Navy Conventional Prompt Strike Weapon System Flight Tests

Marine Biological Evaluation

Revised Final

Prepared for:
Department of the Navy Strategic Systems Programs
and
U.S. Army Space and Missile Defense Command

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Acronyms and Abbreviations

§	Section, Part
AUR	All-Up-Round
BOA	Broad Ocean Area
C-HGB	Common Hypersonic Glide Body
CFR	Code of Federal Regulations
CPS	Conventional Prompt Strike
dB	Decibel(s)
DON	Department of the Navy
DPS	Distinct Population Segment
EEZ	Exclusive Economic Zone
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FR	Federal Register
ft	Feet
km	Kilometer(s)
m	Meter(s)
nm	Nautical Mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OEIS	Overseas Environmental Impact Statement
OPAREA	Operating Area
PTS	Permanent Threshold Shift
re 1 μPa	Referenced to 1 Micropascal
TTS	Temporary Threshold Shift
UES	United States Army Kwajalein Atoll Environmental Standards
U.S.	United States
USAKA	United States Army Kwajalein Atoll
USASMDC	United States Army Space and Missile Defense Command
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service

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1.0 Introduction

1.1 Purpose and Objectives

The purpose of this Biological Evaluation is to evaluate the potential effects of proposed Department of the Navy (DON or Navy) Conventional Prompt Strike (CPS) Weapon System Flight Tests (Proposed Action) on species listed as threatened or endangered, species proposed for listing, designated critical habitat, and proposed critical habitat under the Endangered Species Act (ESA). This Biological Evaluation addresses species and habitats within broad ocean areas (BOAs) of the Atlantic and Pacific which are the responsibility of the National Marine Fisheries Service (NMFS) under the ESA. The Navy Strategic Systems Programs (the Action Proponent) has prepared this Biological Evaluation in accordance with the requirements of section 7 of the ESA with support from the United States (U.S.) Army Space and Missile Defense Command (USASMDC).

The Action Proponent and USASMDC have also prepared this evaluation in cooperation with Navy Facilities Engineering Systems Command, U.S. Fleet Forces, and U.S. Pacific Fleet.

The Proposed Action consists of conducting proposed Navy CPS weapon system (missile) flight tests in both Atlantic and Pacific Ocean regions. Testing would involve up to eight flight test launches per year from various sea-based launch locations conducted over a 10-year period. All flight tests would be at-sea missile tests launched from existing naval vessels operating in Atlantic and Pacific BOAs[1]. After launch, flight test activities would include vehicle flight over the Atlantic and/or Pacific Oceans and would involve splashdown of spent boosters and fairings in Atlantic and Pacific BOAs. Navy CPS flight test payloads would impact at either target sites in the BOA or at ocean and land-based target sites at Kwajalein Atoll within the Republic of the Marshall Islands. Locations at Kwajalein Atoll are not addressed in this Biological Evaluation as Navy CPS activities at these locations are subject to provisions of the *Environmental Standards and Procedures for U.S. Army Kwajalein Atoll (USAKA) Activities in the Republic of the Marshall Islands* (UES) (USASMDC 2021). The potential effects of Navy CPS activities within Kwajalein Atoll on species listed as consultation species under the UES, which include all ESA-listed species and those proposed for listing, have been evaluated in a separate biological assessment (DON and USASMDC 2023). This separate biological assessment has been submitted to the UES appropriate NMFS and U.S. Fish and Wildlife (USFWS) offices for consultation under the UES.

Based on preliminary analyses, the Action Proponent determined that proposed Navy CPS flight test activities within the Atlantic and Pacific BOAs may affect species listed under the ESA or designated critical habitats. Therefore, the Action Proponent has prepared this Biological Evaluation to support consultation with NMFS under section 7 of the ESA.

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[1] For the purposes of the Biological Evaluation, BOA is defined as any ocean area that is within the Navy CPS study areas but outside of territorial seas. Under maritime law, territorial seas generally extend seaward up to 22 km or 12 nm from a nation’s territorial sea baseline (NOAA 2023b).

This Biological Evaluation describes proposed Navy CPS flight test activities for the purposes of evaluating the potential effects of the Proposed Action, conducted over a 10-year period, on ESA-listed species and designated critical habitats under the jurisdiction of NMFS.

1.2 Regulatory Setting

This Biological Evaluation addresses the potential effects of Proposed Action activities within Atlantic and Pacific BOAs on ESA-listed species and designated critical habitats in compliance with section 7 of the ESA. For the portions of the Proposed Action that would take place in and over Republic of the Marshall Islands territory, a separate biological assessment has been prepared where necessary to comply with requirements under the UES and ESA. This assessment addresses only the portions of the Proposed Action in and over BOAs, including international waters.

Endangered Species Act

The purpose of the ESA is to conserve the ecosystems upon which threatened and endangered species depend and to conserve and recover listed species. Under section 9 of the ESA, it is unlawful for any person subject to the jurisdiction of the United States to take ESA-listed species within the United States or territorial sea of the United States. As defined in the ESA, the term “take” means to harass, harm, pursue, hunt, wound, kill, trap, capture, or collect an ESA-listed species (16 United States Code [U.S.C.] sections [§§] 1532, 1538). For all ESA-listed species, the ESA defines “harm” as an act which kills or injures wildlife including significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 Code of Federal Regulations [CFR] § 17.3). The ESA defines harassment as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR § 17.3).

Section 7(a)(2) of the ESA requires federal agency cooperation and consultation with USFWS and/or NMFS to ensure that any federal action, including federal permits or funding, is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of their critical habitat (16 U.S.C. § 1536).

Destruction or adverse modification of designated critical habitat means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species (50 CFR § 402.02). Alterations of critical habitat may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (81 Federal Register [FR] 7214 [11 February 2016]). Destruction or adverse modification of critical habitat is determined on the basis of whether implementation of the proposed federal action would result in alteration of the quantity or quality of the essential physical or biological features of designated critical habitat, or would preclude or significantly delay the capacity of that habitat to develop those features over time, and if the effect of the alteration was to appreciably diminish the value of critical habitat for the conservation of the species (81 FR 7214 [11 February 2016]).

2.0 Description of the Proposed Action and Action Area

2.1 Overview of the Proposed Action

The Proposed Action consists of conducting proposed Navy CPS weapon system (missile) flight tests within broad Atlantic and Pacific Ocean areas. The Proposed Action would include up to eight flight test launches at up to eight different sea-based launch locations per year, conducted over a 10-year period beginning in fiscal year 2025. All flight tests would be at-sea missile tests launched from existing naval vessels operating in Atlantic and Pacific BOAs with ocean-based or land-based payload target locations. The proposed flight tests would be conducted within broad Atlantic and Pacific study areas, which are delineated in **Figure 1** and **Figure 2**.

2.2 Description of the Action Area

The Action Area for this Biological Evaluation includes the location of Navy CPS flight tests within BOAs of the Atlantic and Pacific Oceans (see **Figure 4** and **Figure 5**). The BOA portions of the Action Area are composed mostly of deep ocean waters and the airspace above those waters. The Action Area occurs entirely outside of U.S. territorial seas, which extend seaward up to 22 kilometers (km; 12 nautical miles [nm]) from the territorial baseline. The Action Area for this evaluation includes:

- Proposed launch sites at least 93 km (50 nm) and up to 370 km (200 nm) from the baseline in the BOAs and excluding marine national monuments and national marine sanctuaries;
- Proposed stage 1 booster splashdown sites in areas downrange of the launch site and as far as 611 km (330 nm) from the baseline in the BOAs;
- Proposed stage 2 booster splashdown sites and payload target sites in BOA areas outside exclusive economic zones (EEZs) within international waters; and
- Any areas subject to potential stressors of the Proposed Action including elevated sound levels, direct contact from components, exposure to hazardous materials and wastes, and vessel operations.

Navy CPS activities proposed to be conducted at Kwajalein Atoll and within Republic of the Marshall Islands waters are not considered in this Biological Evaluation. Because ESA-listed species occurring at Kwajalein Atoll are afforded comparable protections under requirements of the UES, the potential effects of CPS flight test activities on ESA-listed species in the Republic of the Marshall Islands are described and analyzed in separate documents.

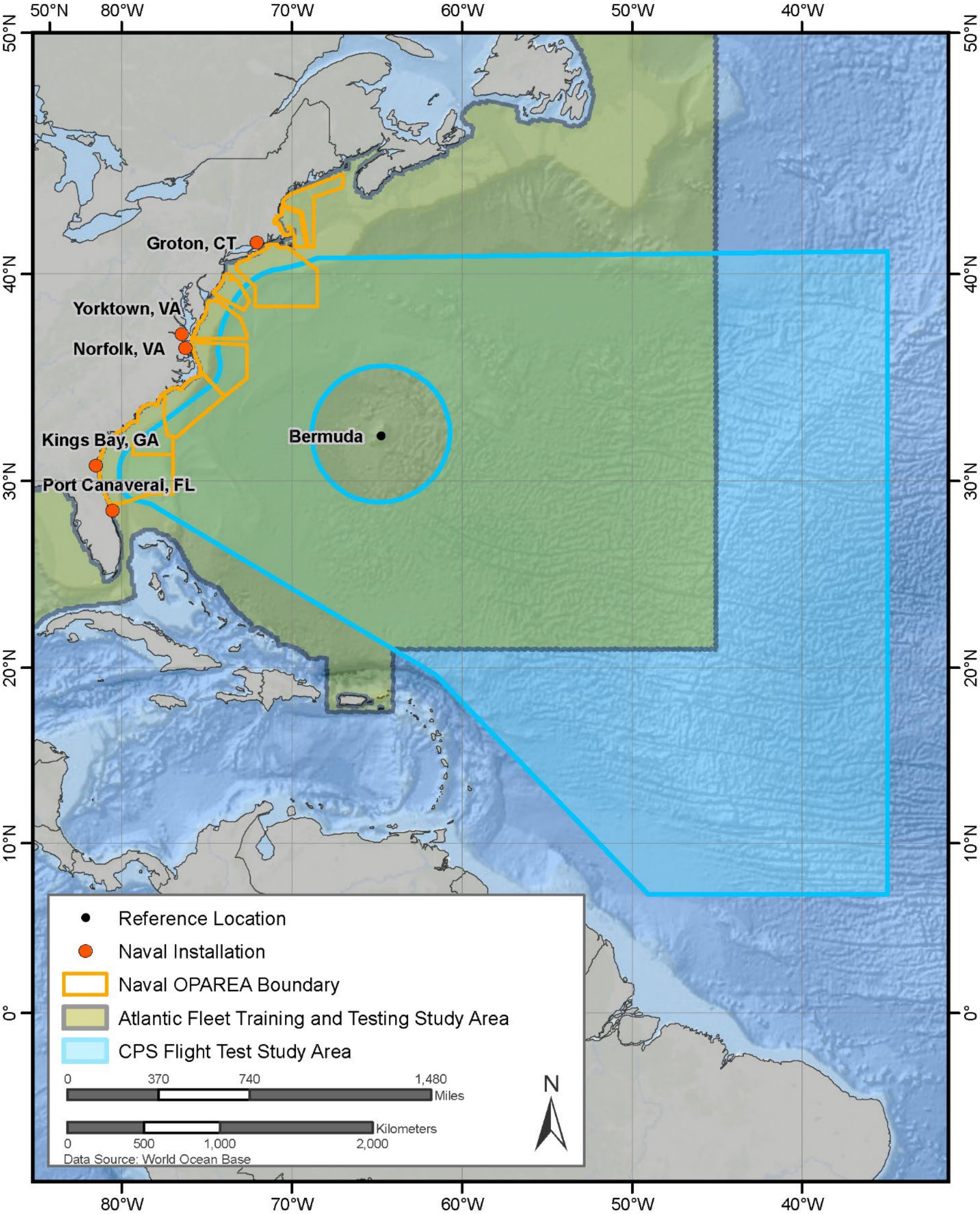

Figure 1. CPS Flight Test Study Area in the Atlantic Ocean Region

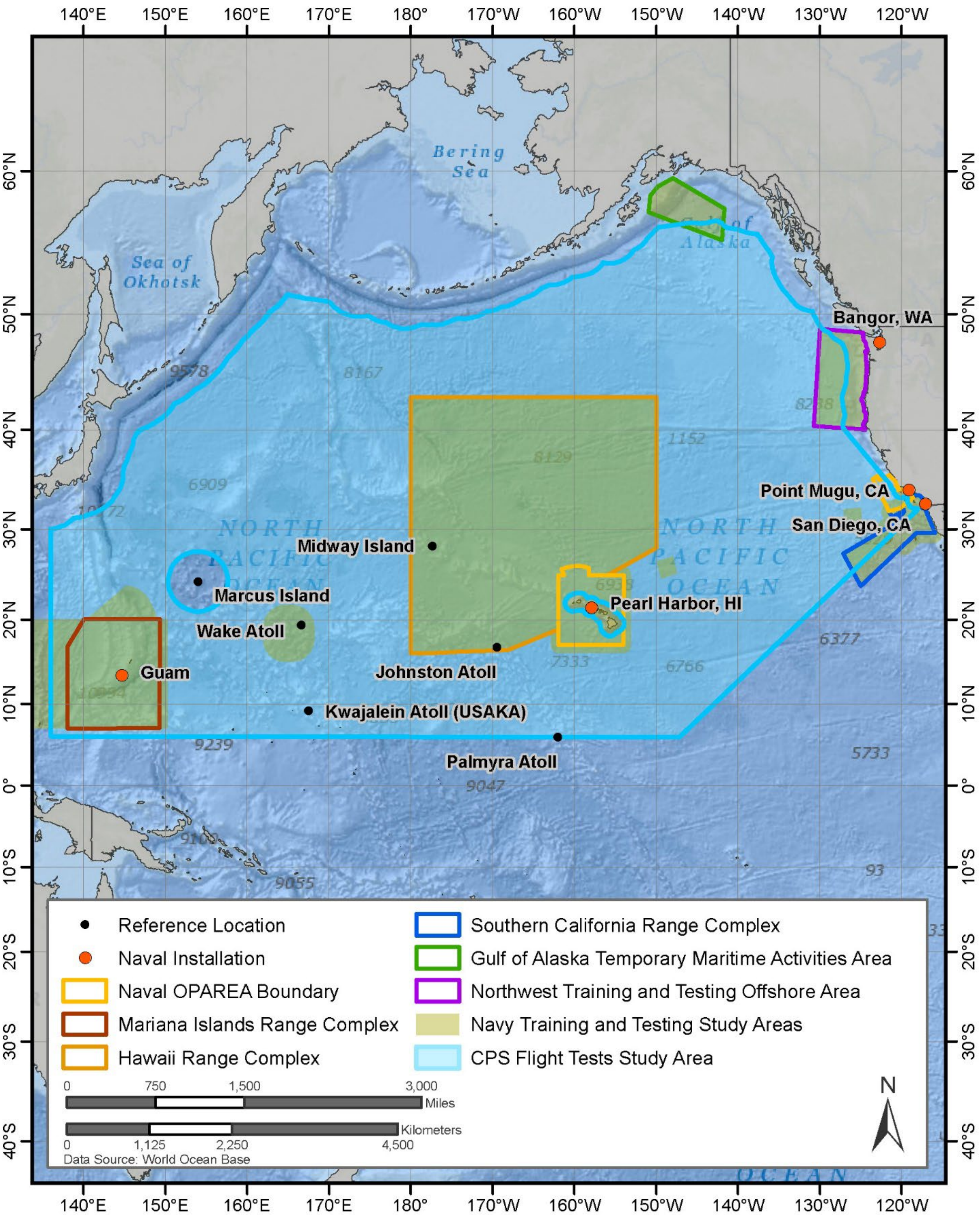

Figure 2. CPS Flight Test Study Area in the Pacific Ocean Region

2.3 Description of the Proposed Action

2.3.1 CPS Flight Test Vehicle

The proposed CPS flight test vehicle design and operation is expected to be very similar to the test vehicles previously analyzed for the Joint Flight Campaign, which is a joint action between the Navy Strategic Systems Programs and the U.S. Army Rapid Capabilities and Critical Technologies Office (DON and U.S. Army 2021). Like the Joint Flight Campaign flight test vehicles currently undergoing testing, the proposed CPS flight test vehicle missile body consists of a two-stage booster system and payload adapter. When combined with the payload, the vehicle is referred to as an All-Up-Round (AUR) missile. Shown in **Figure 3**, the AUR missile body is approximately 10 meters (m) (30 feet [ft]) in length and 1 m (3 ft) in diameter.

The AUR first- and second-stage rocket motors would contain a total of up to 9,000 kilograms (20,000 pounds) of rocket propellant. Other ordnance carried on the test vehicle is a Flight Termination System used only if the vehicle were to deviate from its course or should other problems occur during flight. The Flight Termination System serves as a destruct package that would stop forward thrust when activated, causing the vehicle to terminate flight and fall into the ocean. A list of characteristics for the missile body portion of the AUR is presented in **Table 1**.

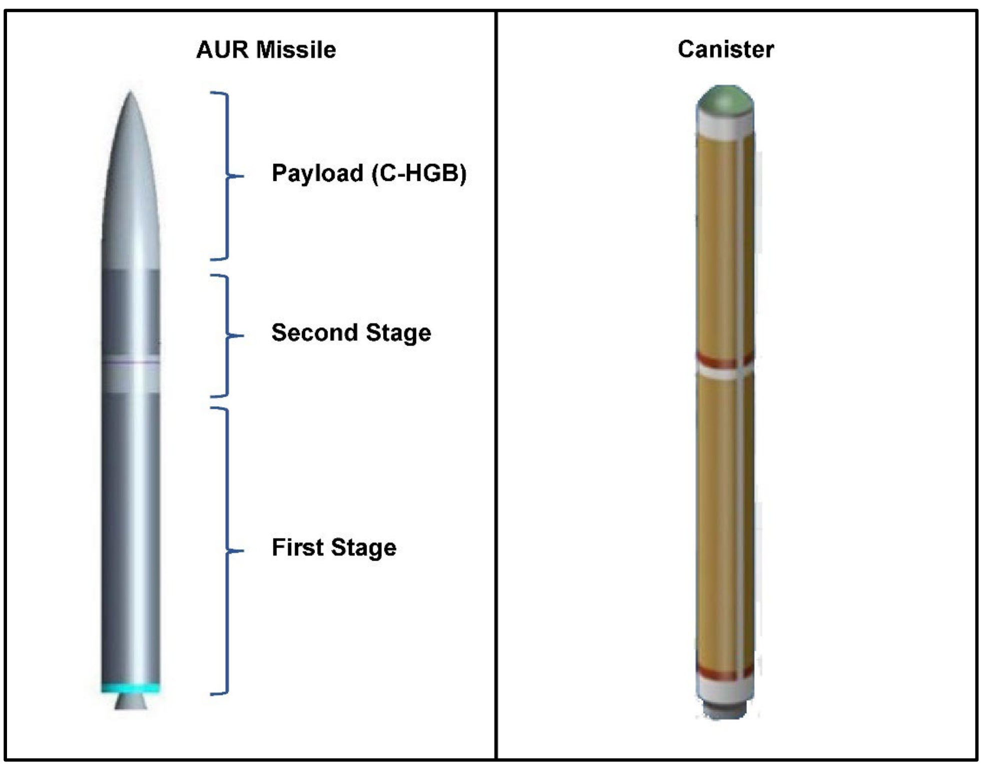

Figure 3. CPS Flight Test Vehicle and Canister

Table 1. CPS Missile Body Characteristics

Major Components	Rocket motors, magnesium thorium, nitrogen gas, halon, asbestos
Communications	Various 5- to 20-watt radio frequency transmitters; one maximum 400-watt radio frequency pulse
Power	Up to 9 lithium ion polymer and silver zinc batteries, each weighing between 1 and 18 kg (3 and 40 lb)
Propulsion/Propellant	Rocket propellant and approximately 1 kg (3 lb) of pressurized nitrogen gas
Other	Small electro-explosive devices for the Flight Termination System

Abbreviations: kg = kilogram(s), lb = pound

A Common Hypersonic Glide Body (C-HGB) would be used as the missile payload (**Figure 3**). The C-HGB payload is a hypersonic glider designed to deliver a conventional warhead payload. Once launched and released from the booster system in the upper atmosphere, the C-HGB payload would glide to a predetermined target location without any propulsion. The C-HGB payload would not contain any propellants or radioactive materials. Flight test payloads may be conventional or may be inert and incorporate a mass simulator. A list of characteristics for the C-HGB payload is presented in **Table 2**.

Table 2. CPS Payload Characteristics

Structure	Aluminum, steel, titanium, magnesium and other alloys, copper, fiberglass, chromate coated hardware, tungsten, plastic, Teflon, quartz, silicone
Communications	Two up-to-20-watt radio frequency transmitters
Power	Up to 3 lithium ion polymer batteries and 1 thermal battery, each weighing between 1 and 23 kg (3 and 50 lb)
Propulsion/Propellant	None
Other	Small electro-explosive devices for safety and subsystems operations

Abbreviations: kg = kilogram(s), lb = pound

For safe handling and rapid fielding, the AUR would be encased in a launch canister (**Figure 3**). The function of the canister would be to protect the missile from damage during storage, transport, and loading onto naval vessels[2]; and to help facilitate missile launch.

2.3.2 Sea-Based Launch Platforms and Support Ships

All proposed CPS flight tests would involve AUR launches conducted at sea from several existing naval surface ships and submarines that have been modernized to accommodate the new missile systems and launch canisters. All launches are expected to be conducted from surface and sub-surface firing platforms that are under the control of the Naval Sea Systems Command. Naval Sea Systems Command is responsible for developing, acquiring, delivering, and maintaining surface ships, submarines, unmanned vehicles, and other weapon system platforms; and oversees vessel operations.

[2] For the purposes of this Biological Evaluation, the term “vessel” is inclusive of surface ships and submarines.

In addition to the sea-based launch platforms, other smaller ships and watercraft would be used in support of the CPS flight tests downrange. These support vessels would host various sensor systems, including telemetry and radar, and support target placement and recovery operations at designated target sites. Refer to **Section 2.3.4** for information on vessel operations downrange.

2.3.3 Launch Preparations and Operations

The proposed CPS flight tests would occur within the ocean study areas shown in **Figure 1** for the Atlantic region, and in **Figure 2** for the Pacific region.

Logistical and operational support for the launch vessels would be provided at various naval installations. The locations of these installations are shown in **Figure 1** and **Figure 2**. With the exception of U.S. Naval Base Ventura County, Point Mugu in California, the launch vessels would be readied for testing at any of these locations prior to departure to a predetermined launch point in the BOA. The effects of these logistical support and military readiness activities have been previously analyzed within the various Navy Fleet and range complex environmental impact statements (EISs) / overseas environmental impact statements (OEISs) and associated ESA section 7 consultations. As such, these land-based actions are not analyzed as part of the Proposed Action in this Biological Evaluation.

After a launch vessel departs and is in transit to the launch point in the BOA, CPS flight test activities would involve onboard pre-flight checks in preparation for launch. In addition to CPS flight test activities, crew members would conduct basic and routine unit-level activities such as surveillance and sonar training, and vessel maintenance. In some instances, the launch vessels may participate in fleet training exercises. The effects of such routine activities and fleet exercises on ESA-listed species have also been previously analyzed within Navy EIS/OEISs and associated ESA section 7 consultations and are not analyzed as part of the Proposed Action in this Biological Evaluation. In all instances, vessels would be operated in accordance with applicable navigation rules, including international laws and regulations. Personnel are assigned to stand watch at all times, day and night, when vessels are moving through the water (underway) for safety of navigation, collision avoidance, range clearance, and man-overboard precautions. Environmental mitigation measures and standard operating procedures are used by the Navy (see also **Section 2.4**) to benefit public health and safety, marine animals, and seafloor resources by identifying potential hazards and by reducing the potential for vessel strikes.

In all instances, test launches would be conducted at least 93 km (50 nm) and up to 370 km (200 nm) offshore within the Atlantic and Pacific BOAs (**Figure 4** and **Figure 5**). Usually, test launches would occur within the existing naval operating areas (OPAREAs), sea ranges, and range complexes shown on **Figure 1** and **Figure 2**, so as to maximize use of fleet assets. For some tests, however, launches could occur from more distant locations within the ocean study areas. No launches are planned to occur within the marine national monuments or national marine sanctuaries located in the ocean study areas.

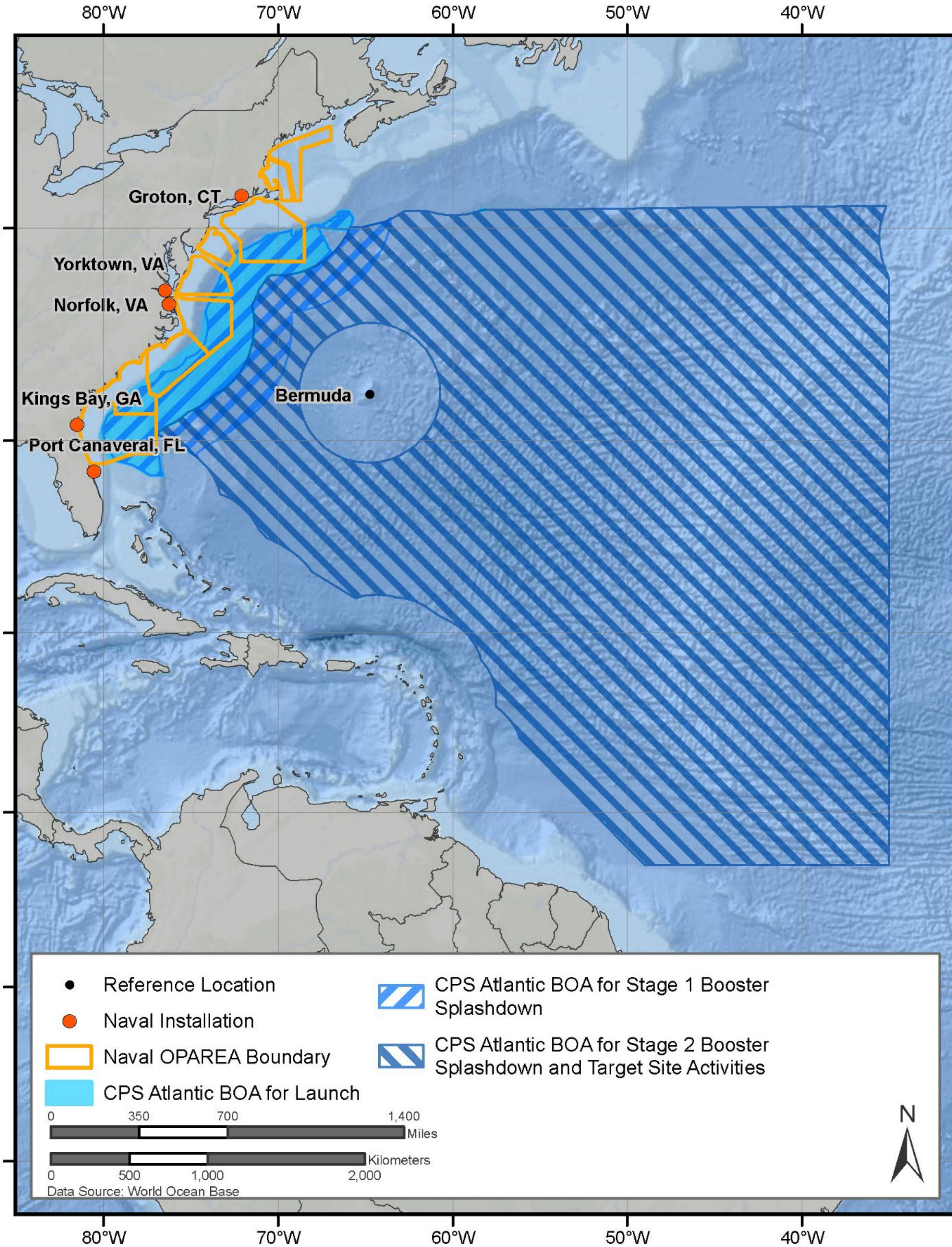

Figure 4. Atlantic CPS Flight Test Activity Areas

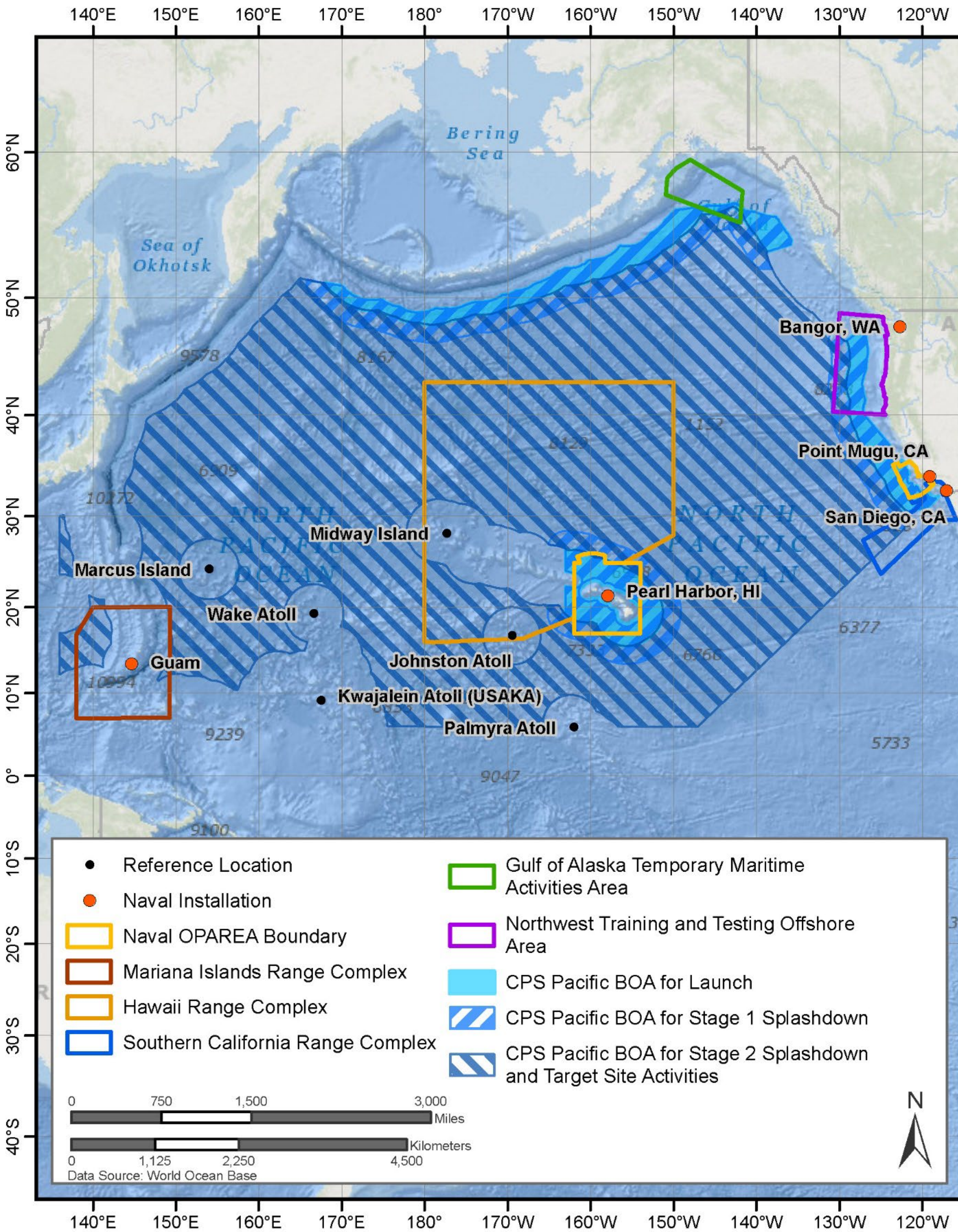

Figure 5. Pacific CPS Flight Test Activity Areas

2.3.4 Downrange Preparations and Operations

For each flight test, there would be two to three additional support ships downrange from the launch point serving as host platforms for various sensors including telemetry and radar. A support ship and smaller watercraft would be used in the terminal area to support pre-flight test target placement/set-up, and post-flight test recovery and clean-up activities. Just as for the launch vessels described in **Section 2.3.3**, support ships and watercraft used downrange would operate in accordance with applicable navigation rules, including international laws and regulations, and monitor for marine mammals and sea turtles to avoid potential vessel strikes. Prior to downrange support ship and watercraft operations, Navy personnel would use the Navy's Protective Measures Assessment Protocol to identify applicable environmental mitigation requirements which minimize potential impacts to protected marine species (see **Section 2.4** for a list of measures relevant to the Proposed Action).

Depending on the particular trajectory for each flight test, existing fixed or mobile telemetry and radar sensors on land areas within view of the missile trajectory may be used. Such assets are planned to be operated as part of other programs within existing military installations.

At the terminal end of the CPS flight test would be a target site for the C-HGB. Target sites primarily would be located in the BOA in deep waters. In addition to BOA target sites, one island location in an established range operational area at Kwajalein Atoll would serve as an occasional land-based target site. The sea-based BOA target sites are further described in the following sections. Sea-based and land-based target sites at Kwajalein Atoll in the Republic of the Marshall Islands are not discussed in this Biological Evaluation.

Broad Ocean Area Target Sites

All BOA payload target sites would be offshore in international waters outside EEZs. In preparation for using target sites in the Atlantic and Pacific BOAs, the Navy may place self-stationing instrumented rafts around the targeted site for purposes of measuring and recording the C-HGB ocean impact. Equipped with radar, telemetry, and acoustic and optical sensors, the rafts would use battery powered trolling motors to maintain position; no anchoring systems would be used. Up to 12 sensor rafts would be deployed from a support ship prior to each flight test, which would then depart to a safe zone.

For some target sites in the BOA, a floating target raft may be used. Floating target rafts would be pontoon rafts approximately 3 m wide by 4 m long (11 ft by 13 ft) (**Figure 6**). For flight tests involving a floating target raft, the raft would be deployed from a support ship prior to the flight test and would remain on-station for several hours using small electric motors. Target rafts would include several sensor types and scoring devices. A list of characteristics for the target raft is presented in **Table 3**.

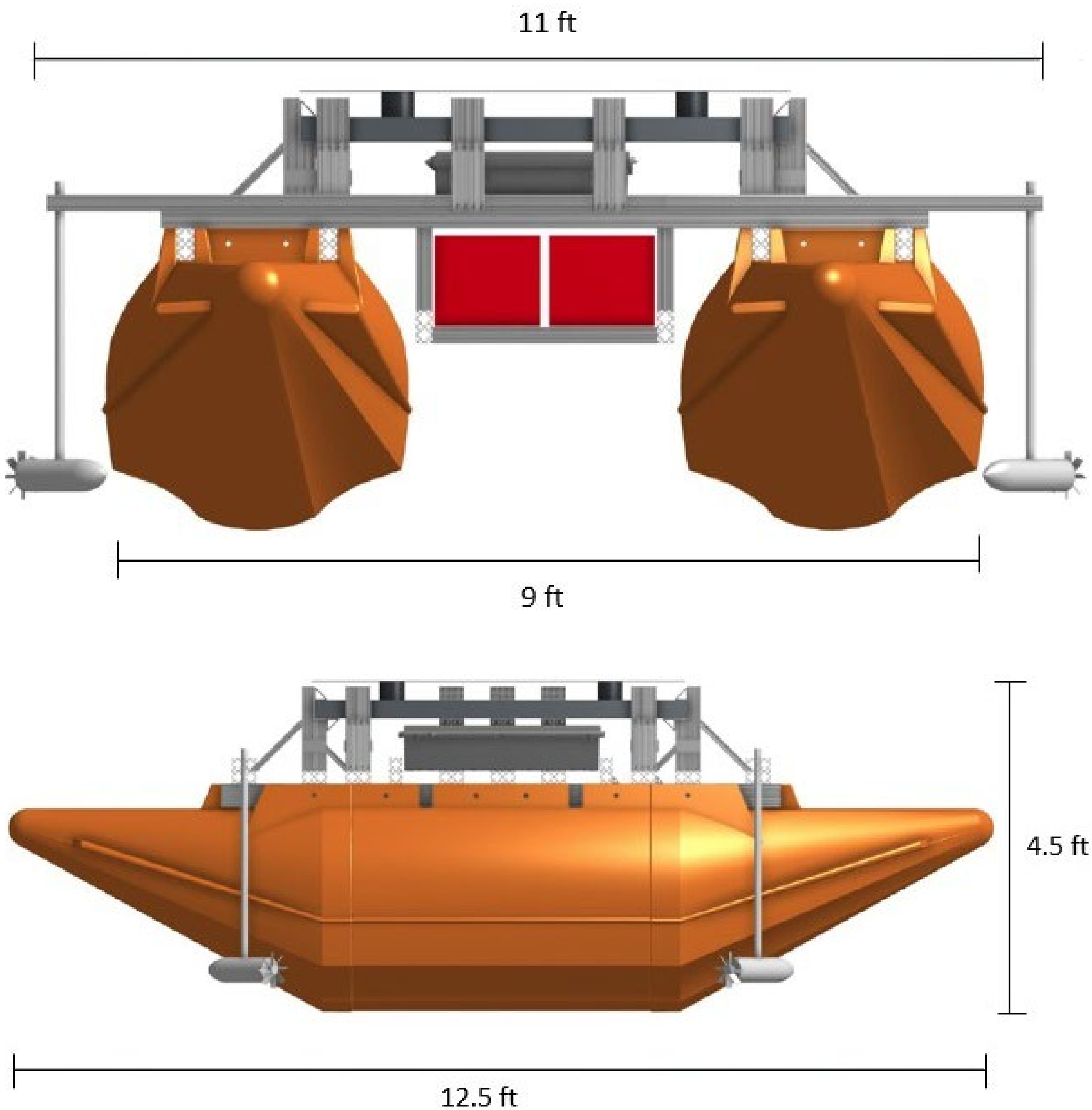

Figure 6. Notional Target Raft

Table 3. Target Raft Characteristics

Structural Components	Raft pontoons: high density polyethylene shell and urethane foam filler Raft frame: aluminum
Electronic Components	Sensors: hydrophones, pressure probes, camera system Electric motors Other electrical components: circuit boards, global positioning system, antennas, computer equipment and copper electrical wiring
Power	Lithium-ion phosphate batteries
Other	Aluminum and steel plates

2.3.5 Flight Test Scenario

Once the launch vessel has reached the designated launch point in the BOA and is cleared by range safety to commence testing, the AUR would be launched. During the boost phase following launch of the AUR, the first-stage motor would burn out downrange and separate from the second stage. Farther into flight, the second stage would burn out and separate, then the payload adapter would be jettisoned from the payload. Jettison of the second-stage booster and payload adaptor would occur outside the atmosphere. The spent booster stages and payload adapter would splash down in the BOA at different points downrange. All booster and payload adapter splashdown locations would be within the ocean study areas. First-stage boosters would splash down downrange of the launch site and as far as 611 km (330 nm) offshore. Second-stage boosters and payload adapters would splash down outside EEZs within international waters. The payload would continue flying towards the predesignated sea-based or land-based target site before impact at the target sites.

The CPS missile flight paths would be designed to avoid Bermuda in the Atlantic, Marcus Island in the Pacific, and any other populated islands. With the exception of target sites at Kwajalein Atoll, no missile components are expected to splash down or impact within territorial seas or non-U.S. EEZs. Additionally, the Navy would plan all missile component splashdowns and payload impacts to avoid marine national monuments and national marine sanctuaries.

Based on data from other weapon system flight testing and on CPS weapon system design, the reliability rate of this developmental system is expected to be 80% during flight testing. Flight test failures would be expected no more than 20% of the time and would fall into four scenario categories presented in **Table 4**. If flight data were to indicate insufficient energy for the payload to reach the target site, the vehicle could be directed to descend in a controlled termination into the BOA. All flight paths would be designed to ensure that, in the event of a failure, no CPS weapon system components or debris would descend into populated areas or marine protected areas.

Table 4. Flight Test Failure Scenarios

Scenario Number	Flight Test Failure Description	Results of Flight Test Failure	Post-Flight Test Response Actions
1	Flight test vehicle does not launch.	None. CPS AUR remains onboard the launch vessel.	None
2	Vehicle launches but there is no motor ignition. No auto destruct or command destruct is activated.	CPS AUR falls intact into the BOA, likely near the launch point. AUR would sink to the ocean floor.	Post-flight test clean-up and recovery. Recovery operations would be conducted to retrieve the payload or critical technologies if significant portions remain intact and if in waters less than 15,000 feet deep. Any visible debris found floating would be recovered, as much as practicable.
3	Vehicle launches but there is no motor ignition. Auto destruct or command destruct is activated using the Flight Termination System.	Intact CPS components or debris fall into the BOA, likely near the launch point. Debris would be large and small pieces. Most debris would sink to the ocean floor. It is unlikely that any pieces would float.	
4	Vehicle launches and motors ignite but the missile cannot reach the target site. Flight is terminated using command destruct.	Intact CPS components or debris fall into the BOA downrange. Debris would be large and small pieces. Most debris would sink to the ocean floor. It is unlikely that any pieces would float.	

Acronyms and Abbreviations: AUR = All Up Round, BOA = Broad Ocean Area, CPS = Conventional Prompt Strike

2.3.6 Post-Flight Test Activities

Following completion of each CPS flight test, the launch vessel would depart from the launch point and continue normal operations before returning to port. Downrange, sensor support ships would also return to port. Post-flight test activities for BOA target sites are described in the following subsections.

Broad Ocean Area Target Sites

For the sea-based target sites in the BOA, support ships would retrieve instrumented rafts and search for any floating debris before returning to port. All or most of the missile components would be expected to sink to the ocean bottom, including the spent booster stages. Any visible payload or other missile debris found floating would be recovered, as much as practicable. During post-light BOA searches after flight tests of similar systems, only the payload nose fairing segments (panels covering the payload) have been found floating and have been recovered; all other components sank to the ocean bottom.

In the event of a flight test failure, post-flight test clean-up and recovery operations would be conducted to retrieve portions of the payload or critical technologies that remain intact as described for the flight test failure scenarios in **Table 4.**

For those flight tests involving a floating target raft, a support vessel would return to the BOA target site to retrieve the target. It is not planned or expected that target rafts would be sunk during flight test activities. Safety and other test support personnel would: (1) inspect the target raft for any hazards; (2) conduct an impact assessment of the raft and the test support equipment on the raft; and (3) recover any visible C-HGB or other test debris to the extent practicable. The raft would then be loaded onto a support ship for transport back to the appropriate port to remove the equipment, further evaluate damage to the raft, and determine whether the raft can be reused as a target.

The test would not involve any intentional sinking or abandonment of the target raft or test components on the target raft (e.g., sensors and motors). It is possible that materials on the target raft might be inadvertently dislodged from the raft during a flight test. If materials were dislodged from the target raft, it is expected that most materials would sink (e.g., metal components) or be cleaned up during post-test operations if found floating (e.g., pontoon foam filler material). All lithium-ion batteries used on the target raft for sensor operation would be recovered unless they were inadvertently damaged beyond the point of safe retrieval/recovery. While there is some potential for the target raft to be sunk or for test materials on the raft to be dislodged or unrecoverable, it is considered unlikely that this would occur.

2.4 Standard Operating Procedures and Mitigation Measures

This section includes the standard operating procedures and mitigation measures to be implemented as part of Navy CPS flight tests program activities in the BOAs. Some measures are specific to Navy CPS activities, others have been developed for routine Navy at-sea activities as part of previously evaluated at-sea training and testing programs. Since Navy vessels typically operating as part of these at-sea programs would be utilized for CPS flight testing, relevant measures which would be implemented for those vessel operations are also included. Relevant to proposed CPS flight test activities are measures detailed in the Atlantic Fleet Training and Testing EIS/OEIS (Chapter 5 of DON 2018a), Hawaii–Southern California Training and Testing EIS/OEIS (Chapter 5 of DON 2018b), and the Mariana Islands Training and Testing Supplemental EIS/OEIS (Chapter 5 in DON 2020). Navy mitigation measures and standard operating procedures within these Navy operational areas are centralized in the Navy's "Protective Measures Assessment Protocol." Navy policy requires applicable personnel to access the Protective Measures Assessment Protocol during the event planning process.

Because the Navy CPS weapon system is an experimental weapon system with unique characteristics compared to other Navy at-sea testing programs, the relatively small scale of the CPS flight tests program and design of the system allow for increased planning and flexibility in the time and location in which proposed activities can occur. During the testing phase of the CPS weapon system, there is a failure rate associated with testing activities that is not typically associated with routine at-sea training and testing programs. As a result, additional measures will be implemented to the greatest extent practicable to avoid effects to biological resources during launch, booster splashdown, and payload impact as detailed in the following standard operating procedures and mitigation measures.

Mitigations would be implemented as compatible with the purpose and need of the Proposed Action, more specifically if the implementation is safe, sustainable, and allows the Navy to continue meeting its mission requirements.

2.4.1 Standard Operating Procedures

- Vessel operations would not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes that could potentially harm marine life.
- Test launches would be conducted at least 93 km (50 nm) and up to 370 km (200 nm) offshore.
- No launches or missile component splashdown would occur within marine national monuments or national marine sanctuaries located in the ocean study areas. No anchoring would occur within marine national monuments or national marine sanctuaries.
- Flight tests would be designed to avoid conducting launch activities and missile component splashdown within designated critical habitat for leatherback sea turtles (*Dermochelys coriacea*) or for Central America and Mexico Distinct Population Segments (DPSs) of humpback whales (*Megaptera novaeangliae*).
- Flight tests would be designed to avoid conducting launch activities and missile component splashdown within the areas identified as biologically important areas for sei whale (*Balaenoptera borealis*) feeding, minke whale (*Balaenoptera acutorostrata*) feeding, or North Atlantic right whale (*Eubalaena glacialis*) migration in the Atlantic Ocean as identified in **Section 3.1.1**.
- CPS missile flight paths would be designed to avoid Bermuda in the Atlantic, Marcus Island in the Pacific, and any other populated islands.
- With the exception of target sites at Kwajalein Atoll, no missile components are expected to splash down or impact within territorial seas or non-U.S. EEZs.
- Stage 1 booster splashdowns would occur in deep ocean waters downrange from launch and as far as 330 nm offshore of any land areas.
- All stage 2 splashdown and payload target sites would be outside of EEZs in international waters.
- For the sea-based target sites in the BOA, support vessels would be present near the target site prior to, during, and after payload impact to observe the test and perform flight test activities.
- Support ship personnel would search for any visible floating test debris after payload impact. Any visible C-HGB or other test debris found floating would be recovered, as much as practicable.
- Personnel aboard support vessels will survey the at-sea payload impact area for 30 minutes after impact to verify no injury to protected species (marine mammals and ESA-listed species). This measure can be done concurrently with debris retrieval.

2.4.2 Vessel Movement and Operations Mitigation Measures

- Surface ship launch platforms and other moving vessels will have a lookout on an observation platform to monitor mitigation zones, including 460 m (500 yards) around the vessel for whales, 180 m (200 yards) around the vessel for other marine mammals (except bow-riding dolphins), and within the vicinity for sea turtles. One or more trained lookouts would observe the mitigation zones and report observations to the watch station.
- If marine mammals or sea turtles are sighted in mitigation zones, the Navy would maneuver the vessel to maintain distance, until the animal is deemed to no longer be in the mitigation zone.
- Data would be collected for any marine mammal or ESA-listed species strike or injury due to Navy activities.
- If a marine mammal or ESA-listed species vessel strike occurs, the Navy will follow established incident reporting procedures.
- When within a 320-m (350-yard) radius of live hard bottom, the Navy would not place anchors or mooring devices on the seafloor.

2.4.3 BOA Target Site Mitigation Measures

- A 2,300-m (2,500-yard) mitigation zone around a target location will be established. Lookouts aboard support vessels shall monitor this zone for floating vegetation, marine mammals, and sea turtles to the best extent practical. If a marine mammal or sea turtle is spotted in the zone and communications are available with the launch platform, launch will be delayed by 30 minutes or until the animal is observed to leave the mitigation zone. Detailed commencement/recommencement conditions for Navy activities are detailed in Chapter 5 of DON 2018a, DON 2018b, and DON 2020.
- Sightings of any marine mammal or ESA-listed species within the mitigation zone around the payload target location shall be reported to USFWS or NMFS.
- Data would be collected for any marine mammal or ESA-listed species strike or injury due to Navy activities.
- If a marine mammal or ESA-listed species strike occurs, the Navy will follow established incident reporting procedures.

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3.0 Listed Species and Designated Critical Habitat in the Action Area

This section includes the species listed as threatened or endangered species and species proposed for listing under the ESA that occur or have the potential to occur in the BOA portions of the Action Area and may be affected by the Proposed Action (**Table 5**). This section also includes descriptions of designated critical habitat and areas proposed for designated critical habitat in the BOA portions of the Action Area. To determine whether the Proposed Action may affect these species or the habitats on which they depend, each species or habitat was evaluated based on the potential for exposure and response to Proposed Action stressors.

3.1 ESA-Listed Species in the Action Area

ESA-listed species in the Action Area include a number of cetacean, pinniped, sea turtle, and fish species (**Table 5**). The presence of each listed species, DPS, or evolutionarily significant unit (ESU) in the Action Area is characterized based on potential presence in coastal Large Marine Ecosystems and pelagic (open ocean) zones (Sutton et al. 2017) as shown in **Figure 7** for the Atlantic study area and **Figure 8** for the Pacific study area. The affected areas for proposed launch activities would be within coastal and Large Marine Ecosystems as well as pelagic zones. The affected areas for booster splashdowns and payload impacts would be almost entirely within areas categorized as pelagic zones. ESA-listed species which do not occur in the Action Area or would not be exposed to or respond to Proposed Action stressors were not considered in detail in this Biological Evaluation.

Because of the large number of species and DPSs in the Action Area, detailed descriptions of each species are not included in this evaluation. This section includes a summary of each species group (e.g., marine mammals) and major threats to species in the group. Descriptions of each species are available in the National Oceanic and Atmospheric Administration (NOAA) Fisheries species directory (NOAA 2023a) as well as in several Navy assessments and reports (DON 2019, DON 2017a, DON 2018b, DON 2014), and are incorporated here by reference. Additional species information can be provided upon request.

Table 5. ESA-Listed Species and Designated Critical Habitat in the Action Area.

Common Name	Scientific Name	ESA Listing Status	Occurrence in the Action Area				
			Atlantic Coastal Waters / Large Marine Ecosystem	Atlantic Pelagic Zone	Pacific Coastal Waters / Large Marine Ecosystem	Pacific Pelagic Zone	Critical Habitat
Cetaceans							
Sei whale	*Balaenoptera borealis*	E	NE U.S., SE U.S., and Caribbean Sea	N Atlantic and Atlantic Subarctic	GOA, California Current, and Insular Pacific	NC, E Tropical, Equatorial, and Subarctic Pacific	
Blue whale	*Balaenoptera musculus*	E	NE U.S., SE U.S., and Caribbean Sea	N Atlantic and Atlantic Subarctic	GOA, California Current, and Insular Pacific	NC, E Tropical, Equatorial, and Subarctic Pacific	
Fin whale	*Balaenoptera physalus*	E	NE U.S., SE U.S., and Caribbean Sea	N Atlantic and Atlantic Subarctic	GOA, California Current, and Insular Pacific	NC, E Tropical, Equatorial, and Subarctic Pacific	
Gray whale –Western North Pacific DPS	*Eschrichtius robustus*	E			GOA and California Current	Pacific Subarctic	
North Atlantic right whale	*Eubalaena glacialis*	E	NE U.S. and SE U.S.	Atlantic Subarctic			
North Pacific right whale	*Eubalaena japonica*	E			GOA and California Current	NC Pacific and Pacific Subarctic	
Humpback whale	*Megaptera novaeangliae*						
Central America DPS		E			California Current	NC and E Tropical Pacific	Yes
Mexico DPS		T			GOA and California Current	NC, E Tropical and Subarctic Pacific	Yes
Western North Pacific DPS		E			GOA, California Current, and Western Insular Pacific	NC Pacific and Pacific Subarctic	
Sperm whale	*Physeter macrocephalus*	E	NE U.S., SE U.S., and Caribbean Sea	N Atlantic and Atlantic Subarctic	GOA, California Current, and Insular Pacific	NC Pacific and Pacific Subarctic	
False killer whale – Main Hawaiian Islands Insular DPS	*Pseudorca crassidens*	E			Insular Pacific-Hawaii		
Pinnipeds							
Guadalupe fur seal	*Arctocephalus townsendi*	T			California Current	NC and E Tropical Pacific	
Steller sea lion – Western DPS	*Eumetopias jubatus*	E			GOA	Pacific Subarctic	
Hawaiian monk seal	*Neomonachus schauinslandi*	E			Insular Pacific-Hawaii		

Common Name	Scientific Name	ESA Listing Status	Occurrence in the Action Area				
			Atlantic Coastal Waters / Large Marine Ecosystem	Atlantic Pelagic Zone	Pacific Coastal Waters / Large Marine Ecosystem	Pacific Pelagic Zone	Critical Habitat
Sea Turtles							
Loggerhead turtle	*Caretta caretta*						
North Pacific Ocean DPS		E			GOA, California Current, and Insular Pacific	NC, E Tropical, Equatorial, and Subarctic Pacific	
Northeast Atlantic Ocean DPS		E		N Atlantic			
Northwest Atlantic Ocean DPS		T	NE U.S., SE U.S., and Caribbean Sea	N Atlantic and Atlantic Subarctic			Yes
Green turtle	*Chelonia mydas*						
Central North Pacific DPS		T			Insular Pacific	NC Pacific	
Central South Pacific DPS		E			Insular Pacific -Palmyra	E Tropical and Equatorial Pacific	
Central West Pacific DPS		E			Western Insular Pacific (including Mariana and Marshall Islands)	NC and Equatorial Pacific	
East Pacific DPS		T			California Current	NC and E Tropical Pacific	
North Atlantic DPS		T	NE U.S., SE U.S., and Caribbean Sea	N Atlantic			Yes
South Atlantic DPS		T	Caribbean Sea	CN Atlantic			
Leatherback turtle	*Dermochelys coriacea*	E	NE U.S., SE U.S., and Caribbean Sea	N Atlantic and Atlantic Subarctic	GOA, California Current, and Insular Pacific	NC, E Tropical, Equatorial, and Subarctic Pacific	Yes
Hawksbill turtle	*Eretmochelys imbricata*	E	NE U.S., SE U.S., and Caribbean Sea	CN Atlantic	California Current and Insular Pacific	NC, E Tropical and Equatorial Pacific	
Kemp's ridley turtle	*Lepidochelys kempii*	E	NE U.S., SE U.S., and Caribbean Sea				
Olive ridley turtle	*Lepidochelys olivacea*						
All other populations (not Mexico's Pacific Coast breeding populations)		T			California Current and Insular Pacific	NC, E Tropical and Equatorial Pacific	
Mexico's Pacific Coast Breeding Population		E			California Current	E Tropical	

Common Name	Scientific Name	ESA Listing Status	Occurrence in the Action Area				
			Atlantic Coastal Waters / Large Marine Ecosystem	Atlantic Pelagic Zone	Pacific Coastal Waters / Large Marine Ecosystem	Pacific Pelagic Zone	Critical Habitat
Fishes							
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*						
Carolina DPS		E	NE U.S. and SE U.S.				
Chesapeake Bay DPS		E	NE U.S. and SE U.S.				
Gulf of Maine DPS		T	NE U.S. and SE U.S.				
New York Bight DPS		E	NE U.S. and SE U.S.				
South Atlantic DPS		E	NE U.S. and SE U.S.				
Oceanic whitetip shark	*Carcharhinus longimanus*	T	NE U.S., SE U.S., and Caribbean Sea	N Atlantic and Atlantic Subarctic	California Current and Insular Pacific	NC, E Tropical and Equatorial Pacific	
Giant manta ray	*Mobula* (*Manta*) *birostris*	T	NE U.S., SE U.S., and Caribbean Sea	N Atlantic and Atlantic Subarctic	California Current and Insular Pacific	NC, E Tropical and Equatorial Pacific	
Chum salmon – Hood Canal Summer run ESU	*Oncorhynchus keta*	T			GOA and California Current		
Coho salmon	*Oncorhynchus kisutch*						
Central California Coast ESU		E			GOA and California Current		
Lower Columbia River ESU		T			GOA and California Current		
Oregon Coast ESU		T			GOA and California Current		
Southern Oregon and Northern California Coast ESU		T			GOA and California Current		
Steelhead Trout	*Oncorhynchus mykiss*						
California Central Valley DPS		T			GOA and California Current		
Central California Coast DPS		T			GOA and California Current		
Lower Columbia River DPS		T			GOA and California Current		
Middle Columbia River DPS		T			GOA and California Current		
Northern California DPS		T			GOA and California Current		
Puget Sound DPS		T			GOA and California Current		
Snake River Basin DPS		T			GOA and California Current		
South-Central California Coast DPS		T			GOA and California Current		
Southern California DPS		E			California Current		
Upper Columbia River DPS		T			GOA and California Current		
Upper Willamette River DPS		T			GOA and California Current		

Common Name	Scientific Name	ESA Listing Status	Occurrence in the Action Area: Atlantic Coastal Waters / Large Marine Ecosystem	Atlantic Pelagic Zone	Pacific Coastal Waters / Large Marine Ecosystem	Pacific Pelagic Zone	Critical Habitat
Fishes (continued)							
Sockeye salmon – Snake River ESU	*Oncorhynchus nerka*	E			GOA and California Current		
Chinook salmon	*Oncorhynchus tshawytscha*						
California Coastal ESU		T			California Current		
Central Valley Spring-run ESU		T			California Current		
Lower Columbia River ESU		T			GOA and California Current		
Puget Sound ESU		T			GOA and California Current		
Sacramento River Winter-run ESU		E			California Current		
Snake River Fall-run ESU		T			GOA and California Current		
Snake River Spring/Summer-run ESU		T			GOA and California Current		
Upper Columbia River Spring-run ESU		E			GOA and California Current		
Upper Willamette River ESU		T			GOA and California Current		
Smalltooth sawfish	*Pristis pectinata*	E	NE U.S. and SE U.S.				
Atlantic salmon – Gulf of Maine DPS	*Salmo salar*	E	NE U.S.				
Scalloped hammerhead shark	*Sphyrna lewini*						
Central and Southwest Atlantic DPS		T	Caribbean Sea	CN Atlantic			
Eastern Atlantic DPS		E		CN Atlantic			
Eastern Pacific DPS		E			California Current	NC and E Tropical Pacific	
Indo-West Pacific DPS		T			Western Insular Pacific (including Mariana and Marshall Islands)	NC and Equatorial Pacific	

Notes: Occurrence information from NOAA 2023a and various literature sources. Gray shaded cells indicate the species, listed population/unit, or designated critical habitat does not occur in that portion of the Action Area.
Abbreviations: C = Central, DPS = distinct population segment, E (in ESA listing status) = ESA endangered, E (in occurrence) = East/Eastern, ESA = Endangered Species Act, ESU = Evolutionarily Significant Unit, GOA = Gulf of Alaska, N = North/Northern, S = South T = ESA threatened.

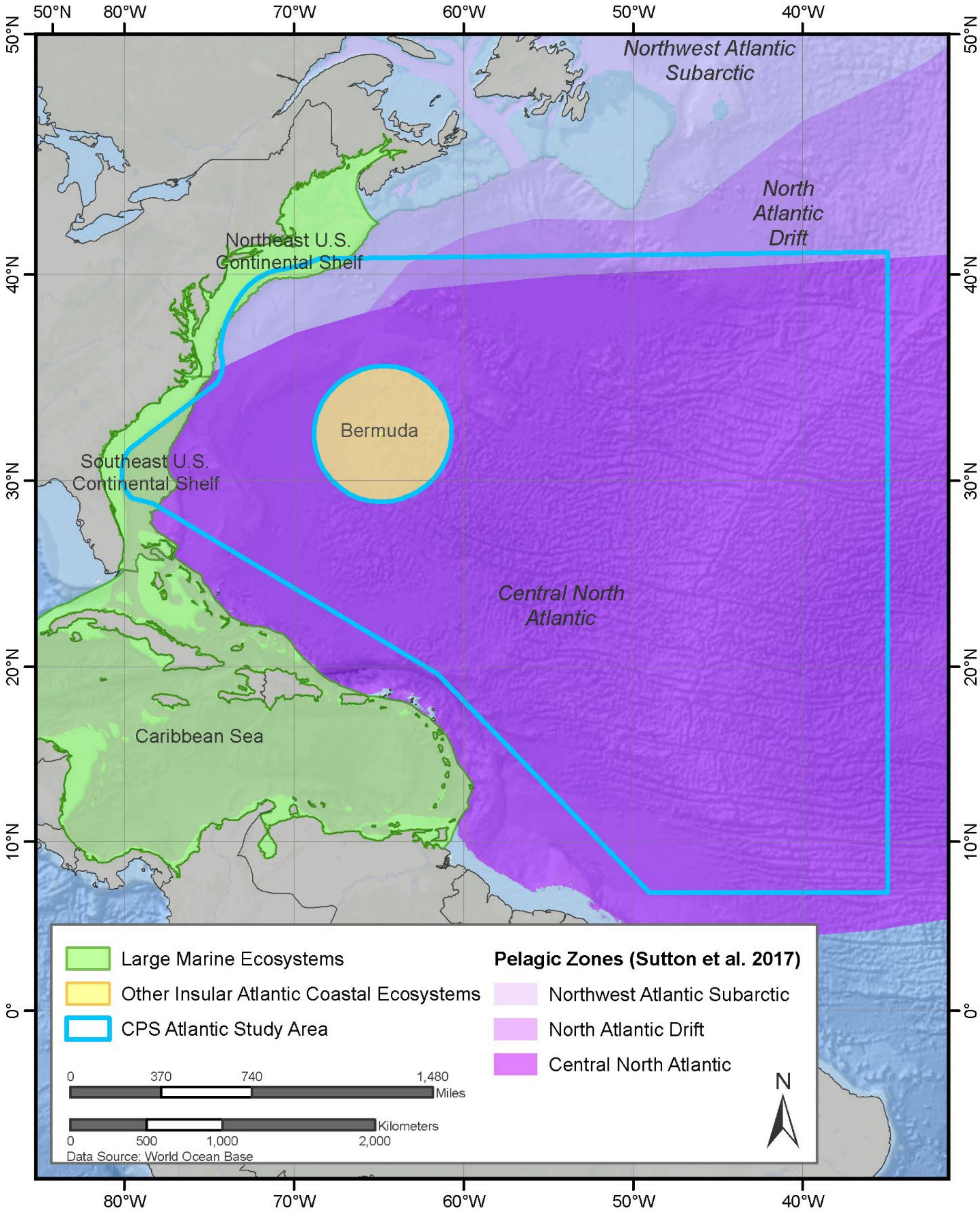


Figure 7. Ecoregions for Classifying Species Presence in the Atlantic Study Area

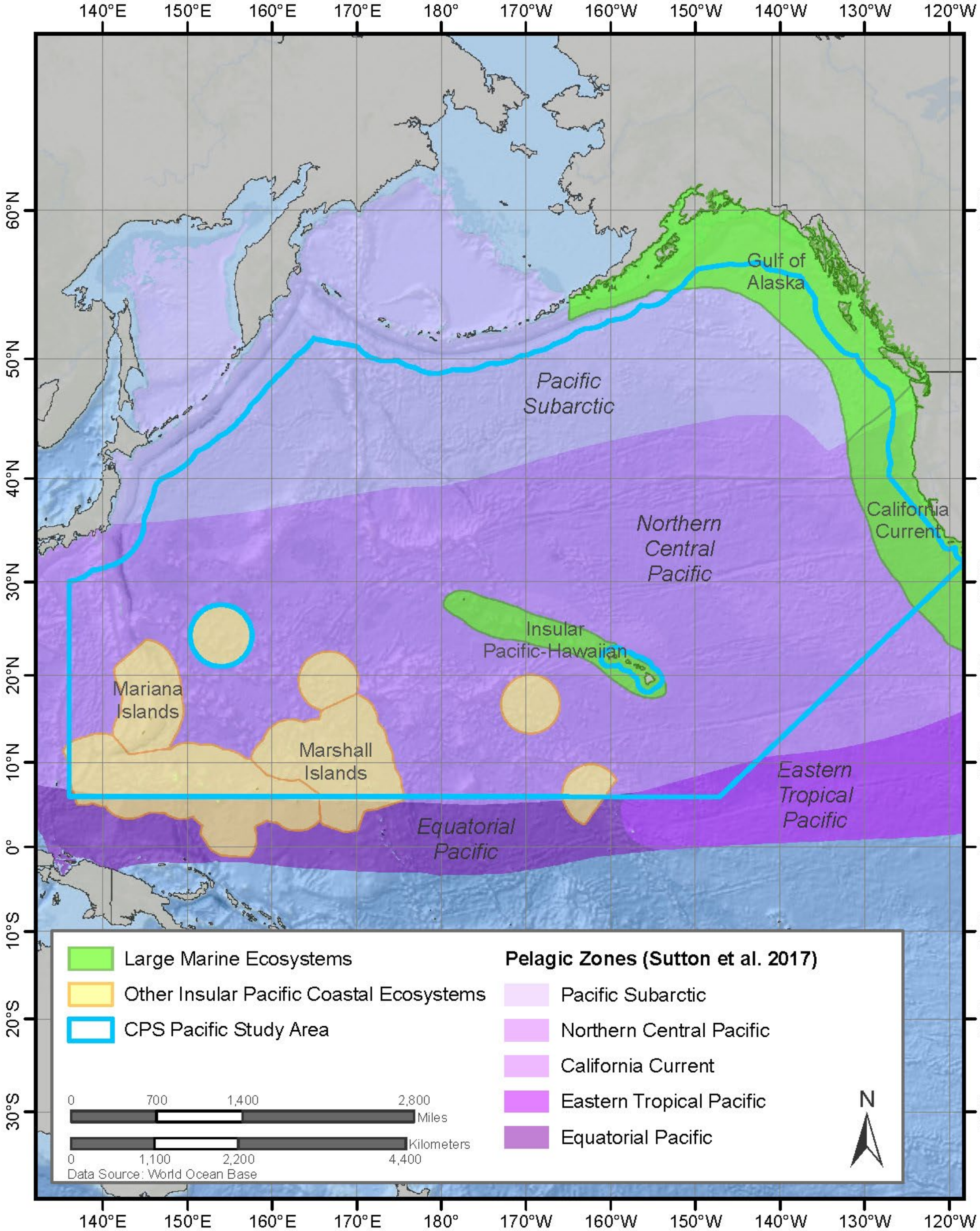


Figure 8. Ecoregions for Classifying Species Presence in the Pacific Study Area

3.1.1 Marine Mammals

ESA-listed marine mammals in the Action Area include seven species of baleen whales, sperm whales (*Physeter macrocephalus*), the Main Hawaiian Islands Insular DPS of false killer whale (*Pseudorca crassidens*), and three pinniped species (**Table 5**). The best available information on populations size for marine mammal stocks in the United States portions of the Action Area can be found in the most recent Marine Mammal Stock Assessment Reports (NOAA 2023d) and are incorporated here by reference. The best available density data for ESA-listed marine mammals in the BOA of the Action Area comes from the Navy's marine species density models developed for training and testing areas in the Atlantic (Roberts et al. 2023, DON 2017c) and the Pacific (DON 2017b, DON 2018c, DON 2014, Rone et al. 2017) as described in **Section 4.0**, *Effects of the Proposed Action*.

Marine mammal species diversity and density are higher in shelf waters of the Action Area (within areas classified as coastal or Large Marine Ecosystems) and a number of Biologically Important Areas for cetaceans occur in continental shelf waters (Harrison et al. 2023, Ferguson et al. 2015). As with other marine wildlife, marine mammal density and distribution shift seasonally. Most baleen whales are highly migratory, tracking the distribution of high-density prey items, while other cetaceans have primarily resident populations with relatively small seasonal shifts in density (DON 2018a). Pinnipeds are primarily coastal in distribution. Individuals of the ESA-listed species in the Action Area also occur further offshore in continental shelf waters (DON 2018a) but are less likely to occur in deeper, open ocean portions of the Action Area.

Biologically Important Areas and designated critical habitat for several ESA-listed cetaceans occur in or near the Action Area (see **Figure 9**). These cetacean Biologically Important Areas are areas identified by the NOAA Cetacean Density and Distribution Mapping Working Group as important feeding, reproductive, or migratory areas for cetaceans (Harrison et al. 2023, Ferguson et al. 2015). While Biologically Important Areas have no regulatory protections or requirements, these areas have been developed using the best available data regarding species distributions, movement patterns, and abundance and therefore indicate especially important or high-use areas for these species. The Action Area for launch-related activities on the U.S. East Coast overlaps Biologically Important Areas for sei whale (*Balaenoptera borealis*) feeding and North Atlantic right whale (*Eubalaena glacialis*) migration (see **Figure 9**). In the Pacific BOA, Biologically Important Areas for gray whale (*Eschrichtius robustus*) feeding and migration, blue whale (*Balaenoptera musculus*) feeding, and humpback whale feeding occur near the Action Area offshore of California. Designated critical habitats for marine mammals in the Action Area are described in **Section 3.2**.

General threats to marine mammal species in the Action Area include ingestion of marine debris, entanglement in fishing nets or other marine debris, collision with vessels, loss of prey species due to new seasonal shifts in prey species or overfishing, excessive noise above baseline levels in a given area, disturbance from whale watching activities, chemical and physical pollution of the marine environment, parasites and diseases, and changing sea surface temperatures due to global climate change (NOAA 2023a). There is increasing evidence that loud underwater noise can be lethal, physically damaging, or disruptive to cetaceans (NOAA

2023a, Miller 2023). Increased anthropogenic noise in the ocean can alter the normal vocalizations or communication patterns in marine mammals and can even increase stress levels, alter feeding or migratory behaviors, or cause animals to leave feeding or mating grounds (NOAA 2023a, Miller 2023). Certain cetaceans are affected by elevated noise levels more than others. Some deep-diving species seem to be particularly susceptible to acoustic damage and anthropogenic noise has been linked to strandings in some species (Miller 2023).

3.1.2 Sea Turtles

Six species of sea turtle occur in the Action Area (**Table 5**). Sea turtles are highly migratory and each sea turtle species and DPS in the Action Area has unique life history characteristics which result in different patterns of distribution and abundance in the open ocean. For many sea turtle species, hatchlings and early juveniles are largely pelagic (Dutton et al. 2008, USFWS and NMFS 2013a, Musick and Limpus 1997). While older juveniles and adults of many species (i.e., green, hawksbill, loggerhead, olive ridley, Kemp's ridley) are mainly found in nearshore habitats, these species likely occur in the open ocean during foraging, developmental, and/or reproductive migrations (DON 2017a, USFWS and NMFS 2013a, Godley et al. 2003, Polovina et al. 2004; Putman et al. 2013). Green turtles (*Chelonia mydas*) spend much of their time resting and foraging in shallow, nearshore waters; however, after hatching, juveniles are pelagic, and adults are also known to migrate through deeper waters (DON 2017c, DON 2018a). Hawksbill turtle (*Eretmochelys imbricata*) hatchlings and small juveniles live in the open ocean where water depths are greater than 200 m (656 ft) before settling into nearshore coral reef habitats as older juveniles (USFWS and NMFS 2013a). Similarly, loggerhead turtle (*Caretta caretta*) hatchlings and early juveniles live in the open ocean, often associating with mats of *Sargassum*, before moving to nearshore foraging habitats close to their birth area (DON 2018a, Musick and Limpus 1997). Leatherback turtles occur mostly in the open ocean and are only occasionally found in coastal areas. While hatchling distribution is likely determined by passive drift, juveniles begin to actively swim toward warmer latitudes during winter and higher latitudes during spring (USFWS and NMFS 2013b). Olive ridley turtles (*Lepidochelys olivacea*) are mainly pelagic but may live in coastal habitats, especially during breeding migrations (NOAA 2023a). Adult Kemp's ridley turtles (*Lepidochelys kempii*) occur in nearshore habitats, but hatchling and juvenile turtles may occur further from shore and are associated with *Sargassum* habitats (NOAA 2023a, DON 2018a).

The primary threats to sea turtles in the Action Area include bycatch in commercial fisheries, ship strikes, and marine debris (Lutcavage et al. 1997). One comprehensive study estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al. 2010). Precise data are lacking for sea turtle deaths directly caused by ship strikes; however, live and dead turtles are often found with deep cuts and fractures indicative of a collision with a boat hull or propeller (Hazel et al. 2007, Lutcavage et al. 1997). Marine debris can also be a problem for sea turtles through entanglement or ingestion. Sea turtles can mistake debris for prey; one study found 37% of dead leatherbacks to have ingested various types of plastic (Mrosovsky et al. 2009). In another study of loggerhead turtles in the north Atlantic, 83% (n = 24) of juvenile turtles were found to have ingested plastic marine debris (Pham et al. 2017). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown turtles in all life stages. Aquatic degradation issues, such as poor water quality and invasive species, can alter ecosystems, limit food availability, and decrease survival rates. Environmental degradation can also increase susceptibility to diseases, such as fibropapillomatosis, a debilitating tumor-forming disease that primarily affects green turtles (Santos et al. 2010). Sea turtles' long life expectancy and site fidelity may make them vulnerable to chronic exposure to marine contaminants (Bruno et al. 2021). Sea turtles may also be vulnerable to the bioaccumulation of heavy metals in their tissues (Bruno et al. 2021).

3.1.3 Fishes

Several DPSs and ESUs of 11 ESA-listed species of fish have the potential to occur in the Action Area (**Table 5**). Many of the listed fish species that have the potential to occur in the Action Area are only likely to occur in coastal waters of the Action Area during the marine phase of their life cycles. Only the oceanic whitetip shark (*Carcharhinus longimanus*), oceanic giant manta ray (*Mobula birostris*, formerly *Manta birostris*), and scalloped hammerhead shark (*Sphyrna lewini*) are considered likely to occur in the open ocean portion of the Action Area (beyond 370 km [200 nm] from land).

The ESUs and DPSs of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), Atlantic salmon (*Salmo salar*), smalltooth sawfish (*Pristis pectinata*), chum salmon (*Oncorhynchus keta*), coho salmon (*Oncorhynchus kisutch*), chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*Oncorhynchus nerka*), and steelhead trout (*Oncorhynchus mykiss*) may occur in coastal waters of the Action Area where launch-related activities may occur. Fish from these ESA-listed DPSs and ESUs are either unlikely to occur in the Action Area or would occur there in very low densities seasonally. Atlantic sturgeon are anadromous fish that spawn in freshwater rivers on the east coast of North America but spend most of their adult life in marine habitats (ASSRT 2007). After leaving natal estuarine habitats, subadults move into coastal habitats where subadults and adults undertake long and short-distance migrations, moving among coastal and estuarine habitats (ASSRT 2007). Adults and subadults are primarily captured in shallow, nearshore waters 10 to 50 m (33 to 164 ft) deep but are occasionally found in deeper offshore shelf waters (Dunton et al. 2015, Dunton et al. 2010, ASSRT 2007). Smalltooth sawfish are primarily estuarine and coastal in distribution. Smaller juveniles inhabiting estuarine or nearshore coastal waters would not be within the Action Area; however, larger juveniles and adults can be found in deeper shelf waters (up to 76 m or 600 ft) (NMFS 2018). The primary range of Gulf of Maine DPS Atlantic salmon occurs north of the Action Area. These fish are unlikely to occur in the Action Area and would be found at very low densities if they did occur there. All ESA-listed salmon and steelhead ESUs and DPSs that occur in the Pacific BOA only have the potential to occur in the Action Area seasonally and at very low densities. During their marine phase, chum, coho, and chinook salmon are more commonly found in coastal and inland waters than further offshore (Echave et al. 2012, Quinn and Myers 2005, Myers et al. 2005). Sockeye salmon and steelhead are more commonly found in deeper offshore waters during their marine phase (Quinn and Myers 2005). Sockeye salmon tend to migrate along the continental shelf and tend to move further offshore to the open ocean as they grow larger (Quinn and Myers 2005). Steelhead are known to migrate longer distances offshore into the open ocean than many of the other salmonid species and may range across almost the entire North Pacific (Quinn and Myers 2005). However, steelhead from ESA-listed DPSs would still be very rare in the Action Area.

The oceanic whitetip shark is a highly migratory species and is one of the most widespread shark species in tropical and subtropical waters of the world (Young et al. 2018). While these sharks may occasionally be found in coastal waters, oceanic whitetip sharks are usually found far offshore in the open ocean, on the outer continental shelf, or around oceanic islands in deeper waters (Young et al. 2018). No estimates are available for population size and density of this species in the Action Area, but populations have undergone substantial declines throughout the species' range (Young et al. 2018). The primary threats to oceanic whitetip sharks are commercial fishing and bycatch-related mortality (Young et al. 2018).

The giant manta ray is commonly sighted along productive coastlines with upwelling but primarily occurs near offshore pinnacles and seamounts (Marshall et al. 2022). This species is thought to spend the majority of its time in deep water with occasional visits to coastal areas (Defenders of Wildlife 2015). While oceanic giant manta rays are known to occur in the Action Area, densities, distributions, and migratory patterns are poorly known. Globally, giant manta rays have decreasing population numbers (Marshall et al. 2022). The most significant threats to the giant manta ray are both targeted and bycatch fishing (Marshall et al. 2022, Miller and Klimovich 2016).

The scalloped hammerhead shark occurs globally in coastal tropical and warm temperate seas (Miller et al. 2014). Individuals from four ESA-listed DPSs may occur in the Action Area (**Table 5**). These sharks primarily occur over continental and insular shelves and occasionally in some adjacent deep waters (Miller et al. 2014). The nearshore waters off the southeastern U.S. coast may provide important nursery habitat for scalloped hammerhead sharks (Miller et al. 2014, Adams and Paperno 2007). Threats include both target and bycatch capture in fisheries as a significant cause of mortality for the species. Scalloped hammerheads are sought for their highly valuable fins and are being increasingly targeted in some areas (DON 2018c).

3.2 Designated Critical Habitat in the Action Area

Designated or proposed critical habitat for one cetacean and three sea turtle species occurs within the Action Area (**Table 5**). Several other ESA-listed species which occur in the Action Area have had critical habitat designated for them; however, those critical habitats do not occur within the proposed Action Area and would not be affected by proposed activities.

3.2.1 Humpback Whale Critical Habitat

Designated critical habitat for both the Central America DPS and the Mexico DPS of humpback whales occurs in the Action Area offshore of the California coast (see **Figure 10**). These designated critical habitat areas include waters which serve as seasonal feeding habitat for these DPSs and contain the essential biological feature of humpback whale prey (86 FR 21082 [21 April 2021]). The physical and biological features essential to the conservation of both humpback whale DPSs are prey species, primarily euphausiids and small pelagic schooling fishes, of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth (86 FR 21082 [21 April 2021]).

3.2.2 Loggerhead Turtle Critical Habitat

Designated critical habitat for the Northwest Atlantic Ocean DPS of loggerhead turtles occurs in the Action Area offshore of the U.S. East Coast (**Figure 9**). There are several designated critical habitat areas for loggerheads in the Atlantic Ocean but the only designated critical habitat in the CPS Action Area is the pelagic *Sargassum* habitat of the loggerhead turtle. This habitat, in the convergence zone area at the margin of the Gulf Stream, allows *Sargassum* growth in concentrations that support adequate prey abundance and cover for young loggerhead turtles (NMFS 2014). The primary constituent elements of this habitat are (1) convergence zones and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerheads; (2) *Sargassum* in concentrations that support adequate prey abundance and cover; (3) available prey associated with *Sargassum* habitat including plants, cyanobacteria, and animals such as hydroids and copepods; and (4) sufficient water depth (greater than 10 m [34 ft]) and proximity to available currents to ensure offshore transport, and foraging and cover requirements for post-hatchling loggerheads (NMFS 2014).

3.2.3 Green Turtle Critical Habitat

Proposed critical habitat for the North Atlantic DPS of green turtles occurs in the Action Area offshore of the U.S. East Coast (**Figure 9**). Critical habitat for green turtles was proposed for designation by both the USFWS (88 FR 46376 [19 July 2023]) and NMFS (88 FR 46572 [19 July 2023]) in July 2023. The only proposed critical habitat for green turtles that occurs within the Action Area is the proposed *Sargassum* critical habitat for the North Atlantic DPS. This proposed critical habitat contains the *Sargassum*-dominated drift community which contains surface-pelagic foraging/resting essential features for turtles. The essential physical and biological features of the proposed *Sargassum* critical habitat are that it provides sufficient food resources and refugia in waters greater than 10 m (34 ft) deep to support survival, growth, and development of post-hatchling and juvenile turtles as well as the currents which carry turtles to *Sargassum*-dominated drift communities (88 FR 46572). Within the Action Area, this proposed critical habitat is essentially the same area designated as loggerhead sea turtle critical habitat (**Figure 9**) since post-hatchling and surface-pelagic juvenile green turtles occupy the same *Sargassum* habitat as loggerhead turtles (see **Section 3.2.2**).

3.2.4 Leatherback Turtle Critical Habitat

Designated critical habitat for leatherback turtles occurs in the Action Area offshore of the California coast (**Figure 10**). This designated critical habitat includes waters from the surface down to a maximum of 80 m (262 ft) and from the shoreline out to the 3,000 m (9,840 ft) depth contour (77 FR 4170 [January 26, 2012]). The primary constituent element essential for conservation of leatherback sea turtles identified in the final rule is “the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (e.g., *Chrysaora*, *Aurelia*, *Phacellophora*, and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks” (77 FR 4170 [January 26, 2012]).

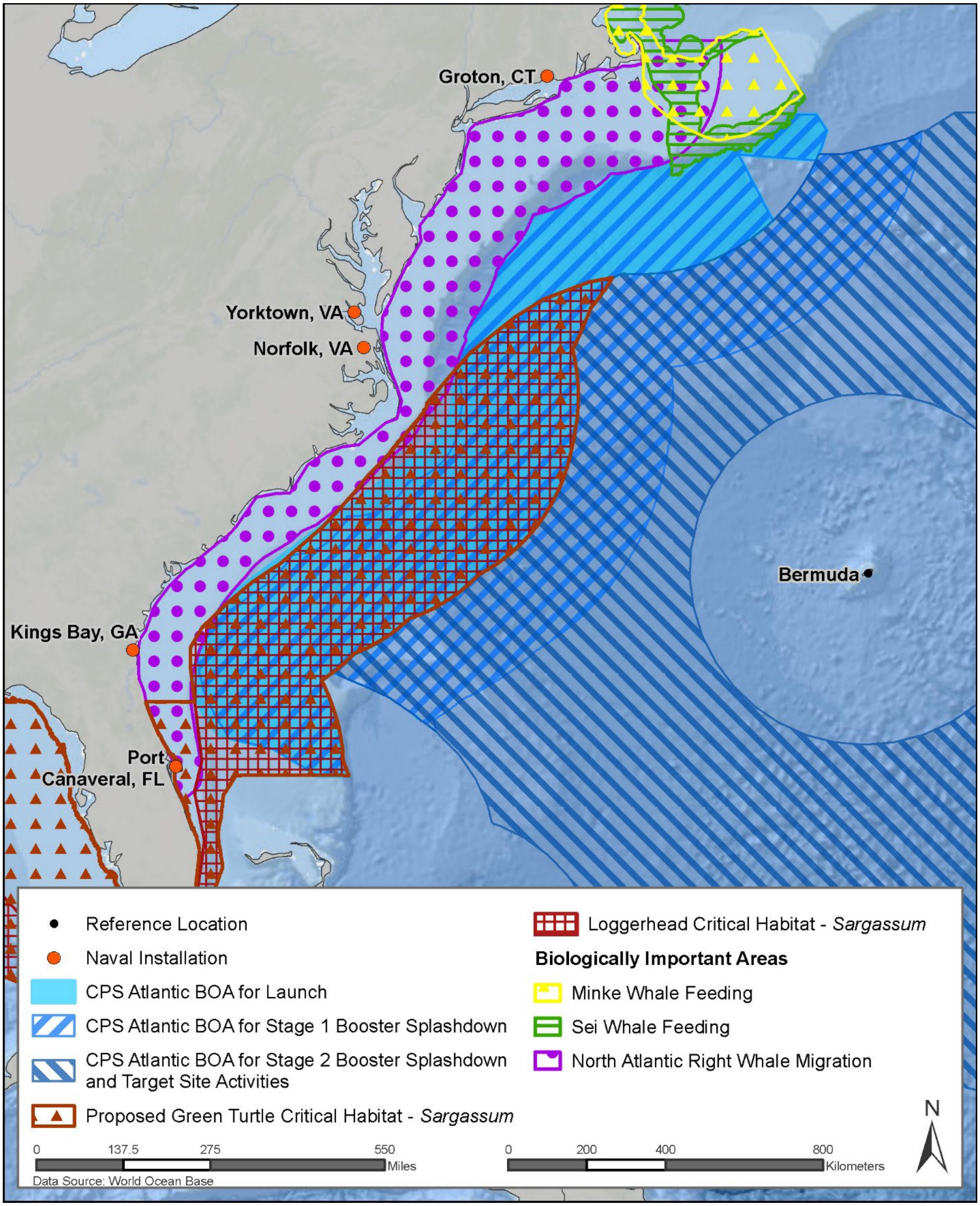


Figure 9. Designated and Proposed Critical Habitat and Biologically Important Areas in the Atlantic BOA Action Area

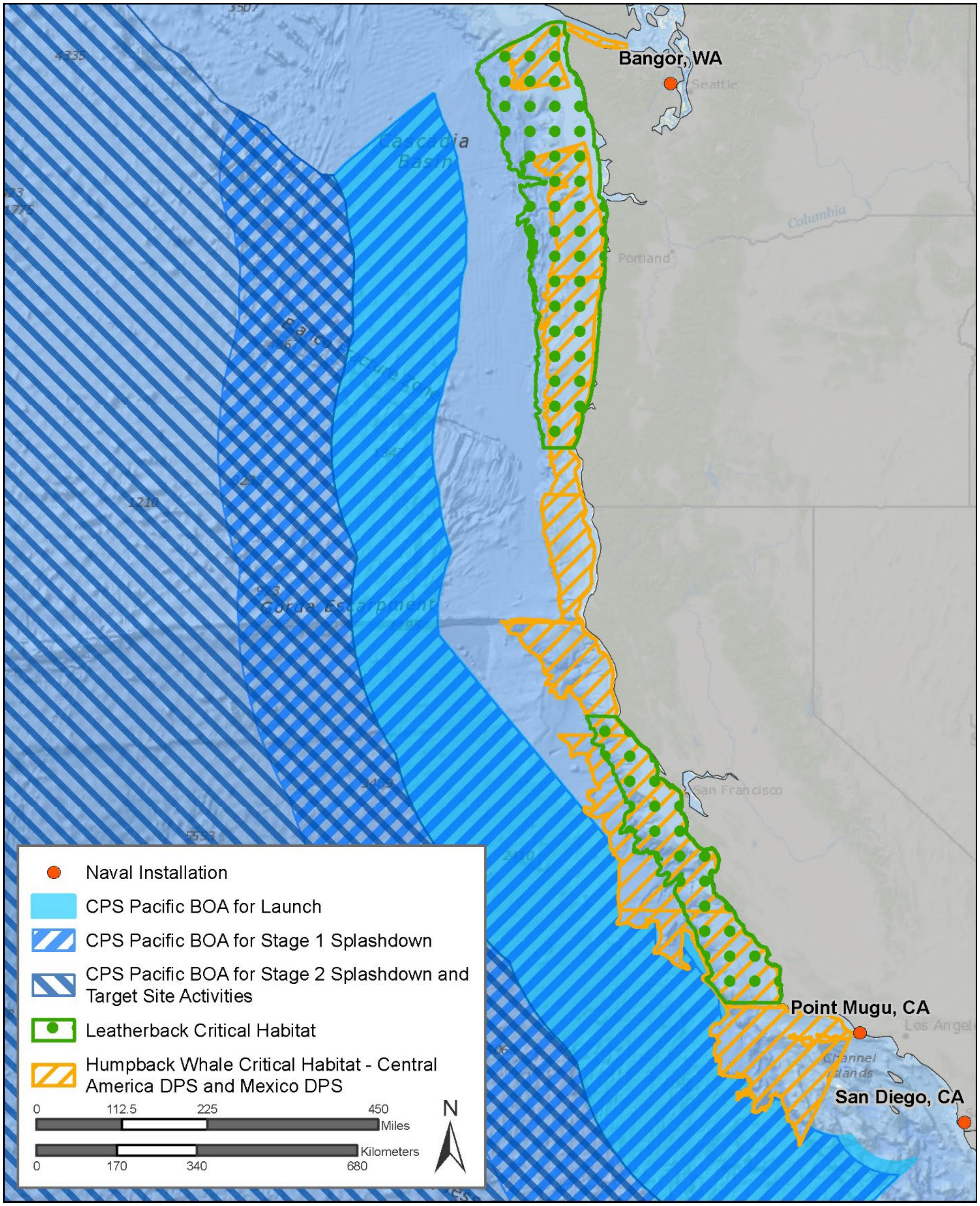


Figure 10. Designated Critical Habitat in the Pacific BOA Action Area

4.0 Effects of the Proposed Action

This section describes how the Proposed Action has the potential to directly or indirectly affect listed species, their habitats, and designated critical habitats. Direct effects are the immediate effects of the Proposed Action on species, their habitats, or designated critical habitat. Indirect effects are effects of the Proposed Action which occur at a later point in time. The following describes the elements of the Proposed Action that may act as stressors on ESA-listed species and critical habitats and provides an analysis of the effects of those stressors on those species or habitats. Many of the stressors for the Proposed Action are of the same type and magnitude as other recent flight test programs; therefore, portions of the Flight Experiment-2 Biological Assessment (DON 2019), the Ground Based Strategic Deterrent Biological Assessment (U.S. Air Force 2020), the Joint Flight Campaign Biological Evaluations (DON and U.S. Army 2021, DON and U.S. Army 2023) and the NMFS Biological Opinions and Letters of Concurrence on those actions (NMFS 2019, NMFS 2021a, NMFS 2021b) are excerpted and used in this document where relevant.

The Proposed Action has the potential to directly or indirectly affect ESA-listed marine species and their habitats due to exposure to elevated sound levels, direct contact, exposure to hazardous materials, and collision with vessels. The potential stressors, stressor sources, stressor location within the Action Area, and stressor descriptions and assumptions are summarized in **Table 6** and described in this section. The effects of the Proposed Action stressors are evaluated for each species or for a group of species (e.g., cetaceans) where the potential effects are expected to be essentially identical for all species within a group.

Table 6. Stressors Resulting from Proposed Navy CPS Flight Test Activities in the BOA

Stressor and Sources	Description of Stressor in the Action Area by Location (see Figures 4 and 5 for location maps)		
	BOA for Vehicle Launch	BOA for Stage 1 Booster Splashdown	BOA for Stage 2 Booster Splashdown and Payload Impact
Frequency of Flight Tests			
Number of Tests	Up to eight flight tests per year between Fiscal Years 2025 and 2035 (10 years)		
Elevated Sound Pressure Levels			
Vehicle Launch	Maximum sound pressures in water (re 1 μPa): • 176 dB at 15 m from launch, duration less than 1 second • 160 dB at 91 m from launch, duration less than 2 seconds • 150 dB at 290 m from launch, duration less than 3 seconds	None	None
Sonic Booms	Maximum sound pressures up to 135 dB in-water (re 1 μPa) at the surface for vehicle flight. Average sound pressures for vehicle flight 130 dB in-water. Duration approximately 0.27 second.		Maximum sound pressure up to 175 dB in-water (re 1 μPa) at the surface near point of payload impact. Duration 0.08 second for loudest sounds and 0.27 second for weakest sonic boom.

Stressor and Sources	Description of Stressor in the Action Area by Location (see Figures 4 and 5 for location maps)		
	BOA for Vehicle Launch	**BOA for Stage 1 Booster Splashdown**	**BOA for Stage 2 Booster Splashdown and Payload Impact**
Elevated Sound Pressure Levels Continued			
Booster Splashdown	None	Estimated maximum of 218 dB in-water (re 1 µPa) for stage 1 booster. Duration on the order of a few seconds.	Estimated maximum of 201 dB in-water (re 1 µPa) for stage 2 booster. Duration on the order of a few seconds.
Payload Impact	None	None	Estimated maximum of up to 191 dB in-water (re 1 µPa) at the surface. Duration on the order of a few seconds.
Vessel Activity	Estimated to range from 150 to 190 dB re 1 µPa for operational launch platform and support vessels.		Estimated operational noise of sensor and target rafts with trolling motors less than 140 dB re 1 µPa.
Direct Contact			
Test Components	None	One spent booster splash down or impact in the ocean. Approximate dimensions: • Stage 1= 5 m long x 1 m diameter	One spent booster and the payload would splash down or impact in the ocean. Approximate dimensions: • Stage 2 = 2 m long x 1 m diameter • Payload = 3 m long x 1 m diameter • Payload debris area estimated to be no more than land debris dispersion area (less than 91 m from point of impact).
Hazardous Materials			
Chemicals or Debris from Test Components	None	Introduction of launch vehicle and payload materials into deep ocean waters, including rocket motors, unused propellant, battery electrolytes, residual explosives, and heavy metals. Components and materials expected to sink to the bottom or rapidly dilute. Floating visible debris at payload impact site would be cleaned up to the extent practicable post-test.	
Chemicals or Waste from Support Equipment	Potential for accidental spills or leaks from launch platform and support vessels. Vessel operations would not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes.		Target and sensor raft operations would not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes.

Stressor and Sources	Description of Stressor in the Action Area by Location (see Figures 4 and 5 for location maps)		
	BOA for Vehicle Launch	BOA for Stage 1 Booster Splashdown	BOA for Stage 2 Booster Splashdown and Payload Impact
Vessel Movement			
Vessel Movement	Launch platform ship operation on route to launch site. Support ship operation for sensor coverage.	Support ship operation for sensor coverage and post-test operations.	Support ship operation for sensor coverage and post-test operations. Operation of target raft and up to 12 self-stationing sensor rafts with small trolling motors, deployed near the target site from a support ship and recovered post-test.

Abbreviations: BOA = broad ocean area, dB = decibels, m = meter(s), re = referenced to, μPa = micropascal

4.1 Exposure to Elevated Sound Levels

4.1.1 Sources of Elevated Sound Levels

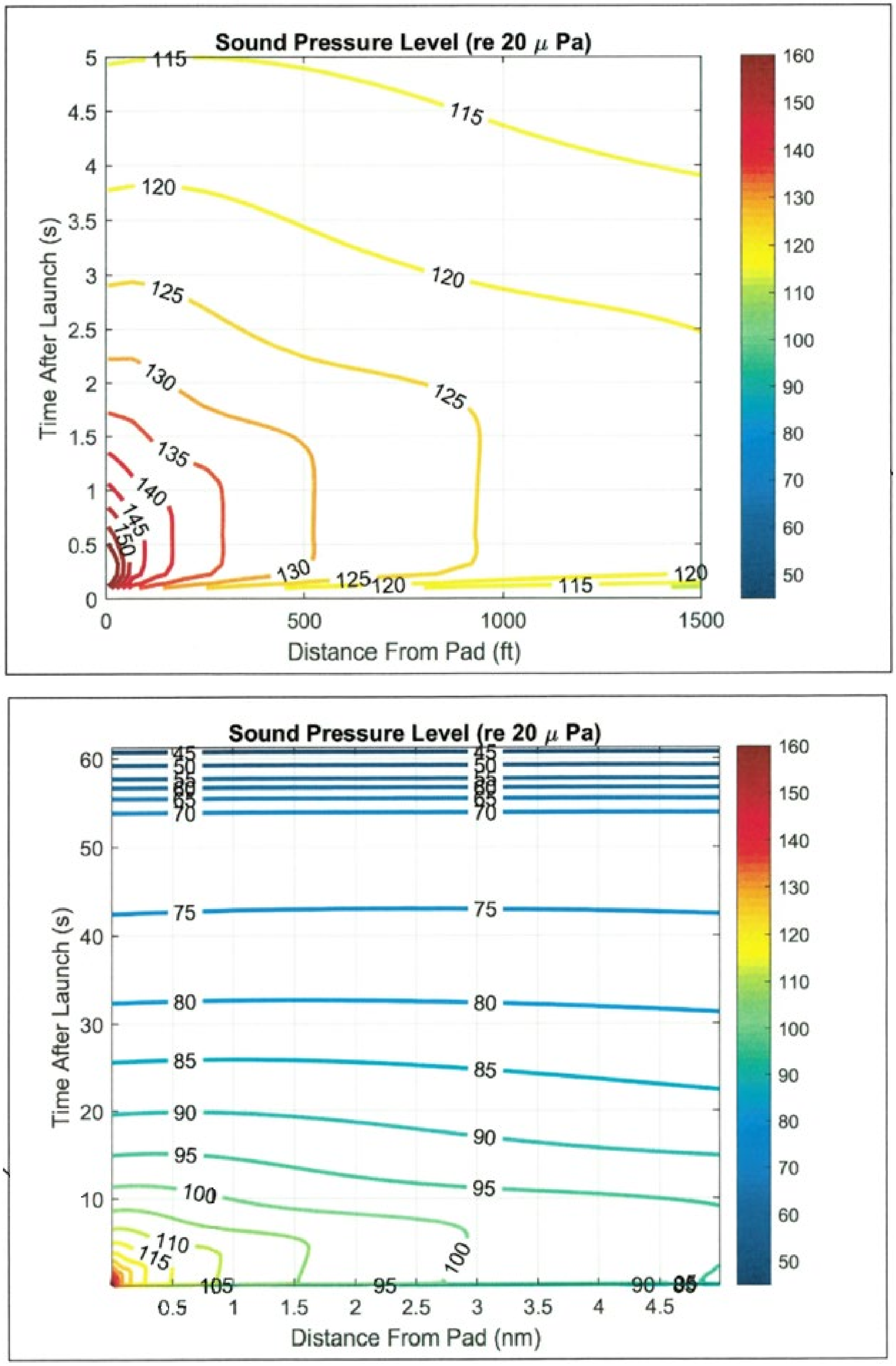
The Proposed Action may result in elevated noise levels both in-air and underwater due to vehicle launch, due to sonic booms from vehicle overflight, as a result of CPS vehicle component splashdown, as a result of payload impact, and due to vessel operations.

Vehicle Launch

The CPS AUR would be launched from a Navy surface or sub-surface firing platform at sea. Empirical data on sound pressures generated during CPS vehicle launch have not yet been collected, but modeling indicates that initial liftoff of the launch vehicle would be within the envelope of sound pressures evaluated for Joint Flight Campaign vehicle launches (DON and U.S. Army 2021). Based on the expected characteristics of CPS AUR launch, modeled Joint Flight Campaign launch sound pressures at surface level are used as conservative (high) estimates of CPS launch sound pressures which might occur in ocean waters. Peak sound pressures for CPS AUR launch (either surface or subsurface launch) are estimated to be 176 decibels (dB) in water (referenced to 1 micropascal [re 1 μPa]) at the surface or launch location and would last less than a second. This is based on the Joint Flight Campaign estimated in-air sound pressures (**Figure 11**) (Kahle et al. 2021) and the characteristics of a CPS AUR launch. After launch, the vehicle would ascend quickly and in water sound pressures would be expected to decrease quickly, remaining above 150 dB in water for less than 4 seconds (**Figure 11**) (Kahle et al. 2021). The Joint Flight Campaign launch acoustics model used several conservative assumptions and did not account for atmospheric absorption, ground interference, atmospheric conditions (Kahle et al. 2021), or any attenuation at the air-water interface; therefore, these sound pressure estimates should be considered maximum possible sound pressures from CPS vehicle launch.

Sonic Booms

The CPS AUR vehicle would fly at speeds sufficient to generate sonic booms from close to launch and extending to payload impact in the BOAs. Sonic booms create elevated pressure levels both in the air and underwater. No model estimates are available for sonic boom



Source: Figures from Kahle et al. 2021; Note: Modeled sound pressure in figure are in-air (re 20 μPa) at the surface.

Figure 11. Modeled Maximum Sound Pressure Levels and Duration for Navy CPS Launches

footprints resulting from Navy CPS flight, but similar to other recent flight tests (DON 2019, DON and U.S. Army 2021), sonic booms are expected to average 130 dB in-water (re 1 μPa) at the surface for most of the vehicle flight and last no more than 270 milliseconds. Maximum sound levels from sonic booms for vehicle flight are expected to be 135 dB re 1 μPa (DON 2019). Sonic booms generated by the payload near impact may be up to 175 dB re 1 μPa near the impact point and last approximately 75 milliseconds (DON 2019).

Booster Splashdown Noise

No model estimates of noise levels are available for splashdown of Navy CPS vehicle components; however, the expected sound pressure levels are expected to be similar to other recent flight tests (DON and U.S. Army 2021, DON 2019), depending on vehicle component size. Therefore, the peak noise levels for CPS booster splashdown have been estimated based on the size characteristics of the vehicle components compared to the component sizes for other test vehicles for which splashdown noise estimates are available (DON 2019). Using peak sound pressure estimates for the largest Navy Flight Experiment-2 stage (approximately 1.4 times bigger than CPS AUR stage 1) for the stage 1 booster and the smallest Flight Experiment-2 stage (approximately the same size as CPS AUR stage 2) for the stage 2 booster, the peak sound pressures are expected to be less than 218 dB in-water (re 1 μPa) at the point of stage 1 booster splashdown and 201 dB re 1 μPa for the stage 2 booster (DON 2019). The sound pressures would decrease with water depth and distance from the point of component splashdown.

Payload Impact Noise

No Navy CPS-specific model estimates of noise levels are available for payload impact; therefore, the peak noise levels estimated for other similar test payloads are used as a bounding case for CPS flight tests. Estimated sound levels for impact of the Flight Experiment-2 payload (DON 2019) are used as a bounding case for the CPS payload. Sound pressures from payload impact are expected to be less than 191 dB in-water (re 1 μPa) at the point of payload impact at ocean surface and would last no more than a few seconds. The sound pressures would decrease with water depth and distance from the point of payload impact.

Vessel Noise

Vessels would be used to transport equipment and personnel to the launch and target sites, for sensor coverage, to deploy sensor and target rafts, to recover sensor and target rafts, and for post-test cleanup activities. The Proposed Action would involve vessel movement in the BOAs for up to 4 weeks for each flight test including the following:

- Operation of surface ships and submarines as sea-based launch platforms.
- Operation of two to three support ships for downrange sensor coverage.
- Operation of a support ship and smaller watercraft for downrange target placement, clean-up activities, and recovery operations.

All Navy vessels used as part of proposed activities would operate in accordance with applicable Navy policies and with implementation of a number of standard operating procedures and mitigation measures, many of which were established for typical Navy at-sea training and testing operations (see **Section 2.2**). These standard operating procedures and mitigation measures include lookouts for marine mammals and sea turtles as summarized in **Section 2.2**. NMFS estimates that large vessels can create sounds ranging from 170–190 dB (re 1 μPa) and sounds from smaller vessels would range from 150–170 dB (re 1 μPa) (NMFS 2019).

The Proposed Action would also involve sensor and target raft operation at a BOA target site for several hours for each flight test. Proposed activities would include deployment and operation of a target raft and up to 12 self-stationing instrumented rafts around the targeted site for sensor coverage and data collection. No anchoring systems would be used for self-stationing rafts. It is estimated that the small trolling motors used for raft operations would generate sounds no louder than 140 dB (re 1 μPa).

4.1.2 Effects of Elevated Sound Levels on Listed Species

Noise has the potential to affect the behavior and hearing sensitivity of marine mammals and fish. Loud sounds might cause these organisms to quickly react, altering their normal behavior either briefly or more long term or may even cause physical injury. The extent of the effect depends on the frequency and intensity of the sound as well as on the hearing ability of the animal and its distance from the noise source. The species considered in this document have varying hearing abilities and thresholds for effects, which have been detailed in several documents including the Flight Experiment-2 Biological Assessment (DON 2019), NMFS Biological Opinion for Flight Experiment-2 (NMFS 2019), and NMFS Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NOAA 2018, NMFS 2023). The detailed descriptions of general sound characteristics and species effect thresholds in these documents are incorporated here by reference. The marine noise effect thresholds for species included in this evaluation are summarized in **Table 7**.

In general, a sound level that is sufficient to cause physical injury to auditory receptors is a sound that exceeds an organism's permanent threshold shift (PTS) level. The extent of physical injury depends on the received sound pressure level as well as the anatomy of each species. A temporary threshold shift (TTS) is when an organism is exposed to sound pressures below the threshold of permanent physical injury but loud enough to result in temporary hearing alteration. Sound levels above the TTS threshold have the potential to temporarily impair an animal's ability to communicate, navigate, forage, and detect predators.

Table 7. Maximum Underwater Radial Distance to Elevated Sound Pressure Level Effect Thresholds and Estimated Area of Potential Effect for ESA-Listed Species

Functional Hearing Group	Effect Category	Effect Threshold Criterion (re 1 μPa)	Radial Distance to Effect Threshold				Area of Potential Effect			
			Vehicle Launch	Stage 1 Booster Splashdown	Stage 2 Booster Splashdown	Payload Impact	Vehicle Launch	Stage 1 Booster Splashdown	Stage 2 Booster Splashdown	Payload Impact
Low Frequency Cetaceans (*Balaenoptera*, *Eschrichtius*, *Eubalaena*, and *Megaptera* whales)	PTS (non-lethal injury)	219 dB_{peak}	-	-	-	-	-	-	-	-
	TTS	213 dB_{peak}	-	1.8 m	-	-	-	0.00001 km^2	-	-
Mid Frequency Cetaceans (*Physeter* and *Pseudorca* whales)	PTS (non-lethal injury)	230 dB_{peak}	-	-	-	-	-	-	-	-
	TTS	224 dB_{peak}	-	-	-	-	-	-	-	-
Phocid Pinnipeds (monk seals)	PTS (non-lethal injury)	218 dB_{peak}	-	-	-	-	-	-	-	-
	TTS	212 dB_{peak}	-	2.0 m	-	-	-	0.00001 km^2	-	-
Otariid Pinnipeds (fur seals and sea lions)	PTS (non-lethal injury)	232 dB_{peak}	-	-	-	-	-	-	-	-
	TTS	226 dB_{peak}	-	-	-	-	-	-	-	-
All Marine Mammals	Behavioral Disturbance	160 dB_{RMS}	6.3 m	794 m	112 m	35.5 m	0.0001 km^2	2.0 km^2	0.04 km^2	0.004 km^2
Sea Turtles	PTS (non-lethal injury)	232 dB_{peak}	-	-	-	-	-	-	-	-
	TTS	226 dB_{peak}	-	-	-	-	-	-	-	-
	Behavioral Disturbance	175 dB_{RMS}	1.1 m	141 m	20 m	6.3 m	0.000004 km^2	0.06 km^2	0.001 km^2	0.0001 km^2
Fishes [1]	Physical Injury	206 dB_{peak}	-	4.0 m	-	-	-	0.00005 km^2	-	-
	Behavioral Disturbance	150 dB_{RMS}	19.9 m	2,512 m	355 m	112 m	0.001 km^2	19.8 km^2	0.4 km^2	0.04 km^2

Sources: NMFS 2023, DON 2019, NMFS 2019, NOAA 2018, Finneran and Jenkins 2012, Popper et al. 2014

Notes: Effect thresholds listed are for impulsive sounds.

1 The physical injury threshold for fishes is not specific to auditory injury.

Abbreviations: μPa = micropascals, dB = decibels, km = kilometers, m = meters, PTS = Permanent Threshold Shift, SEL = Sound Exposure Level, RMS = root mean squared, SPL = Sound Pressure Level, TTS = Temporary Threshold Shift, "-" = sound pressures would not exceed effect threshold criterion

Another common effect of elevated sound levels is behavioral modification. For marine mammals, behavioral responses may include changes in surfacing, breathing patterns, dive duration, vocalization, feeding, travel, and group composition but tend to be highly variable (NRC 2005, Gomez et al. 2016). Marine mammal behavioral responses to anthropogenic sounds depend on many factors including the received levels of sound, an animal's functional hearing group, the source of the sound, the frequency of sounds received, environmental factors, and on the individual animal exposed (Erbe et al. 2018, Southall et al. 2007, NRC 2005, Gomez et al. 2016). Realized behavioral responses can vary from minor temporary reactions like altering vocalization or small movements (Erbe et al. 2018, NRC 2005), to larger responses such as longer-term abandonment of normal behaviors or habitat use. Some studies divide behavioral response into severity groups which can be generalized as minor/brief responses (i.e., brief to prolonged orientation response or responses unlikely to affect vital rates), moderate effect potential (i.e., higher potential to affect vital rates, foraging, reproduction, or survival), and high effect potential (i.e., likely to affect vital rates, foraging, reproduction, or survival) (Southall et al. 2007, Miller et al. 2012, Gomez et al. 2016). Sounds that have a moderate to high behavioral effect potential might have a biologically significant effect on animals as they are more likely to keep an animal from growing, surviving, or reproducing (NRC 2005, Erbe et al. 2018).

Analysis Methodology

For each marine functional hearing group, the range to potential effect was calculated for Proposed Action noise sources where the maximum expected sound pressure exceeded injury or behavioral effect thresholds (**Table 7**). The range to potential effect was calculated using a spherical spreading model:

$$Range\ to\ Threshold\ (m) = 10\verb|^|\left(\frac{dB_{source} - dB_{threshold}}{x}\right)$$

where x is the spreading coefficient (x=20 for deep ocean waters and x=15 for shallow waters), and sound pressure levels are in dB_{peak} re 1μPa. The distance to potential effect from CPS launch, booster splashdown, and payload impact are detailed in **Table 7** for each functional hearing group of animals. This is a simplified and conservative approach, as it does not account for differential sound attenuation at the air-water interface or due to ocean conditions such as water depth, temperature, salinity, or stratification, and likely represents the maximum area where pressures would be above respective effect thresholds. The potential affect area was then calculated for each relevant threshold using the formula:

$$Affect\ Area\ (km^2) = \pi(Range\ to\ Threshold)^2$$

The number of animal exposures to sound pressures above the relevant potential effect thresholds (see **Table 7**) for each Proposed Action noise source was calculated based on the best available density information for each species and the affect area.

Species densities in the Action Area were estimated based on the best available scientific data. Species densities were derived primarily from the Navy's marine species density models for at-sea training and testing study areas in the Atlantic and Pacific Oceans, as well as from primary literature sources. While the Navy's modeled marine species density models for naval training and testing study areas do not overlap 100% with CPS BOA Action Areas (see **Figure 1** and **Figure 2**), they are used as the primary source of density information for most marine mammal and sea turtle species since they provide the best available density models incorporating a synthesis of relatively current primary literature sources. The most recent Navy Atlantic Fleet Training and Testing Area models (Roberts et al. 2023, DON 2017c) cover approximately 42% of the Atlantic BOA Action Area. Primary density coverage in the Pacific BOA Action Area comes from the Hawaii-Southern California Training and Testing Area models (DON 2017b), the Mariana Islands Training and Testing Area models (DON 2018c), models for the Gulf of Alaska Training and Testing Area (DON 2014, Rone et al. 2017), and the Training and Testing Area technical report (DON 2015). Where possible, the average density in the areas of model overlap with the Action Area were determined for all modeled months/seasons and the maximum density across months/seasons was used to represent the species density for the entire Action Area. Where it was not possible to calculate the average for an area of overlap, the maximum density within that area was used. These density estimates should be considered maximum density estimates for the Action Area since (1) the maximum density across seasons was used, (2) the maximum density for any location in the Action Area was used for the entire Action Area when species may not be distributed across the entire area, and (3) density estimates apply to species and not specifically to ESA-listed populations. For species without density model coverage in the Navy models or where densities were believed to be substantially different in the areas without model coverage, other primary literature sources were used for analyses.

Reliable density data for fishes in the BOA are largely lacking and in most cases calculations of the estimated number of exposures were not possible for ESA-listed fish species. Where available data did not support quantitative analysis, a qualitative analysis was conducted based on distribution, life history, and abundance relative to ESA-listed species for which densities are available.

The number of animals expected to be exposed to sounds above potential effect thresholds was calculated using the formula:

$$Number\ of\ Animal\ Exposures = \ Affect\ Area\ (km^2) \times Animal\ Density\ \left(\frac{individuals}{km^2}\right)$$

Since the proportion of annual tests (up to eight per year) which would occur in each study area (Atlantic and Pacific) is unknown, it was assumed for analysis purposes that up to eight tests per year could occur in each study area.

Several analysis assumptions lead to conservative or worst-case results and to overestimation of potential effects. These analyses assume that all animals would be at or near the surface 100% of the time and that the animals are stationary. The analyses do not account for animals that spend the majority of their time underwater or for any animal movement. As described above, density estimates used in analyses are maximum density estimates for species across density coverage areas within the Action Area.

Because the frequency spectrum for proposed CPS flight test related noises is unknown or unavailable for these analyses, no auditory weighting functions were used in these analyses. These quantitative analyses also did not incorporate behavioral response functions. Several functional hearing group effect thresholds are defined by root mean square sound pressure levels (**Table 7**). All modeled Proposed Action sound pressure levels are available only in peak decibels and no root mean square decibel estimates are available. Root mean square sound pressure is the average sound pressure across the duration of a sound; therefore, root mean square decibels would by definition be lower than peak decibels for a single impulsive sound (DON 2017c). For these analyses estimated peak decibels for Proposed Action sounds were compared to root mean square effect thresholds, where necessary, as a conservative approach which would lead to an overestimation of potential effects.

Effects of Launch Noise

Launch noise is expected to have discountable effects on ESA-listed species. Expected maximum sound pressures from launch would not exceed the PTS or TTS effect thresholds for any ESA-listed species in the Action Area. Based on species for which reliable density information is available, the calculated number of animal exposures per test to sounds above the potential behavioral disturbance threshold is substantially less than one for all species (**Table 8** and **Table 9**). For example, for the marine mammal species with the highest density in the launch activities BOA (sperm whales in the Atlantic), the expected maximum number of exposures above the behavioral threshold annually (up to eight flight tests per year) would be 0.0005. Even if summed across eight possible tests per year over 10 years, the expected number of exposures is still less than one for all species and the effects would be discountable. For species where calculation of estimated number of exposures was not feasible, especially for fish species, densities are not expected to be higher than those with available densities. These species would be expected to have similarly low chances of exposure above the behavioral disturbance threshold and effects would be discountable.

Effects of Sonic Booms

Sonic booms would have insignificant effects on ESA-listed species in the Action Area. For most of the vehicle’s flight, sonic booms (maximum 135 dB re 1 μPa) would not exceed any injury or behavioral disturbance thresholds for ESA-listed species. Near payload impact, sounds would be louder; however, even at its loudest (175 dB re 1 μPa), the sonic boom would not exceed PTS or TTS effect thresholds for listed species.

Table 8. Annual Maximum Number of Animal Exposures to Elevated Sound Pressure Levels above Effect Thresholds in the Atlantic Study Area

Common Name	Scientific Name	Launch BOA		Stage 1 Booster Splashdown BOA				Stage 2 Splashdown / Payload Impact BOA		
		Density (individuals per km^2)	Behavioral Disturbance Exposures	Density (individuals per km^2)	PTS Exposures	TTS Exposures	Behavioral Disturbance Exposures	Density (individuals per km^2)	TTS Exposures	Behavioral Disturbance Exposures
Cetaceans										
Sei whale	*Balaenoptera borealis*	0.0319	<0.0001	0.0319	-	<0.0001	0.5062	0.0319	-	0.0112
Blue whale	*Balaenoptera musculus*	0.0020	<0.0001	0.0020	-	<0.0001	0.0319	0.0020	-	0.0007
Fin whale	*Balaenoptera physalus*	0.0960	0.0001	0.0685	-	<0.0001	1.0859	0.0123	-	0.0043
North Atlantic right whale	*Eubalaena glacialis*	0.1641	0.0002	0.0151	-	<0.0001	0.2389	0.0005	-	0.0002
Sperm whale	*Physeter macrocephalus*	1.0135	0.0010	0.9559	-	-	15.1560	0.4784	-	0.1684
Sea Turtles										
Hardshell sea turtle guild	*Chelonia mydas* [1] and *Eretmochelys imbricata*	0.3182	<0.0001	0.3182	-	-	0.1596	0.3182	-	0.0035
Loggerhead turtle	*Caretta caretta* [1]	0.4063	<0.0001	0.4063	-	-	0.2037	0.4063	-	0.0045
Leatherback turtle	*Dermochelys coriacea*	0.6371	<0.0001	0.6371	-	-	0.3195	0.6371	-	0.0070
Kemp's ridley turtle	*Lepidochelys kempii*	0.0068	<0.0001	0.0068	-	-	0.0034	0.0068	-	0.0001

Note: Number of exposures based on up to eight flight tests per year in both the Atlantic and Pacific study areas since the proportion of annual test which would take place in each study area is unknown.

[1] Species density for entire species within the Action Area and not specific to listed populations.

Abbreviations: BOA = broad ocean area, km = kilometers, PTS = Permanent Threshold Shift, TTS = Temporary Threshold Shift, "-" = stressor would not exceed effect threshold

Table 9. Annual Maximum Number of Animal Exposures to Elevated Sound Pressure Levels above Effect Thresholds in the Pacific Study Area

Common Name	Scientific Name	Launch BOA		Stage 1 Booster Splashdown BOA				Stage 2 Splashdown / Payload Impact BOA		
		Density (individuals per km^2)	Behavioral Disturbance Exposures	Density (individuals per km^2)	PTS Exposures	TTS Exposures	Behavioral Disturbance Exposures	Density (individuals per km^2)	TTS Exposures	Behavioral Disturbance Exposures
Cetaceans										
Sei whale	*Balaenoptera borealis*	0.0003	<0.0001	0.0003	-	<0.0001	0.0048	0.0003	-	0.0001
Blue whale	*Balaenoptera musculus*	0.0063	<0.0001	0.0063	-	<0.0001	0.0997	0.0014	-	0.0005
Fin whale	*Balaenoptera physalus*	0.0821	0.0001	0.0821	-	<0.0001	1.3023	0.0160	-	0.0056
Gray whale	*Eschrichtius robustus* [1]	<0.0001	<0.0001	<0.0001	-	<0.0001	0.0002	<0.0001	-	<0.0001
North Pacific right whale	*Eubalaena japonica*	<0.0001	<0.0001	<0.0001	-	<0.0001	0.0002	<0.0001	-	<0.0001
Humpback whale	*Megaptera novaeangliae* [1]	0.0203	<0.0001	0.0203	-	<0.0001	0.3218	0.0150	-	0.0028
Sperm whale	*Physeter macrocephalus*	0.0044	<0.0001	0.0150	-	-	0.2382	0.0054	-	0.0053
False killer whale - Main Hawaiian Islands Insular DPS	*Pseudorca crassidens*	0.0006	<0.0001	0.0006	-	--	0.0090			
Pinnipeds										
Guadalupe fur seal	*Arctocephalus townsendi*	0.0628	0.0001	0.0628	-	-	0.9962	0.0628	-	0.0221
Steller sea lion	*Eumetopias jubatus* [1]	0.0098	<0.0001	0.0098	-	-	0.1554	0.0098	-	0.0034
Hawaiian monk seal	*Neomonachus schauinslandi*	<0.0001	<0.0001	<0.0001	-	-	0.0005			
Sea Turtles										
Loggerhead turtle	*Caretta caretta* [1]	0.2400	<0.0001	0.2400	-	-	0.1204	0.0018	-	<0.0001
Green turtle	*Chelonia mydas* [1]	0.0003	<0.0001	0.0003	-	-	0.0001	0.0004	-	<0.0001
Leatherback turtle	*Dermochelys coriacea*	0.0020	<0.0001	0.0020	-	-	0.0010	0.0012	-	<0.0001
Hawksbill turtle	*Eretmochelys imbricata*	0.0001	<0.0001	0.0001	-	-	<0.0001	0.0001	-	<0.0001
Olive ridley turtle	*Lepidochelys olivacea* [1]	0.0018	<0.0001	0.0018	-	-	0.0009	0.0018	-	<0.0001

Note: Number of exposures based on up to eight flight tests per year in both the Atlantic and Pacific study areas since the proportion of annual test which would take place in each study area is unknown. Gray shaded cells indicate species or listed population does not occur in that portion of the Action Area.

[1] Species density for entire species within the Action Area and not specific to listed populations.

Abbreviations: BOA = broad ocean area, km = kilometers, PTS = Permanent Threshold Shift, TTS = Temporary Threshold Shift, "-" = stressor would not exceed effect threshold

The maximum noise levels for sonic booms may exceed the behavioral disturbance threshold for ESA-listed species at the surface near the payload target site. Sonic boom sounds would dissipate rapidly with depth in the ocean but animals near the surface may be exposed to sounds loud enough to cause temporary behavioral disturbance. The sonic boom footprint for sounds above 160 dB re 1 µPa would likely cover a large area around the flight path near the target site; however, the sound would last less than 0.3 seconds. Because of the expected sound intensity loss at the air-water interface, the rapid attenuation of the sound in water, and the short duration of the sound, the low intensity sonic boom noise is expected to have insignificant effects on ESA-listed marine mammals, sea turtles, and fishes in the Action Area. As NMFS concluded in their biological opinions for other recent flight tests, “at most, an exposed individual may experience temporary behavioral disturbance in the form of slight changes in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the animal's fitness, and [animals] would return to normal within moments of the exposure. Therefore, [...] exposure [to sonic boom noise] is expected to have insignificant effects” on species considered in this evaluation (NMFS 2015).

Effects of Booster Splashdown and Payload Impact Noise

The effects of booster splashdown and payload impact noise would be discountable or insignificant for all ESA-listed species in the Action Area. No Proposed Action noise would exceed the PTS effect thresholds for any listed species. Stage splashdowns may exceed the physical injury threshold for fish but only within 4 m (13 ft) of stage 1 splashdown, 5 (**Table 7**). Given their likely low densities in the BOA and the fact that they are unlikely to spend substantial amounts of time near the ocean surface, it is very unlikely that ESA-listed fishes would be exposed to sound pressure high enough to cause physical injury and the effects would be discountable.

Booster splashdown and payload impact may create sound pressures above the TTS effect threshold for wildlife but only over small areas (**Table 7**). Stage 1 booster splashdown may exceed the TTS effect threshold for low frequency cetaceans (baleen whales) within 1.8 m (6 ft) of splashdown. Based on densities in the action area, substantially less than one exposure to sounds above TTS effect thresholds would be expected annually (eight tests per year) for all species considered (**Table 8** and **Table 9**). For the ESA-listed species in the low frequency cetacean functional hearing group with the highest estimated density in the splashdown/impact BOAs (fin whales in the Pacific BOA), the expected number of exposures to sound above the TTS threshold would be less than 0.00002 individuals annually. These analyses assume that the maximum eight tests per year would be conducted and that all tests would take place in the portion of the Action Area (Atlantic or Pacific) with the highest species density. Even for fish species where lack of reliable density estimates did not allow for quantitative analyses, densities would not be expected to be higher than other listed species and no animal exposures to sounds above the TTS threshold are expected. Overall, the chances of individuals of any ESA-listed species being exposed to sounds loud enough to cause TTS are so low as to be considered discountable.

Booster splashdown and payload impact would create sounds above the behavioral disturbance threshold. ESA-listed marine mammals might be exposed to sound pressures above 160 dB (re 1 μPa) up to 794 m (2,606 ft) from component splashdown or impact. Based on expected animal densities in the Action Area (**Table 8** and **Table 9**), very few marine mammals have the potential to be exposed to sounds above the behavioral disturbance threshold during a flight test. For the ESA-listed marine mammal with the highest expected density in the splashdown/impact BOAs (sperm whales in the Atlantic BOA), the estimated number of exposures annually (eight flight tests) is eight individuals. Overall, a maximum of one sei whale, four fin whales (*Balaenoptera physalus*), and eight sperm whales annually might be exposed to sound pressures above the behavioral disturbance threshold. ESA-listed sea turtles might be exposed to sound pressures above 175 dB (re 1 μPa) up to 141 m (463 ft) from component splashdown or impact. Based on maximum densities in the Action Area, the number of sea turtles that might be exposed to sounds above the behavioral disturbance threshold was also calculated (**Table 8** and **Table 9**). A maximum of one hard shelled turtle (green or hawksbill), one loggerhead, and one leatherback might be exposed to sounds above the behavioral disturbance threshold annually. These analyses assume that a maximum of eight tests per year would be conducted and that all tests would take place in the portion of the Action Area (Atlantic or Pacific) with the highest species density. Fish might be exposed to sounds above 150 dB (re 1 μPa) up to 2,512 m (8,241 ft) from splashdown or impact. As described above, reliable density estimates are not available for fish species in the Action Area but if densities are similar to marine mammals in the action area, very few fish would be exposed to sounds above the behavioral disturbance threshold.

If any marine mammals, sea turtles, or fish were exposed to sounds above the behavioral disturbance threshold, only a fraction would have the potential to respond to the sound (see Erbe et al. 2018 and DON 2018a for a review of behavioral response functions). Based on other studies, the probability of response to received sounds at 160 dB would be approximately 20% for baleen whales and 50% for toothed whales (section 3.7.3 of DON 2018a). The probability of behavioral response would increase as sound intensity increased (DON 2018a) closer to the point of splashdown/impact. Some individual animals may respond to component splashdown and payload impact noise with behavioral modification. However, as concluded by NMFS for similar flight tests (NMFS 2015, NMFS 2019, NMFS 2021a, NMFS 2021b), any effects of this type of single impulsive noise are expected to "be limited to a temporary behavioral modification in the form of slight changes in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the animal's fitness, and would return to normal within moments of the exposure." Therefore, exposure to elevated sound pressures from booster splashdown and payload impact in deep ocean waters is expected to have insignificant effects on ESA-listed marine mammals, sea turtles, and fish in the Action Area.

Effects of Vessel Noise. Noise from launch and support vessel operation would likely range from 150 to 190 dB re 1 μPa depending on the vessel type (NMFS 2019). Vessels would be moving, and sounds would be continuous. While some marine mammals, sea turtles, or fish might be exposed to sounds loud enough to cause behavioral disturbance, the low intensity noise would at most cause temporary disturbance, such as changes in swimming direction or speed, feeding, or socializing, that would have no measurable effect on the individual fitness (NMFS 2019). Animals would be expected to return to normal behaviors after the vessel passed and the noise is expected to have insignificant effects on ESA-listed marine mammals, sea turtles, and fish in the Action Area.

Noise from the trolling motors used in raft operation would be no higher than 140 dB re 1 μPa. Based on the expected sound pressures for raft operation and the effect thresholds for listed species, raft operation noise would have no effect on ESA-listed marine mammals, sea turtles, or fish.

Elevated sound levels may affect but are not likely to adversely affect ESA-listed species in the Action Area. All potential effects of exposure to proposed activity elevated sound levels on ESA-listed species would be insignificant or discountable.

4.2 Exposure to Direct Contact

4.2.1 Sources of Direct Contact

The Proposed Action would result in the spent stage 1 and 2 boosters splashing down and the payload impacting in the splashdown/impact BOAs of the Atlantic and Pacific Oceans. These falling components would enter marine habitats and have the potential to directly contact marine organisms.

Spent Booster Splashdown

For each flight test, one spent stage 1 booster and one spent stage 2 booster would splash down in deep ocean waters of the Atlantic or Pacific within the booster splashdown/payload impact BOAs (see **Figure 4** and **Figure 5**). The exact dimensions of the spent boosters are not presented in this evaluation but were used in the quantitative direct contact analyses. The approximate dimensions of the boosters are presented in **Table 6**.

Payload Impact

For each flight test, one payload would impact in deep ocean waters of the Atlantic or Pacific within the booster splashdown/payload impact BOAs (outside EEZs within international waters). The exact dimensions of the payload are not presented in this evaluation but were used in the quantitative direct contact analyses. The approximate dimensions of the payload are presented in **Table 6**. Since the payload may break up upon impact, debris might be dispersed over a larger area, radiating out from the point of impact. Debris dispersal for ocean payload impact is not expected to be further than for land impacts for which estimates of dispersal are available. Therefore, as a worst-case scenario, it is estimated that payload debris might be dispersed up to 91 m (300 ft) from the point of impact. As for other test programs with a similar payload (U.S. Army 2020, DON 2019), a direct contact area of 26,016 square meters (31,115 square yards) was used as a conservative direct contact area to account for any fragmentation of the payload upon impact.

4.2.2 Effects of Direct Contact on Listed Species

If a spent booster, payload, or debris were to strike a marine mammal, sea turtle, or fish near the ocean surface, the animal would most likely be killed or injured. In order to assess the potential for direct contact effects on listed species, a quantitative analysis of the probability of direct contact and number of exposures was conducted for species with reliable density data available and a qualitative analysis was conducted for other listed species.

Analysis Methodology

The probability of direct contact and total number of exposures was calculated for each marine mammal and sea turtle species for each CPS AUR component based on component characteristics and animal density in the Action Area.

The probability analysis is based on probability theory and modified Venn diagrams with rectangular "footprint" areas for the individual animals and the component impact footprints within the Action Area. Species densities in the booster splashdown/payload impact BOAs of the Atlantic and Pacific Oceans were derived from the best available information as described in **Section 4.1.2**. In the Pacific BOA, sea turtles were combined into a "sea turtle guild" for analyses due to the lack of species-specific occurrence data (DON 2017b). This sea turtle guild is composed of primarily green and hawksbill turtles as they account for nearly all sightings; however, in theory, the guild also encompasses leatherback, olive ridley, and loggerhead turtles (DON 2017b). These analyses assume that all animals would be at or near the surface 100% of the time and that the animals are stationary. Since these assumptions do not account for animals that spend the majority of time underwater or for any animal movement, these assumptions should lead to a conservative (high) estimate of the number of exposures for listed species.

Direct contact probability methods are modified from those used by the Navy for other recent environmental analyses (DON 2020, DON 2017a, DON 2019, DON and U.S. Army 2021). Model variables and calculations are summarized in **Table 10**.

For each marine mammal species and for the sea turtle guild, individual animal "footprints" (A) were estimated using A = animal length (La)*animal width (W_a), where animal width (breadth) is assumed to be 20% of its length for marine mammals and 112% of its length for sea turtles. The number of animals (N) in the Action Area was calculated as the product of the highest average seasonal animal density (D) and the Action Area size (R): $N = D*R$. For purposes of estimating density and for calculating direct contact probability, the Action Area (R) was considered to be the booster splashdown and payload impact BOAs (**Figure 4** and **Figure 5**). Animal density (D) in the Action Area was estimated based on the best available scientific data as described in **Section 4.1.2**.

Table 10. Variables Used in Direct Contact Probability Calculations

Variable	Definition and Units	Calculation
A	Individual Animal Footprint (km^2)	$= L_a*W_a$
A_{buffer}	Buffered Animal Footprint (km^2)	$= 0.5*I$
d_C	Diameter of Component (km)	
D	Species Density in the Action Area (per km^2)	
E	Number of Exposures	$=N*P$
I	Component Impact Footprint (km^2)	$= l_C*d_C*N_C$
P	Probability	$= T/R$
l_C	Length of Component (km)	
L_a	Length of Individual Animal (km)	
L_i	Length of Impact (km)	$=W_i * \left(\frac{W_a}{L_a}\right)$
N	Number of Animals in the Action Area	$=D*R$
N_C	Number of Each Component	
r_a	Radius of Animal Footprint (km)	$= \sqrt{\frac{(L_a * W_a)}{\pi}}$
r_i	Radius of Impact Area (km)	$= \sqrt{\frac{(0.5 * L_i * W_i)}{\pi}}$
R	Action Area (km^2)	
T	Total Area of A and I Overlap	
W_a	Width of Individual Animal (km)	= 20% of L_a for marine mammals =112% of L_a for sea turtles
W_i	Width of Impact (km)	$= \frac{I}{2L_i} = L_i * \left(\frac{W_a}{L_a}\right)$

The likelihood of direct contact from CPS AUR component splashdown or impact in deep ocean waters was calculated as the probability (P) that an individual animal footprint (A) and the impact footprint (I) for a component will intersect within the Action Area (R). This probability is calculated as the area ratio A/R or I/R, respectively. The impact footprint (I) refers to the impact footprint for each component calculated separately as: I = component length (l_C)*component diameter (d_C)*number of each component (N_C). Since only one of each component will be used for each flight test, N_C = 1 for all components and $I = l_C*d_C$. The probability that a random point in the Action Area is within both the animal footprint (A) and impact footprint (I) depends on the degree of overlap of A and I. The probability that I overlaps A is calculated by adding a buffer distance around A based on one-half of the impact area (A_{buffer} = 0.5 $*I$), such that an impact center occurring anywhere within the combined (overlapping) area would impact the animal. To account for the buffer and achieve similar geometry between the animal footprint and the impact footprint, the length (L_i) and width (W_i) of the impact footprint are defined by $W_i/L_i = W_a/L_a$ and L_i*W_i = 0.5 $*I$. The total overlapping areas (T) of A and I (including the buffer area) and the buffer areas were defined for four scenarios:

- Scenario 1: Static and rectangular scenario where the impact is assumed to be static (i.e., direct impact effects only; no explosions or scattering of debris after the initial impact), $T = (L_a + 2*L_i)* (W_a + 2*W_i)$, and $A_{buffer} = T - L_a*W_a$.
- Scenario 2: Dynamic scenario with end-on collision where the length (L_i) of the impact footprint is enhanced by 5 lengths of the component (l_C)to reflect forward momentum, $T = (L_a + (2*(L_i+(5*l_C))))* (W_a + 2*W_i)$, and $A_{buffer} = T - L_a*W_a$.
- Scenario 3: Dynamic scenario with broadside collision where the width (Wi) of the impact footprint is enhanced by 5 lengths of the component (lC) to reflect forward momentum, $T = (L_a + 2* L_i)* (W_a + (2*(W_i+(5* l_C))))$, and $A_{buffer} = T - L_a*W_a$.
- Scenario 4: Static and radial scenario where the rectangular animal and impact footprints are replaced with circular footprints while conserving area. The animal footprint radius (r_a) $= \sqrt{((L_a*W_a))/\pi)}$, the impact footprint radius (r_i) $= \sqrt{(((0.5*L_i*W_i))/\pi)}$, the total overlapping area (T) $= \pi*[\![(r_a+r_i)]\!]^2$, and $A_{buffer} = T - \pi*r_a2$.

Static impacts (Scenarios 1 and 4) assume no additional areal coverage effects beyond the initial impact. For dynamic impacts (Scenarios 2 and 3), the distance of scattered components or debris must be considered by increasing the length (Scenario 2) or width (Scenario 3) depending on entry orientation, to account for forward momentum. Forward momentum typically accounts for five object lengths, resulting in a corresponding increase in impact area.

Impact probability (P) is the probability of impacting one animal with the given number (in the case of the Proposed Action there is only one of each component per flight test) and type of component and is given by the ratio of total area (T) to the Action area (R): $P = T/R$. Number of exposures (E) is $E=N*P$, where N is the number of animals in the Action Area in a given year (calculated as the product of the animal density and Action Area size).

Using this logic, probability (P) and total exposures (E) were calculated for each of the four scenarios, for each marine mammal or sea turtle species, and for each CPS AUR component. The scenario-specific P and E values were averaged over the four scenarios (using equal weighting) to obtain a single scenario-averaged estimate of P and E for a single flight test (**Table 11**).

The number of animal exposures was then multiplied by the number of possible flight tests per year (up to eight) to get an annual estimate of animal exposures. Since the proportion of annual tests (up to eight per year) which would occur in each study area (Atlantic and Pacific) is unknown, it was assumed for analysis purposes that up to eight tests per year could occur in each study area.

Table 11. Estimated Maximum Number of Marine Mammal and Sea Turtle Exposures to Direct Contact from Navy CPS Booster Splashdown and Payload Impact in the BOA

Common Name	Scientific Name	Atlantic Study Area				Pacific Study Area			
		Density (individuals per km²)		Estimated Number of Exposures to Direct Contact				Estimated Number of Exposures to Direct Contact	
		Stage 1 Splashdown BOA	Stage 2 / Payload Impact BOA	Per Test	Per Year (8 Tests)	Stage 1 Splashdown BOA	Stage 2 / Payload Impact BOA	Per Test	Per Year (8 Tests)
Cetaceans									
Sei whale	*Balaenoptera borealis*	0.0319	0.0319	3.63E-05	2.90E-04	0.0003	0.0003	3.41E-07	2.73E-06
Blue whale	*Balaenoptera musculus*	0.0020	0.0020	3.55E-06	2.84E-05	0.0063	0.0014	6.32E-06	5.06E-05
Fin whale	*Balaenoptera physalus*	0.0685	0.0123	5.14E-05	4.11E-04	0.0821	0.0160	6.26E-05	5.01E-04
Gray whale [1]	*Eschrichtius robustus* [1]					0.00001	0.00001	1.23E-08	9.84E-08
North Atlantic right whale	*Eubalaena glacialis*	0.0151	0.0005	7.09E-06	5.67E-05				
North Pacific right whale	*Eubalaena japonica*					0.00001	0.00001	8.78E-09	7.03E-08
Humpback whale [1]	*Megaptera novaeangliae* [1]					0.0203	0.0080	1.37E-05	1.09E-04
Sperm whale	*Physeter macrocephalus*	0.9559	0.4784	6.06E-04	4.85E-03	0.0150	0.0150	1.29E-05	1.03E-04
False killer whale – Main Hawaiian Islands Insular DPS	*Pseudorca crassidens* [1]					0.0006		1.21E-07	9.66E-07
Pinnipeds									
Guadalupe fur seal	*Arctocephalus townsendi*					0.0628	0.0628	1.70E-05	1.36E-04
Steller sea lion [1]	*Eumetopias jubatus* [1]					0.0098	0.0098	3.10E-06	2.48E-05
Hawaiian monk seal	*Neomonachus schauinslandi*					0.00003		4.41E-09	3.53E-08
Sea Turtles									
Green turtle [1]	*Chelonia mydas* [1]	0.3183	0.3183	7.34E-05	5.87E-04	0.0003	0.0004	7.65E-08	6.12E-07
Hawksbill turtle	*Eretmochelys imbricata*					0.0001	0.0001	1.13E-08	9.07E-08
Loggerhead turtle [1]	*Caretta caretta* [1]	0.4063	0.4063	9.21E-05	7.37E-04	0.2400	0.0018	2.91E-05	2.32E-04
Leatherback turtle	*Dermochelys coriacea*	0.6371	0.6371	1.79E-04	1.43E-03	0.0020	0.0012	4.47E-07	3.57E-06
Olive ridley turtle [1]	*Lepidochelys olivacea* [1]					0.0018	0.0018	3.64E-07	2.91E-06
Kemp's ridley turtle	*Lepidochelys kempii*	0.0068	0.0068	1.34E-06	1.07E-05				

Note: Number of exposures based on up to eight flight tests per year in both the Atlantic and Pacific study areas since the proportion of annual test which would take place in each study area is unknown. Gray shaded cells indicate the species or listed population does not occur in that portion of the Action Area.

[1] Species density for entire species within the BOA and not specific to listed populations.

Abbreviations: BOA = broad ocean area, DPS = distinct population segment, km = kilometers

Effects of Direct Contact

Overall, the effects of direct contact on ESA-listed marine species would be discountable. For species with available density estimates (marine mammals and sea turtles), the estimated number of animal exposures is substantially less than one animal for all ESA-listed species (**Table 11**) and no direct contact is expected to occur. Even when summed for the maximum eight tests per year over 10 years, the number of animals expected to be exposed to direct contact is still less than one (**Table 11**).

For a flight test taking place in the Atlantic study area, the maximum number of estimated animal exposures for any ESA-listed species in the BOA is for sperm whales at 0.0006 individuals (**Table 11**). This corresponds to a 1 in 1,650 chance of contacting a sperm whale during a single test in the Atlantic BOA. When summed across all possible tests per year (up to eight tests per year), the maximum number of exposures for any ESA-listed marine mammal or sea turtle species in the Atlantic BOA is less than 0.005 individuals annually (**Table 11**).

For a flight test taking place in the Pacific study area, the maximum number of estimated animal exposures for any ESA-listed species in the BOA is for fin whales at 0.00006 individuals (**Table 11**). This corresponds to a 1 in 16,000 chance of contacting a fin whale during a single test in the Pacific BOA. When summed across all possible tests per year (up to eight tests per year), the maximum number of exposures for any ESA-listed marine mammal or sea turtle species in the Atlantic BOA is less than 0.0005 individuals annually (**Table 11**). For species where the ESA listing unit is a DPS (e.g., humpback whales, gray whale, and Steller sea lions) it is important to note that density and exposure estimates in the model do not distinguish between listed and non-listed DPSs. Therefore, direct contacts estimates would apply to the entire species and are likely overestimates of potential effects on listed populations.

Even if the maximum number of eight flight tests per year over 10 years is assumed, the number of annual animal exposures is less than 0.05 animals for each ESA-listed marine mammal and sea turtle species or group. These exposure estimates are likely overestimates because they do not account for differences in seasonal distribution but rather assume the maximum seasonal density for the entire year and for the entire BOA. These analyses also assume that the up to eight tests per year might all occur in each of the two study regions (i.e., Atlantic or Pacific). Based on these results, the chances of CPS AUR components directly contacting any ESA-listed marine mammal or sea turtle are so low as to be discountable.

While density data are not available for ESA-listed fishes in the Action Area, these species are likely to have very low densities, patchy distributions, and in many cases seasonal occurrence in the Action Area. Given the small direct contact area and the low density and patchy distribution of ESA-listed fish in the Action Area, it is very unlikely that these fish would be subject to direct contact from CPS AUR components. Overall, no direct contact of ESA-listed wildlife is expected, and the effects would be discountable.

Direct contact may affect but is not likely to adversely affect ESA-listed species in the Action Area. All potential effects of direct contact on ESA-listed species would be discountable.

4.3 Exposure to Hazardous Materials

4.3.1 Sources of Hazardous Materials

The Proposed Action has the potential to introduce hazardous materials into the Action Area. Any substances of which the spent boosters or payload are constructed or that are contained in the stages and not consumed during flight or jettison (**Table 1** and **Table 2**) would fall into marine habitats of the BOA.

Spent Booster Splashdown

Booster stages would contain propellants, battery acids, asbestos, and heavy metals (**Table 1**) which would be introduced into the ocean at the splashdown sites. The propellant would be consumed during the flight tests; therefore, only a minimal residual amount of propellant would enter the ocean. All durable materials of which the boosters are composed or that are contained within the boosters are expected to sink to the ocean bottom. Booster splashdown would occur within deep ocean waters downrange of the launch site.

The propellants would be consumed before splashdown and the area affected by the dissolution of chemicals would be relatively small because of the size of the launch vehicle components and the minimal amount of residual materials they would contain. Any chemicals introduced to the water column would be quickly diluted and dispersed by wave action, ocean currents, and the large volume of water.

The principal source of potential impacts on water and sediment quality would be unburned rocket propellant residue and batteries. Each of the two rocket motor boosters would exhaust onboard propellant before dropping into the ocean. Rocket propellant normally contains 50 to 85% ammonium perchlorate by weight and 5 to 22% aluminum powder, a fuel additive (DON 2018a). Based on U.S. Environmental Protection Agency and other studies evaluating munitions constituents at military sites where explosives and propellants have been used, the U.S. Environmental Protection Agency concluded that perchlorate was generally not detected at test ranges and that perchlorate is so soluble in water that surface accumulation (on land) does not occur (DON 2018a). Studies have concluded that the motors used in rockets and missiles are highly efficient, consuming over 99% of the rocket propellant perchlorate during use (DON 2018a). It is expected that only trace amounts, likely at undetectable levels, of propellant would remain in boosters when they splash down into the ocean (DON 2018a).

De minimus residual quantities of some hazardous materials may remain on the boosters, and these would be carried to the ocean floor by the sinking components and would undergo changes in the presence of seawater. When metals are exposed to seawater, they begin to corrode but movement of metals into the sediments or water column would be slow and restricted to a small area around the metals (DON 2018a). Residual materials would slowly dissolve, and substances would be redistributed and diluted by physical ocean mixing and diffusion (DON 2018a). Any residual chemical concentration near submerged boosters would decrease over time as the leaching rate decreases and further redistribution and dilution occurs. Even at active military bombing sites, studies have revealed low concentrations of metals, generally below minimum detection limits (DON 2018a). Expected metal concentrations at BOA sites where CPS components enter the ocean would be expected to be significantly lower than at active bombing ranges given the size of the BOA and likely scattered distribution of CPS components. Therefore, metals would likely be undetectable in surrounding sea water and sediments.

Payload Impact

The test payloads would contain varying quantities of hazardous materials, potentially including batteries, small electro-explosive devices, asbestos, tungsten, and other heavy metals (**Table 2**) which would enter the water at the payload impact site. All durable materials of which the payloads are composed or that are contained within the payloads are expected to sink to the ocean bottom. Payload impact would occur within deep ocean waters outside EEZs within international waters. Support ships would retrieve instrumentation rafts and search for any floating debris at the payload impact site. Any visible debris found floating would be recovered, as much as practicable.

As discussed for spent boosters above, residual quantities of hazardous materials may remain on payload components and would be carried to the ocean floor by the sinking payload debris. While metals would slowly dissolve and be redistributed by physical ocean mixing and diffusion, residual concentrations of metals in surrounding ocean waters and sediments are expected to be extremely low and likely undetectable.

Vessel Operations

While there is a potential for accidental spills or leaks from support vessel operations, vessel operations would not involve any intentional ocean discharges of fuel, toxic wastes, or plastics and other solid wastes. No introduction of hazardous materials would be expected from vessel operations.

Target Raft

For tests using a floating target raft, the raft is expected to remain relatively intact and floating. Little to no floating debris would be expected and any visible debris found floating would be collected for disposal as much as practicable. It is not planned or expected that the target raft would be sunk during Navy CPS flight test activities. It is possible that material on the target raft might be inadvertently dislodged from the raft during a flight test. If materials were dislodged from the target raft, it is expected that most materials would sink (e.g., metal components) or be cleaned up during post-test operations if found floating (e.g., pontoon foam filler material). All lithium-ion batteries used on the target raft for sensor operation would be recovered unless they were inadvertently damaged beyond the point of safe retrieval/recovery. While there is some potential for test materials on the raft to be dislodged or unrecoverable, it is not planned and is considered unlikely to occur.

4.3.2 Effects of Hazardous Materials on Listed Species

Marine species have the potential to be affected by hazardous materials if they are found in concentrations high enough to harm ESA-listed species or change water or sediment quality to the extent they cause changes in food availability or habitat quality for these species. Marine debris also has the potential to pose ingestion or entanglement risks for ESA-listed species. Marine debris is an increasing problem in the world's oceans and is a concern for ingestion and entanglement by fish, invertebrates, sea turtles, marine mammals, and marine vegetation, contributing to habitat degradation and damage (NOAA 2023c).

For all species considered in this Biological Evaluation, exposure to hazardous materials as a result of the Proposed Action would have insignificant effects.

Overall, hazardous materials are not expected to be found in concentrations high enough to adversely affect listed species or habitat quality for marine life in the Action Area. No detectable chemical, physical, or biological changes in water or sediment quality would be expected (DON 2018a). No intentional ocean dumping would occur, and CPS flight test vehicle components would not contribute to floating or suspended marine debris as they are expected to sink to the ocean floor. While floating debris is not expected, post-test operations will include inspection of the payload target area and cleanup of any visible floating debris, to the extent practicable.

Considering the planned cleanup of man-made materials, the very small quantities of hazardous materials expected to be introduced into marine habitats, and the dilution and mixing capabilities of the ocean waters, materials released during booster splashdown and payload impact would not be present in sufficient quantities or concentrations to adversely affect any ESA-listed marine mammal, fish, sea turtle, or their habitats in the Action Area. ESA-listed wildlife are also extremely unlikely to encounter debris from proposed activities. The effects of hazardous materials on ESA-listed species would be insignificant or discountable.

Hazardous materials and debris may affect but are not likely to adversely affect all ESA-listed species in the Action Area. All potential effects of hazardous materials resulting from proposed activities on ESA-listed species would be insignificant or discountable.

4.4 Vessel Movement

4.4.1 Sources of Vessel Movement

Vessels would be used to transport equipment and personnel to the launch and target sites, for sensor coverage, to deploy sensor and target rafts, to recover sensor and target rafts, and for post-test cleanup activities. The Proposed Action would involve vessel movement in the BOAs for up to 4 weeks for each flight test including:

- Operation of surface ships and submarines as sea-based launch platforms.
- Operation of two to three support ships for downrange sensor coverage.

- Operation of a support ship and smaller watercraft for downrange target placement, clean-up activities, and recovery operations.

All Navy vessels used as part of proposed activities would operate in accordance with applicable Navy policies and with implementation of a number of standard operating procedures and mitigation measures, many of which were established for typical Navy at-sea training and testing operations (see **Section 2.2**). These standard operating procedures and mitigation measures include lookouts for marine mammals and sea turtles as summarized in **Section 2.2**. Vessels to be used as launch platform or support ships would be a variety of sizes from small watercraft to large Navy vessels with a range of typical and maximum operating speeds. Overall, vessel traffic for the Proposed Action would be a small fraction of total naval vessel traffic and an even smaller fraction of total commercial, recreational, and military vessel traffic in the Atlantic and Pacific BOAs.

The Proposed Action would also involve sensor and target raft operation at a BOA target site for several hours for each flight test. Proposed activities would include deployment and operation of a target raft and up to 12 self-stationing instrumented rafts around the targeted site for sensor coverage and data collection. No anchoring systems would be used for self-stationing rafts. Self-stationing rafts would be powered by two small battery-powered trolling motors and would pose very little strike risk for wildlife. No self-stationing raft or other vessel equipment is expected to pose an entanglement risk for wildlife.

Noise stressors associated with vessel operations are discussed in **Section 4.1** and the potential for hazardous material release associated with vessel operations is discussed in **Section 4.3**.

4.4.2 Effects of Vessel Movement on Listed Species

ESA-listed species have the potential to be affected by vessel strike primarily by being at the surface when a vessel or raft is operating in an area. Organisms at the surface, such as marine mammals and sea turtles that must surface to breathe air, are at risk of being struck by vessels or their propellers. Vessel collisions have been documented for at least 75 marine species globally, including smaller whales, dolphins, porpoises, sea turtles, sharks, and other fish (Schoeman et al. 2020). Vessel collision risk is generally highest in areas with higher vessel and/or animal density but depends on vessel types, vessel speeds, and the natural history of each species (e.g., relative time spent at the surface) (Schoeman et al. 2020).

Navy vessels utilized for the Proposed Action would operate under standard operating procedures and mitigation measures similar to those established for other Navy at-sea training and testing programs in the Atlantic and Pacific regions. Several measures would be in place to reduce the chances of a marine mammal or sea turtle being struck by a vessel (**Section 2.2**), including the requirement that Navy vessel operators watch for and avoid marine protected species where possible based on ocean conditions. Large naval vessels in offshore areas typically operate at slower speeds (between 10 and 15 knots) than commercial vessels (DON 2018a, DON 2018b) which reduces the chances of vessel strikes.

The Navy has evaluated vessel strike risk for vessel operations as part of their training and testing programs in the Atlantic and Pacific (DON 2018a, DON 2018b, DON 2020) and concluded that even for these relatively large-scale vessel operations, very few vessel strikes are expected. For example, in the Atlantic Fleet training and testing study area, a total of three whale strikes were reported for a total of 39,040 Navy vessel steaming days for the 8 years from 2009 to 2016 (DON 2018a). For the Hawaii-Southern California training and testing study area in the Pacific there were an estimated 45,048 at-sea days for vessels greater than 20 m (65 ft) long for the 15 years between 2009 and 2023 and only five marine mammal vessel strikes were reported (88 FR 68290 [3 October 2023]). There have been no known collisions between Navy vessels and whales in the Mariana Islands training and testing study area (DON 2020). The only reported naval vessel strikes involved large vessels (greater than 18 m or 60 ft; DON 2018a, DON 2018b) and vessel strikes are not expected with movement of smaller vessels. In general, smaller toothed whales move quickly and are not as likely to be struck by a naval vessel as larger baleen whales (DON 2018a). Pinnipeds also appear be less likely to be struck by vessels, likely due to the large amount of time they spend on land and their high maneuverability (DON 2018a).

Large naval vessel traffic for the Proposed Action would be a small fraction of total naval vessel traffic and an even smaller fraction of total commercial, recreational, and military vessel traffic in the Atlantic and Pacific BOAs. Large vessel movement for each proposed flight test would include up to four vessels operating for up to 30 days. While the exact at-sea steaming time for these vessels that would be related to the Proposed Action is not known at this time, vessel movement for the Proposed Action would be a small fraction of the total Navy vessel steaming hours in the Atlantic and Pacific Oceans each year. No Proposed Action-related vessel strikes of ESA-listed species are expected and the effects would be discountable.

Because the self-stationing rafts would be slow moving and powered by two small battery-powered trolling motors, the rafts would pose very little strike risk for wildlife. Based on the expected low density of ESA-listed marine mammals and sea turtles in the Action Area (see **Section 4.1.2** and **Tables 8** and **9**), it is discountable that any ESA-listed species considered in this evaluation would come in contact with a project-related raft. Even if ESA-listed individuals were to come into contact with deployed or operating rafts, the rafts are not expected to harm animals and the effects would be insignificant or discountable.

It is also discountable that ships or rafts would strike ESA-listed fish in the Action Area. The fish species listed in **Table 5** are agile animals capable of avoiding oncoming vessels and are only infrequently found near the ocean surface since they do not need to surface to breathe (NMFS 2019). It is discountable that any ESA-listed fish would be struck by a project-related vessel.

Vessel movement may affect but is not likely to adversely affect ESA-listed marine mammal, sea turtle, and fish species in the Action Area as all effects would be discountable.

4.5 Effects on Proposed or Designated Critical Habitat

The Proposed Action may affect but is not likely to adversely affect designated critical habitats in the Action Area. All proposed or designated critical habitats occur only within the U.S. EEZ which extends out to 370 km (200 nm) from the territorial sea baseline. Therefore, no stage 2 spent boosters or payloads would enter proposed or designated critical habitats. The only proposed activities which have the potential to occur within certain proposed or designated critical habitats are launch activities, vessel operations, and stage 1 booster splashdown.

Designated critical habitat for Central America DPS and the Mexico DPS of humpback whales and for leatherback turtles off the west coast of California in the Pacific study area have been excluded from the proposed launch and stage 1 booster splashdown areas. Some vessel activity may occur within these designated critical habitats; therefore, only stressors associated with vessel operations might occur in these habitats. All Navy vessels used as part of proposed activities would operate in accordance with applicable Navy policies and with implementation of a number of standard operating procedures and mitigation measures (**Section 2.4**). Vessel traffic for the Proposed Action would be a small fraction of Navy and total vessel traffic in the Pacific study area and no stressors are expected to affect prey availability or feeding accessibility for these species. Proposed Action stressors would have insignificant effects on the primary constituent elements and essential features of designated critical habitat for humpback whales and leatherback turtles.

Proposed launch activities and spent stage 1 booster splashdown may occur within designated *Sargassum* critical habitat for Northwest Atlantic Ocean DPS loggerhead turtles and proposed *Sargassum* critical habitat for North Atlantic DPS green turtles in the Atlantic Ocean. Proposed Action stressors in these habitats would be launch noise, vessel operations, and stage 1 booster splashdown (**Table 6**). Based on the primary constituent elements and essential features of proposed and designated critical habitats in the Action Area (**Section 3.2**), launch noise would have no effect on the essential features necessary for conservation of ESA-listed species within critical habitats in the Action Area. Proposed Action vessel traffic would be a very small fraction of Navy and of total vessel traffic in these areas and would have undetectable effects on prey availability and *Sargassum* concentrations. Similarly, stage 1 booster splashdown is not expected to have detectable effects on the primary constituent elements or essential features of these habitats as the maximum surface area for stage 1 booster contact would be approximately 5 square meters and components are expected to sink to the ocean bottom where they would not pose an entanglement or ingestion risk for sea turtles. Overall, the Proposed Action would have insignificant effects on designated or proposed critical habitat for loggerhead and green turtles.

The Proposed Action may affect but is not likely to adversely affect designated or proposed critical habitat for ESA-listed species in the Action Area.

5.0 Conclusions

Based on analyses of all of the potential stressors in the Action Area, the Navy has determined that the Proposed Action “may affect but is not likely to adversely affect” nine cetacean species, three pinniped species, six sea turtle species, and eleven fish species listed as threatened or endangered under the ESA in the Action Area (**Table 12**). Based on the analysis in **Section 4.0**, all effects of the Proposed Action on these species would be insignificant or discountable. The species, including all relevant DPSs and ESUs, that may be but are not likely to be adversely affected by the Proposed Action are listed in **Table 12**.

The Navy has determined that the Proposed Action “may affect but is not likely to adversely affect” designated critical habitat for the Central America DPS and Mexico DPS of humpback whales, designated *Sargassum* habitat for the Northwest Atlantic Ocean DPS of loggerhead turtles, proposed critical habitat for the North Atlantic DPS of green turtles, and designated critical habitat for leatherback turtles. Based on the analysis presented in **Section 4.5**, the Proposed Action would have no measurable or detectable effect on the essential features of these critical habitats necessary for listed species conservation.

Table 12. ESA-Listed Species Not Likely to be Adversely Affected by the Proposed Action.

Common Name	Scientific Name	ESA Listing Status
Cetaceans		
Sei whale	*Balaenoptera borealis*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Gray whale – Western North Pacific DPS	*Eschrichtius robustus*	Endangered
North Atlantic right whale	*Eubalaena glacialis*	Endangered
North Pacific right whale	*Eubalaena japonica*	Endangered
Humpback whale	*Megaptera novaeangliae*	
Central America DPS		Endangered
Mexico DPS		Threatened
Western North Pacific DPS		Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
False killer whale – Main Hawaiian Islands Insular DPS	*Pseudorca crassidens*	Endangered
Pinnipeds		
Guadalupe fur seal	*Arctocephalus townsendi*	Threatened
Steller sea lion – Western DPS	*Eumetopias jubatus*	Endangered
Hawaiian monk seal	*Neomonachus schauinslandi*	Endangered
Sea Turtles		
Loggerhead turtle	*Caretta caretta*	
North Pacific Ocean DPS		Endangered
Northeast Atlantic Ocean DPS		Endangered
Northwest Atlantic Ocean DPS		Threatened
Green turtle	*Chelonia mydas*	
Central North Pacific DPS		Threatened
Central South Pacific DPS		Endangered
Central West Pacific DPS		Endangered
East Pacific DPS		Threatened
North Atlantic DPS		Threatened
South Atlantic DPS		Threatened
Leatherback turtle	*Dermochelys coriacea*	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley turtle	*Lepidochelys kempii*	Endangered
Olive ridley turtle	*Lepidochelys olivacea*	
All other populations (not Mexico's Pacific Coast breeding populations)		Threatened
Mexico's Pacific Coast Breeding Population		Endangered

Common Name	Scientific Name	ESA Listing Status
Fishes		
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	
Carolina DPS		Endangered
Chesapeake Bay DPS		Endangered
Gulf of Maine DPS		Threatened
New York Bight DPS		Endangered
South Atlantic DPS		Endangered
Oceanic whitetip shark	*Carcharhinus longimanus*	Threatened
Giant manta ray	*Mobula* (*Manta*) *birostris*	Threatened
Chum salmon – Hood Canal Summer run ESU	*Oncorhynchus keta*	Threatened
Coho salmon	*Oncorhynchus kisutch*	
Central California Coast ESU		Endangered
Lower Columbia River ESU		Threatened
Oregon Coast ESU		Threatened
Southern Oregon and Northern California Coast ESU		Threatened
Steelhead Trout	*Oncorhynchus mykiss*	
California Central Valley DPS		Threatened
Central California Coast DPS		Threatened
Lower Columbia River DPS		Threatened
Middle Columbia River DPS		Threatened
Northern California DPS		Threatened
Puget Sound DPS		Threatened
Snake River Basin DPS		Threatened
South-Central California Coast DPS		Threatened
Southern California DPS		Endangered
Upper Columbia River DPS		Threatened
Upper Willamette River DPS		Threatened
Sockeye salmon – Snake River ESU	*Oncorhynchus nerka*	Endangered
Chinook salmon	*Oncorhynchus tshawytscha*	
California Coastal ESU		Threatened
Lower Columbia River ESU		Threatened
Puget Sound ESU		Threatened
Sacramento River Winter-run ESU		Endangered
Snake River Fall-run ESU		Threatened
Snake River Spring/Summer-run ESU		Threatened
Upper Columbia River Spring-run ESU		Endangered
Upper Willamette River ESU		Threatened
Smalltooth sawfish	*Pristis pectinata*	Endangered
Atlantic salmon – Gulf of Maine DPS	*Salmo salar*	Endangered

Common Name	Scientific Name	ESA Listing Status
Fishes (continued)		
Scalloped hammerhead shark	*Sphyrna lewini*	
Central and Southwest Atlantic DPS		Threatened
Eastern Atlantic DPS		Endangered
Eastern Pacific DPS		Endangered
Indo-West Pacific DPS		Threatened

Abbreviations: DPS = distinct population segment, ESA = Endangered Species Act, ESU = evolutionarily significant unit

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7.0 List of Preparers

Government Preparers

David Fuller, Biologist / National Environmental Policy Act Program Manager
M.S., 1980, Biology, Pittsburg State University
B.S., 1978, Biology, Missouri Southern State University
Years of Experience: 44

Contractor Preparers

Karen Hoksbergen, Biologist, KFS, LLC
M.S., 2004, Biology, Northern Michigan University
B.S., 2001, Biology and Wildlife, University of Wisconsin Stevens Point
Years of Experience: 23

Amy McEniry, Technical Editor, KFS, LLC
B.S., 1988, Biology, University of Alabama in Huntsville
Years of Experience: 36

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