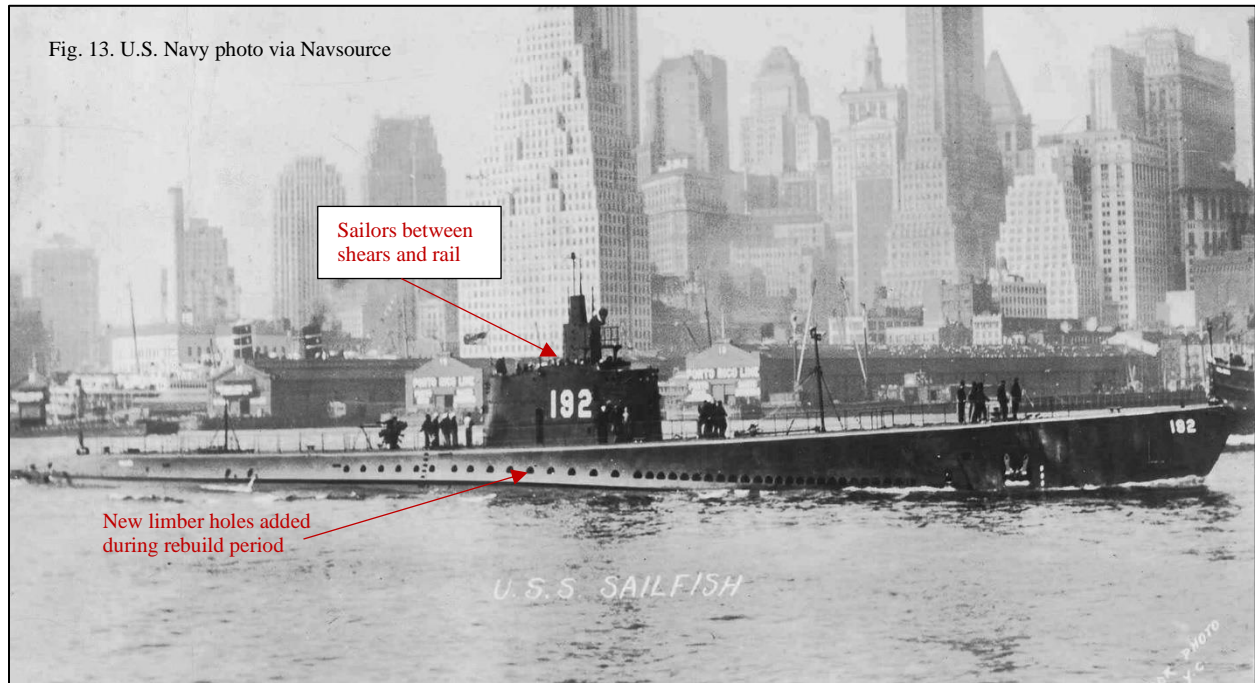
Figure 11 is *Sculpin*, taken during the *Squalus* salvage operation, June 1939. It is a good view of the conning tower fairwater. The portholes for the covered pilohouse are on the left, followed by the bridge, the periscope shears, a lookout platform, and the bulwark around the cigarette deck. Note that the lookout platform is aft of the shears, not alongside them as in previous boats. There is also a sailor leaning against the bulwark outboard of the shears.

A serious problem arose during the construction of these boats in that they turned out badly overweight. Back in 1933 the earlier fleet boats *Cachalot* and *Cuttlefish* had come off the ways considerably underweight due to an aggressive weight control program instituted by both EB and Portsmouth. Extra lead ballast had to be added to the boats in order to achieve the desired stability specifications. Because of this experience, designers at both yards became rather cavalier about weight control and by the time *Sculpin* and *Squalus* slid down the ways the situation had caught up to them and the boats could not pass stability requirements. In particular they were top-heavy. One of the solutions to this problem was to cut away redundant portions of the topside framing.



The most notable part of this action was the removal of portions of the I-beams from inside of the conning tower fairwater. This eliminated the handy lookout platforms on each side of the shears. The sailor pointed out in Figure 11 is standing right where the I-beams would have been. The removal of the beams also forced the designers to move the lookout platform aft of the shears. Visually this modification is difficult to spot and is not very apparent in most photos. However, Figure 12 shows the salvaged and newly re-commissioned *Squalus*

(now *Sailfish*). You can see how the horizontal portions of the I-beams were never installed, effectively lowering the lookout platforms to roughly the same level as that of the bridge watch standers.

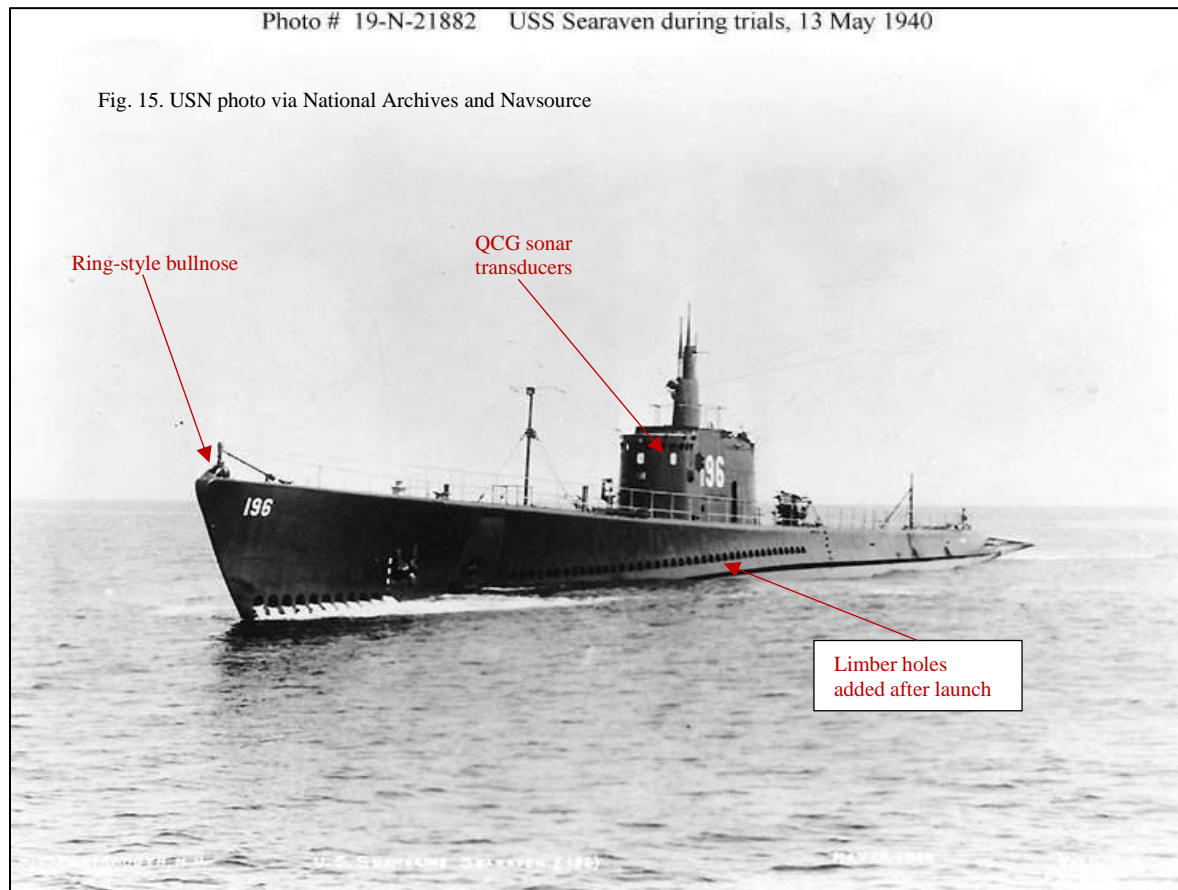


In Figure 13 *Sailfish* can be seen on the Hudson River off Manhattan in late 1940. Crewmen can be seen standing between the shears and the outer plating of the fairwater with only their heads and shoulders visible. This would not be possible if the I-beams and the lookout platforms were in place. Note also that *Sailfish* is now sporting a set of prominent limber holes in the superstructure. Only the three Government boats of this group were this badly affected by the stability issue. The EB boats, while still heavy, were barely able to meet the requirements by redesigning engine mounts and eliminating redundant valves and piping runs. Their I-beam ribs and lookout platforms were unaffected. This bad experience by the Government yards (and to a slightly lesser extent by EB) caused all submarine construction yards to become stringent weight watchers. By the time the *Gato* class came along in 1941 a large enough weight margin had been built up that new equipment could be easily added without adversely affecting stability.

Only four boats were authorized for construction under the FY-38 program, *Seadragon* and *Sealion* from EB, with *Searaven* and *Seawolf* from Portsmouth. It was decided to continue with the *Sargo* plans and these boats were close duplicates of their predecessors. The only major difference was the re-adoption of all-electric drive, although this made no difference visually.



Sealion is shown in Figure 14 on 06 October 1939 about five weeks prior to her commissioning. Very little distinguishes these boats visually from their earlier sisters. EB continued the practice of the faired in bullnose and the row of semi-circular limber holes aft of the bow planes. *Sealion* had the shortest commissioned life of any of the *Salmon/Sargos*. Struck by bombs while in overhaul at Cavite Navy Yard in the Philippines on 10 December 1941, she was wrecked beyond repair and was deliberately sunk alongside the pier on 25 December 1941. She was the first submarine casualty of the war.



This photo of *Searaven* (Figure 15) shows her with a row of limber holes in the superstructure. Both of the Government boats of this group were launched without them, but they were added prior to commissioning. Despite the fact that their presence improved dive times, the conservative Bureau engineers did not add limber holes as part of the original design until the *Gato* class started rolling off the ways in 1941. The light-colored oval plates on the front end of the fairwater are transducers for the QCG passive sonar. The position of these plates allowed passive sonar use when bottoming of the boat prevented the use of the keel mounted transducers. The above deck ring type bullnose also continued as a hallmark of the Government design. Previous hard lessons in weight control had been learned and by carefully redesigning other areas (piping runs and machinery foundations in particular) sufficient weight margin had been built up to enable the reintroduction of the desirable I-beam supports in the conning tower fairwater.

WARTIME MODIFICATIONS

The last boat of this class, the USS *Seawolf* (SS-197) was commissioned on 01 December 1939, less than three months after the start of World War II in Europe and two full years before the United States would become involved in the war. Although an excellent design in most aspects,

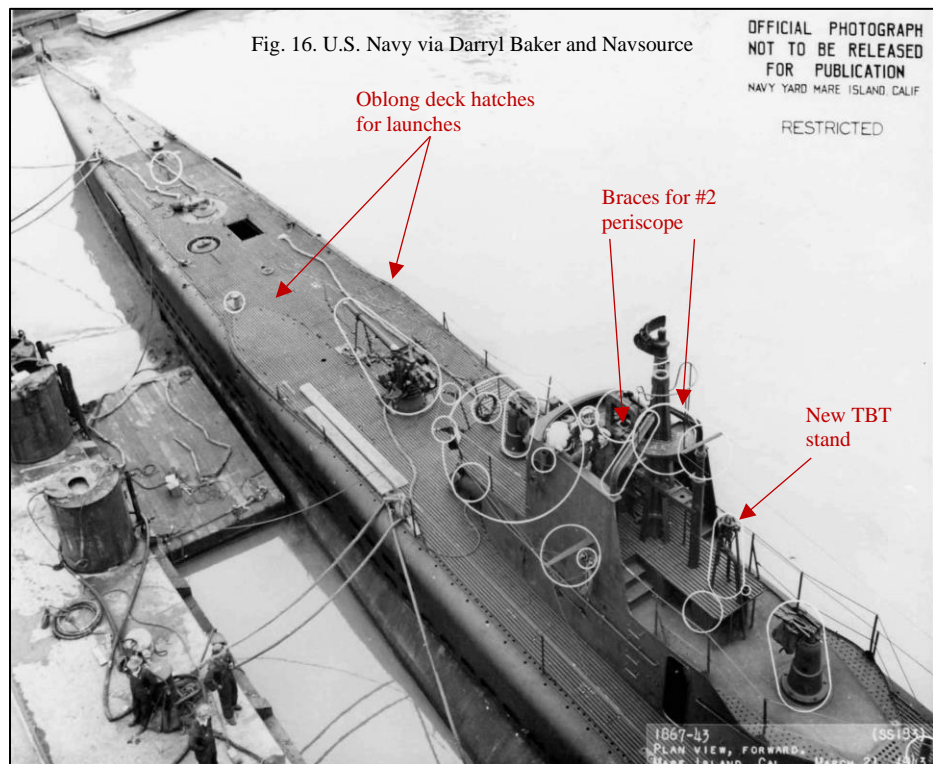
these boats had been optimized for peacetime cruising and thus they contained certain design features that would later prove to be at best unnecessary (the dual liberty launches) or at worst liabilities (the high and bulky conning tower fairwater) once the shooting started. Opinion amongst Navy officials on these issues was divided. There were forward thinkers who saw our involvement in the new war as being inevitable and they sought to put the boats into fighting trim by eliminating some of these “luxuries” and incorporating new technologies. Others had not yet made the mental shift and they strenuously opposed these changes.

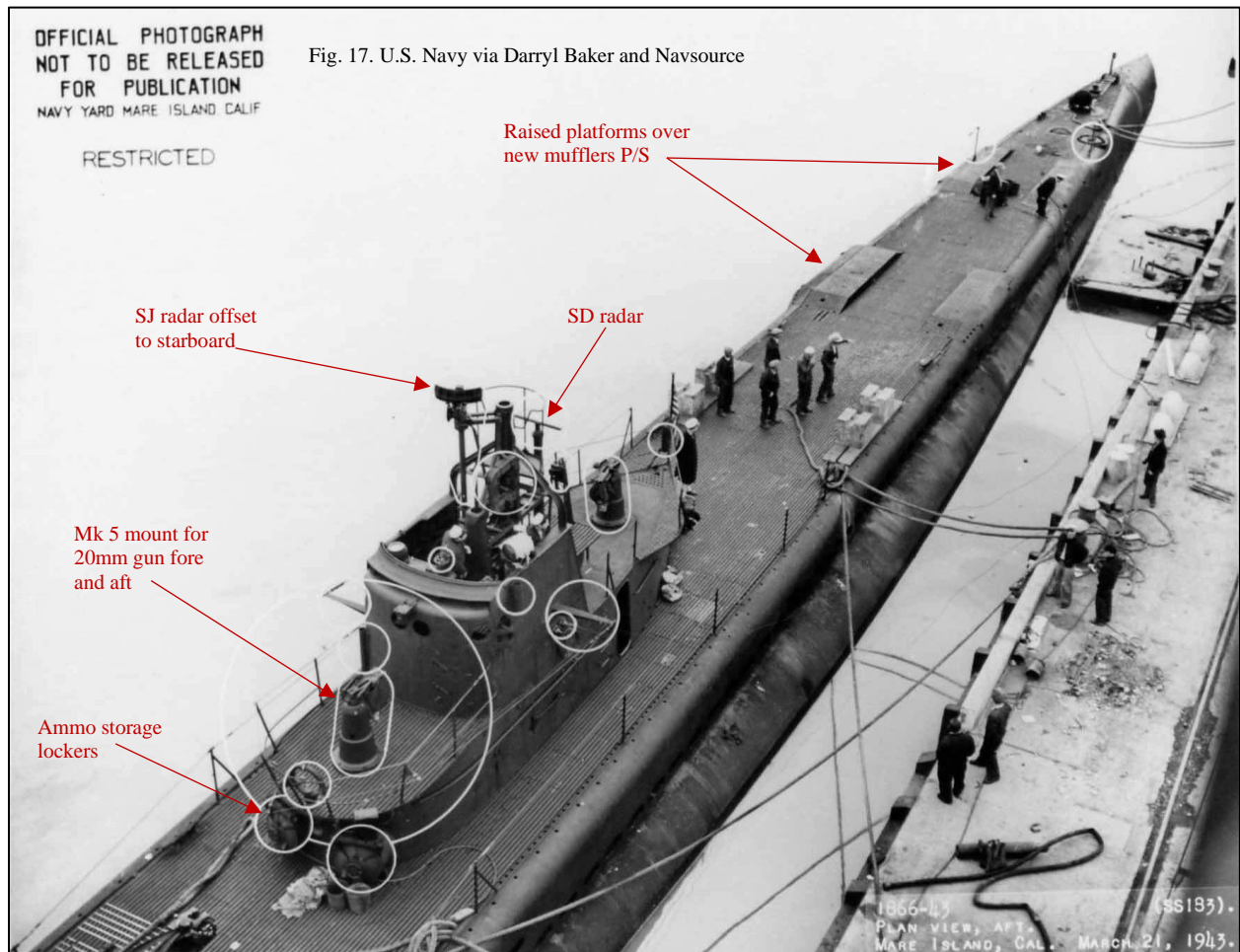
The events of 07 December 1941 swept away any objections that remained and early war patrol experience reinforced the need to simplify and upgrade our submarines so that they could better face the rigors of combat. Within weeks a running list of desired changes was submitted to the ongoing Submarine Officers Conference and after a quick review they were submitted to the General Board and approved. Some of these changes were completed ahead of that official approval between patrols by submarine tender and yard personnel, often at the behest of the boat’s anxious crews. For the *Tambor/Gar* and *Gato* class boats, there was a degree of uniformity to these changes which enables them to be lumped into groups based on what was done when (see Part Four of this series). However, for the *Salmon/Sargo* boats these wartime modifications and upgrades were more singular in nature and many boats received unique, one-off changes that set them apart visually from their sisters, and indeed from the rest of the fleet boats.

All 16 of these submarines were forward deployed to the Asiatic Fleet and home ported in the Philippines when the war began. Few good photographs exist or survived from this early tumultuous period and thus the photographic record of the changes made during this time is rather fragmentary. It is likely that the early war modification pattern was similar to the *Tambor/Gar* and *Gato* classes (i.e. Mod 2 and 2A), but very few photos of a *Salmon/Sargo* class boat with these early mods exist. The information below is grouped together as closely as possible.

SALMON CLASS

Salmon, *Seal*, and *Skipjack*, the EB built members of this class, all received similar modifications. Figures 16 and 17 are photos of *Seal*, taken on 21 Mar 1943 at Mare Island and they show a configuration that was typical for these three boats in the mid-war period. In this configuration they were broadly similar to a *Gato* class Mod 3. However, there are several important differences due to the original design of the periscope shears.

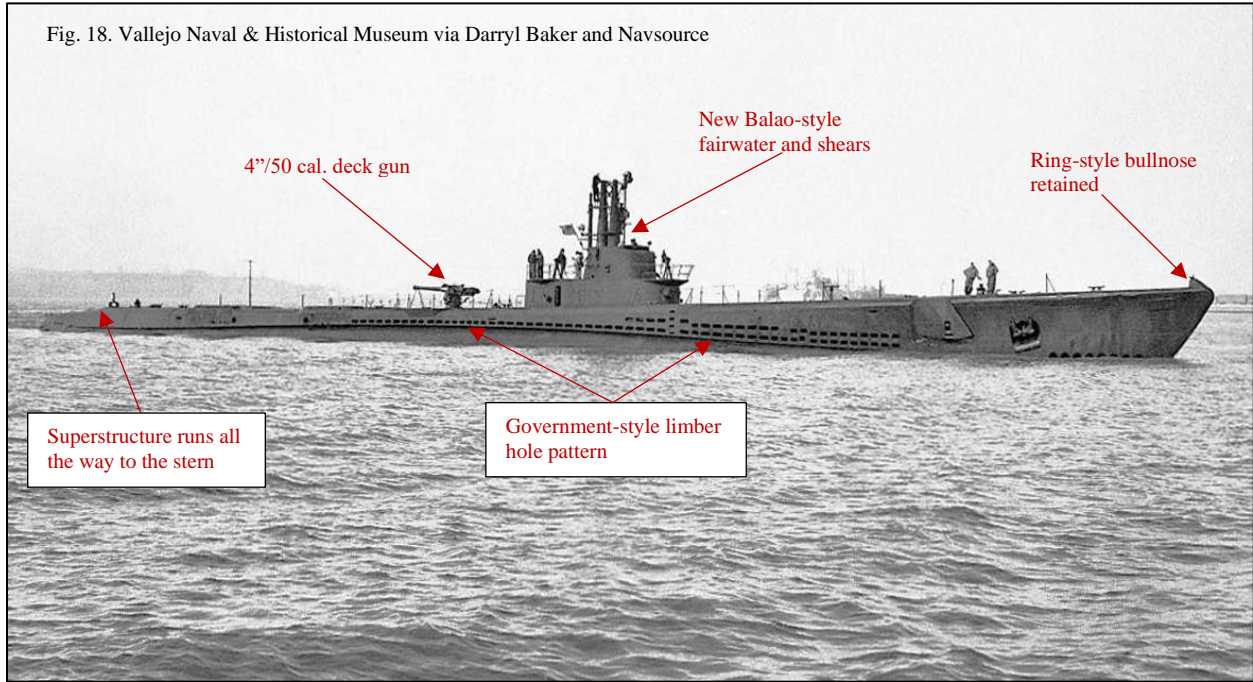




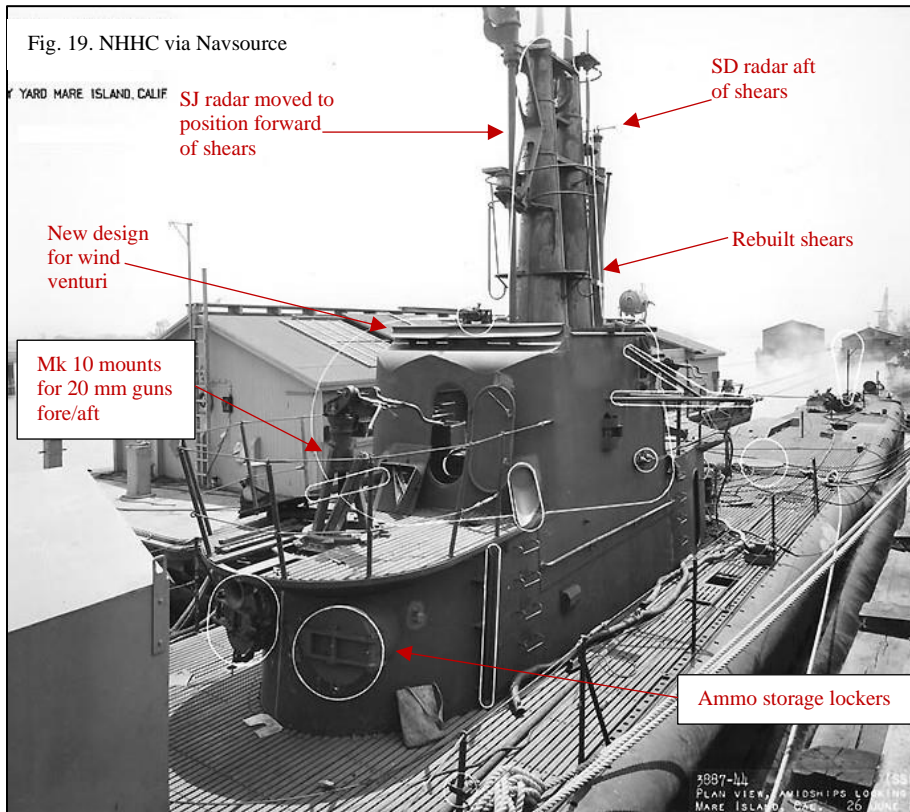
At this point, she retained both 34-foot periscopes, with one letting into the control room and one in the conning tower. The #2 periscope is supported by two braces, angled inward from the outer edges of the bridge fairwater. SD radar has been added on a separate thin mast aft of the scopes, and SJ radar added between the two scopes, offset to starboard in order to clear the shorter #1 scope housing. There is a large square low frequency communications loop antennae sited between the scopes. Target Bearing Transmitter (TBT) brackets have been added to the bridge and on a tripod sited on a raised platform aft of the SD mast. The forward and aft fairwater gun decks sport the early, solid base Mk 5 mounts for the 20 mm automatic cannon. The guns themselves are dismantled and stored below when not in use. At this time *Seal* still has her 3"/50 caliber deck gun, sited forward of the fairwater and two ready service ammo lockers have been added underneath the forward fairwater gun deck. On either side of the deck gun are the oblong deck hatches that originally covered the two small boats, which have already been sent ashore. On the aft deck you can see the raised platforms that cover the larger mufflers of her new GM-Winton 16-278A diesel engines. These hardy and reliable engines were welcomed replacements for the heavily despised Hooven, Owens, Rentschler (HOR) 99DA double acting diesels, disliked by the crews for their gross unreliability and frequent breakdowns.

By the summer of 1944, these three boats had been modified again. The desire to incorporate two 40-foot periscopes and to have both of them let into the conning tower forced a complete rebuild

of the conning tower fairwater. The fairwater and shears were stripped down to the main deck and rebuilt in a configuration very similar to the later *Balao* class boats.



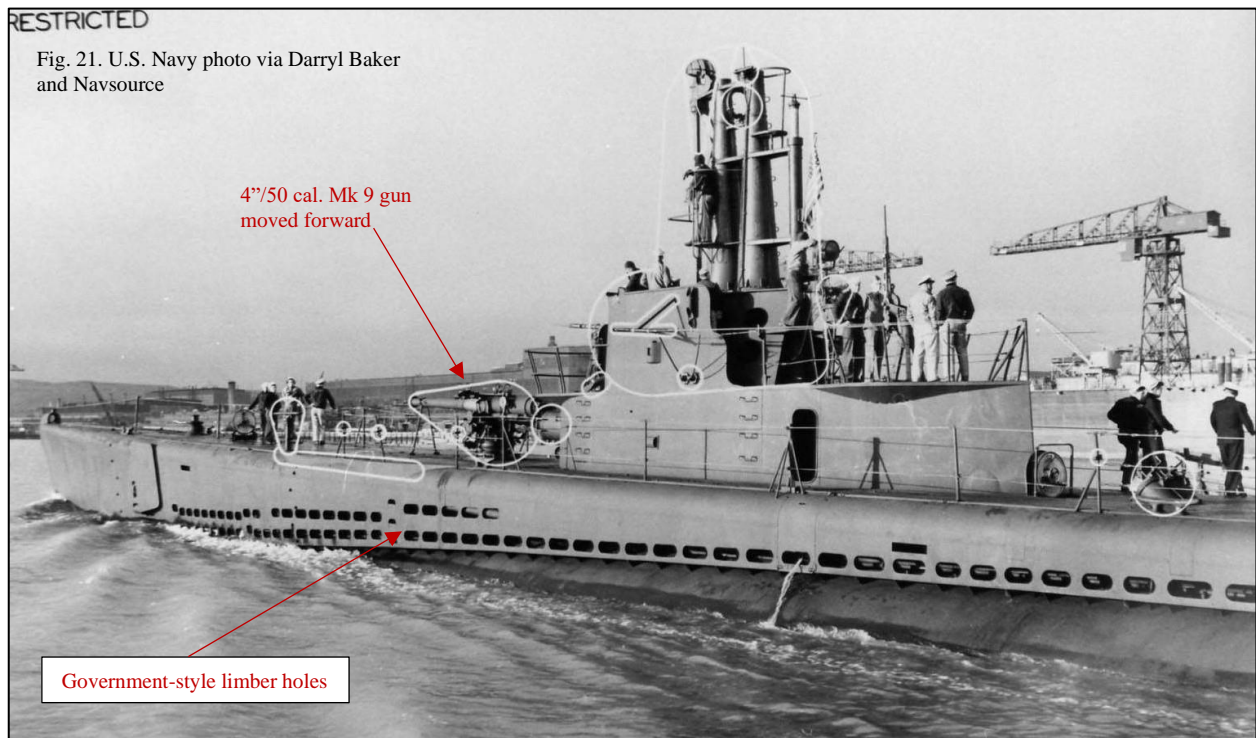
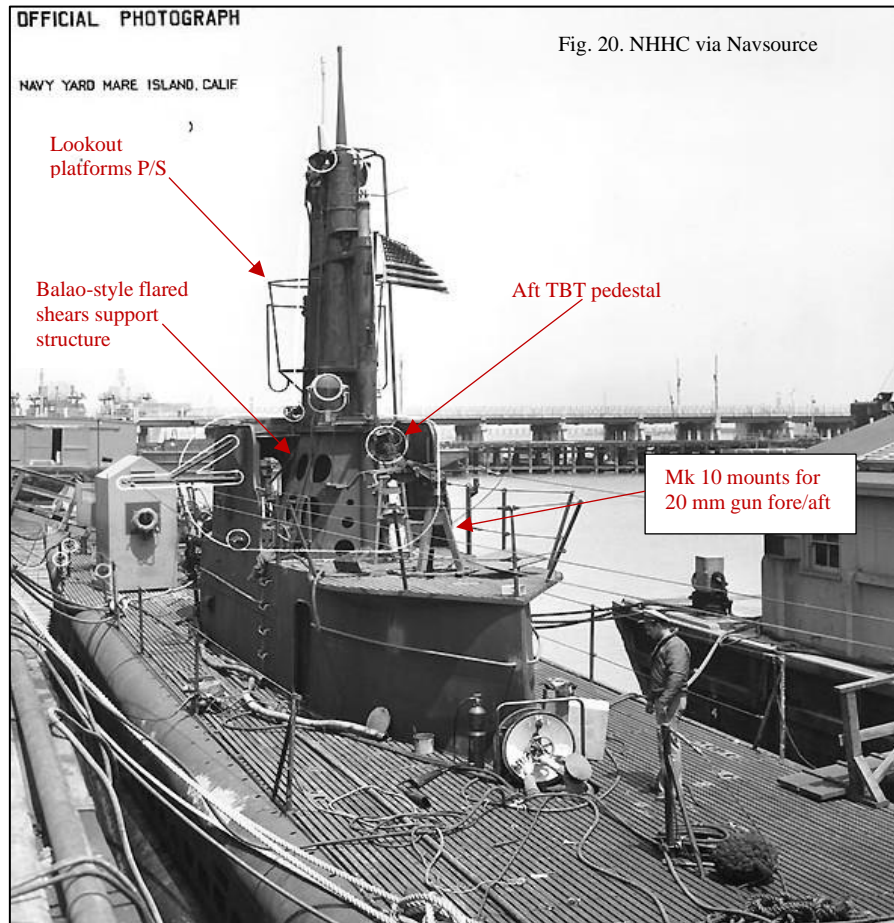
The class boat *Salmon* is shown in Figure 18 in August 1944. The resemblance to a *Balao*-class boat is undeniable. However, she still retains her ring type bullnose, and the aft superstructure still runs all the way to the stern. These two features will identify her as a *Salmon* class boat. Curiously, despite the fact that she was built by EB, subsequent modifications gave her a limber hole pattern in the superstructure that resembles that of a Government built *Gato* or *Balao*.



Seal, shown in Figure 19 in June 1944 has most of the late war modifications typical of later fleet boats. The SJ radar has been moved from its original starboard position and is now mounted directly forward of the shears with the SD radar mast directly aft. The 20 mm gun mounts are now the later tripod Mk 10 type, and an access door for the forward fairwater gun deck has been cut into the bridge fairwater. The bridge wind venturi has been rebuilt and repositioned. Ammunition storage

lockers have been added under the forward fairwater gun deck for ready service ammo for the deck gun and the 20 mm guns.

Figure 20 shows *Seal* from astern and highlights the downward flared support structure for the periscope shears, virtually identical to the *Balao*-class configuration. Lookout platforms with safety railings have been installed on either side of the shears, at the same approximate height as the platforms on the later “covered wagon” boats. She has retained the TBT mount just aft of the shears. This became an important feature as night surface attacks became an important facet of evolving submarine tactics. *Skipjack*, in Figure 21 below in July, 1944 shows a very similar configuration, but with the 4”/50 caliber gun mounted forward, vice the aft position shown on *Salmon* above. She also has the Government style limber holes.



Snapper, *Stingray*, and *Sturgeon* were the Government built boats of this class. There were enough differences in their original, as-built configuration to easily differentiate them from their EB built sisters. Their wartime modifications set them apart as well. Each of these three boats received similar wartime modifications, but there were enough detail differences to make each boat unique.

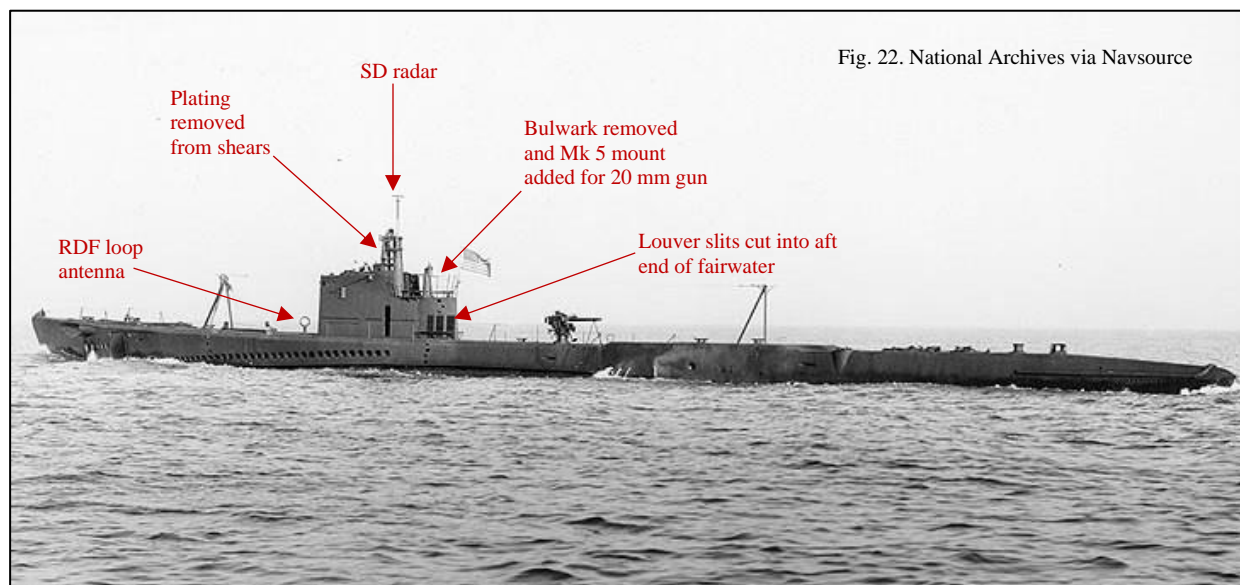


Fig. 22. National Archives via Navsource

Figures 22 and 23 show *Stingray* in October 1942 after an overhaul at Mare Island. She has a modification that is roughly analogous to a *Gato* class Mod 2A. The bulwark around the cigarette deck has been cut down and the plating removed from around the periscope shears. A Mk 5 mount for the 20 mm cannon has been added to the cigarette deck, but the 3"/50 caliber deck gun has been retained in the aft position. SD radar has been added just aft of number two periscope and as you will see in the photo below SJ radar added on a mast sited on the starboard side of the bridge. Louver type slits have been cut in the fairwater around the main air induction valve and a small circular radio direction finding (RDF) loop has been placed on the deck just forward of the fairwater. However, her most prominent feature at this time was the addition of two external torpedo tubes in the

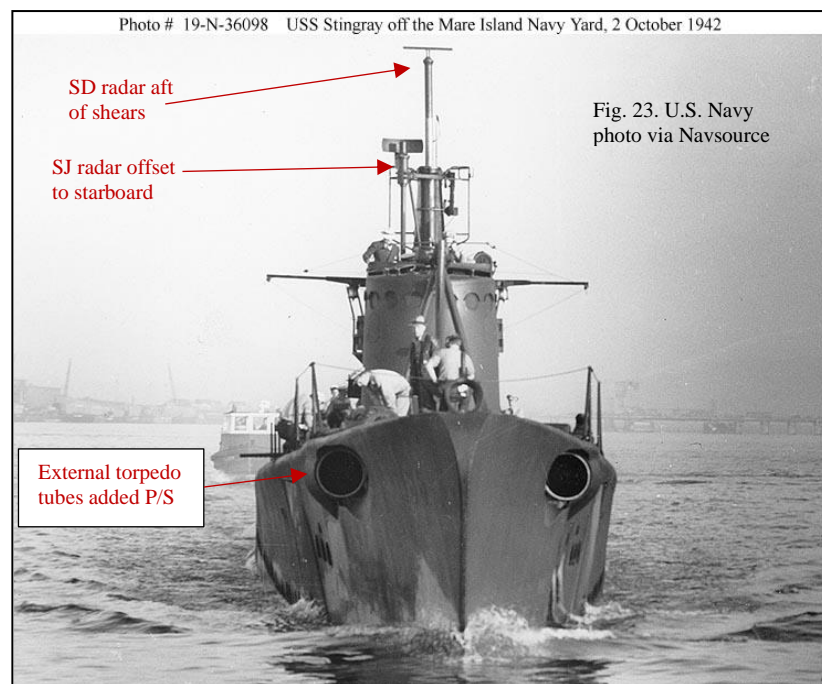
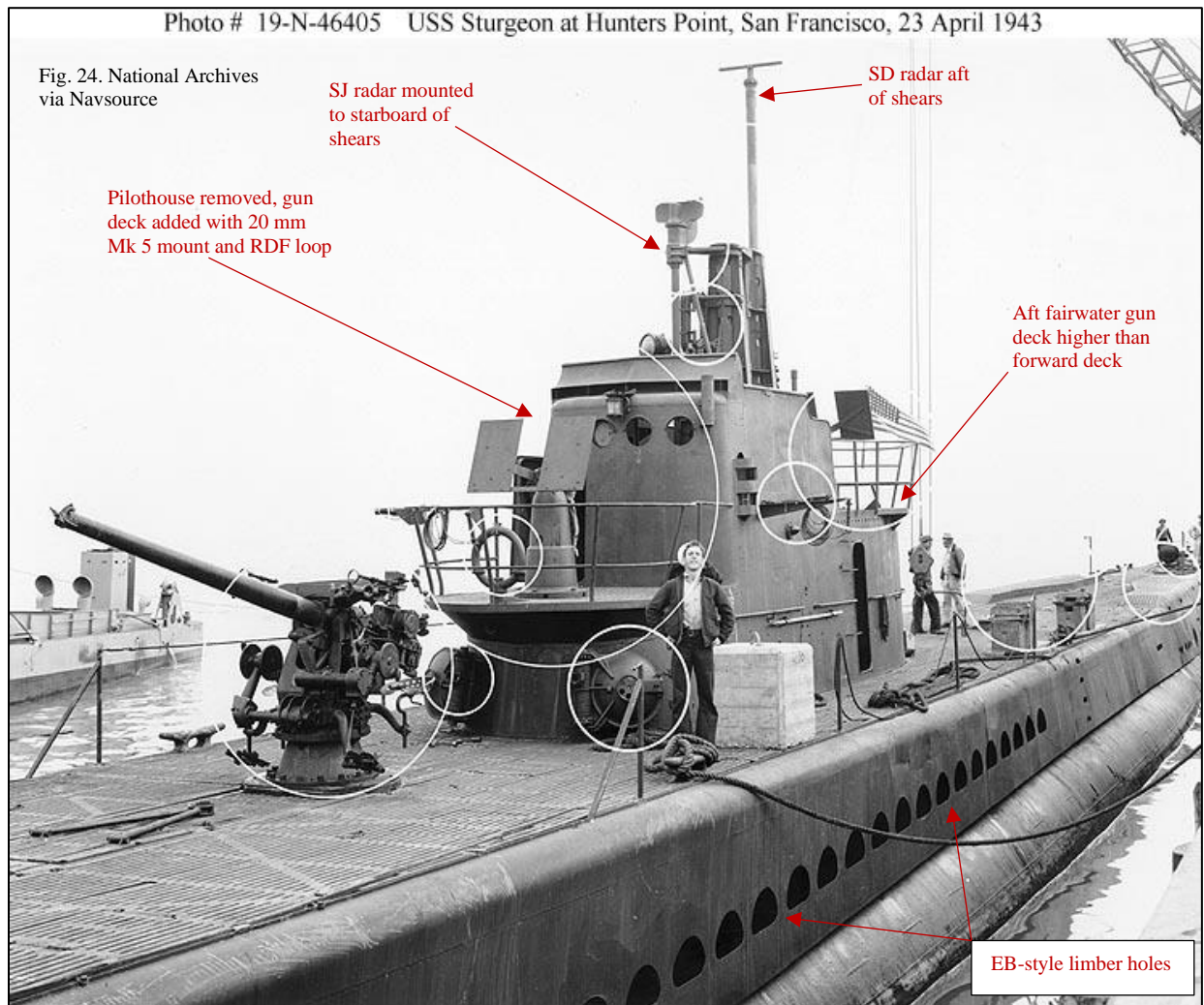


Photo # 19-N-36098 USS Stingray off the Mare Island Navy Yard, 2 October 1942

Fig. 23. U.S. Navy photo via Navsource

superstructure forward of the bow planes. Many of the earlier *Porpoise*-class boats had received this modification as an attempt to increase firepower. These tubes were not accessible from the interior of the boat, being loaded prior to going on patrol. The weapons in these tubes could not be maintained by the torpedomen and thus tended to be even less reliable than the already unreliable Mk. 14. They could not be reloaded at sea and were also subject to damage from depth charge attack. Providing little additional benefit, they were

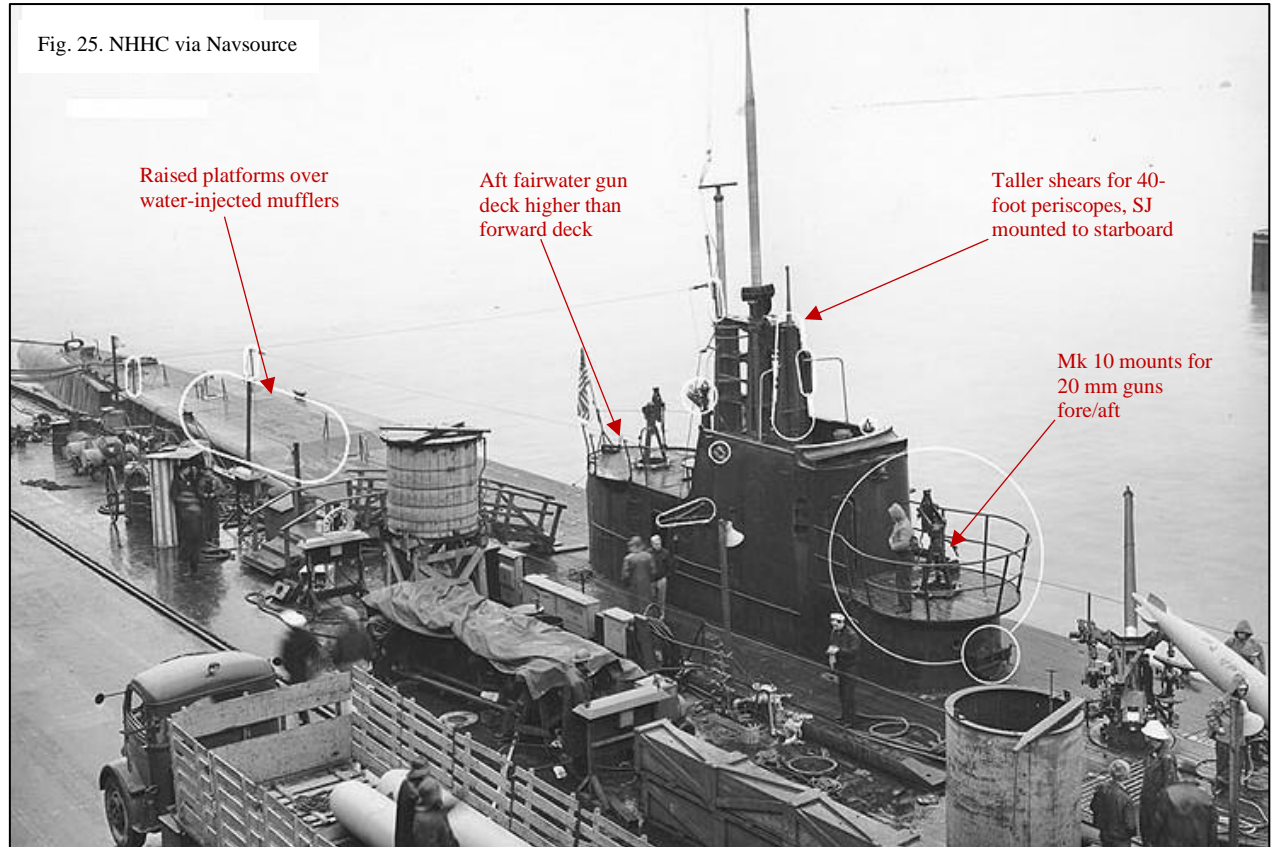
not popular with the crew and were removed during the boat's next overhaul in 1943. The *Stingray* was the only *Salmon/Sargo* class boat to receive these tubes. It is not readily apparent whether *Snapper* and *Sturgeon* received a similar modification to their fairwaters, although it is likely that they did sometime in 1942. By 1943 they had been modified again, this time receiving the rough equivalent of a *Gato* Mod 3. Notice in Figure 24 below of *Sturgeon* that the navigation bridge has been cut away and replaced with a gun deck, sporting a Mk 5 solid base 20 mm gun mount with



shields and a RDF loop. The revised bridge fairwater retains a portion of the circular windows and a high wind venturi has been installed. At this time *Sturgeon* still retains the shorter 34-foot #1 periscope. The aft cigarette deck is about two and a half feet higher than the forward gun deck, a distinguishing feature of these three boats. The 3"/50 caliber deck gun has been moved to the forward position and two ready service ammo lockers have been added under the forward fairwater gun deck. The gun is slightly elevated and the bipod barrel brace is laying flat on the deck. This Government built boat displays a set of EB style limber holes in the superstructure.

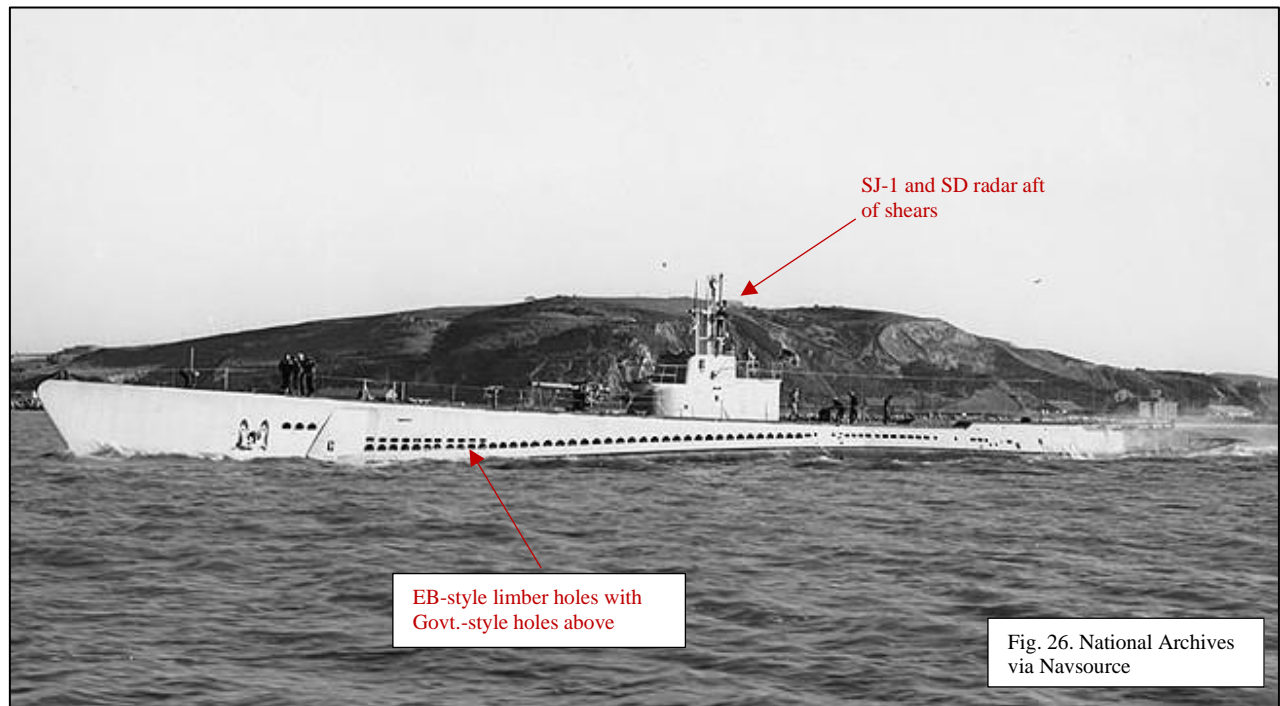
The progression of modifications can be seen in Figure 25, a January 1944 photo of *Stingray*. Both 20 mm mounts have been changed to the lighter, open Mk 10 versions. She has had her short 34-foot periscope removed and replaced with a standard 40-foot model, with both scopes now letting into the conning tower. The SJ radar, however, has been retained in the starboard bridge position. A door has been cut into the bridge fairwater to allow easier access to the forward 20 mm mount, and the bridge fairwater has lost the circular windows (she may not have had them at all in this version). Note in both the *Sturgeon* and *Stingray* photos that there are raised platforms over the engine mufflers on the after deck. This usually indicates a re-engining with bigger, more powerful engines. The three Government built *Salmons* all had the hardy and rugged GM-Winton 16-248

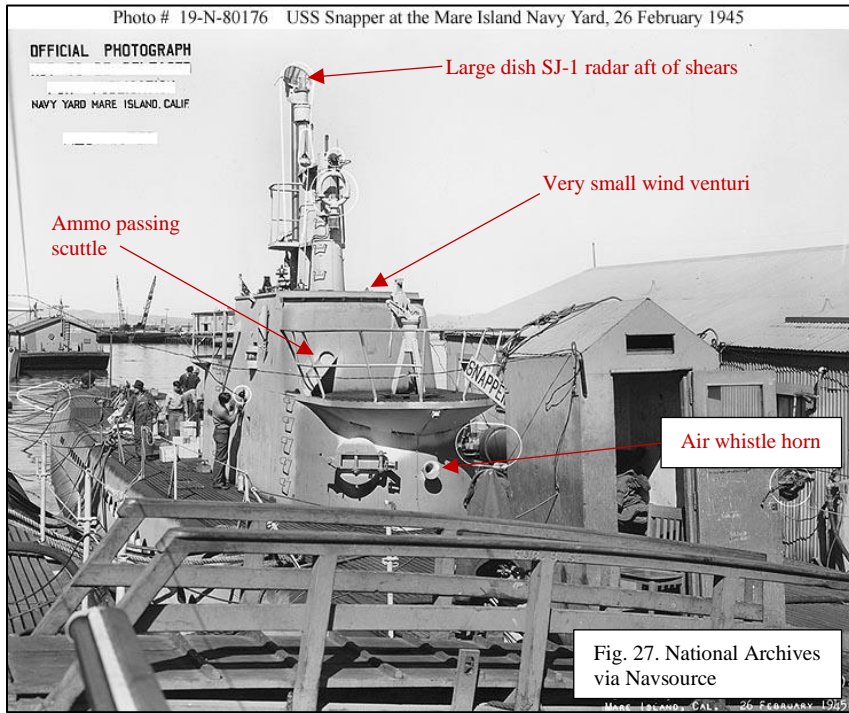
diesels as part of their original equipment. Appendix 1 of Alden's *The Fleet Submarine in the U.S. Navy* does not indicate that these three boats were ever re-engined. The presence of these raised



platforms indicate that these boats received new water-injected mufflers to replace the smaller units that were originally installed.

By 1945 these boats had received their final modifications. *Snapper* is shown below in Figures 26 and 27 in this configuration. Note her odd combination of both EB and Government style limber



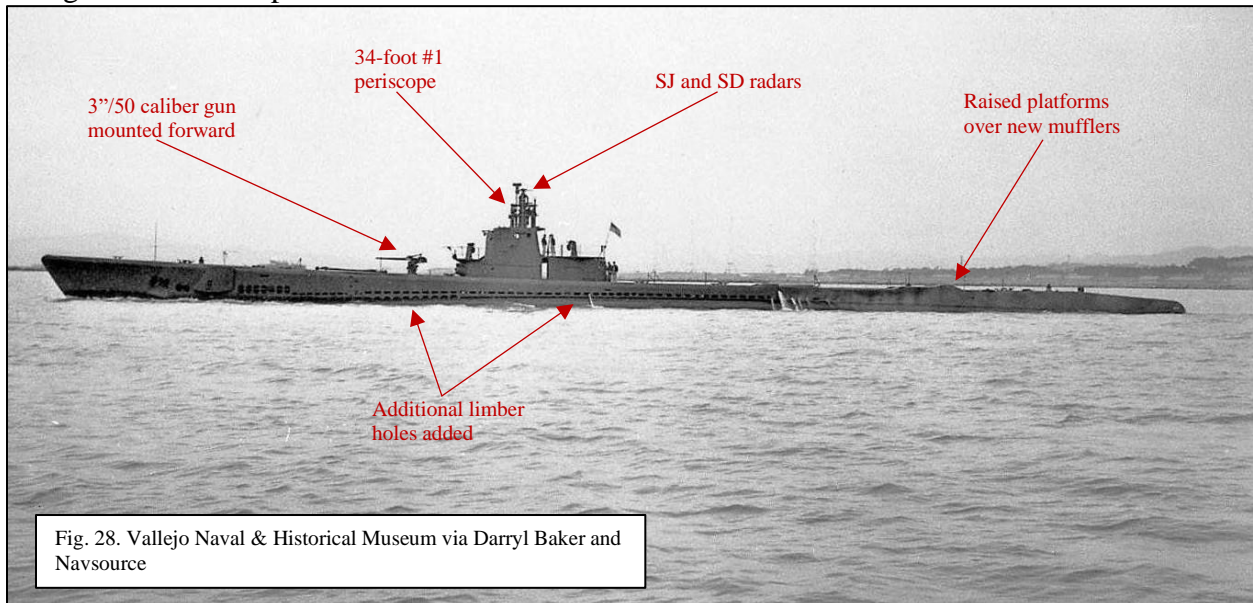


holes. The periscope shears had been reworked and simplified. To reduce periscope vibration at higher speeds, the shears had been thickened and strengthened. Both the SJ-1 and the SD radar masts were now located aft of the periscopes. *Balao*-style lookout platforms were placed on each side of the shears. *Snapper* retained her high cigarette deck and this bulk made her easy to distinguish. A circular ammo passing scuttle was cut into her bridge fairwater and a semi-circular tray enabled the easy passing of rounds to

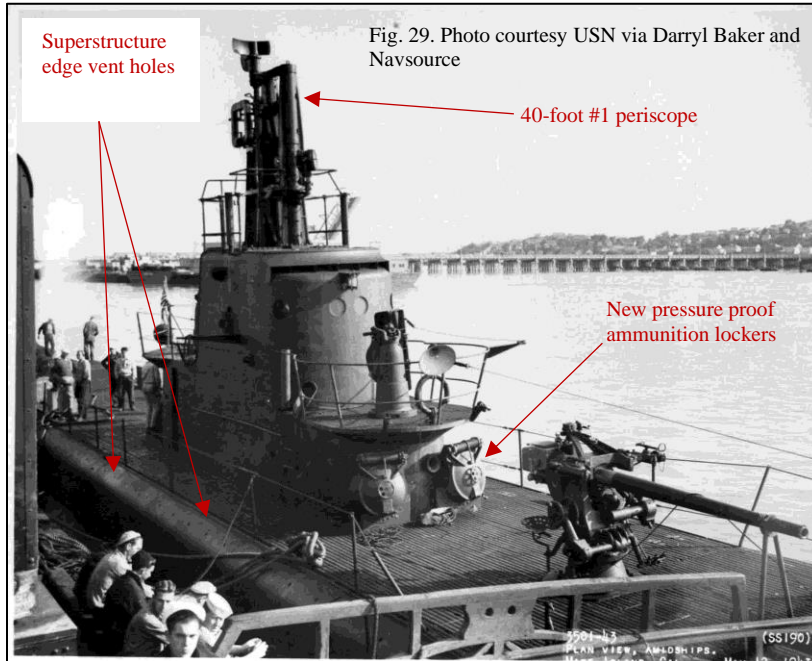
crewmembers on deck for the 4"/50 caliber deck gun. Directly below the forward 20 mm gun deck is the horn for the air whistle. Note also that a prominent RDF loop has been installed on the forward edge of the #1 periscope shear. The wind venturi mounted on the upper edge of the bridge fairwater is very minimal in size, reflecting the amazing variety of designs for this feature. At least *Sturgeon* (and probably *Stingray* as well) received similar final modifications.

SARGO CLASS

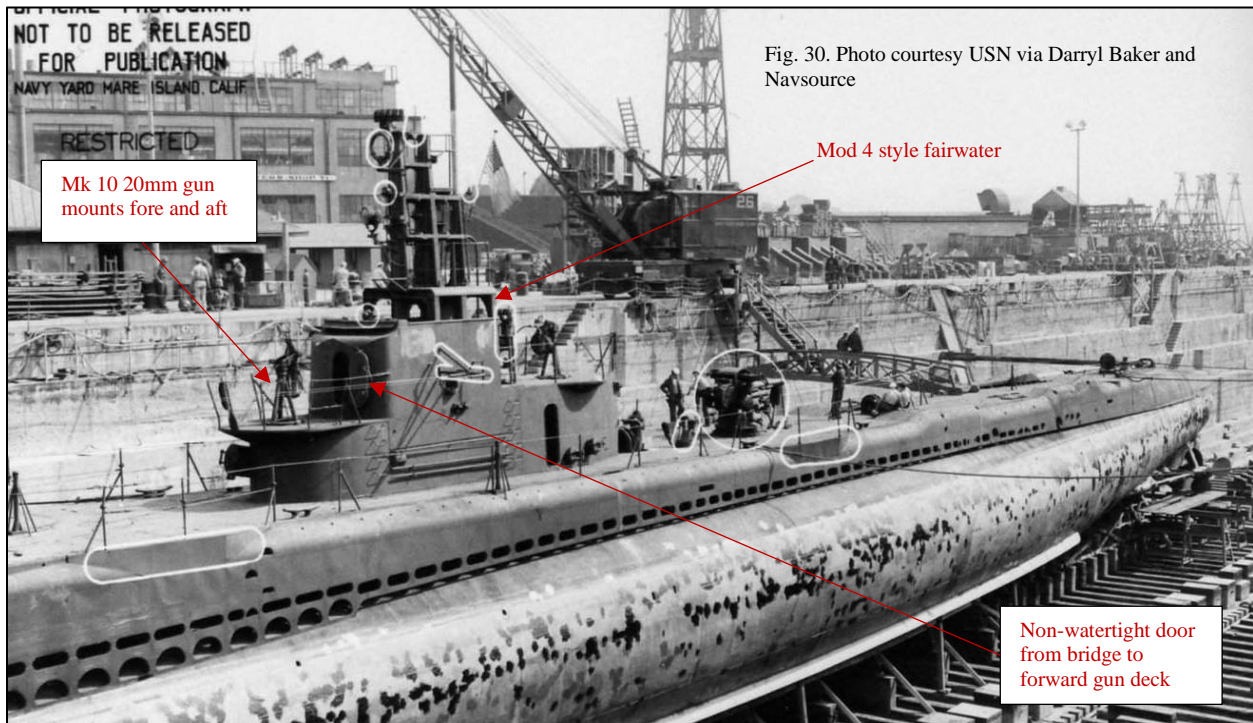
Once again, there is a paucity of photographs of the *Sargo* class boats from the first year of the war. While it cannot yet be confirmed, it is likely that their modifications also followed the pattern set by the *Gato* class with the Mod 2 cut-down of the bulwark railing around the cigarette deck and the addition of radars. As with the *Salmon* class, photography picked up in 1943 as the boats went into overhaul stateside and the pattern of modifications becomes clearer. The first three EB built members of the *Sargo* class follow a roughly similar pattern. *Sargo* herself is shown below in Figure 28 on 21 April 1943 off Mare Island.



Both the forward and after portions of the conning tower fairwater have been cut down to provide gun platforms for 20 mm automatic cannon (with Mk. 5 solid mounts). At this point she still has one 34-foot and one 40-foot periscope, with the corresponding one low/one high periscope shears. SJ radar is mounted to starboard of the shears, with the support brackets attached to the higher #2 periscope shear. The SD radar mast is directly aft of the shears. These boats were also original recipients of the greatly disliked HOR diesels. In this photo you can just see the raised muffler covers on the aft deck for the new GM-Winton 16-278A's that replaced the HOR's. *Sargo* has also received additional limber holes aft of the bow planes and her 3"/50 caliber deck gun has been moved forward. *Saury* was in a very similar configuration at this time.



On 12 May 1943 *Spearfish* of this group emerged from overhaul closely resembling her two EB sisters, but with one important difference (Figure 29). She has received a 40-foot replacement for her original 34-foot #1 scope, with a correspondingly higher shear. You can also see in this photo the two ready access ammo storage lockers underneath the forward 20 mm gun deck. In an attempt to speed diving, a line of small circular holes has been drilled along the upper edge of the superstructure. These holes would allow trapped air to vent faster.



By the summer of 1944 these boats had received their final major modifications. *Spearfish* (Figure 30) and *Sargo* had the bridge lowered in a fashion similar to a *Gato* Mod 4, exposing the covered wagon ribs, although *Saury* apparently retained her Mod 3 equivalent. All three boats now had two 40-foot periscopes, but the SJ radar stayed in its regular starboard side location. Figure 30 also shows that *Spearfish* has acquired a 5"/25 caliber deck gun in the aft position (rare for a *Salmon/Sargo* class boat) and she has retained her three bladed propellers. The wind venturi on the forward edge of the bridge was different on all three boats, reflecting the many schools of thought that existed on how to mitigate the wind issues on the new bridge designs. By this time, all three boats lost the circular windows in the bridge fairwater and had doors installed that led onto the forward 20 mm gun deck. A battle surface would require the crew for this gun to come up into the conning tower and wait there until the boat had surfaced. They then proceeded to the bridge and onto the gun deck through this door. This had the undesirable effect of badly crowding the conning tower just before surfacing, but it couldn't be helped.

The mid-1943 overhauls of the three Government built boats of this group put them in a very similar configuration to their EB built sisters. *Sculpin* is shown in Figure 31 on 01 May 1943 at the Bethlehem Steel yard in San Francisco. The one major difference from the EB built boats is the lack of periscope support I-beams. As stated earlier, they had been removed during the initial construction phase as a weight saving measure, with the shears structure being accordingly redesigned with beefier, thicker support tubes, which is now very apparent when compared to the EB versions. Note the stepped appearance of the shears due to the 34-foot #1 scope. At this point *Sculpin* retains the weld bead outlines for her hull number on the side of the fairwater. She has the Mk 5 mounts for the 20 mm guns and she retains the 3"/50

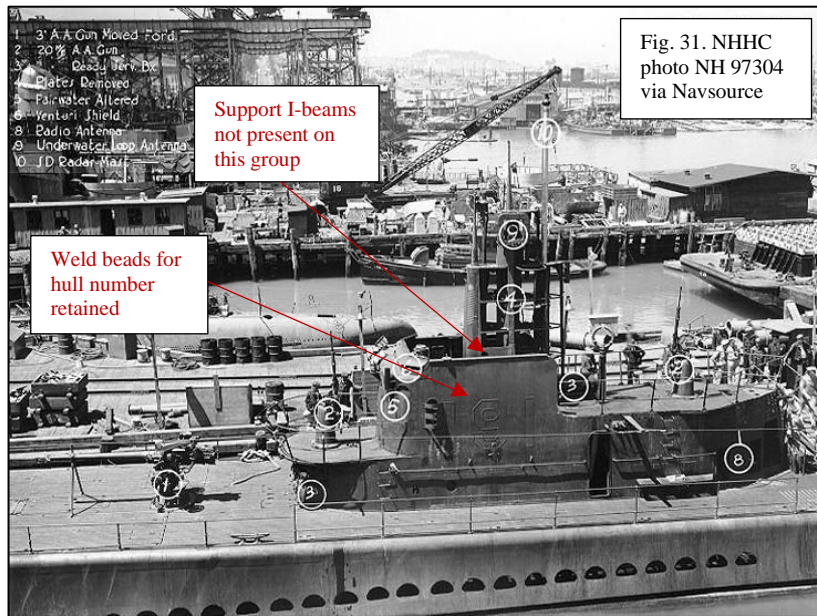


Fig. 31. NHHC photo NH 97304 via Navsource

caliber gun forward.

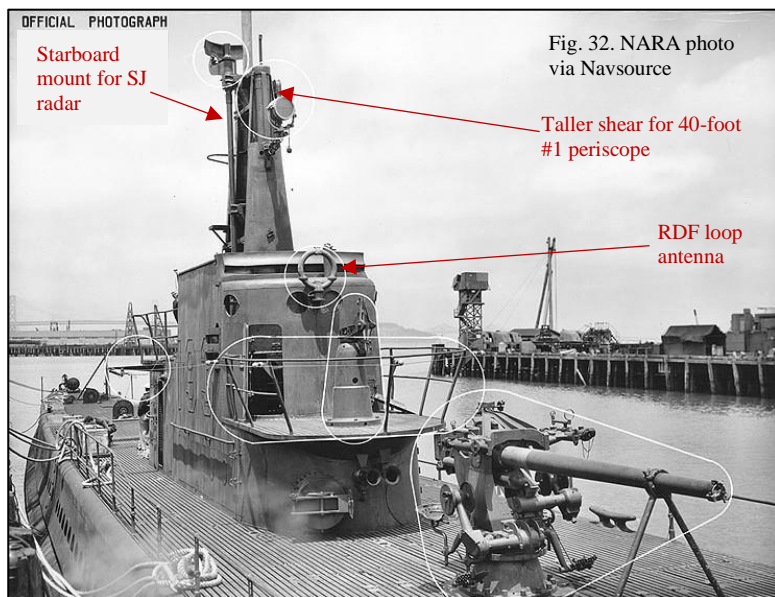


Fig. 32. NARA photo via Navsource

caliber gun forward.

Sculpin and *Sailfish* were very similar in this period, but *Swordfish* is shown in Figure 32 on 13 June 1943. She has received a 40-foot replacement for her #1 periscope with the shear lengthened accordingly. The round antenna on the front of the bridge is the RDF loop antenna. There was a wide variety of where these antennas were mounted. She also retains the weld beads for her hull number. Most of the boats that had them when built had the beads

ground off altogether. This photo also gives a good view of how the SJ radar mast is mounted on the starboard side of the #2 periscope shear. None of these boats were re-engined as their original GM-Winton 16-248 diesels proved to be quite satisfactory in service. *Swordfish* retains her 3"/50 caliber gun at this point, in this case a Mk 18 model. At least six different marks and mods of this gun were used on submarines, all of them specially adapted as a "wet mount" to survive being submerged. Despite the advantages of being lightweight, easy to handle, and of rugged construction, it did not have enough hitting power to finish off small or crippled targets fast enough. As soon as the supply chain could provide quantities of the more powerful 4"/50 caliber Mk 9 and Mk 12 guns the smaller guns were swapped for the larger ones. This change could be made in theater by a tender if necessary.

The color photo (Figure 33) shows the fairwater and shears of the *Sailfish* as it currently sits on the grounds of the Portsmouth Naval Shipyard in Kittery, Maine. *Sailfish* is unique among all of the fleet boats as she is the only boat originally built without the periscope support I-beams (see Figure 12) to have them added later, probably in her June 1944 overhaul at Mare Island. Why is not immediately

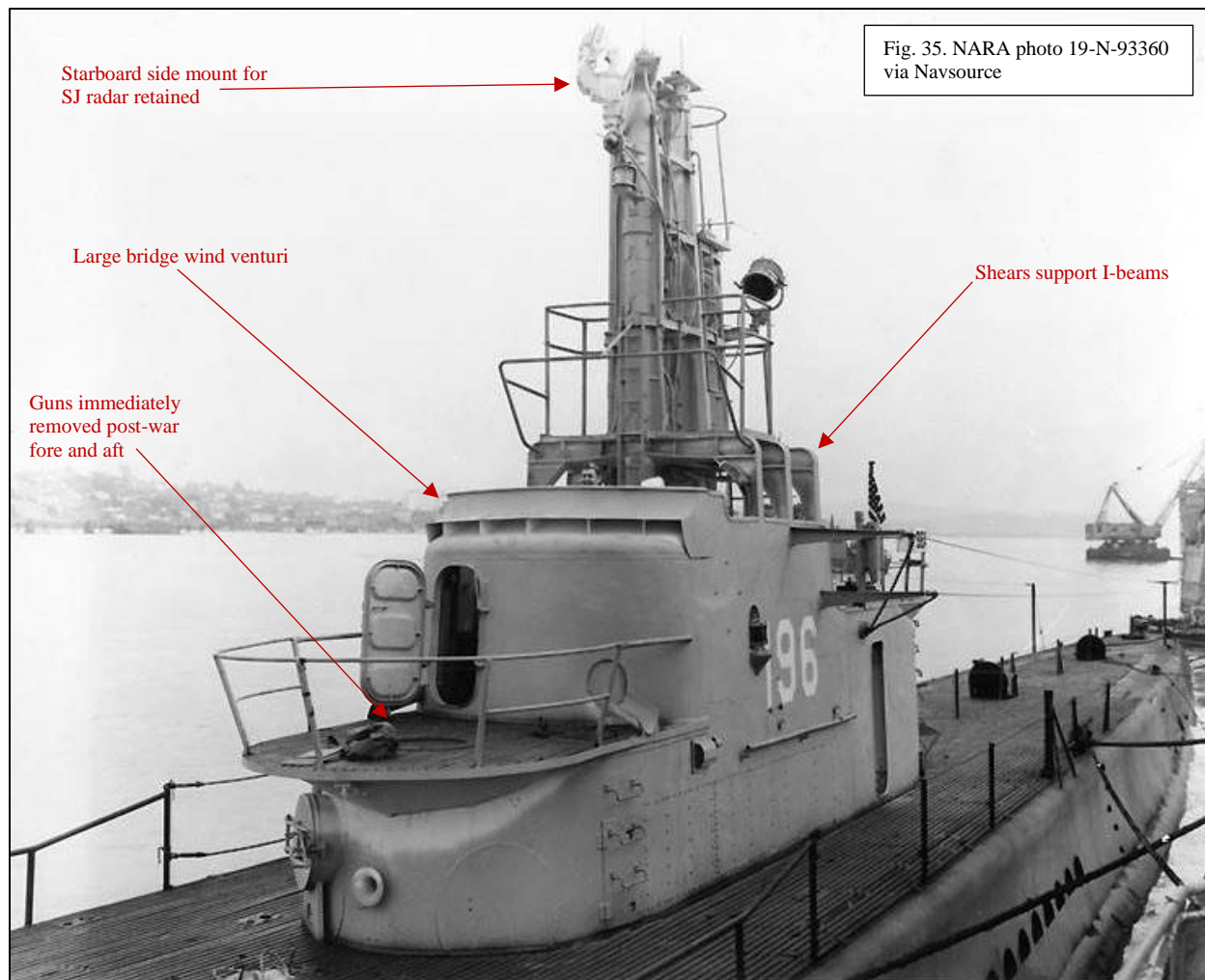


apparent, but it may have had to do with water flow vibration problems with the periscopes. Removing the covered wagon ribs during construction may have exacerbated this issue and this added bracing is how it was eventually solved for *Sailfish*. *Sculpin* was lost six months after the photo above was taken and thus never received this modification. It is likely that this is also the case with *Swordfish*, but the existing photographic record does not confirm her final configuration.

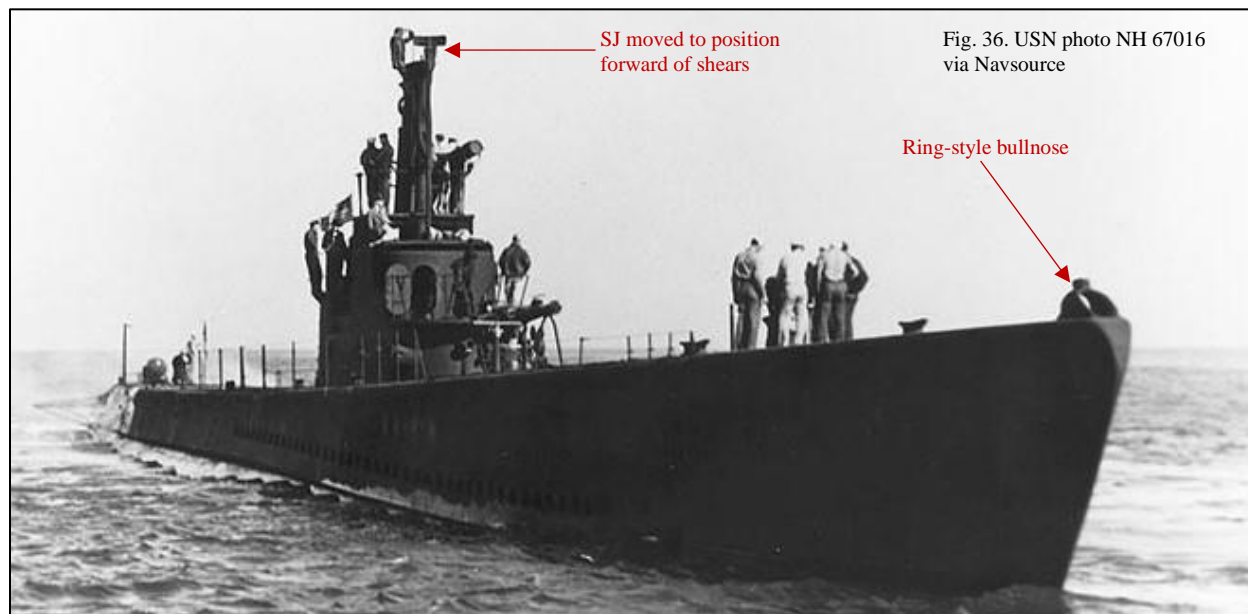
The four FY-38 boats of the *Sargo* group were subjected to basically the same modifications that the *Sargo*, *Saury*, & *Spearfish* received, and at roughly the same times. These boats received the Mod 3 equivalent during overhauls in the spring and summer of 1943 and the Mod 4 equivalent in mid 1944. Most of the boats also were up gunned with the 4"/50 caliber deck gun, although it appears that none of the *Salmon/Sargo*-class submarines received the 40 mm guns like the newer boats did. *Sealion* of course received no modifications to her as built configuration, owing to her



loss on the 2nd day of the war. Shown above in Figure 34 is *Seadragon* on 17 April 1943, looking very much like her FY-37 EB sisters during the same period. She is configured with a Mod 3 equivalent and carries a gun armament and radar outfit typical of the mid war period. The other survivor of this group was *Searaven* and she is shown below in Figure 35, a post war photo.



Sporting a Mod 4 equivalent, she looks very much like a late war Mod 4 *Gato*. However, she retains her class typical starboard side mount for the SJ radar. In addition, her cigarette deck is higher than what is typical for the *Gato* class boats. This high cigarette deck is a common wartime modification feature on all of the Government built *Salmon/Sargo* class boats and is indicative of a larger main air induction valve design that required more space. The cigarette deck on the EB boats was very nearly the same height as the forward fairwater gun deck.



Seadragon finished the war in a very similar configuration, but she had two vertically mounted ready service ammunition lockers on the forward edge of the forward fairwater gun deck, as opposed to the single horizontal locker shown here on *Searaven*. The hard fighting but ill-fated *Seawolf* in Figure 36 received a similar Mod 4 equivalent before her tragic loss in a friendly fire incident on 3 October 1944. Note, though in the photo below her SJ radar was mounted forward of the shears, and she retained the above deck ring-style bullnose to the end of her life.

CONCLUSION

Built at the tail end of the experimental phase of USN submarine development, the submarines of the *Salmon* and *Sargo* classes ultimately rose above any limitations of their design and provided excellent service during the war. Rugged and hardy in design (*Salmon* barely survived a horrific depth charging in October 1944 but still brought her crew home) these boats were well liked by their crews, the unfortunate experiment with the HOR diesels aside. Although possessed of an initially confusing array of detail differences, a sense of order can be arrived at once you know what to look for.

ACKNOWLEDGEMENTS

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