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3.6 Fishes

FISHES SYNOPSIS

Stressors to fishes that could result from the Proposed Action were considered, and the following conclusions have been reached for the Preferred Alternative (Alternative 1):

- Acoustic: The use of each acoustic substressor (sonar and other transducers, air guns, pile driving, vessel noise, aircraft noise, and weapons noise) could result in impacts on fishes. Some sonars, vessel and weapons noise could result in masking, physiological responses, or behavioral reactions. Aircraft noise would not likely result in impacts other than brief, mild behavioral responses in fishes that are close to the surface. Each of these substressors would be unlikely to result in temporary threshold shift. Air guns and pile driving have the potential to result in mortality, injury, or hearing loss at very short ranges (tens of meters) in addition to the effects listed above. Most impacts are expected to be temporary and infrequent as most activities involving acoustic stressors would be temporary, localized, and infrequent resulting in short-term and mild to moderate impacts. More severe impacts (e.g., mortality) could lead to permanent effects for individuals but, overall, long-term consequences for fish populations are not expected. As such, effects would be less than significant.
- Explosives: The use of explosives could result in impacts on fishes within the Study Area. Sound and energy from explosions can cause mortality, injury, hearing loss, masking, physiological stress, or behavioral responses. The time scale of individual explosions is very limited, and military readiness activities involving explosions are dispersed in space and time, therefore, repeated exposure of individuals is unlikely. Most effects such as hearing loss or behavioral responses are expected to be short term and localized. More severe impacts (e.g., mortality) could lead to permanent effects for individuals but, overall, long-term consequences for fish populations are not expected. As such, effects would be less than significant.
- Energy: The use of in-water electromagnetic devices may elicit brief behavioral or physiological stress responses only in those exposed fishes with sensitivities to the electromagnetic spectrum. This behavioral impact is expected to be temporary and minor. Similar to regular vessel traffic that is continuously moving and covers only a small spatial area during use. Except for some seafloor cables that could produce electromagnetic fields, most fields generated by in-water devices would be continuously moving and cover only a small spatial area during use; thus, population-level impacts are unlikely. As such, effects would be less than significant.
- Physical Disturbance and Strike: The use of vessels, in-water devices, military expended materials, and seafloor devices pose a risk for collision, stress response, or impacts caused by sediment disturbance, particularly near coastal areas and bathymetric features where fish densities are higher. Most fishes are mobile and have sensory capabilities that enable them to detect and avoid vessels and other items. Behavioral and stress responses would be temporary. As such, effects would be less than significant.

FISHES SYNOPSIS (continued)

- Entanglement: Fishes could be exposed to a number of entanglement stressors and the potential for impacts is dependent on the physical properties of the expended materials and the likelihood that a fish would encounter a potential entanglement stressor and then become entangled in it. Physical characteristics of wires and cables and decelerators/parachutes, combined with the sparse distribution of these items throughout the Study Area, indicates a very low potential for fishes to encounter and become entangled in them. Because of the low numbers of fishes potentially impacted by entanglement stressors, population-level impacts are unlikely. As such, effects would be less than significant.
- Ingestion: Military expended materials from munitions and military expended materials other than munitions present an ingestion risk to fishes that forage at the surface, in the water column, and on the seafloor. The likelihood that expended items would be ingested and cause an adverse effect would depend on the size and feeding habits of a fish, the rate at which a fish would encounter items, and the composition and physical characteristics of the item. Because of the low numbers of fish potentially impacted by ingestion stressors, population-level impacts are unlikely. As such, effects would be less than significant.

3.6.1 Introduction

The following sections provide an overview of fishes found in the Study Area and the potential adverse effects of the proposed military readiness activities on them. For this EIS/OEIS, marine fish are evaluated as groups of species characterized by distribution, morphology (body type), or behavior relevant to the stressor being evaluated. Activities are evaluated for their potential effects on the fish species in the Study Area that are listed or proposed for listing under the ESA, as well as other fish in the Study Area.

3.6.2 Affected Environment

The affected environment provides the context for evaluating the effects of the proposed military readiness activities on fishes.

3.6.2.1 General Background

Fishes are not distributed uniformly throughout the Study Area but are closely associated with a variety of habitats. Some species, such as large sharks, salmon, tuna, and billfishes, range across thousands of square miles. Other species, such as gobies and most reef fish, generally have small home ranges and restricted distributions (Helfman et al., 2009). The early life stages (e.g., eggs and larvae) of many fish may be widely distributed even when the adults have relatively small ranges. The movements of some open-ocean species may never overlap with coastal fishes that spend their lives within several hundred feet of the shore. The distribution and specific habitats in which an individual of a single fish species occurs may be influenced by its life stage, size, sex, reproductive condition, and other factors. Approximately 78 percent of all marine fish species occur in waters less than 200 m deep and in close association with land, while 13 percent are associated with the open ocean (Moyle & Cech, 2004).

Each major habitat type in the Study Area (e.g., reef, hard bottom, soft bottom, and beds of submerged aquatic vegetation) supports an associated fish community with the number of species increasing with decreasing latitude (transition from north to south). However, this pattern is not as clearly defined for wide-ranging migratory open-ocean species (Macpherson, 2002).

Detailed information on habitat use, movement, and behavior, sound sensing and production, and threats that affect or have the potential to affect natural communities of fishes within the Study Area are presented in Appendix C.

3.6.2.2 Endangered Species Act-Listed Species

Table 3.6-1 presents ESA-listed fishes in the Study Area, including three Evolutionarily Significant Units (ESUs) of Chinook salmon (*Oncorhynchus tshawytscha*), three ESUs of coho salmon (*O. Kisutch*), five Distinct Population Segments (DPS) of steelhead (*O. mykiss*), green sturgeon (*Acipenser medirostris*), eulachon (*Thaleichthys pacificus*), oceanic whitetip shark (*Carcharhinus longimanus*), scalloped hammerhead shark (*Sphyrna lewini*), and giant manta (*Manta birostris*). There are no fish species in the Study Area that are proposed for listing under the ESA, however, the tope shark (*Galeorhinus galeus*) is a candidate for listing under the ESA. Detailed information on each ESA-listed species and critical habitat is presented in Appendix C. Note that designated critical habitat for salmon, steelhead, and eulachon does not overlap with the Study Area and will not be analyzed further in this document. Green sturgeon designated critical habitat overlaps with a small portion of the California Study Area (Figure C.5-4).

Table 3.6-1: Regulatory Status and Occurrence of Endangered Species Act-Listed Fishes and Critical Habitat in the Study Area

Species	Distinct Population Segment (DPS)/Evolutionarily Significant Unit (ESU) in the Study Area	Species Status	*Critical Habitat in the Study Area*	Occurrence in the Study Area	
				Hawaii Study Area	California Study Area
Chinook salmon (*Oncorhynchus tshawytscha*)	California Coastal ESU	Threatened			X
	Central Valley Spring-Run ESU	Threatened			X
	Sacramento River Winter-Run ESU	Endangered			X
Coho salmon (*Oncorhynchus kisutch*)	Oregon Coast ESU	Threatened			X
	Southern Oregon/Northern California Coast ESU	Threatened			X
	Central California Coast ESU	Endangered			X
Steelhead (*Oncorhynchus mykiss*)	Northern California DPS	Threatened			X
	California Central Valley DPS	Threatened			X
	Central California Coast DPS	Threatened			X
	South-Central California Coast DPS	Threatened			X
	Southern California DPS	Endangered			X
Green sturgeon (*Acipenser medirostris*)	Southern DPS	Threatened	X		X
Eulachon (*Thaleichthys pacificus*)	Southern DPS	Threatened			X
Oceanic whitetip shark (*Carcharhinus longimanus*)		Threatened		X	X
Scalloped hammerhead shark (*Sphyrna lewini*)	Eastern Pacific DPS	Endangered			X
Giant manta (*Manta birostris*)		Threatened		X	X
Tope shark (*Galeorhinus galeus*)		Candidate			X

3.6.2.3 Species Not Listed Under the Endangered Species Act

Taxonomic categories of major fish groups in the Study Area are provided in Table 3.6-2. These fish groups are based on the organization presented by Moyle and Cech (2004), Nelson (2006), Helfman et al. (2009), and Froese and Pauly (2016). These groupings are intended to organize the extensive and diverse list of fishes that occur in the Study Area and serve to structure the analysis of potential effects on fishes with similar physiological characteristics and habitat use. Exceptions to these generalizations exist within each group and are noted wherever appropriate in the analysis of potential effects. For simplicity, the fishes are presented in generally accepted evolutionary order. Supporting information on each group is provided in Appendix C.

Table 3.6-2: Major Taxonomic Groups of Fishes in the Study Area

Major Fish Groups			Occurrence in the Study Area	
Group Names	Description	Representative Species	Open Ocean	Coastal Waters *
Jawless Fishes (Orders Myxiniformes and Petromyzontiformes)	Primitive, cartilaginous, eel-like vertebrates; parasitic or feed on dead fish	Hagfishes, Lamprey	Seafloor	Water column, seafloor
Ground Sharks, Mackerel Sharks, and Bullhead Sharks (Orders Carcharhiniformes, Lamniformes, Orectolobiformes, and Heterodontiformes)	Cartilaginous, two dorsal fins or first large, an anal fin, and five gill slits	Great White, Horn, Oceanic Whitetip, Scalloped Hammerhead, Whale, and Tiger sharks	Water column, seafloor	Water column
Frilled and Cow Sharks, Sawsharks, Dogfish, and Angel Sharks (Orders Hexanchiformes, Squaliformes, and Squatiniformes)	Cartilaginous, anal fin and nictitating membrane absent, 6-7 gill slits	Dogfish, Frill, Sevengill, and Sixgill sharks	Water column, seafloor	Seafloor
Stingrays, Sawfishes, Skates, Guitarfishes, Electric Rays and Rays (Orders Myliobatiformes, Pristiformes, Rajiformes, and Torpediniformes)	Cartilaginous, flat-bodied, usually 5 gill slits	Electric ray, Giant Manta rays, Skates, Stingrays	Water column, seafloor	Water column, seafloor
Ratfishes (Order Chimaeriformes)	Cartilaginous, placoid scales	Chimaera, Rabbitfish, Ratfishes	Seafloor	NA
Herrings and allies (Order Clupeiformes)	Silvery, lateral line on body and fin spines absent, usually scutes along ventral profile	Anchovies, Herrings, Sardines	NA	Surface, water column

Table 3.6-2: Major Taxonomic Groups of Fishes in the Study Area (continued)

Major Fish Groups			Occurrence in the Study Area	
Group Names	**Description**	**Representative Species**	**Open Ocean**	**Coastal Waters ***
Tarpons and allies (Orders Elopiformes and Albuliformes)	Body encased in silvery scales, mouth large, mostly a single dorsal fin, some with tapered tail fin, spines absent	Bonefishes, Ladyfish, Malacho, Tarpons	Water column, seafloor	Surface, water column, seafloor
Eels and allies (Orders Anguilliformes, Notacanthiformes, and Saccopharyngiformes)	Body very elongate, usually scaleless with pelvic fins and fin spines absent	American, Conger, Duckbill, Halosaur, Morays, Sawtooth, Short-tailed, Spiny, Gulper, Pelican	Water column, seafloor	Water column, seafloor
Salmonids (Orders Salmoniformes)	Silvery body, adipose fin present	Chinook and Chum salmon, Steelhead	NA	Surface, water column
Argentines and allies (Order Argentiniformes)	Body silvery, and elongate; fin spines absent; adipose fin sometimes present, pelvic fins and ribs sometimes absent	Barreleyes, Deep sea smelts, Slickheads, Tubeshoulders	Water column, seafloor	NA
Bristlemouths and allies (Orders Stomiiformes)	Photophores present, adipose and chin barbels fin sometimes present	Dragonfishes, Fangjaws, Hatchetfishes, Lightfishes	Water column, seafloor	NA
Greeneyes and allies (Order Aulopiformes)	Upper jaw protrusible adipose fin present, forked tail usually present	Barracudinas, Daggertooth, Greeneyes, Lizardfishes, Pearleyes, Waryfishes	Surface, water column, seafloor	NA
Lanternfishes and allies (Order Myctophiformes)	Small-sized, adipose fin, forked tail and photophores usually present	Lanternfishes	Water column, seafloor	NA
Hakes and allies (Order Gadiformes)	Long dorsal and anal fins; no true spines, spinous rays present in dorsal fin, barbels present	Cods, Codlings, Grenadiers, Hakes, Whiptails	Water column, seafloor	Surface, water column, seafloor
Brotulas and allies (Order Ophidiiformes)	Pelvic absent or far forward and filamentous, no sharp spines, Dorsal and anal fins joined to caudal fins	Brotulas, Cusk-eels	Water column, seafloor	Water column, seafloor

Table 3.6-2: Major Taxonomic Groups of Fishes in the Study Area (continued)

Major Fish Groups			Occurrence in the Study Area	
Group Names	**Description**	**Representative Species**	**Open Ocean**	**Coastal Waters ***
Toadfishes and allies (Order Batrachoidiformes)	Body compressed; head large; mouth large with tentacles; two dorsal fins, the first with spines	Toadfish, Midshipman	NA	Seafloor
Anglerfishes and allies (Order Lophiiformes)	Body globulose, first spine on dorsal fin usually modified, pelvic fins usually absent	Anglerfishes, Footballfishes, Frogfishes, Goosefishes, Sea devils	Water column, seafloor	Seafloor
Flyingfishes (Order Beloniformes)	Jaws extended into a beak; pelvic fins very large wing-like; spines absent	Flyingfishes, Halfbeaks, Needlefishes Sauries	Surface, water column	Surface, water column
Killifishes (Orders Cyprinodontiformes)	Small-sized, silvery stripe on sides, pectoral fins high, first dorsal fin with flexible spine, pelvic fin with one spine	California killifish	NA	Surface, water column
Silversides (Order Atheriniformes)	Protrusible upper jaw; fin spines rarely present; single dorsal fin	Grunion, Jacksmelt, Topsmelt	NA	Water column
Opahs and allies (Order Lampriformes	Upper jaw protrusible; pelvic fins forward on body, below or just behind insertion of pectoral fins	Crestfishes, Oarfishes, Opahs, Ribbonfishes, Tapertails, Tube-eyes	Water column, seafloor	NA
Squirrelfishes and allies (Order Beryciformes)	Body usually round, one dorsal fin often set far back, pelvic fins absent, fin spines often present	Bigscales, Fangtooths, Pricklefish, Slimeheads, Squirrelfishes Whalefishes	Water column, seafloor	NA
Dories and allies (Order Zeiformes)	Body deeply compressed, protrusible jaws, spines in dorsal fin, pelvic fin spines sometimes present	Boarfishes, Dories, Oreos, Tinselfishes	Water column, seafloor	NA

Table 3.6-2: Major Taxonomic Groups of Fishes in the Study Area (continued)

Major Fish Groups			Occurrence in the Study Area	
Group Names	**Description**	**Representative Species**	**Open Ocean**	**Coastal Waters ***
Pipefishes (Order Syngnathiformes)	Snout tube-like, mouth small, scales often modified bony plates	Cornetfish, Seahorses, Snipefishes	Water column, seafloor	Seafloor
Sticklebacks (Order Gasterosteiformes)	Mouth small, scales often modified bony plates	Threespine stickleback	Water column, seafloor	Seafloor
Scorpionfishes (Order Scorpaeniformes)	Usually strong spines on head and dorsal fin; cheeks with bony struts, pectoral fins usually rounded	Poachers, Rockfishes, Sculpins Snailfishes	Water column, seafloor	NA
Mullets (Order Mugiliformes)	Streamline body, forked tail, hard angled mouth, large scales	Acute-jawed, Flathead grey, Kanda	NA	Surface, water column, seafloor
Perch-like Fishes and Allies (Order Perciformes)	Deep bodied, to moderately elongate, 1–2 dorsal fins, large mouth and eyes, and throracic pelvic fins	Angelfishes, Cardinal Fishes, Drums, Groupers, Jacks, Remoras, Surfperches	Water column, seafloor	Water column, seafloor
Wrasses and Allies (Order Perciformes)	Compressed body, scales large, well-developed teeth, usually colorful	Hogfishes, Parrotfishes, Wrasses, Damselfishes	NA	Seafloor
Eelpouts and Allies (Order Perciformes)	Eel-like body, long dorsal and anal fins, pelvic fins usually absent	Gunnels, Ocean pout, Pricklebacks, Wolfeels	Seafloor	Seafloor
Stargazers (Order Perciformes)	Body elongated, lower jaw usually projecting beyond upper jaw, pelvic and anal fins with spines	Stargazers	Water column, seafloor	Water column, seafloor
Blennies, Gobies, and Allies (Order Perciformes)	Body eel-like to sculpin-like, pelvic fins reduced or fused	Blackeye and Cheekspot goby, mussel blenny	NA	Seafloor
Surgeonfishes (Order Perciformes)	Body deeply compressed laterally, mouth small, scales usually small, pelvic fins with spines	Achilles tang, Surgeonfishes	NA	NA

Table 3.6-2: Major Taxonomic Groups of Fishes in the Study Area (continued)

Major Fish Groups			Occurrence in the Study Area	
Group Names	**Description**	**Representative Species**	**Open Ocean**	**Coastal Waters ***
Tunas and Allies (Order Perciformes)	Large mouth, inlets and keels usually present, pelvic fins often absent or reduced, fast swimmers	Barracudas, Billfishes, Swordfishes, Tunas	Surface, water column	Water column for juvenile barracudas only
Butterfishes (Order Perciformes)	Snout blunt and thick, teeth small, maxilla mostly covered by bone	Ariommatids, Driftfishes, Medusafishes	Surface, water column, seafloor	NA
Flatfishes (Order Pleuronectiformes)	Body flattened; eyes on one side of body	Flounders, Halibuts, Sanddabs, Soles, Tonguefishes	Seafloor	Seafloor
Pufferfishes (Order Tetraodontiformes)	Skin thick or rough sometimes with spines or scaly plates, pelvic fins absent or reduced, small mouth with strong teeth coalesced into biting plate	Boxfishes, Filefishes, Ocean sunfishes, Triggerfishes	Water column	Surface, water column, seafloor

* Coastal Waters include bays, estuaries, and harbors.
Note: NA = not applicable

3.6.3 Environmental Consequences

None of the proposed military readiness activities would be conducted under the No Action Alternative. Therefore, baseline conditions of the existing environment for fishes would either remain unchanged or would improve slightly after cessation of ongoing military readiness activities. As a result, the No Action Alternative is not analyzed further within this section.

This section describes and evaluates how and to what degree the activities and stressors described in Chapter 2 and Section 3.0.3.3 potentially effect fishes known to occur within the Study Area.

The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors analyzed for fishes are as follows:

- **acoustic** (sonar and other transducers; air guns; pile driving; vessel noise; aircraft noise; and weapons noise)
- **explosives** (in-air explosions and in-water explosions)
- **energy** (in-water electromagnetic devices and high-energy lasers)

- **physical disturbance and strikes** (vessels and in-water devices, MEM, seafloor devices, and cable installation)
- **entanglement** (wires and cables, decelerators/parachutes, nets)
- **ingestion** (MEM)

The analysis considers standard operating procedures and mitigation measures that would be implemented under Alternative 1 and Alternative 2. The standard operating procedures and mitigation specific to fishes are listed in Table 3.6-3.

Table 3.6-3: Relevant Mitigation Measures for Fishes

Applicable Stressor	Requirements Summary and Protection Focus	Section Reference
Explosives	The Action Proponents will not detonate any in-water explosives within a horizontal distance of 350 yards (yd.) from shallow-water coral reefs and precious coral beds.	Section 5.7.1[1]
	The Action Proponents will not detonate any in-water explosives within a horizontal distance of 350 yd. from artificial reefs, biogenic habitat, and shipwrecks, except in designated locations where these resources will be avoided to the maximum extent practical.	Section 5.7.2[1]
	The Action Proponents will conduct visual observations as part of activity-based mitigation for large schools of fish during events with the largest net explosive weights involving explosive torpedoes and ship shock trials.	Section 5.6[2]
	The Action Proponents will not: (1) deploy non-explosive ordnance against surface targets within 350 yd. of shallow-water coral reefs	Section 5.7.1[1]
	The Action Proponents will not: (1) place non-explosive seafloor devices directly on artificial reefs, biogenic hard bottom, submerged aquatic vegetation, or shipwrecks	Section 5.7.2[1]

[1]The mitigation was developed to protect specific habitats, which also protects fish that are associated with those habitats.
[2]The mitigation was developed to protect possible indicators of marine mammal presence, which includes large schools of fish.

As noted in Section 3.0.2, a significance determination is only required for activities that may have reasonably foreseeable adverse effects on the human environment based on the significance factors in 40 CFR 1501.3(d). All stressors analyzed could have a reasonably foreseeable adverse effect; thus requiring a significance determination.

A stressor is considered to have a significant effect on the human environment based on an examination of the context of the action and the intensity of the effect. In the present instance, the effects of the stressors analyzed would be considered significant if the impacts to fishes would be short-term or long-term and well outside the limits of natural variability of species' populations, their habitats, or the natural processes sustaining them. A significant effect finding would be appropriate if the effects caused mortality beyond a small number of individuals, resulting in a decrease in population levels, or if fish habitat would be degraded over the long term or permanently such that it would no longer support a sustainable fishery and/or would cause the population of a managed species to become stressed, less productive, or unstable.

3.6.3.1 Acoustic Stressors

This section summarizes the potential effects of acoustic stressors used during military readiness activities within the Study Area. The acoustic substressors included for analysis are (1) sonar and other transducers, (2) air guns, (3) pile driving, (4) vessel noise, (5) aircraft noise, and (6) weapons noise. Table 3.6-4 contains brief summaries of background information that is relevant to the analyses of effects for each acoustic substressor (sonar and other transducers, etc.) on fishes. Detailed information on acoustic impact categories in general, as well as effects specific to each substressor, is provided in Appendix D. For a listing of the types of activities that use or produce acoustic stressors, refer to Appendix A and Appendix B. The types and quantities of sonar sources, air guns, and pile driving, the number of events using vessels and aircrafts, and the locations of those events under each alternative are shown in Section 3.0.3.3.1.

Due to updated acoustic effects modeling, the quantitative analysis of effects due to sonars and other transducers, air guns, and pile driving (i.e., ranges to effects) provided in this section supplant the analyses in the 2018 HSTT EIS/OEIS. The detailed assessment of these acoustic stressors under this Proposed Action is in Appendix E. Potential changes in the predicted acoustic effects are due to the following:

- Improvements to criteria used to determine if acoustic stressors may cause effects.
- Revisions to the modeling of explosive effects in the Navy Acoustic Effects Model. For additional details see the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase IV Training and Testing* (U.S. Department of the Navy, 2024).
- Changes in the locations, numbers, and types of modeled military readiness activities as described in Chapter 2, and associated quantities (hours and counts) of acoustic stressors shown in Section 3.0.3.3.1.

Table 3.6-4: Acoustic Stressors Information Summary

Substressor	Information Summary
All acoustic substressors	Fishes are not equally sensitive to sound at all frequencies. • Most fishes are hearing generalists and primarily detect particle motion at frequencies below 2 kilohertz (kHz). • Hearing specialists can detect low frequencies but also possess anatomical specializations to enhance hearing and are capable of sound pressure detection up to 10 kHz, or over 100 kHz in some species. • Fishes with a swim bladder are generally more susceptible to temporary threshold shift (TTS) than those without a swim bladder, regardless of the sound source.
Sonar and other transducers	Sonar and other transducers may result in hearing loss, masking, physiological stress, or behavioral reactions. • Most low-frequency sonars have relatively low source levels (see Table 3.0-2, in Section 3.0.3.3.1 for the quantities of low-frequency sonars with source levels < 205 decibels) and would not likely result in TTS. If TTS did occur, it would occur within near to intermediate distances from a sound source (a few to tens of meters) from systems with high source levels, or those that are operated at high duty cycles or continuously. • Although masking is possible for sources that fish can hear, the narrow bandwidth and intermittent nature of most sonar signals would result in only a limited probability of effects.

Table 3.6-4: Acoustic Stressors Information Summary (continued)

Substressor	Information Summary
Sonar and other transducers (continued)	• Available research showed very little response of both captive and wild Atlantic herring (hearing specialists) to sonar (e.g., no avoidance). Such data suggests sonar poses little risk to populations of herring and that there is a low probability of behavioral reactions to sonar for most fishes. • Direct injury from sonar and other transducers is highly unlikely and is not considered further in this analysis.
Air guns	Exposure to air guns could result in hearing loss, masking, physiological stress, or behavioral reactions, and in some cases, injury. • Hair cell loss and TTS have been reported in fishes exposed to air guns, though fishes typically recovered from these effects in controlled laboratory settings. • Although masking could occur, air gun pulses are typically brief (fractions of a second) and biological sounds can be detected between pulses within close distances to the source. Masking could also indirectly occur because of repetitive impulsive signals where the repetitive sounds and reverberations over distance may create a more continuous noise exposure. • Fish may react behaviorally to any impulsive sound source within near and intermediate distances (tens to hundreds of meters), with decreasing probability of reaction at increasing distances. Examples of reported behavioral reactions to impulsive sources include startle response, changes in swimming speeds and movement patterns, avoidance of the sound source, and no observed response. • Exposure to air gun shots has not caused mortality, and fishes typically recovered from injuries in controlled laboratory settings.
Pile driving	Pile installation and removal involves both impact and vibratory methods. Exposure to pile driving could result in hearing loss, masking, physiological stress, or behavioral reactions, and in some cases, injury. • Hair cell loss and TTS have been reported in fishes exposed to impact pile driving, though fishes typically recovered from these effects in controlled laboratory settings. • Although masking could occur, impact pile driving pulses are typically brief (fractions of a second) and biological sounds can be detected between pulses within close distances to the source. Masking could also indirectly occur because of repetitive impulsive signals where the repetitive sounds and reverberations over distance may create a more continuous noise exposure. • Vibratory pile driving could result in reductions in auditory sensitivity and masked biological signals. The relative risk of masking due to vibratory pile driving is highest in the near and moderate distances from the source (up to hundreds of meters) but decreases with increasing distance. • Fish may react behaviorally to any impulsive sound source within near and intermediate distances (tens to hundreds of meters), with decreasing probability of reaction at increasing distances. Examples of reported behavioral reactions to impulsive sources include startle response, changes in swimming speeds and movement patterns, avoidance of the sound source, and no observed response. • Exposure to impact pile driving has not caused mortality, and fishes typically recovered from injuries in controlled laboratory settings. • Direct injury from vibratory pile driving, like other continuous sources, is highly unlikely and is not considered further in this analysis.

Table 3.6-4: Acoustic Stressors Information Summary (continued)

Substressor	Information Summary
Vessel disturbance (including vessel noise)	Vessel disturbance (including the production of noise) may result in hearing loss, masking, physiological stress, or behavioral reactions. In some more industrialized or populated areas, vessel noise is a chronic and frequent stressor. • Behavioral responses to vessels can be caused by multiple factors (e.g., visual cues) as vessel sound exposure is rarely decoupled from the physical presence of a vessel. • Fishes with hearing specializations are more susceptible to TTS from long duration continuous noise (e.g., 12 hours). However, it is less likely that TTS would occur in fishes that are hearing generalists. • The probability of masking, physiological responses, and behavioral reactions from vessel noise is higher at near to moderate distances from the source (up to hundreds of meters) but decreases with increasing distance. • Direct injury from vessel noise is highly unlikely and is not considered further in this analysis.
Aircraft disturbance (including aircraft noise)	Aircraft noise may result in masking, physiological stress, or behavioral reactions in fishes near the surface as aircrafts pass overhead. • Aircraft sound exposure is rarely decoupled from the physical presence of an aircraft therefore responses may be due to multiple factors (e.g., visual cues). • Most aircraft activities are transient resulting in brief periods of exposure (seconds to minutes), with fewer instances where aircraft noise would persist for longer periods (e.g., hovering helicopters, which are accompanied by other disturbance factors such as shadows and water displacement). • Sound from an overhead aircraft would only be transmitted into the water in a narrow beam directly below the source, minimizing the total energy that enters the water and limiting the total ensonified area. • Documented reactions by fishes to aircraft noise is limited, however fishes would be expected to react to aircraft noise as they would react to other transient sounds (e.g., vessel noise).
Weapons noise	Weapons noise may result in hearing loss, masking, physiological stress, or behavioral reactions. • Weapons noise is rarely decoupled from the physical presence of a vessel or object (e.g., projectiles) therefore responses may be due to multiple factors (e.g., visual cues). • Sound from weapons firing would only be transmitted into the water directly below the firing source, transiting projectile, or at the area of impact, minimizing the total energy that enters the water and limiting the total ensonified area. • Reactions by fishes to weapons noise is limited; however, fishes would be expected to react to weapons noise as they would react to other transient sounds (e.g., vessel noise). • Documented reactions by fishes weapons noise is limited, however fishes would be expected to react to weapons noise as they would react to other impulsive sounds (e.g., impact pile driving or air guns).

3.6.3.1.1 Effects from Sonar and Other Transducers

Table 3.6-4 contains a summary of the background information used to analyze the potential effects of sonar and other transducers (hereafter inclusively referred to as sonars) on fishes. Many non-impulsive sounds associated with military readiness activities are produced by sonar. Other transducers include items such as acoustic projectors and countermeasure devices.

Although some marine fishes are considered hearing specialists (e.g., shad) and could be impacted by mid- or high-frequency sources, sound from these systems do not propagate as far as other sonars limiting the range these sources would be detectable, and therefore minimizing potential risk of effects. Most marine fishes (hearing generalists) would not detect most mid- or high-frequency sonars and therefore would not experience effects from these systems. Therefore, only sonars below 2 kHz, including low-frequency sonar, are analyzed for their effects on fishes. Potential effects from sonars could include TTS, behavioral reactions, physiological response, and masking.

3.6.3.1.1.1 Effects from Sonar and Other Transducers Under Alternative 1

Training and Testing. All fishes can detect low-frequencies, therefore, most effects would be limited to a subset of activities that utilize low-frequency (<2 kHz) sonars. Low-frequency sonars are operated less often than mid- or high-frequency sources throughout the Study Area. These systems could be used throughout the Study Area in the locations identified in Chapter 2 but would be concentrated in the Hawaii Range Complex and SOCAL Range Complex. Some low-frequency sonars could also be utilized in shallow water training ranges or nearshore areas (e.g., SCI nearshore under training and Pearl Harbor under testing activities), though these systems are typically operated farther offshore, in deeper waters. Generally, sonar is used more often during testing than training activities, resulting in slightly more potential effects from testing activities.

Fishes may only detect the most powerful low-frequency systems within a few kilometers; and most other, less powerful systems, at shorter ranges. Overall, TTS is not anticipated to occur in fishes exposed to low-frequency sonars as these systems generally lack the power necessary to generate hearing loss. Although unlikely, hearing specialists in proximity (tens of meters) to some mid-frequency systems may experience TTS. These individuals may experience a reduced ability to detect biologically relevant sounds until their hearing recovers (likely within a few minutes to hours depending on the amount of threshold shift).

Most sonars do not have the potential to substantially mask key environmental sounds due to the limited time of exposure resulting from the moving sound sources and variable duty cycles. Although available research has shown a lack of behavioral reactions to military sonar by hearing specialists (herring) (e.g., Sivle et al., 2012), it is possible that fish exposed to sonar could show some physiological or behavioral responses, especially in fish or schools of fish located close to the source (hundreds of meters). However, these effects, if any, would be localized and infrequent, only lasting a few seconds or minutes due to the transient nature of most sonar operations.

Based on the updated background and analysis for training and testing under Alternative 1, sonar effects on fishes would be limited to brief (seconds to minutes) periods of physiological or behavioral reactions to individual fish found within localized areas.

Modernization and Sustainment of Ranges. Sonars would not be used during modernization and sustainment of range activities.

Conclusion. Activities that include the use of sonars under Alternative 1 would result in less than significant effects due to the limited to brief (seconds to minutes) periods of physiological or behavioral reactions to individual fish found within localized areas. Overall, sonar use is unlikely to impact individuals and long-term consequences for fish populations would not be expected.

3.6.3.1.1.2 Effects from Sonar and Other Transducers under Alternative 2

Because sonar use in terms of types, duration, and locations is similar to Alternative 1, effects from sonar and other transducers under Alternative 2 would be similar to those discussed under Alternative 1. Therefore, activities that include the use of sonar under Alternative 2 would result in less than significant effects.

3.6.3.1.2 Effects from Air Guns

Table 3.6-4 contains a summary of the background information used to analyze the potential effects of air guns on fishes. The broadband impulses from air guns are within the hearing range of all fishes. Potential effects from air guns could include auditory injuries, TTS, behavioral reactions, physiological response, and masking. The ranges to auditory effects for air guns are in in Appendix E.

3.6.3.1.2.1 Effects from Air Guns Under Alternative 1

Training and Testing. Air guns would not be used during training activities. During testing activities, small air guns would be fired over a limited period within a single day. Air gun use would occur nearshore in the SOCAL Range Complex and greater than 3 NM from shore in the Hawaii, NOCAL, and SOCAL Range Complexes.

A quantitative analysis was performed to estimate range to effects for fishes exposed to air guns. However, calculated ranges to effects indicate injury and hearing loss would only occur within a short distance (less than 5 m). Exposure to air guns could also result in masking, physiological response, or behavioral reactions. These effects are expected to be brief (seconds to minutes) due to the short pulse length (approximately 0.1 second) and intermittent use of air guns throughout the Study Area.

Based on the updated background and analysis for training and testing under Alternative 1, air gun effects on fishes would be limited to temporary (minutes to hours) physiological and behavioral responses, and some instances of TTS or direct injury (though this would be rare) in individual fishes found within localized areas.

Modernization and Sustainment of Ranges. Air guns would not be used during modernization and sustainment of ranges activities.

Conclusion. Activities that include the use of air guns under Alternative 1 would result in less than significant effects due to the unlikelihood of injurious effects and hearing loss (i.e., due to the short ranges to effects), and the limited to brief (seconds to minutes) periods of physiological or behavioral reactions to individual fish found within localized areas. Overall, air guns use is unlikely to impact individuals and long-term consequences for fish populations would not be expected.

3.6.3.1.2.2 Effects from Air Guns Under Alternative 2

Effects from air guns under Alternative 2 are not meaningfully different from Alternative 1. Therefore, activities that include the use of air guns under Alternative 2 would result in less than significant effects.

3.6.3.1.3 Pile Driving

Table 3.6-4 contains a summary of the background information used to analyze the potential effects of pile driving noise on fishes. Only port damage repair training includes pile driving. The impact and vibratory pile driving hammers would expose fishes to impulsive and continuous non-impulsive broadband sounds, respectively. Potential effects could include injuries, TTS, behavioral reactions, physiological responses (stress), and masking. The ranges to injurious and auditory effects for pile driving are in in Appendix E.

3.6.3.1.3.1 Effects from Pile Driving Under Alternative 1

Training and Testing. Impact and vibratory pile driving would not occur during testing activities. Pile driving would occur as part of Port Damage Repair activities in Port Hueneme, California. Impact and vibratory pile driving during Port Damage Repair training activities can occur over a period of 14 days during each training event, and up to 12 times per year. Pile driving activities would occur intermittently in very limited areas and would be of temporary duration. The activity location is in a highly urbanized all quay wall port.

A quantitative analysis was performed to estimate range to effects for fishes exposed to pile driving. Due to the static nature of pile driving activities, two exposure times were used when calculating potential range to effects for different types of fish (e.g., transient, or migratory species versus resident species or those with high site fidelity). The calculations for ranges to effects assumed that some transient fishes would likely move through the area during pile driving activities, resulting in low exposure durations. In contrast, calculations for ranges to effects assumed that resident fishes may remain in the area during pile driving activities and therefore would receive a higher cumulative exposure level.

Estimated ranges to mortality and injury for transient species from the largest pile type and size (i.e., up to 20-inch steel piles) was 10 meters. Although it was estimated that TTS could occur within 131 m for some species, TTS would likely occur at shorter distances for other pile types and sizes, and for hearing generalists. In contrast, ranges to effects for resident species from the largest pile type and size was 50 and 93 m, respectively. Furthermore, it is anticipated that most hearing specialists present in the port for a full day may receive TTS as the estimated ranges would cover the entire footprint of Port Hueneme. However, the port is a highly disturbed environment with high existing ambient levels of noise so it is unlikely most fishes would remain in the port for long periods of time due to high amount of human disturbance and the lack of suitable habitat. Additionally, the standard operating procedure for soft starts may warn nearby fishes causing them to avoid the ensonified area. Available research suggest fishes are more likely to startle or avoid the immediate area surrounding a pile driving activity or, in some cases, would habituate and return to normal behaviors after initial exposure. In the rare event some individuals remain in the area for a full day and receive TTS, these fish may experience a reduced ability to detect biologically relevant sounds until their hearing recovers (likely within a few minutes to days depending on the amount of threshold shift).

Fishes exposed to vibratory extraction would not experience mortality, injury, or TTS based on the low source level and limited duration of these activities. Based on the predicted noise levels, fishes may exhibit other responses such as temporary masking, physiological response, or behavioral reactions such as increasing their swimming speed, moving away from the source, or not responding at all. Individual fish that avoid the pile driving location would likely find similar suitable habitat in adjacent areas or would return to the location after cessation of the noise, reducing the potential for long-term effects.

Based on the updated background and analysis for training and testing under Alternative 1, pile driving effects on fishes could result in the death or injury of a small number of individual fish, as well as brief (seconds to minutes) periods of physiological or behavioral reactions of fish found within localized areas. This is consistent with a moderate (due to limited potential injury/mortality to some individuals) impact on fish populations.

Modernization and Sustainment of Ranges. Pile driving would not be used during modernization and sustainment of range activities.

Conclusion. Activities that include pile driving or removal under Alternative 1 would result in less than significant effects due to the likelihood that only a small number of individuals would be harmed, which would have minimal effects on the overall population and abundance of a given species, and the limited to brief (seconds to minutes) periods of physiological or behavioral reactions to individual fish found within localized areas. Although some individuals may be impacted, long-term consequences for fish populations would not be expected.

3.6.3.1.3.2 Effects from Pile Driving Under Alternative 2

Effects from pile driving during training under Alternative 2 are no different from Alternative 1. Therefore, activities that include pile driving or removal under Alternative 2 would be the same as Alternative 1 and would result in less than significant effects.

3.6.3.1.4 Vessel Noise

Table 3.6-4 contains a summary of the background information used to analyze the potential effects of vessel noise on fishes. The broadband, non-impulsive, and continuous noise from vessels is within the hearing range of all fishes. Additional information on the assessment of this acoustic stressor under the Proposed Action is in Appendix E.

3.6.3.1.4.1 Effects from Vessel Noise Under Alternative 1

Training and Testing. Based on the updated background and previous analysis for training and testing under Alternative 1, vessel noise effects on fishes would be limited to temporary (hours) behavioral and stress-startle responses to individual fish found within localized areas. This is consistent with a negligible impact on fish populations.

Modernization and Sustainment of Ranges. Vessel noise would be produced during SOAR Modernization, SWTR Installation, Sustainment of Undersea Ranges, Deployment of Seafloor Cables and Instrumentation, Installation and Maintenance of Mine Warfare and Other Training Areas, and Installation and Maintenance of Underwater Platforms. Vessel noise may result in masking, physiological stress, or behavioral reactions. During installation activities, vessels would move slowly (0 to 3 knots) which would limit ship-radiated noise from propeller cavitation and water flow across the hull.

Conclusion. Activities that include vessel noise under Alternative 1 would result in less than significant effects due to the limited to brief (seconds to minutes) periods of physiological or behavioral reactions to individual fish found within localized areas. Overall, vessel noise is unlikely to impact individuals and long-term consequences for fish populations would not be expected.

3.6.3.1.4.2 Effects from Vessel Noise Under Alternative 2

Effects from vessel noise under Alternative 2 are not meaningfully different from Alternative 1. Therefore, activities that include vessel noise under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.1.5 Aircraft Noise

Table 3.6-4 contains a summary of the background information used to analyze the potential effects of aircraft noise on fishes. Aircrafts produce broadband, non-impulsive, continuous noise during operation and transit that is within the hearing range of all fishes. Additional information on the assessment of this acoustic stressor under the Proposed Action is in Appendix E.

3.6.3.1.5.1 Effects from Aircraft Noise Under Alternative 1

Training and Testing. Based on the updated background and previous analysis for training and testing under Alternative 1, aircraft noise effects on fishes would be limited to brief (seconds to minutes) behavioral and stress-startle responses to individual fish found within localized areas.

Modernization and Sustainment of Ranges. Aircraft noise would not be produced during modernization and sustainment of range activities.

Conclusion. Activities that include aircraft noise under Alternative 1 would result in less than significant effects due to the limited to brief (seconds to minutes) periods of physiological or behavioral reactions to individual fish found within localized areas. Overall, aircraft noise is unlikely to impact individuals. If impacts do occur, they are expected to be insignificant; therefore, long-term consequences for fish populations would not be expected.

3.6.3.1.5.2 Effects from Aircraft Noise Under Alternative 2

Effects from aircraft noise under Alternative 2 are not meaningfully different from Alternative 1. Therefore, activities that include aircraft noise under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.1.6 Weapons Noise

Table 3.6-4 contains a summary of the background information used to analyze the potential effects of weapons noise on fishes. Firing of guns, vibrations from the hull of ships, items that impact the water's surface, and items launched from underwater may produce weapons noise that are within the hearing range of all fishes. Additional information on the assessment of this acoustic stressor under the Proposed Action is in Appendix E.

3.6.3.1.6.1 Effects from Weapons Noise Under Alternative 1

Training and Testing. Based on the updated background and previous analysis for training and testing under Alternative 1, weapons noise effects on fishes would be limited to brief (seconds to minutes) behavioral and stress-startle responses to individual fish found within localized areas.

Modernization and Sustainment of Ranges. Weapons noise would not be produced during modernization and sustainment of range activities.

Conclusion. Activities that include weapons noise under Alternative 1 would result in less than significant effects due to the limited to brief (seconds to minutes) periods of physiological or behavioral reactions to individual fish found within localized areas. Overall, sonar use is unlikely to impact individuals. If impacts do occur, they are expected to be insignificant; therefore, long-term consequences for fish populations would not be expected.

3.6.3.1.6.2 Effects from Weapons Noise Under Alternative 2

Effects from weapons noise under Alternative 2 are not meaningfully different from Alternative 1. Therefore, activities that include weapons noise under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.2 Explosive Stressors

This section summarizes the potential effects of explosives used during military readiness activities within the Study Area. Table 3.6-5 summarizes background information that is relevant to the analyses of effects for explosives. New applicable and emergent science regarding explosive effects is presented in Appendix D. Due to updates to acoustic effects modeling, criteria and thresholds used to assess effects, and changes to proposed use of explosives, the analysis of effects due to explosives provided in this section supplant the analyses in the 2018 HSTT EIS/OEIS. The detailed assessment of explosive stressors under this Proposed Action is in Appendix E. Changes in the predicted explosive effects are due to the following:

- Improvements to criteria used to determine if an exposure to explosive energy may cause effects.
- Revisions to the modeling of explosive effects in the Navy Acoustic Effects Model. See the technical report Quantifying Acoustic Effects on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase IV Training and Testing (U.S. Department of the Navy, 2024).
- Changes in the locations, numbers, and types of modeled military readiness activities as described in Chapter 2, and associated quantities of explosives (counts) shown in Section 3.0.3.3.2.

Table 3.6-5: Explosive Stressors Information Summary

Substressor	Information Summary
Explosives in water	Sound and energy from explosives in water pose the greatest potential threats for injury and mortality in marine fishes and may also cause hearing loss, masking, physiological stress, or behavioral responses. • Fishes without a swim bladder, adult fishes, and larger species would generally be less susceptible to injury and mortality from sound and energy associated with explosive activities than fishes with a swim bladder, small, juvenile, or larval fishes. • Sound and energy from explosions could result in mortality, injury, and temporary threshold shift, on average, for hundreds or even thousands of meters from some of the largest explosions. • Generally, the size of the explosive correlates to the ranges to effects (i.e., larger charges produce longer ranges). Observed effects also depend on the geometry of the exposure (e.g., distance and depth relationship to the receiver). • Though hearing loss has never been measured in fishes exposed to explosives, fish may respond to explosives similarly to other impulsive sources. • Masking would be unlikely due to the intermittent nature of explosions. If masking were to occur, it would only occur during the duration of the signal. • Without specific data, it is assumed that fishes with similar hearing capabilities show similar behavioral reactions to all impulsive sounds (e.g., air guns and impact pile driving) outside the zone for hearing loss and injury.
Explosives in air	In-air detonations at or near the water surface could transmit sound and energy into the water and impact fishes. However, detonations within a few tens of meters of the surface are analyzed as if detonating completely underwater and the background information described above would also apply. Detonations that occur at higher altitudes would not propagate enough sound and energy into the water to result in effects on fishes and therefore are not analyzed in this section.

As discussed in Section 3.6.3, the Action Proponents will implement mitigation under Alternative 1 and Alternative 2 to reduce potential effects from explosives on fish. Activity-based mitigation will include visual observations for large schools of fish during ship shock trials, and restrictions on the use of certain explosives within important habitats used by fish for important life processes (e.g., in proximity to shallow-water coral reefs).

3.6.3.2.1 Effects from Explosives

Table 3.6-5 contains a summary of the background information used to analyze the potential effects of explosives on fishes. Potential effects from explosive energy and sound include non-auditory injury (including mortality), auditory effects (auditory injuries and TTS), behavioral reactions, physiological response, and masking. Ranges to effects for mortality, non-auditory injury, and auditory effects are shown in Appendix E. Explosive noise is very brief and intermittent, and detonations usually occur in a limited area over a brief period rather than being widespread. The potential for masking is limited. Fishes may behaviorally respond, but responses to single detonations or small numbers of clusters may be limited to startle responses.

3.6.3.2.1.1 Effects from Explosives Under Alternative 1

Training and Testing. Most explosive activities would occur in the SOCAL Range Complex, Hawaii Range Complex, and PMSR, although activities with explosives would also occur in other areas as described in Appendix A. Activities involving in-water explosives from medium- and large-caliber naval gunfire, missiles, bombs, or other munitions are conducted more than 12 NM from shore. This includes Small Ship Shock Trials that could occur in the SOCAL Range Complex. Sinking Exercises (SINKEX) are conducted greater than 50 NM from shore. Certain activities with explosives may be conducted closer to shore at locations identified in Appendix A, including the training activity Mine Neutralization Explosive Ordnance Disposal and testing activities Semi-Stationary Equipment Testing.

The death of an animal would eliminate them from the population and impact future reproductive potential. Exposures that result in non-auditory injuries may limit an animal's ability to find food, communicate with other animals, interpret the surrounding environment, or detect and avoid predators. Impairment of these abilities can decrease an individual's chance of survival or affect its ability to reproduce depending on the severity of the impact. Though TTS can impair an animal's abilities, individuals may recover quickly with little significant effect depending on the amount of threshold shift.

Fishes may also experience brief periods of masking, physiological response, or behavioral reactions, depending on the level and duration of exposure. However, due to the short duration of single explosive detonations, these effects are expected to be brief (seconds to minutes). Although multiple shots conducted during large events could lead to prolonged or repeated exposures within a short period of time (hours), military readiness activities involving explosions are generally dispersed in space and time. Consequently, repeated exposures over the course of a day or multiple days are unlikely and most behavioral effects are expected to be brief (seconds or minutes) and localized, regardless of the size of the explosion, and fish would likely return to their natural behavior shortly after exposure.

Based on the updated background and analysis for training and testing under Alternative 1, explosive effects on fishes could result in the death or injury of a small number of individual fish, as well as brief (seconds to minutes) periods of physiological or behavioral reactions of fish found within localized areas. This is consistent with a moderate (due to limited potential injury/mortality to some individuals) impact on fish populations.

Modernization and Sustainment of Ranges. Explosives would not be used during modernization and sustainment of range activities.

Conclusion. Activities that include the use of explosives under Alternative 1 would result in less than significant effects due to the likelihood that only a small number of individuals would be harmed, which would have minimal effects on the overall population and abundance of a given species, and the limited to brief (seconds to minutes) periods of physiological or behavioral reactions to individual fish found within localized areas. Although some individuals may be impacted, long-term consequences for fish populations would not be expected.

3.6.3.2.1.2 Effects from Explosives Under Alternative 2

Effects from explosives in water under Alternative 2 are not meaningfully different from Alternative 1. Therefore, activities that include the use of explosives under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.3 Energy Stressors

The potential adverse effects on fishes from energy stressors that can occur during military readiness activities within the Study Area are from (1) in-water and in-air electromagnetic devices and (2) high-energy lasers. The characteristics of energy introduced through military readiness activities and the relative magnitude and location of these activities that are the basis for analysis of potential effects on biological resources are provided in Section 3.0.3.3.3. The number and location of in-water electromagnetic devices and high-energy lasers events are provided in Table 3.0-10 and 3.0-12, respectively.

Summary information relevant to the analyses of effects for each energy substressor on fishes is provided in Table 3.6-6. Detailed information on energy effect categories in general, as well as effects specific to each substressor, is provided in Appendix F. In-air electromagnetic stressors are not applicable to fishes because they are transmitted in the air and not underwater and will not be analyzed further in this section.

Table 3.6-6: Energy Stressors Information Summary

Substressor	Information Summary
In-Water Electromagnetic Devices	Although many fish groups (particularly sharks and rays) are sensitive to electric and magnetic fields, the range to effects would be small and adverse physiological and behavioral effects would be unlikely at field strengths encountered by most individuals during proposed military readiness activities: • The potential response of various species to electric fields and electrical pulses may include no reaction, avoidance, habituation, changes in activity level, or attraction, but effects would only occur near the source. • Some shark and ray species have demonstrated behavioral reactions to magnetic fields (including avoidance), and some freshwater species have shown developmental and physiological effects, but the experimental field intensities were much greater than those associated with proposed activities. • Salmon navigate using Earth's magnetic field (Scanlan et al., 2018), and electromagnetic fields can alter their magnetic orientation (Naisbett-Jones et al., 2020). • A recent review of the effects of power cables and other energized devices found an overall relatively low risk of physiological and behavioral effects on fish (Copping et al., 2021). • Due to the relatively low field intensity, highly localized impact area, and limited duration of the activities (hours), exposure is not likely to impact the health of resident or migratory populations or have lasting effects on survival, growth, recruitment, or reproduction at the population level.

Table 3.6-6: Energy Stressors Information Summary (continued)

Substressor	Information Summary
High-Energy Lasers	The potential for fishes to be exposed to high-energy lasers would be low based on laser operational use and fish distribution: • High-energy lasers are directed at surface targets and would only affect fishes very near the surface if the laser missed its target. • Most fish species do not occur near the surface. • Most pelagic fishes do not occur at or near the surface during the day, when lasers would be used. Fishes located near the surface during the day would likely move away from mobile laser targets before lasers were fired, decreasing the potential for exposure.

3.6.3.3.1 In-Water Electromagnetic Devices

3.6.3.3.1.1 Effects from In-Water Electromagnetic Devices Under Alternative 1

Training and Testing. Military readiness activities involving in-water electromagnetic devices occur in the Hawaii and California Study Areas. Exposure of fishes to electromagnetic stressors is limited to those fish groups that can detect the electromagnetic properties in the water column (Bullock et al., 1983; Helfman et al., 2009) such as sharks and rays. A detailed analysis of potential electromagnetic effects on fishes from training and testing activities is provided in in the 2018 HSTT and the 2022 PMSR EIS/OEISs (U.S. Department of the Navy, 2018, 2022).

The in-water electromagnetic devices used in training and testing activities would not be anticipated to result in more than minimal effects on fishes as individuals or populations because (1) the range of effect (i.e., greater than Earth's magnetic field) is small (0.2 microtesla at 200 m from the source), (2) the electromagnetic components of these activities are limited to simulating the electromagnetic signature of a vessel as it passes through the water, and (3) the electromagnetic signal is temporally variable and would cover only a small spatial range during each activity in the Study Area. Some fishes could have a detectable response to electromagnetic exposure, but the fields generated are typically well below physiological and behavioral responses of magnetoreceptive fishes, and any effects would be temporary with no anticipated effect on an individual's growth, survival, annual reproductive success, or lifetime reproductive success (i.e., fitness), or species recruitment, and are not expected to result in population-level effects. Electromagnetic exposure of eggs and larvae of sensitive bony fishes would be low relative to their total ichthyoplankton biomass (Able & Fahay, 1998); therefore, potential effects on recruitment would not be expected.

The generation of electromagnetic fields during training and testing activities has the potential to interfere with prey detection and navigation in some ESA-listed fishes, such as scalloped hammerhead sharks, white tip reef sharks, and giant manta rays, but any disturbance would be inconsequential due to the reasons described in Table 3.6-6. As the locations, number of events, area affected, and potential effects associated with in-water electromagnetic devices would be similar under both alternatives (Section 3.0.3.3.3.1), the effects would also be similar.

Modernization and Sustainment of Ranges. New range modernization and sustainment activities include installation of undersea cables and sensor nodes to sustain the capabilities of the SOAR. Undersea cables and sensor nodes would also be installed at the two new SWTRs as an extension to the SOAR. Deployment of fiber optic cables along the seafloor would occur in three locations: south and west of SCI in the California Study Area, to the northeast of Oahu, and west of Kauai in the Hawaii Study

Area. The EMF produced by these cables as electromagnetic energy dissipates exponentially by distance from the energy source, the magnetic field from the cable would be equal to 0.1 percent of the Earth's at a distance of 6 m (20 ft.). The cables and nodes would be installed at the bottom of the ocean floor, in most cases at a minimum depth of 37 m (120 ft.). Given this depth, fish are unlikely to come into extended contact with cables or nodes and it is extremely unlikely that they would be affected by the magnetic field.

Conclusion. Activities that include the use of in-water electromagnetic devices under Alternative 1 would result in less than significant effects since physiological and behavioral effects on fishes would be unlikely at the electromagnetic field strengths that fishes encountered, as supported by a recent review (Copping et al., 2021), demonstrating that the overall potential risk to the physiological and behavioral health of fishes from energized devices is relatively low.

3.6.3.3.1.2 Effects from In-Water Electromagnetic Devices Under Alternative 2

The only difference between Alternatives 1 and 2 in use of in-water electromagnetic devices is that the number of events using in-water electromagnetic devices would be greater under Alternative 2 (Table 3.0-10). Even though the number of events in Alternative 2 would be greater than Alternative 1, potential impacts on fishes are not expected to be meaningfully different.

Therefore, activities that include the use of in-water electromagnetic devices under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.3.2 High-Energy Lasers

3.6.3.3.2.1 Effects from High-Energy Lasers

Training and Testing. As discussed in Section 3.0.3.3.3.3, high-energy laser weapons are designed to disable surface targets, rendering them immobile. The primary concern is the potential for a fish to be struck with the laser beam at or near the water's surface, where extended exposure could result in injury or death. High-energy lasers would only be used during testing activities.

Fishes could be exposed to the laser only if the beam misses the target. Should the laser strike the sea surface, individuals at or near the surface could potentially be exposed. Fish species, including some ESA-listed species such as oceanic whitetip sharks and giant mantas that are found in offshore locations and occur near the surface of the water column may have a higher risk of being exposed to high-energy lasers. However, it is not anticipated that an individual would surface at the exact moment in the exact place that the laser hit the surface. In addition, the laser shuts down once contact with the target is lost.

Modernization and Sustainment of Ranges. High-energy lasers would not be used during modernization and sustainment of ranges activities.

Conclusion. Activities that include the use of high-energy lasers would not have reasonably foreseeable adverse effects on fishes based on (1) the relatively low number of events, (2) the very localized potentially affected area of the laser beam, (3) the temporary duration of potential effects (seconds), and (4) the low likelihood of a fish surfacing at the precise time and location where a laser missed the target and hit the ocean surface.

3.6.3.4 Physical Disturbance and Strike Stressors

Table 3.6-7 contains brief summaries of information relevant to the analyses of effects for each physical disturbance and strike substressor (vessels and in-water devices, MEM, seafloor devices). Effects from aircraft and aerial targets are not applicable because fishes do not occur in airborne environments and will not be analyzed further in this section. Supporting information on effects on fishes from physical disturbance and strike stressors are provided in Appendix F.

Table 3.6-7: Physical Disturbance and Strike Stressors Information Summary

Substressor	*Information Summary*
Vessels and In-Water Devices	Most fishes would detect and avoid vessels and in-water devices and therefore, with the exception of certain slow-moving species located near the surface, strikes would be unlikely: • Fishes generally respond to an approaching vessel or in-water device with lateral or downward avoidance, although some fishes are attracted to them. • Most in-water devices move slowly or are closely monitored by observers. • Early life stages of most fishes could be displaced by a moving vessel and then entrained by the vessel (e.g., propeller movement or wash and cooling system) rather than struck. Large slow-moving fishes such as whale shark, mola molas, and manta rays may occur near the surface, making them susceptible to strikes.
Military Expended Materials	Fishes could be struck by military expended materials at the surface and on the seafloor as items settle on the bottom, and could also be disturbed by materials sinking through the water column. • Direct strike potential is greatest at or near the surface, but the number of fishes at the surface is typically low, particularly during the day when most activities would occur. • Most missiles and projectiles are fired at and hit their targets, so only a very small proportion hit the water. • Expended aerial targets and aerial target fragments hit the water surface with relatively high velocity and force, although they fall rather than being fired/propelled. • Disturbance or strike as expended materials sink through the water column is possible but not likely because most objects sink slowly and can be avoided. • Fishes on the seafloor (where an item settles) could be struck or displaced, but only small numbers of individuals would likely be affected. • Propelled fragments produced by an exploding bomb are large and decelerate rapidly, posing little risk to fishes. Sediment disturbance and turbidity caused by materials settling on the seafloor would be temporary and affect a small area.
Seafloor Devices	Strikes and disturbance of fishes by seafloor devices are possible but not likely: • Items dropped into the water could strike fishes, but the probability would be low based on the low number of fish at the surface and the ability of fish to avoid sinking objects. Few individuals would likely be affected by items deployed on the bottom, and many fishes would be able to avoid unmanned vehicles (e.g., bottom-crawling vehicles).

3.6.3.4.1 Vessels and In-Water Devices

3.6.3.4.1.1 Effects from Vessels and In-Water Devices Under Alternative 1

Training and Testing. The number and location of activities that include vessels and in-water devices is shown in Table 3.0-15. Most training and testing activities include vessels, while a lower number of activities include in-water devices. As indicated in Section 3.0.3.3.4.1, vessel operation would be widely dispersed throughout the Study Area but would be more concentrated near ports, naval installations, and range complexes. Most vessel use would occur in the California Study Area, less in the Hawaii Study Area.

The risk of a strike from vessels and in-water devices such as a remotely operated vehicles, unmanned surface vehicles, unmanned underwater vehicles, motorized autonomous targets, or towed mine warfare devices used in training and testing activities would be low because (1) most fishes can detect and avoid vessel and in-water device movements and (2) the types of fish that are likely to be exposed to vessel and in-water device strikes are limited (such as whale sharks and manta rays) and occur in low concentrations where vessels and in-water devices are most frequently used. Potential effects from exposure to vessels and in-water devices are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level effects. In addition, best management practices would be implemented prior to deploying a towed in-water device to search the intended path of the in-water device for any floating debris (e.g., driftwood) or other potential obstructions (e.g., floating vegetation rafts and animals), since they have the potential to cause damage to the device. In addition, Navy personnel standing watch or serving as a lookout must complete Marine Species Awareness training, which includes detecting floating vegetation to minimize effects on the natural environment (U.S. Department of the Navy, 2021). Therefore, the device would not be used in areas where pelagic (open ocean) fish naturally aggregate.

The potential risk of a vessel or in-water device strike to an ESA-listed fish such as an Eastern Pacific DPS scalloped hammerhead shark, oceanic whitetip shark or giant manta ray would be extremely low, but possible in the surface waters where this species can be observed swimming. As a vessel approaches, an individual could have a detectable behavioral or physiological response (e.g., swimming away and increased heart rate) as the passing vessel displaces them. However, Eastern Pacific DPS scalloped hammerhead sharks, oceanic whitetip sharks and giant manta rays would be able to detect and avoid vessel movements and would return to their normal behavior after the ship or device passes. Vessels or in-water devices would not adversely affect the water and sediment quality, quantity, or functionality within the small portion of designated green sturgeon critical habitat that overlaps with a small portion of the California Study Area (Figure C.54, Appendix C).

As described above, the use of vessels and in-water devices may result in short-term and local displacement of fish in the water column. However, these behavioral reactions are not expected to result in substantial changes to an individual's fitness, or species recruitment, and are not expected to result in population-level effects. As the locations, number of events, and potential effects associated with vessels and in-water devices would be similar under both alternatives (Section 3.0.3.3.4.1), the potential effects on fishes would also be similar.

Modernization and Sustainment of Ranges. No vessels are involved in the proposed Special Use Airspace Modernization. Vessels and in-water devices associated with SOAR Modernization; SWTR Installation; Sustainment of Undersea Ranges; Hawaii and California undersea cable projects; and Installation and Maintenance of Underwater Platforms, Mine Warfare, and Other Training Areas would move very slowly during installation activities (0–3 knots) and would not pose a collision threat to fishes.

Conclusion. Activities that include the use of vessels and in-water devices under Alternative 1 would result in less than significant effects due to (1) the low likelihood for most fishes to be struck by a vessel, since most fish occupy waters below the surface; (2) the fact that fish typically display an avoidance response to an approaching vessel; and (3) the fact that most in-water devices move slowly and are closely monitored during deployment.

3.6.3.4.1.2 Effects from Vessels and In-Water Devices Under Alternative 2

The only difference between Alternatives 1 and 2 in use of vessels and in-water devices is that the number of events using vessels or in-water devices would be greater under Alternative 2 (Table 3.0-15). Even though the number of events in Alternative 2 would be greater than Alternative 1, potential impacts on fishes are not expected to be meaningfully different.

Therefore, activities that include the use of vessels and in-water devices under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.4.2 Military Expended Materials

3.6.3.4.2.1 Effects from Military Expended Materials Under Alternative 1

Training and Testing. A potential strike to a fish comes from the following categories of MEM: (1) all sizes of non-explosive practice munitions (Table 3.0-16); (2) fragments from high-explosive munitions (Table 3.0-17); (3) expendable targets (Table 3.0-18); and (4) expended materials other than munitions, such as sonobuoys or torpedo accessories (Table 3.0-19). A discussion of the types of activities that use MEM is presented in Appendix B, and supporting information on potential MEM effects on fishes is presented in Appendix F.

While disturbance or strike from any of these objects as they sink through the water column is possible, it is not very likely for most expended materials because the objects generally sink through the water slowly and can be avoided by most, if not all fishes. Therefore, the analysis of MEM strikes focuses on strikes at the surface or in the upper water column from fragments (of high-explosives) and projectiles because those items have a greater potential for a fish strike as they hit the water, before slowing down as they move through the water column.

MEM would occur throughout the Study Area, although relatively few items would be expended in the HCTT Transit Corridor. Most MEM would occur within the California and Hawaii Study Areas. Major fish groups identified above in Table 3.6-2 that are particularly susceptible to MEM strikes are those occurring at the surface, within the offshore and continental shelf portions of the Study Areas (where the strike would potentially occur). Those groups include salmonids, pelagic sharks, flyingfishes, jacks, tunas, mackerels, billfishes, ocean sunfishes, and other similar species (Table 3.6-2). Additionally, certain deep-sea fishes would be exposed to strike risk as a ship hulk, expended during a sinking exercise, settles to the seafloor. These groups include hagfishes, dragonfishes, lanternfishes, anglerfishes, and oarfishes.

Projectiles, bombs, missiles, rockets, and associated fragments have the potential to directly strike fish as they hit the water surface and below the surface to the point where the projectile loses its forward momentum. Fishes at and just below the surface would be most susceptible to injury from strikes. Fishes that occur deeper in the water column would be less susceptible to injury because the velocity of these materials would rapidly decrease upon contact with the water and as they travel through the water column. Consequently, most water column fishes would have ample time to detect and avoid approaching munitions or fragments as they fall through the water column. The probability of strike based on the “footprint” analysis included in Appendix I indicates that even for an extreme case of expending all small-caliber projectiles within a single gunnery box, the probability of any of these items striking a fish (even as large as bluefin tuna or whale sharks) is extremely low. Therefore, since most fishes are smaller than bluefin tuna or whale sharks, and most MEM are less abundant than small-caliber projectiles, the risk of strike by these items is exceedingly low for fishes overall. A possibility exists that a small number of fish at or near the surface may be directly affected if they are in the target area and near the point of physical effect at the time of MEM strike, but population-level effects would not occur.

Sinking exercises could occur in open-ocean areas, outside of the coastal portions of the Study Areas. While serious injury or mortality to individual fish would be expected if they were present within range of high-explosive activities (analyzed in Section 3.6.3.1), sinking exercises would not result in effects on pelagic fish populations at the surface based on the low number of fish in the immediate area and the placement of these activities in deep, ocean areas where fish abundance is low or widely dispersed. Also, these activities are very few in number (up to three events annually). Disturbances to benthic fishes from sinking exercises would be highly localized. Any deep-sea fishes located on the bottom where a ship hulk would settle could experience displacement, injury, or death. However, population-level effects on the deep-sea fish community would not occur because of the limited spatial extent of the effect and the wide dispersal of fishes in deep ocean areas.

All ESA-listed fish species near the training and testing would be potentially exposed to MEM. While MEM use could overlap with the occurrence of ESA-listed species, the likelihood of a strike would be extremely low given their low abundance in the Study Area and the dispersed nature of the activity. As indicated in the analyses in Section 3.2.3, effects on sediments and water quality from explosives, explosives byproducts, and metals under Alternative 1 are expected to be minimal. The analysis of proportional footprint effects on the seafloor from MEM in Appendix I, Section I.1 indicates that the percentage of affected substrate relative to the entire Study Area is very low. Therefore, it is highly unlikely that the functionality of the very small proportion of designated green sturgeon critical habitat that overlaps with the NOCAL portion of the California Study Area (Figure C.54, Appendix C) would be affected from MEM under Alternative 1. Mitigation, such as not conducting gunnery activities within a specified distance of shallow-water coral reefs, precious coral beds, artificial reefs, and shipwrecks, would be implemented to avoid potential impacts from MEM wherever these seafloor resources occur within the Study Area. The mitigation would consequently help avoid potential effects on fishes that inhabit shallow-water coral reefs and rocky reefs.

The effect of MEM strikes on fishes would be inconsequential due to (1) the limited number of species found directly at the surface where MEM strikes could occur, (2) the rare chance that a fish might be directly struck at the surface by MEM, and (3) the ability of most fishes to detect and avoid an object falling through the water below the surface. The potential effects of MEM strikes would be short-term (seconds) and localized disturbances of the water surface (and seafloor areas within sinking exercise boxes) and are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level. As the locations, number of events, and potential effects associated with MEM would be similar under both alternatives (Section 3.0.3.3.4.2), the potential effects on fishes would also be similar.

Modernization and Sustainment of Ranges. No MEM are expected during modernization and sustainment of ranges activities.

Conclusion. Activities that include the use of MEM under Alternative 1 would result in less than significant effects because (1) the greatest strike risk occurs at the surface, away from areas occupied by the majority of fishes, which occupy demersal and pelagic habitat; (2) only a small proportion of missile and projectiles hit the water, creating a risk; (3) MEM sinking in the water column would typically occur at a slow rate, with low potential to create a strike risk; and (4) few fishes on the seafloor would be affected by falling MEM.

3.6.3.4.2.2 Effects from Military Expended Materials Under Alternative 2

The only difference between Alternatives 1 and 2 in use of MEM is that the overall quantity of MEM would be greater under Alternative 2 (Tables 3.0-16 through 3.0-19). Even though the quantity of MEM in Alternative 2 would be greater than Alternative 1, potential impacts on fishes are not expected to be meaningfully different.

Therefore, activities that include the use of MEM under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.4.3 Seafloor Devices

3.6.3.4.3.1 Effects from Seafloor Devices Under Alternative 1

Training and Testing. Seafloor devices represent items used during training and testing activities that are deployed onto the seafloor and recovered. Section 3.0.3.3.4.3 provides the number and location of seafloor devices in the Study Area (Table 3.0-20). Supporting information on effects of seafloor devices on marine fishes is presented in Appendix F.

Aircraft-deployed mine shapes deployed at the surface during aerial mine laying activities has the greatest potential to strike a fish within the water column. While seafloor device use could overlap with some ESA-listed species distributions, the likelihood of a strike would be extremely low given the low abundance of these species in the Study Area, the ability for these ESA-listed species to detect and avoid falling objects through the water below the surface, and the dispersed nature of the activity. However, there would be the potential for effect. In addition, the probability of a physical disturbance or strike on a fish during cable installation activities would be extremely low. Fish would be able to move away from disturbed areas and return when activities are completed.

Mitigation would be implemented that includes not conducting precision anchoring (except in designated anchorages) within the anchor swing circle of shallow-water coral reefs, precious coral beds, artificial reefs, and shipwrecks to avoid potential effects from seafloor devices on seafloor resources in mitigation areas throughout the Study Area (Section 5.7). This mitigation would consequently help avoid potential effects on fishes that inhabit these areas. As the locations, number of events, and potential effects associated with Seafloor Devices would be similar under both alternatives (Section 3.0.3.3.4.3), the potential effects on fishes would also be similar.

Modernization and Sustainment of Ranges. New range modernization and sustainment activities include installation of undersea cables integrated with hydrophones and underwater telephones to sustain the capabilities of the SOAR. Deployment of fiber optic cables along the seafloor would occur in three locations: south and west of SCI in the California Study Area, to the northeast of Oahu in the Hawaii Study Area, and to the west of Kauai in the Hawaii Study Area. In all locations the installations would occur completely within the water; no land interface would be involved. These activities would occur far offshore of where most ESA-listed fish species do not occur. Some ESA-listed fish species such as oceanic whitetip sharks and scalloped hammerhead sharks could be present in the vicinity of the cable laying vessel during installation activities. However, effects on these species would be discountable since the species spends little time at the bottom habitat where the disturbance from laying the cable would occur.

Installation and maintenance of underwater platforms, mine warfare training areas, and installation of other training areas involve seafloor disturbance where those activities would take place. Each installation would occur on soft, typically sandy bottom, avoiding rocky substrates.

Conclusion. The use of seafloor devices under Alternative 1 would result in less than significant effects because (1) there would be a low probability of fish being struck during deployment of seafloor devices; and (2) fish would easily be able to avoid slow-moving, bottom-crawling devices. Most of the non-cable seafloor devices would only be placed temporarily and would not adversely affect the water and sediment quality, quantity, or functionality within the small portion of designated green sturgeon critical habitat that overlaps with the NOCAL portion of the California Study Area (Figure C.54, Appendix C). The long-term placement of seafloor cables in the SOAR and SWTRs occurs away from the NOCAL portion of the California Study Area and would not overlap with designated green sturgeon critical habitat.

3.6.3.4.3.2 Effects from Seafloor Devices Under Alternative 2

The only difference between Alternatives 1 and 2 in use of seafloor devices is that the number of events using seafloor devices would be greater under Alternative 2 (Table 3.0-20). Even though the number of events in Alternative 2 would be greater than Alternative 1, potential effects on fishes are not expected to be meaningfully different.

Therefore, activities that include the use of seafloor devices under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.5 Entanglement Stressors

Table 3.6-8 contains brief summaries of information relevant to the analyses of effects for each entanglement substressor such as wires and cables and decelerators/parachutes. The number and locations where wires and cables would be expended are presented in Table 3.0-22. Supporting information on effects from entanglement stressors on fishes are provided in Appendix F.

Table 3.6-8: Entanglement Stressors Information Summary

Substressor	Information Summary
Wires and Cables	Fiber-optic cables, guidance wires, bathythermograph wires, and sonobuoy components would pose a generally low potential entanglement risk to susceptible fishes, although the potential would be higher for sonobuoy components than for wires and cables: • Fiber-optic cables do not easily form loops. • Guidance wires typically sink immediately after release and remain on the seafloor and would not likely form loops because of their size and rigidity. • The encounter rate for fiber optic cables and guidance wires would be extremely low, as few would be expended. • Most sonobuoys are expended in offshore areas where large open-ocean species (e.g., manta rays) could become entangled in vertical cable. • Smaller species could become entangled in components such as plastic mesh. Fish species with protruding physical features, such as hammerhead sharks, manta rays, and billfishes, would be more susceptible to entanglement in wires and cables than other types of fish.

Table 3.6-8: Entanglement Stressors Information Summary (continued)

Substressor	Information Summary
Decelerators/ Parachutes	Decelerators/parachutes pose a potential entanglement risk to fishes (the risk is higher for decelerators/parachutes on the seafloor), although the number of fish affected would likely be low: • Decelerators/parachutes are relatively large and visible, reducing the chance that fish would accidentally become entangled. • Entanglement in the water column is unlikely because fish generally react to disturbance at the surface by swimming away. • Once a decelerator/parachute is on the bottom, a fish could become entangled in the item or its attachment lines while diving and feeding, especially at night or in deeper waters. • If a decelerator/parachute dropped in an area of strong bottom currents, it could billow open and pose a short-term entanglement threat to large fish feeding on the bottom. Most smooth-bodied fishes would not become entangled, but fish with spines or other protrusions would be more susceptible.
Nets	Nets would be deployed during testing of extra large unmanned underwater vehicles. • Nets are anticipated to be a maximum size of 300 ft. wide and 100 ft. deep, with a 1-inch mesh. • Nets would be temporary, tethered to one or two support vessel(s), and monitored at all times when in the water. • Areas where nets would be deployed will not overlap sensitive areas, and nets would not contact bottom substrates.

3.6.3.5.1 Wires and Cables

3.6.3.5.1.1 Effects from Wires and Cables Under Alternative 1

Training and Testing. Activities that expend fiber optic cables, guidance wires, and sonobuoy wires occur in both the California and Hawaii Study Areas. Fiber optic cables are comprised of silicon and are somewhat flexible, durable, and abrasion or chemical resistant. When fiber optic cables are placed, they sink rapidly to the bottom. The physical characteristics of the fiber optic material render the cable easily broken when tightly kinked or bent at a sharp angle, but highly resistant to breaking when wrapped or looped around an object.(U.S. Department of the Navy, 2001).

The likelihood of fish entanglement from wires and cables expended during training and testing activities is low because these species would be able to see and avoid cables and wires in the water column. In the rare instance where a fish did encounter a fiber optic cable, entanglement is unlikely because the cable is not strong enough to bind most fishes (U.S. Department of the Navy, 2001).

Guidance wire would only be expended in offshore areas and not within nearshore habitats in the Study Area. Some fishes could potentially encounter guidance wire because they can occur in nearshore waters out to the shelf break, where many fish species feed near the bottom and could encounter a guidance wire while feeding. However, it would be rare for a fish to encounter guidance wires expended during training and testing activities. If a guidance wire were encountered, the most likely result would be that the fish ignores it, which is inconsequential and considered negligible. In the rare instance where an individual fish became entangled in guidance wire and could not break free, the individual could be affected by impaired feeding, bodily injury, or increased susceptibility to predators. However, this is an extremely unlikely scenario because the density of guidance wires would be very low, as discussed in Section 3.0.3.3.5.1.

Sonobuoy wires may be expended throughout the HCTT Study Area. A sonobuoy wire runs through the stabilizing system and leads to the hydrophone components. The hydrophone components may be covered by thin plastic netting depending on type of sonobuoy but pose no entanglement risk. This is mainly due to the sonobuoy being made of a single wire that hangs vertically in the water column. Therefore, it would be highly unlikely that a fish would be entangled by a sonobuoy wire.

While individual fish susceptible to entanglement could encounter guidance wires, fiber optic cables, and sonobuoy wires, the long-term consequences of entanglement are unlikely for either individual or populations because (1) the encounter rate for cables and wires is low, (2) the types of fishes that are susceptible to these items is limited, (3) the restricted overlap with susceptible fishes, and (4) the physical characteristics of the cables and wires reduce entanglement risk to fishes compared to monofilament used for fishing gear. Potential effects from exposure to guidance wires and fiber-optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level effects. As the locations, number of events, and potential effects associated with wires and cables would be similar under both alternatives (Section 3.0.3.3.5.1), the potential effects on fishes would also be similar.

Modernization and Sustainment of Ranges. Fiber-optic cables are deployed on the seafloor during SOAR modernization, and the installation of two SWTRs. The Navy also proposes to deploy undersea fiber optic cables and connected instrumentation to existing undersea infrastructure along the seafloor in the California Study area (south and west of SCI), and the Hawaii Study Area (northeast of Oahu and west of Kauai). Entanglement of fishes is not likely because of the rigidity of the cable that is designed to lie extended on the sea floor. Once installed on the seabed, the new cable and communications instruments would be equivalent to other hard structures on the seabed, again posing no risk of adverse effect on fishes.

Conclusion. Activities that include the use of wires and cables under Alternative 1 would result in less than significant effects due to (1) a very low entanglement risk from fiber optic cables and guidance wires, (2) a low encounter rate between fish and the fiber-optic cables and guidance wires, and (3) the fact that most sonobuoys are expended offshore.

3.6.3.5.1.2 Effects from Wires and Cables Under Alternative 2

The only difference between Alternatives 1 and 2 in use of wires and cables is that the number of wires and cables expended would be greater under Alternative 2 (Table 3.0-22). Even though the number of wires and cables in Alternative 2 would be greater than Alternative 1, potential effects on fishes are not expected to be meaningfully different.

Therefore, activities that include the use of wires and cables under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.5.2 Decelerators/Parachutes

3.6.3.5.2.1 Effects from Decelerators/Parachutes Under Alternative 1

Training and Testing. The number and location of decelerator/parachutes expended during proposed training and testing activities are presented in Table 3.0-19, and the size categories of decelerators/parachutes are presented in Table 3.0-23. Supporting information on fish effects from entanglement stressors are provided in Appendix F.

Training and testing activities involving decelerator/parachute only occur in the open ocean portions of the Study Area. Given the size of the Study Area and the resulting widely scattered decelerators/parachutes, it would be very unlikely that a fish would encounter and become entangled in any decelerators/parachutes.

Some elasmobranchs (sharks and rays), swordfishes, and billfishes occurring within the offshore and continental shelf portions of the Study Area may be more susceptible to entanglement in decelerators/parachutes than most fish species, due primarily to their unusual body shape or projections. However, due to the highly maneuverable swimming capabilities of these fishes, entanglement would be highly unlikely while the decelerators/parachutes are at the surface or sinking through the water column. Oceanic whitetip sharks and giant manta rays occurring in offshore areas of the Hawaii Study Area could encounter a parachute/decelerator during training and testing activities. These species are also highly mobile and could easily avoid floating or suspended decelerators/ parachutes or break free if they got entangled. If any of these ESA-listed sharks or rays were to become entangled in a decelerator/parachute, they would likely thrash to break free. If such an effort were unsuccessful, the individual could remain entangled, possibly resulting in injury or death, but this scenario is considered so unlikely that it would be discountable. Individual fish are not prone to be repeatedly exposed to decelerators/parachutes, so long-term consequences of entanglement risks from decelerators/parachutes are unlikely for either individuals or populations. As the locations, number of events, and potential effects associated with decelerators/parachutes would be similar under both alternatives (Section 3.0.3.3.5.2), the potential effects on fishes would also be similar.

Modernization and Sustainment of Ranges. Decelerators/parachutes would not be expended during modernization and sustainment of ranges activities.

Conclusion. Activities that include the use of decelerators/parachutes under Alternative 1 would result in less than significant effects because (1) the decelerators/parachutes are relatively large, visible, and slow moving, making them easier to avoid; and (2) should a fish encounter a decelerator/parachute, it would likely display avoidance behavior and swim away.

3.6.3.5.2.2 Effects from Decelerators/Parachutes Under Alternative 2

The only difference between Alternatives 1 and 2 in use of decelerators/parachutes is that the number of decelerators/parachutes expended would be greater under Alternative 2 (Table 3.0-19). Even though the number of decelerators/parachutes in Alternative 2 would be greater than Alternative 1, potential effects on fishes are not expected to be meaningfully different.

Therefore, activities that include the use of decelerators/parachutes under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.5.3 Nets

3.6.3.5.3.1 Effects from Nets Under Alternative 1

Training and Testing. Nets would only be used during testing activities. The description for net deployments that occur during XLUUV testing is described in Section 3.0.3.3.5.1. Net dimensions are anticipated to be a maximum size of 300 ft. wide and 100 ft. deep, with a one-inch maximum mesh size. Areas where nets would be deployed would not overlap sensitive areas, and nets would not contact bottom substrates. Net deployment and retrieval are estimated to take approximately 30 minutes. Nets would be deployed four times for up to 4 hours per deployment (not to exceed 16 hours) during a given

48-hour period. Nets would only be deployed during daylight hours, would be tethered to one or two support vessel(s), and would be continuously monitored when in the water.

Larger pelagic fish (sharks, rays, dorado, steelhead, and tuna) would likely be able to detect this large net and avoid it (National Marine Fisheries Service, 2024a). Should they come in contact with the net, their risk of entanglement would be expected to be low due to their larger body size and the relatively small mesh size (National Marine Fisheries Service, 2024a). The potential for entanglement of demersal fish and fish associated with reef or kelp habitats is expected to be low because the net would avoid contact with the bottom and avoid these sensitive habitats.

Smaller pelagic fish (i.e., sardine, anchovy, mackerel) may also encounter the XLUUV nets, but are unlikely to experience bycatch levels consistent with commercial fisheries that utilize nets. The type of nets typically used to commercially harvest these species are of a round haul net or purse seine design, as opposed to a single pane of hanging mesh in gillnet fisheries. Fisheries for these species typically use a purse seine net that measure 1,110 ft. long, 132 ft. deep, and 165 ft. deep, and is comprised of 1.25-in. mesh (National Marine Fisheries Service, 2024b). Other commercial fisheries further offshore, also deploy purse seines, but for larger species. Purse seine vessels capture non-target fish species within these fisheries (Duffy et al., 2019; Lennert-Cody et al., 2008). Much of the other net/seine deployed fisheries bycatch that occurs in waters that overlap with XLUUV testing activity that includes nets is either associated with trawl fisheries (Matthews et al., 2022; Pikitch et al., 1998) or large-mesh gillnet fisheries (Hahlbeck et al., 2017; Larese & Coan, 2008; Le Fol, 2016; Matthews et al., 2022; Shester & Micheli, 2011).

While fish in the water column have the potential to encounter the hanging net panel, the smaller mesh size (not to exceed 1 in.) largely limits the risk of exposure to smaller pelagic species of fish that would be small enough to become entangled in these nets. However, the nets deployed during the XLUUV testing would be single pane mesh and would not encircle or entrap schooling fish compared to commercial nets and seines that catch fish by encircling them. The nets proposed would only be deployed for short periods at a time (not to exceed 4 hours) and would be continuously monitored by the vessels attached to the nets.

Due to their relatively large body size relative to the net design and mesh size, the potential risk of entanglement for ESA-listed fish is considered discountable (i.e., extremely unlikely to occur) (National Marine Fisheries Service, 2024a). In addition, the area where XLUUV net testing would occur does not overlap with designated green sturgeon critical habitat. Since the locations, number of events, and potential effects associated with nets deployed during XLUUV testing would be the same under both alternatives (Section 3.0.3.3.5.1), the potential effects on fishes would also be the same.

Modernization and Sustainment of Ranges. Nets associated with XLUUV training would not be deployed during modernization and sustainment of ranges activities.

Conclusion. Nets associated with XLUUV testing would result in less than significant effects because (1) for many pelagic species, including oceanic whitetip sharks, scalloped hammerhead sharks, and steelhead, the risk of entanglement is unlikely given their body shape and ability to avoid materials that could entangle them in the water column; (2) most of the sufficiently large body size that they would not be susceptible to entanglement of their gills in the one-inch mesh size nets proposed for use; (3) larger fish that encounter a submerged net would recognize it as an obstruction and quickly change course to avoid the net; and (4) the nets would only be deployed during daylight hours for no more than

4 hours per deployment, would be tethered to one or two support vessel(s), and would be monitored at all times when in the water.

3.6.3.5.3.2 Effects from Nets Under Alternative 2

The would be no difference between Alternatives 1 and 2 in use of nets. Therefore, activities that include the use of nets under Alternative 2 would be the same as Alternative 1 and would result in less than significant effects.

3.6.3.6 Ingestion Stressors

The various types of MEM used during training and testing activities within the Study Area may be broadly categorized as munitions and MEM other than munitions. Table 3.6-9 contains brief summaries of information relevant to the analyses of effects for each ingestion substressor (MEM – munitions, MEM – materials other than munitions). Aspects of ingestion stressors applicable to marine organisms in general are presented in Section 3.0.3.3.6. The number and location of targets expended in the Study Area that may result in fragments is presented in Table 3.0-24. Supporting information on ingestion stressors for fishes is provided in Appendix F.

It is reasonable to assume that any item of a size that can be swallowed by a fish could be eaten at some time; this analysis focuses on ingestion of materials in two locations: (1) at the surface or water column and (2) at the seafloor. The potential for fish to encounter and ingest expended materials is evaluated with respect to their feeding group and geographic range, which influence the probability that they would eat MEM (Table 3.6-10).

Table 3.6-9: Ingestion Stressors Information Summary

Substressor	*Information Summary*
Military Expended Materials	Fishes in the water column and at the seafloor could purposely or inadvertently ingest many types of expended materials with potentially adverse effects, but the number of individuals affected would be low in the context of population size: • Plastic items are the most commonly ingested anthropogenic materials and can cause digestive or toxicity issues. • Large filter-feeding fishes (e.g., whale sharks) could inadvertently ingest small or medium decelerators/parachutes. • Chaff fibers could be ingested by all lifestages of fishes. Fishes may ingest chaff cartridge and flare components; encounters would mostly occur on the seafloor except for the relatively few items that float or become entangled in floating vegetation.

Table 3.6-10: Ingestion Stressors Potential for Effect on Fishes Based on Feeding Guild

Feeding Guild	Representative Species	ESA-Protected Species	Overall Potential for Effect
Open-ocean Predators	Mahi mahi, most shark species, tunas, billfishes, swordfishes	Scalloped hammerhead sharks (Eastern Pacific DPS), adult Chinook and coho salmon, adult steelhead, oceanic whitetip sharks	These fishes may eat floating or sinking expended materials, but the encounter rate would be extremely low. May result in individual injury or death but is not anticipated to have population-level effects.
Open-ocean consumer of plankton	Basking sharks, whale sharks	Giant manta rays	These fishes may ingest floating expended materials incidentally as they feed in the water column, but the encounter rate would be extremely low. May result in individual injury or death but is not anticipated to have population-level effects.
Coastal bottom-dwelling predators	Rockfishes, groupers, jacks, sturgeon	Green sturgeon	These fishes may eat expended materials on the seafloor, but the encounter rate would be extremely low. May result in individual injury or death but is not anticipated to have population-level effects.
Coastal/estuarine bottom-dwelling predators and scavengers	Skates and rays, flatfishes	Green sturgeon	These fishes could incidentally eat some expended materials while foraging, especially in muddy waters with limited visibility. May result in individual injury or death but is not anticipated to have population-level effects.

Note: ESA = Endangered Species Act, DPS = Distinct Population Segment

3.6.3.6.1 Military Expended Materials

3.6.3.6.1.1 Effects from Military Expended Materials Under Alternative 1

Training and Testing. MEM from munitions associated with training and testing activities that could potentially be ingested by a fish include non-explosive practice munitions (small- and medium-caliber), small-caliber casings, and fragments from high explosives. These items could be expended throughout most of the Study Area but would be concentrated in the Hawaii and California Study Areas. A detailed analysis of potential MEM effects on fishes from training and testing activities is provided in Navy (U.S. Department of the Navy, 2018, 2022).

The potential effects of ingesting small-caliber projectiles, high explosive fragments, or end caps/pistons with the chaff cartridges would be limited to individual cases where a fish might suffer a negative response, for example, ingesting an item too large to be digested. While ingestion of munitions-related materials, or the other MEM identified here, could result in sublethal or lethal effects, the likelihood of ingestion is low based on the dispersed nature of the materials and the limited exposure of those items at the surface/water column or seafloor where certain fishes could be at risk of ingesting those items. Furthermore, a fish might taste an item then expel it before swallowing it (Felix et al., 1995), in the same manner that fish would temporarily take a lure into its mouth, then spit it out. Based on these factors, the number of fish potentially affected by ingestion of munitions-related materials would be low and population-level effects are not likely to occur.

Large, open-ocean predators (e.g., tunas, billfishes, pelagic sharks) have the potential to ingest self-protection flare end caps or pistons as they float on the water column for some time. A variety of plastic and other solid materials have been recovered from the stomachs of billfishes, mahi mahi (South Atlantic Fishery Management Council, 2011) and tuna (Hoss & Settle, 1990). Savoca et al. (2021) conducted a literature review of 129 studies investigating marine fish ingestion of plastics. They found that roughly two thirds (n= 386) of the marine fish investigated in these studies ingested plastics, while roughly one third (n= 148) did not. The potential to determine any statistically significant geographic trends across various bodies of water was limited by lack of data. Based on the low density of expended endcaps and pistons, the encounter rate would be extremely low, and the ingestion rate even lower. The number of fishes potentially affected by ingestion of end caps or pistons would be minimal based on the low environmental concentration. Population-level effects would not be expected.

Larger offshore species such as ESA-listed giant manta rays or oceanic whitetip sharks could mistake larger MEM other than munitions for prey, even though these species typically forage at or near the surface. It is likely that these species would “taste” and then spit it out if an item were accidentally ingested; if ingested, the item would most likely pass through the digestive tract without causing harm.

Mitigation would be implemented (e.g., not conducting gunnery activities within 350 yards of shallow-water coral reefs and precious coral beds) to avoid potential effects from MEM on seafloor resources in mitigation areas throughout the Study Area (Table 3.6-3; Section 5.7). This mitigation would consequently help avoid potential ingestion effects on fishes that feed on shallow-water coral reefs, precious coral beds, artificial reefs, and shipwrecks.

Overall, the potential effects of ingesting munitions (whole or fragments) would be limited to individual fish that might suffer a negative response from a given ingestion event. While ingestion of munitions or fragments identified here could result in sublethal or lethal effects on a small number of individuals, the likelihood of a fish encountering an expended item is dependent on where that species feeds and the amount of material expended. Furthermore, an encounter may not lead to ingestion, as a fish might “taste” an item, then expel it (Felix et al., 1995). Therefore, the number of fishes potentially affected by ingestion of munitions or fragments from munitions would be assumed to be low, and population-level effects would not be expected. As the locations, number of events, and potential ingestion effects associated of MEM would be similar under both alternatives, the potential effects on fishes would also be similar.

Modernization and Sustainment of Ranges. No MEM are expected during modernization and sustainment of ranges activities. Some anchors may not be recovered and would become MEM, but those are covered in the analysis of seafloor devices.

Conclusion. Activities that include the use of MEM under Alternative 1 would result in less than significant effects because (1) the likelihood of ingestion is low based on the dispersed nature of the materials and the limited exposure of those items at the surface/water column or seafloor; and (2) if ingested, a fish would temporarily take the expended material into its mouth, then spit it out.

3.6.3.6.1.2 Effects from Military Expended Materials Under Alternative 2

The only difference between Alternatives 1 and 2 in use of MEM is that the quantity of MEM expended would be greater under Alternative 2 (Tables 3.0-16 through 3.0-19). Even though the quantity of MEM in Alternative 2 would be greater than Alternative 1, potential effects on fishes are not expected to be meaningfully different.

Therefore, activities that include the use of MEM under Alternative 2 would be similar to Alternative 1 and would result in less than significant effects.

3.6.3.7 Secondary Stressors

Fishes could be exposed to stressors indirectly through effects on prey availability and habitat (e.g., sediment or water quality, and physical disturbance). Indirect effects on fishes via sediment or water that do not require trophic transfer to be observed (e.g., bioaccumulation) are discussed below and in Section 3.2. It is important to note that the terms “indirect” and “secondary” do not imply reduced severity of environmental consequences, but instead describe how the effect may occur in an organism or its ecosystem. Secondary or indirect effects on fishes via habitat (e.g., sediment, and water quality) and prey availability could come from (1) explosives and explosion byproducts; (2) metals; (3) chemicals; and (4) other materials such as targets, chaff, and plastics. Supporting information on secondary stressors and their potential effects on fishes are provided in Appendix F.

Mitigation would be implemented to avoid potential effects from explosives and physical disturbance and strike stressors on seafloor resources in mitigation areas throughout the Study Area (Section 5.7). This mitigation would consequently help avoid potential effects on fishes that shelter in and feed on shallow-water coral reefs, precious coral beds, artificial reefs, and shipwrecks.

3.6.3.7.1 Effects on Habitat

Military readiness activities could result in localized and temporary changes to the benthic community during activities that effect fish habitat (see Section 3.5). Hard bottom is important habitat for many different species of fish, including those fishes managed by various fishery management plans. Fish habitat could become degraded during activities that would strike the seafloor or introduce MEM, bombs, projectiles, missiles, rockets, or fragments to the seafloor. The spatial area of habitat affected by the Proposed Action would be relatively small compared to the available habitat in the Study Area. However, there would still be vast expanses of habitat adjacent to the areas of habitat effect that would remain undisturbed by the military readiness activities.

The analysis conclusions for secondary effects on habitat associated with military readiness activities are consistent with a less than significant determination for fishes.

3.6.3.7.2 Effects on Prey Availability

Effects on fish prey availability resulting from explosives, explosives byproducts, unexploded munitions, metals, and chemicals would differ depending upon the type of prey species in the area but would likely be negligible overall and have no population-level effects on fishes. As discussed in Section 3.6.3.1, fishes with swim bladders are more susceptible to blast injuries than fishes without swim bladders. During or following activities where these items might be expended that effect benthic habitats, fish species may experience loss of available benthic prey. Additionally, plankton and zooplankton that are eaten by fishes may also be negatively affected by these same expended materials. Some species of zooplankton that occur in the Pacific such as Pacific oyster (*Crassostrea gigas*) larvae have been found feeding on microplastics (Cole & Galloway, 2015).

In addition to physical effects of an underwater blast such as being stunned, prey might have behavioral reactions to underwater sound. For instance, prey species might exhibit a strong startle reaction to detonations that might include swimming to the surface or scattering away from the source. This startle and flight response is the most common secondary defense among animals (Hanlon and Messenger, 1996). The sound from underwater explosions might induce startle reactions and temporary dispersal of schooling fishes if they are within close proximity (Bowman et al., 2024; Jenkins et al., 2022; Jenkins et al., 2023; Popper et al., 2014; Smith et al., 2022; Wright, 1982).

The abundances of fish and invertebrate prey species near the detonation point could be diminished for a short period of time before being repopulated by animals from adjacent waters. The sound from underwater explosions might induce startle reactions and temporary dispersal of schooling fishes, potentially increasing visibility to predators, if they are within close proximity (Kastelein et al., 2008). Alternatively, any prey species that would be directly injured or killed by the blast could attract predators and scavengers from the surrounding waters that would feed on those organisms, and in turn could be susceptible to becoming directly injured or killed by subsequent explosions. Any of these scenarios would be temporary, only occurring during activities involving explosives, and no lasting effect on prey availability or the food web would be expected. Indirect effects of underwater detonations and high explosive munitions use under the Proposed Action would not result in a decrease in the quantity or quality of fish populations in the Study Area.

The analysis conclusions for secondary effects on prey availability associated with military readiness activities are consistent with a less than significant determination for fishes.

3.6.4 Summary of Potential Effects on Fishes

3.6.4.1 Combined Effects of All Stressors

Additive Stressors – There are generally two ways that a fish could be exposed to multiple stressors. The first would be if a fish were exposed to multiple sources of stress from a single event or activity (e.g., a mine warfare activity may include the use of a sound source and a vessel). The potential for a combination of these effects from a single activity would depend on the range of effects of each stressor and the response or lack of response to that stressor. Most of the activities as described in the Proposed Action involve multiple stressors; therefore, it is likely that if a fish were within the potential effect range of those activities, it may be affected by multiple stressors simultaneously. This would be even more likely to occur during large-scale exercises or activities that span a period of days or weeks (such as a sinking exercises or composite training unit exercise).

Secondly, a fish could also be exposed to a combination of stressors from multiple activities over the course of its life. This is most likely to occur in areas where military readiness activities are more concentrated (e.g., near naval ports, testing ranges, and routine activity locations) and in areas that individual fish frequent because it is within the animal's home range, migratory corridor, spawning or feeding area. However, as described in Appendix C, many fish that school, exhibit this behavior in nearshore, coastal waters. For example, juvenile and adult salmonids occur in their greatest densities in marine waters as they are migrating out of or into their natal estuaries. For Chinook and coho salmon, figures C.51 and C.52 in Appendix C show that these systems occur at least 20 miles from the NOCAL portion of the California Study Area. For steelhead, Figure C.53 in Appendix C shows that only the South Central California Coast DPS and the Southern California DPS have natal estuaries adjacent to the Study Area. Low population levels for these two DPSs have made it difficult to understand their distribution in the marine environment. However, adults may congregate in the nearshore environment waiting for seasonal storms to breach barriers to upstream migration (Crozier et al., 2019; Moyle et al., 2017). Except for in the few concentration areas mentioned above, combinations are unlikely to occur because activities are generally separated in space and time in such a way that it would be very unlikely that any individual fish would be exposed to stressors from multiple activities. However, animals with a home range intersecting an area of concentrated activity would have elevated exposure risks relative to animals that simply transit the area through a migratory corridor. Most of the military readiness activities occur over a small spatial scale relative to the entire Study Area, have few participants, and are of a short duration (on the order of a few hours or less).

Synergistic Stressors – Multiple stressors may also have synergistic effects. For example, fishes that experience temporary hearing loss or injury from acoustic stressors could be more susceptible to physical strike and disturbance stressors via a decreased ability to detect and avoid threats. Fishes that experience behavioral and physiological consequences of ingestion stressors could be more susceptible to entanglement and physical strike stressors via malnourishment and disorientation. These interactions are speculative, and without data on the combination of multiple stressors, the synergistic effects from the combination of stressors are difficult to predict in any meaningful way. Navy research and monitoring efforts include data collection through conducting long-term studies in areas of Navy activity, occurrence surveys over large geographic areas, biopsy of animals occurring in areas of Navy activity, and tagging studies where animals are exposed to Navy stressors. These efforts are intended to contribute to the overall understanding of what effects may be occurring to animals in these areas.

The combined effects of all stressors are consistent with a less than significant determination because (1) activities involving more than one stressor are generally short in duration, and (2) such activities are dispersed throughout the Study Area. Existing conditions would not change considerably under Alternative 1; therefore, no detectable effects on fish populations would occur with implementation of Alternative 1.

3.6.5 Endangered Species Act Determinations

Pursuant to the ESA, NMFS will be consulted on potential effects on ESA-listed fish species from military readiness activities, as required by section 7(a)(2) of the ESA. Determinations for each stressor on ESA-listed fish species is presented in Table 3.6-11.

Table 3.6-11: Fishes ESA Effect Determinations for Military Readiness Activities Under Alternative 1

Species		Acoustic Stressors						Explosive Stressors		Energy Stressors		Physical Disturbance and Strike Stressors				Entanglement Stressors		Ingestion Stressors	
	Overall Determination	Sonar & Other Transducers	Air Guns	Pile Driving	Vessel Noise	Aircraft Noise	Weapons Noise	In-Air Explosions	In-Water Explosions	In-Water Electromagnetic Devices	High Energy Lasers	Vessels & In-Water Devices	Military Expended Material	Seafloor Devices	Pile Driving	Wires & Cables	Decelerators/Parachutes	Military Expended Materials	Indirect Effects
ESA-Listed Species																			
Chinook salmon	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	MA	MA	MA	MA	N/A	MA	MA	MA	MA
Coho salmon	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	MA	MA	MA	MA	N/A	MA	MA	MA	MA
Steelhead	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	MA	MA	MA	MA	N/A	MA	MA	MA	MA
Green sturgeon	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	MA	MA	MA	MA	N/A	MA	MA	MA	MA
Eulachon	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	MA	MA	MA	MA	N/A	MA	MA	MA	MA
Oceanic whitetip shark	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	NE	MA	MA	MA	N/A	MA	MA	MA	MA
Scalloped hammerhead shark	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	NE	MA	MA	MA	N/A	MA	MA	MA	MA
Giant manta ray	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	NE	MA	MA	MA	N/A	MA	MA	MA	MA
Critical Habitat																			
Green sturgeon	MA	MA	N/A	N/A	MA	MA	MA	N/A	MA	MA	N/A	MA	MA	MA	N/A	MA	MA	MA	MA

Notes: MA = may affect; N/A = not applicable, activity related to the stressor does not occur during specified military readiness events (e.g., there are no testing activities that involve the use of pile driving);
The determinations for likelihood of adverse effects are pending consultation with the National Marine Fisheries Service.

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