Barramundi (*Lates calcarifer*)
Ecological Risk Screening Summary

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1 Native Range and Status in the United States

Native Range

From Hill and Hardin (2008):

"Barramundi is native to freshwater, marine, and estuarine habitats in the Indo-Pacific region from the Persian Gulf eastward to southern China and Japan and southward to Papua New Guinea and northern Australia (Berra 2001; Froese and Pauly 2007)."

Status in the United States

Not established in the wild in the United States.

From Hill and Hardin (2008):

"It is also cultured in China, Israel (Volvich and Appelbaum 2001), and the United States. However, there is only very limited culture of barramundi in the United States, with production at one facility (K. Knickerbocker, DACS, personal communication) and research at one facility in Florida and production at one facility in Massachusetts (Australis Aquaculture, Turners Falls, Massachusetts)."

From Hill (2011):

"Expanding the uses of non-native species already being cultured, especially those cultured in small industries, may also trigger increased scrutiny and potential regulation. For example, adding fee fishing to an existing barramundi (*Lates calcarifer*) operation caused the Florida Fish and Wildlife Conservation Commission to conduct a risk analysis of barramundi culture, re-evaluate existing regulations, and subsequently increase restrictions on the possession and culture of all *Lates* species in Florida (Fig. 1[in source material])."

Means of Introductions in the United States

No records of introductions of *Lates calcarifer* into the wild in the United States were found.

Remarks

From Hill and Hardin (2008):

"There have been very few introductions of barramundi perch and no documentation of invasiveness. However, because of the potential for illegal introduction of this trophy sport fish, suitable barramundi perch habitat over much of central and south Florida, and the likelihood of adverse impacts to native fishes, FWC classified the barramundi perch perches of the family Latidae as a conditional species in 1982."

From Fulton-Howard (2008):

"According to a 2008 study of barramundi from Burma and Australia, these fish may be two species (Ward, 2008). The study used DNA barcoding: the comparison of a particular locus (600 base pairs of the cytochrome c oxidase I gene) on the mitochondrial DNA (mtDNA). The study found that there was a significant enough difference in the mtDNA of the fish from the two locations that the species *L. calcarifer* may be split to take these differences into account. The study only examined fish from two locations, so Ward et al. (2008) recommended further study across the range. (Ward, et al., 2008)"

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2016):

"Kingdom Animalia

Phylum Chordata
Subphylum Vertebrata
Superclass Osteichthyes
Class Actinopterygii
Subclass Neopterygii
Infraclass Teleostei
Superorder Acanthopterygii
Order Perciformes
Family Centropomidae
Genus *Lates*
Species *Lates calcarifer* Bloch, 1790"

"Taxonomic Status: Current Standing: valid"

Size, Weight, and Age Range

From Froese and Pauly (2015):

"Max length: 200 cm TL male/unsexed [Kottelat et al. 1993]; common length: 150 cm NG male/unsexed [Larson 1999]; maximum published weight: 60.0 kg [Larson et al. 1989]; Length at first maturity uncertain: range 29-60 cm."

From Hill and Hardin (2008):

"Barramundi perch have a maximum reported length of 6 ft. and a maximum reported weight of 130 lb."

Environment

From Froese and Pauly (2015):

"Demersal; catadromous [Riede 2004]; freshwater; brackish; marine; depth range 10-40 m [Whitehead 1984]."

Climate/Range

From Froese and Pauly (2015):

"Tropical; 15°C - 28°C [Baensch and Riehl 1985]; 49°N - 26°S, 56°E - 155°E [FAO-FIGIS 2005]."

From Hill and Hardin (2008):

"The barramundi perch *L. calcarifer* is a predatory fish that is native to freshwater, marine, and estuarine habitats in tropical and subtropical areas of the Indo-Pacific from the Persian Gulf eastward to southern China and Japan and southward to Papua New Guinea and northern Australia (Berra 2001, Froese and Pauly 2007). Its native range includes climate and habitat similar to those of peninsular Florida (Hill and Thompson 2008)."

Distribution Outside the United States

Native

From Hill and Hardin (2008):

"Barramundi is native to freshwater, marine, and estuarine habitats in the Indo-Pacific region from the Persian Gulf eastward to southern China and Japan and southward to Papua New Guinea and northern Australia (Berra 2001; Froese and Pauly 2007)."

Introduced

From Hill and Hardin (2008):

"It is established in China outside its native range (Ma et al. 2003) and possibly established in French Polynesia (Froese and Pauly 2007). It has been introduced to Guam, but the status of the species there is unknown (Froese and Pauly 2007)."

From Froese and Pauly (2016):

Year / Period	From	To	Established	Ecol. effects
1975-1999	Australia	Israel	Unknown	
Unknown	Unknown	French Polynesia	Probably established	
Unknown	Unknown	French Polynesia	Unknown	Unknown
Unknown	Unknown	Guam	Unknown	
1990-1999	Malaysia	Iran	Unknown	Unknown
1983	Thailand	China	Established	
1998	Not specified	Saudi Arabia	Probably not established	No data

From FAO (2016):

"*Lates calcarifer* introduced to Israel from Australia
Date of introduction:
Status of the introduced species in the wild: unknown"

"*Lates calcarifer* introduced to Iran from Malaysia
Date of introduction: 1990s
Status of the introduced species in the wild: unknown"

"*Lates calcarifer* introduced to China from Thailand
Date of introduction:
Status of the introduced species in the wild: unknown"

"*Lates calcarifer* introduced to Saudi Arabia from Not specified
Date of introduction:
Status of the introduced species in the wild: Probably not established"

Means of Introduction Outside the United States

From FAO (2016):

"Reasons of Introduction: 1) aquaculture"

"Reasons of Introduction: 1) research"

Short Description

From Froese and Pauly (2015):

"Dorsal spines (total): 7 - 9; Dorsal soft rays (total): 10-11; Anal spines: 3; Anal soft rays: 7-8. Body elongate; mouth large, slightly oblique, upper jaw extending behind the eye. Lower edge of pre-opercle serrated, with strong spine at its angle; opercle with a small spine and with a serrated flap above the origin of the lateral line. Caudal fin rounded."

From Fulton-Howard (2008):

"Barramundi are large fish, with a maximum length of over two meters, although they are more commonly around 1.5 meters. Barramundi can have a mass over 55 kilograms. According to the FAO species identification guide, they have a moderately deep, elongate, and compressed body. Barramundi have pointed snouts and large mouths, with jaws extending past the eyes. Nostrils are close together. The dorsal fin is deeply incised, with separate spiny and soft dorsal fins. The spiny dorsal fin has seven to nine spines, and the soft dorsal fin has ten to eleven soft rays. The anal fin has three spines and seven to eight soft rays. Pelvic and pectoral fins are present. These fish have a distinct caudal peduncle, or tail muscle, with a rounded caudal fin. The lateral line extends onto the caudal fin. (UN Fish and Agricultural Organization, 1999)

The scales of barramundi are firmly fixed and ctenoid. Adult barramundi are silver with darker, olive or blue-gray backs. In turbid (cloudy) water, coloration is darker. Juveniles are brown (sometimes grayish-brown) with three white stripes on the head and scattered white spots elsewhere. The markings can be dimmed or may disappear at will. The fins do not have markings. The eyes are golden-brown with a red reflective glow. (UN Fish and Agricultural Organization, 1999)"

Biology

From Hill and Hardin (2008):

"Barramundi perch are catadromous, requiring elevated salinity for successful reproduction (Moore 1982). Furthermore, barramundi perch are protandrous hermaphrodites, as males undergo sex reversal after spawning at least once, typically by age 4 (Davis 1982). However, Australian fisheries biologists have noted the presence of primary females, and sex transformation of males without spawning has been observed on one occasion (Moore 1979). In the species' native range, barramundi perch spawn in marine habitats, with larvae and young developing in coastal nursery areas similar to habitats common in central and south Florida. In

addition, barramundi perch are ecomorphologically similar to the native common snook *Centropomus undecimalis*, an important Florida sport fish (Hill and Thompson 2008)."

From Froese and Pauly (2016):

"A protandrous hermaphrodite [Moore 1979] […] Feed on fishes and crustaceans. They reach 1500-3000 g in one year in ponds under optimum conditions [Hora and Pillay 1962; Allen et al. 2002]. Juveniles also eat insects [Allen et al. 2002]."

"Breed in estuaries throughout the Indo-Pacific. Maturing male barramundi migrate downstream from freshwater habitats at the start of the wet (monsoon) season to spawn with resident females in estuaries [Buschmann et al. 1996] and on tidal flats outside the mouths of rivers [Kailola et al. 1993]. Barramundi spawn on the full moon and new moon, primarily at the beginning of an incoming tide which carries the eggs into the estuary [MacKinnon et al. 1986]. Barramundi are broadcast spawners that aggregate to spawn [Kailola et al. 1993]. Spawning aggregations occur in or around the mouths of rivers [Davis 1987]. While adults and juveniles are capable of living in fresh water, brackish waters are required for embryonic development [Shaklee and Salini 1985]. Female barramundi are capable of producing large numbers of eggs, with estimates as high as 2.3 million eggs per kg of body weight [Davis 1984]. Barramundi are protandrous hermaphrodites, i.e., they undergo sex reversion during their life cycle. Females are generally absent in the smaller length classes, but dominate larger length classes. Most barramundi mature first as males and function as males for one or more spawning seasons before undergoing sex inversion. A few females will develop directly from immature fish [Davis 1987]. Similarly, some males may never undergo sex inversion [Davis 1987]. Also de Mitcheson and Liu [2008]."

"Found in coastal waters, estuaries and lagoons, in clear to turbid water [Allen 1989; Allen et al. 2002]. A diadromous fish, inhabiting rivers before returning to the estuaries to spawn […] Larvae and young juveniles live in brackish temporary swamps associated with estuaries, and older juveniles inhabit the upper reaches of rivers [Kailola et al. 1993; Allen et al. 2002]. Have preference for cover on undercut banks, submerged logs and overhanging vegetation [Allen et al. 2002]."

From Fulton-Howard (2008):

"Barramundi are catadromous, spending most of their life in fresh water and migrating to salt water in order to breed. Smaller fish are found in rivers and streams and larger fish are found in the ocean and estuaries (Pender, 1996; FAO, 1999). There are exceptions to this patter[n], however, with populations of all sizes of fish found throughout their natural range. Pender and Griffin confirmed through chemical analysis that there are populations that spend their entire life cycle in salt water, in brackish water, or in fresh water (Pender, 1996). Barramundi can survive in a wide range of salinities, but must be introduced slowly to a new salinity to avoid shock (Webster, 2002). Barramundi generally prefer to hide under logs or other objects. (Pender and Griffin, 1996; UN Fish and Agricultural Organization, 1999; Webster and Lim, 2002)

Barramundi are demersal, meaning they spend most of their time near but not on the bottom of a body of water."

“Barramundi are serially hermaphroditic, transforming from male to female at three to eight years of age (FAO, 1999; Guiguen, 1993). Moore (1979) suggests some individuals may not undergo this transition, based on a sex ratio of 3.8 males to 1 female. (Guiguen, et al., 1993; Moore, 1979; Pender and Griffin, 1996; UN Fish and Agricultural Organization, 1999)”

“According to Moore, the eggs of fish not exposed to high salinity water do not develop fully, however, Pender and Griffen (1996) concluded that there are populations that spend their entire life cycles in freshwater, estuarine, or saltwater environments, so there may be exceptions to the requirement for high salinities. (Moore, 1982; Pender and Griffin, 1996; Russell and Garrett, 1985; UN Fish and Agricultural Organization, 1999; Webster and Lim, 2002)

There is one spawning season per year towards the end of the dry season and the beginning of the rainy season in the period from October to February (Moore, 1982). Females carry from 2.3 to 32.2 million eggs and can either shed them all at once or as little as 10% at a time (Moore, 1982). Because *Lates calcarifer* is a broadcast breeder, it can be inferred that there is little interaction between males and females. However, barramundi tend to spawn around the full moon, when tides will carry the eggs back into estuaries (Luna, 2008). (Luna, 2008; Moore, 1982)

Lates calcarifer is serially hermaphroditic with males reaching maturity at 37 to 72 cm and changing into females starting at 73 cm, at around five years, three to five years, or six to eight years depending on the source (Moore, 1979, FAO, 1999; Guiguen, 1993). According to Guiguen (1993) males mature at three to five years, but this study was conducted in cage farmed fish, which may have different maturation times than wild fish. Some male specimens do get larger than 73 cm. The transition from male to female is short, lasting as little as a week, and may not occur in all individuals according to Moore (1979). (Guiguen, et al., 1993; Moore, 1979; UN Fish and Agricultural Organization, 1999)

Chemical levels in the scales of fish from southern Papua New Guinea have indicated that adult barramundi do not always migrate to breeding grounds to spawn, with a lifetime non-participation rate of as much as 50% (Milton, 2005). (Milton and Chenery, 2005)”

“Immediately after hatching as plankton, *Lates calcarifer* larvae make their way from the mouths of estuaries into brackish or freshwater swamps or mangroves where they are protected from predators. The developing fish tend to stay in the swamps from February to April, before moving into permanent tidal creeks for another nine months. After the nine months have past, juvenile barramundi make their way into freshwater estuaries to further develop (Russel, 1985). Barramundi return to the mouths of the estuaries to breed (Moore, 1982). Barramundi are found alone or in small groups, they may school in feeding aggregations when feeding on schools of smaller bait fish. (Davis, 1985)”

“Individuals are mostly solitary and may defend territories near submerged structures that they use as hiding spots. (Moore, 1982; Russell and Garrett, 1985)”

“Barramundi are opportunistic predators. They eat microcrustaceans such as copepods and amphipods as juvenile fish under 40 mm. As larger juveniles they eat macrocrustaceans like

Penaeidae and Palaemonidae. These crustacean prey are found mainly near the bottom of the water column, so this diet also protects juveniles from most of their predators, which hunt closer to the water surface. Mollusks are consumed to a lesser degree. When barramundi are around 80 mm, they begin to eat macrocrustaceans and pelagic bony fishes. Larger fish have diets of around 80% bony fish. Barramundi swallow their food whole, sucking their prey into their fairly large mouths. Moderate cannibalism is fairly common in barramundi (Davis, 1985). (Davis, 1985)"

"Although barramundi are opportunistic predators (Davis, 1985), they are also a prey species. The patterns present on the scales of juvenile barramundi (FAO, 1999), in combination with the fact that juveniles reside in protected mangroves and swamps (Moore, 1982; Russell, 1985; and FAO, 1999) suggests a need to protect against predators. There are several species that have been found to prey on juvenile barramundi. In an analysis of stomach contents Davis (1985) demonstrated that barramundi over 40 mm consume juvenile barramundi as part of their diet. Australian pelicans (*Pelecanus conspicillatus*) (Hitchcock, 2007) and file snakes (*Acrochordus arafurae*) (Shine, 1986) feed on both juvenile and adult barramundi. (Davis, 1985; Hitchcock, 2007; Luna, 2008; Moore, 1982; Russell and Garrett, 1985; Shine, 1986; UN Fish and Agricultural Organization, 1999)"

Human Uses

From Froese and Pauly (2015):

"Aquaculture… gamefish…public aquariums."

From Hill and Hardin (2008):

"The barramundi is an important commercial freshwater fish and is the premier inland and coastal sport fish in many regions (Milton et al. 1998; Makaira Pty. Ltd. 1999; Berra 2001)."

"Barramundi is an important aquaculture species within its native range in Australia and Southeast Asia."

From Froese and Pauly (2016):

"Sold fresh and frozen; consumed steamed, pan-fried, broiled and baked [Frimodt 1995]. A very popular and sought-after fish of very considerable economic importance [Larsen 1999]. Presently used for aquaculture in Thailand, Indonesia and Australia [Larsen 1999]. Australia's most important commercial fish and one of the most popular angling species [Allen et al. 2002]."

From Fulton-Howard (2008):

"Barramundi are valuable both as recreational and commercial fish, with a high, fairly stable price (Luna, 2008). They are stocked in lakes and ponds for recreational fishing and are also fished in freshwater creeks and estuaries (Morgan, 2004). Barramundi are heavily farmed in cages, as well as in freshwater and saltwater ponds (Webster, 2002). Worldwide capture peaked in 2000 at 74,207 metric tonnes and declined to 57,074 tonnes caught in 2005 (FAO, 2008; but

see Webster, 2002). Aquaculture of barramundi has grown rapidly with 1646 tonnes (4,357,000 USD) produced in 1984, 18,564 tonnes (70,720,000 USD) produced in 1994, and 30,970 tonnes (79,034,000 USD) produced in 2005. (Luna, 2008; Morgan, et al., 2004; UN Fish and Agricultural Organization, 2008; Webster and Lim, 2002)

Since it is a white fish with delicate flavor, barramundi is also becoming popular in the United States. As of 2006, the indoor fish farming interest Australis, based in Massachusetts, was shipping 40,000 lbs of fish per week (Pierce, 2006). (Pierce, 2006)"

Diseases

***Trypanosoma evansi, Aphanomyces invadans,* and white spot disease are on the 2016 list of OIE reportable diseases.**

From Hill and Hardin (2008):

"Barramundi, as with other fisheries and aquaculture species, is susceptible to a wide range of fish pathogens, many ubiquitous and with broad host ranges. Bacterial pathogens reported from cultured barramundi include gram negatives Aeromonas (e.g., *A. hydrophila*), Edwardsiella (e.g., *E. ictaluri*), epitheliocyctis, Flavobacterium (*F. columnare*, *F. johnsoniae*), Pasteurella, Pseudomonas (e.g., *P. anguilliseptica* and *P. fluorescens*), Vibrio (e.g., *V. alginolyticus*, *V. anguillarum*, *V. damsela*, *V. harveyi*, and *V. vulnificus*), and Yersinia, and the gram positive Streptococcus (e.g., *S. iniae*) (Yong and Seng 1986; Anderson and Prior 1992; Soltani et al. 1996; Bromage and Owens 1999, 2002; Makaira Pty. Ltd. 1999; Gibson-Kueh et al. 2004; Tucker et al. 2005) . Reported parasites of barramundi include the dinoflagellate Amyloodinium; ciliates Brooklynella, Cryptocaryon, Chilodonella, and Trichodina; the flagellates Cryptobia and Trypanosoma; and myxozoans Henneguya and Kudoa (Seng and Yong 1986; Makaira Pty. Ltd. 1999; Tucker et al. 2005; Small 2006). Monogenean parasites reported include *Diplectanum penangi*, *Neobenedenia melleni*, and *Laticola* (*L. lingaoensis*, *L. latesi*, *L. paralatesi*) (Deveney et al. 2001; Tingbao et al. 2006). A digenean parasite in the family Sanguinicolidae has been detected but it is unknown if this parasite has a negative effect on barramundi health (Small 2006). A parasitic copepod, *Lernanthropus*, has been reported from barramundi in sea cages in Australia (Small 2006). Pathogenic fungi, including *Aphanomyces invadans* and Saprolegnia, and viruses, including lymphocystis disease virus, *Bohle iridovirus*, and betanodavirus also have been reported (Moody and Owens 1994; Ariel and Owens 1997; Makaira Pty. Ltd. 1999; Munday et al. 2002; Tucker et al. 2005).

Barramundi is susceptible to redspot disease (ulcerative mycosis [UM], epizootic ulcerative syndrome [EUS], or mycotic granulomatosis [MG]), a condition that affects a number of fish species (Makaira Pty. Ltd. 1999; OIE 2007). This fungal infection (*Aphanomyces invadans*) is an OIE-listed, notifiable disease (OIE 2007)."

"Another disease of note is viral encephalopathy and retinopathy (VER) or viral nervous necrosis (VNN) (DAFF 2004). This disease, caused by a betanodavirus (tentatively named *Lates calcarifer* encephalitis virus [LcEV]), was responsible for heavy mortality in Australian hatchery-reared barramundi larvae in the 1980s (Glazebrook et al. 1990). This virus was

originally thought to be a picorna virus before being recognized as a betanodavirus (Glazebrook et al. 1990; Munday et al. 2002). Viral nervous necrosis (VNN, VER) was previously an OIE-listed reportable disease, but has been removed from this list (OIE 2005). Improved husbandry techniques, including disinfection, isolation of stocks, use of ultraviolet light sterilization, and other biosecurity practices have controlled this disease in barramundi hatcheries (Munday et al. 1992)."

From Froese and Pauly (2016):

"Transversotrema Infestation, Parasitic infestations (protozoa, worms, etc.)
Erilepturus Disease, Parasitic infestations (protozoa, worms, etc.)
Lecithochirium Disease 2, Parasitic infestations (protozoa, worms, etc.)
Pseudometadena Infestation, Parasitic infestations (protozoa, worms, etc.)
Pseudometadena Disease, Parasitic infestations (protozoa, worms, etc.)
Diplectanum Disease, Parasitic infestations (protozoa, worms, etc.)
Callitetrarhynchus Disease, Parasitic infestations (protozoa, worms, etc.)
Pterobothrium Infestation 2, Parasitic infestations (protozoa, worms, etc.)
Psilostomum Disease, Parasitic infestations (protozoa, worms, etc.)
Dasyrhynchus Infestation 1, Parasitic infestations (protozoa, worms, etc.)
Gymnorhynchus Infestation, Parasitic infestations (protozoa, worms, etc.)
Serrasentis Infestation, Parasitic infestations (protozoa, worms, etc.)
White spot Disease, Parasitic infestations (protozoa, worms, etc.)
Lymphocystis Disease, Viral diseases
Columnaris Disease (m.), Bacterial diseases
Iridovirosis, Viral diseases
Vibriosis Disease, Bacterial diseases
Trichodinosis, Parasitic infestations (protozoa, worms, etc.)
Lymphocystis Disease, Viral diseases
Lymphocystis Disease, Viral diseases
Lymphocystis Disease, Viral diseases
Pseudometadena Infestation, Parasitic infestations (protozoa, worms, etc.)
Diplectanum Disease, Parasitic infestations (protozoa, worms, etc.)
Vibriosis Disease (general), Bacterial diseases
Vibriosis Disease (general), Bacterial diseases
Vibriosis Disease (general), Bacterial diseases
Flexibacter maritimus Infection, Bacterial diseases
Baldness disease in Snapper, Parasitic infestations (protozoa, worms, etc.)
Pseudorhabdosynochus Infestation 2, Parasitic infestations (protozoa, worms, etc.)
Lernanthropus Infestation 4, Parasitic infestations (protozoa, worms, etc.)
Pseudorhabdosynochus Infestation 3, Parasitic infestations (protozoa, worms, etc.)
Capsalid Monogenean Infection 1, Parasitic infestations (protozoa, worms, etc.)
Glugeosis Disease, Parasitic infestations (protozoa, worms, etc.)
Epitheliocystis, Bacterial diseases
Fish louse Infestation 1, Parasitic infestations (protozoa, worms, etc.)
Trichodinosis, Parasitic infestations (protozoa, worms, etc.)
Anisakis Disease (juvenile), Parasitic infestations (protozoa, worms, etc.)

Anisakis Disease (juvenile), Parasitic infestations (protozoa, worms, etc.)
Caligus Infestation 1, Parasitic infestations (protozoa, worms, etc.)
Pseudometadena Infestation, Parasitic infestations (protozoa, worms, etc.)
Rhapidascaris Disease (larvae), Parasitic infestations (protozoa, worms, etc.)
Rhapidascaris Disease (larvae), Parasitic infestations (protozoa, worms, etc.)
Bucephalus Disease, Parasitic infestations (protozoa, worms, etc.)
Rhipidocotyle Infestation 7 (*Rhipidocotyle* sp.), Parasitic infestations (protozoa, worms, etc.)
Rhipidocotyle Infestation 7 (*Rhipidocotyle* sp.), Parasitic infestations (protozoa, worms, etc.)
Cymothoa Infection, Parasitic infestations (protozoa, worms, etc.)
Cardicola Infection, Parasitic infestations (protozoa, worms, etc.)
Cardicola Infection, Parasitic infestations (protozoa, worms, etc.)
Ectenurus Infection 2 (*Ectenurus* sp.), Parasitic infestations (protozoa, worms, etc.)
Ectenurus Infection 2 (*Ectenurus* sp.), Parasitic infestations (protozoa, worms, etc.)
Lecithochirum Infestation 3, Parasitic infestations (protozoa, worms, etc.)
Aegathoa Infestation (*Aegathoa* sp.), Parasitic infestations (protozoa, worms, etc.)
Cycloplectanum Infection 2, Parasitic infestations (protozoa, worms, etc.)
Cycloplectanum Infection 2, Parasitic infestations (protozoa, worms, etc.)
Cycloplectanum Infection 2, Parasitic infestations (protozoa, worms, etc.)
Cycloplectanum Infection 1, Parasitic infestations (protozoa, worms, etc.)
Cycloplectanum Infection 1, Parasitic infestations (protozoa, worms, etc.)
Cycloplectanum Infection 1, Parasitic infestations (protozoa, worms, etc.)”

From Bailly (2015):

“*Caligus diaphanus* Nordmann, 1832 (parasitic: ectoparasitic)
Caligus epidemicus Hewitt, 1971 (parasitic: ectoparasitic)
Caligus orientalis Gusev, 1951 (parasitic: ectoparasitic)
Caligus pagrosomi Yamaguti, 1939 (parasitic: ectoparasitic)
Caligus punctatus Shiino, 1955 (parasitic: ectoparasitic)
Caligus rotundigenitalis Yü, 1933 (parasitic: ectoparasitic)
Complexobursa magna Bilqees, 1979 (parasitic: endoparasitic)
Cruoricola lates Herbert, Shaharom-Harrison & Overstreet, 1994 (parasitic: endoparasitic)
Cucullanus exiguus Yamaguti, 1954 (parasitic: endoparasitic)
Diplectanum incertae sedis penangi Liang & Leong, 1991 (parasitic: ectoparasitic)
Ergasilus ogawai Kabata, 1992 (parasitic: ectoparasitic)
Indocucullanus calcariferii Zaidi & Khan, 1975 (parasitic: endoparasitic)
Laticola lingaoensis Yang, Kritsky, Sun, Zhang, Shi & Agrawal, 2006 (parasitic: ectoparasitic)
Lernanthropus latesi Tripathi, 1962 (parasitic: ectoparasitic)
Lernanthropus latis Yamaguti, 1954 (parasitic: ectoparasitic)
Parasanguinicola vastispina Herbert & Shaharom, 1995 (parasitic: endoparasitic)
Pseudorhabdosynochus monosquamodiscusi Balasuriya & Leong, 1995 (parasitic: ectoparasitic)”

Threat to Humans

From Froese and Pauly (2016):

"Harmless"

3 Impacts of Introductions

From Hill and Hardin (2008):

"The most likely hypothetical effects of barramundi on native Florida species would be direct predation and competition for food. …

Given that nearly all introductions of barramundi have been deliberate stock enhancement releases within its native range, there are few evaluations of the effects of introduced barramundi. In these few papers, no data were presented documenting negative effects of introduced barramundi. Arthington and McKenzie (1997) reviewed the effects of aquatic species introductions in Australia and listed concerns over genetic effects or dispersal of pathogens from translocated barramundi. Morgan et al. (2004) investigated the effects of barramundi stocking in a reservoir, Lake Kununurra, Western Australia. They concluded that there was little possibility of negative effects on resident fishes due to competition for food or habitat or from predation. However, barramundi is native to the basin and was previously absent from the reservoir because of recruitment failures due to the inability of barramundi to move upstream of the dam. Therefore, barramundi was not a novel predator or competitor for the resident fauna. Pusey et al. (2006) expressed concern over predatory effects of translocated barramundi in the Burdekin River, Australia. This species is naturally absent from the basin above Burdekin Falls, a substantial barrier to the upstream movement of fishes. Nevertheless, no data were presented to suggest a negative effect of barramundi on native species."

From Pusey et al. (No date):

"For example, Kennard (1995) demonstrated alteration of microhabitat use, foraging behaviour and diet of native fishes in the Normanby River, Queensland, in response to predation by barramundi. Such responses are likely to have life history consequences and have the potential to result in trophic cascades."

4 Global Distribution

Figure 1. Known global distribution of *Lates calcarifer*. Map from GBIF (2013).

The record in Baja California, Mexico is the result of a citizen science program and the coordinate projection is in question by GBIF (2013). This location was not used as a source point in the climate match as the species' presence in that area could not be corroborated by another source.

The location in French Polynesia was not used as a source location for the climate match. There were many issues with the record in GBIF (2013) and no other source listed a wild population in this country.

Figure 2. Known global distribution of *Lates calcarifer*. Map from VertNet (2017).

5 Distribution Within the United States

Lates calcarifer is not known to be present in the wild in the U.S.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Lates calcarifer* was high in southern Florida and Texas. The match was medium along the southern Atlantic Coast, mid-Texas and parts of the West Coast. The match was low everywhere else. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean Distance) for the Continental U.S. was 0.050, medium, and was individually high for Florida, Kansas, Oklahoma, and Texas.

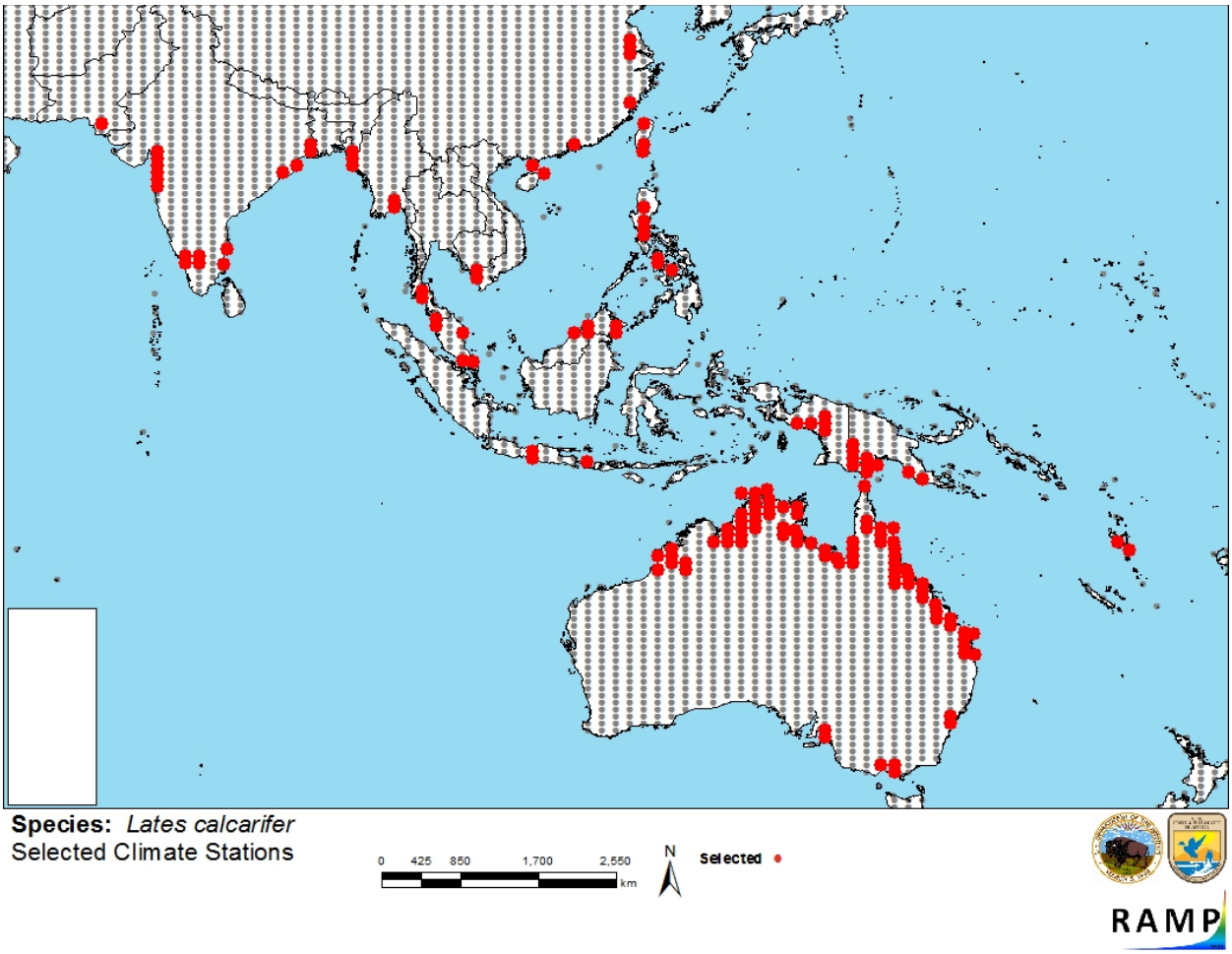

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (grey) for *Lates calcarifer* climate matching. Source locations from GBIF (2013) and VertNet (2017).

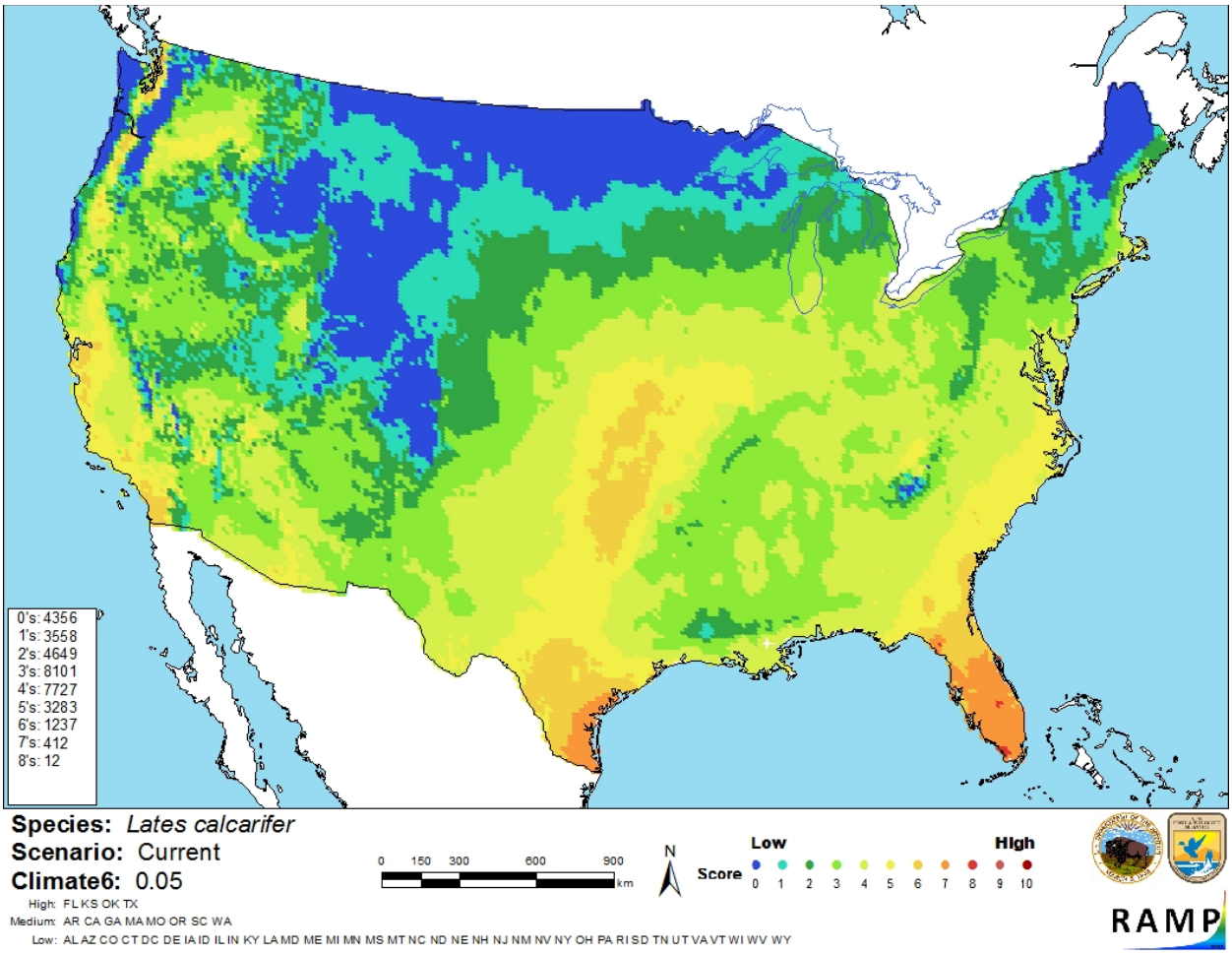

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *Lates calcarifer* in the continental United States based on source locations reported by GBIF (2013) and VertNet (2017). 0 = Lowest match, 10 = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

The certainty of this assessment is medium. There was adequate ecological and biological information. Records of introductions were found and some information about potential impacts of those introductions was found. All introductions have been through deliberate actions of aquaculture or research agencies.

8 Risk Assessment

Summary of Risk to the Contiguous United States

The history of invasiveness is not documented. This species has been introduced outside of its native range, however all introductions were intentional. There were no records of this species being introduced through unintentional means. One study did show *Lates calcarifer* to have an impact on the behavior of native forage species through predation (Pusey et al. no date); *L. calcarifer* was intentionally introduced for sport fishing in this location. The climate match is medium with the areas of highest match in southern Florida and Texas. The certainty of assessment is medium. The overall risk assessment category is Uncertain. One of the two areas that have higher climate matches, Florida, has already placed significant restrictions on the possession of live specimens of the species, precluding the presence of it in the aquaculture industry or introductions for a sport fishery.

Assessment Elements

- **History of Invasiveness (Sec. 3): None documented**
- **Climate Match (Sec. 6): Medium**
- **Certainty of Assessment (Sec. 7): Medium**
- **Remarks/Important additional information:** No remarks.
- **Overall Risk Assessment Category: Uncertain**

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Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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