Monterey Bay Aquarium Seafood Watch®

Red swamp crayfish

Procambarus clarkii

Louisiana: Atchafalaya Basin

Traps (unspecified)

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Seafood Watch Consulting Researcher

Seafood Watch Standard used in this assessment: Standard for Fisheries vF2

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from www.seafoodwatch.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices," "Good Alternatives" or "Avoid." The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch®'s sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling 1-877-229-9990.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed, that can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems.

Based on this principle, Seafood Watch had developed four sustainability **criteria** for evaluating wildcatch fisheries for consumers and businesses. These criteria are:

- How does fishing affect the species under assessment?
- How does the fishing affect other, target and non-target species?
- How effective is the fishery's management?
- How does the fishing affect habitats and the stability of the ecosystem?

Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and **rating**

Once a rating has been assigned to each criterion, we develop an overall recommendation. Criteria ratings and the overall recommendation are color-coded to correspond to the categories on the Seafood Watch pocket guide and online guide:

Best Choice/Green: Are well managed and caught in ways that cause little harm to habitats or other wildlife.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught.

Avoid/Red Take a pass on these for now. These items are overfished or caught in ways that harm other marine life or the environment.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

Crayfish (or crawfish) are found and caught worldwide in freshwater swamps, marshes and slow flowing rivers. They are short-lived and fast growing animals. This report evaluates the wild caught crayfish fishery in Louisiana's Atchafalaya Basin using baited crayfish traps.

The abundance and fishing level of crayfish in the Atchafalaya Basin is unknown, since no population assessments have been conducted. Abundance of crayfish appears to be sensitive to environmental variation, particularly the flood regime and water levels in the rivers and swamps in which they live. The traps used to catch crayfish are moderately selective, but other invertebrates or small fishes could be caught. However, it is likely that most of the non-target catch is released unharmed.

This fishery is managed by the Louisiana Department of Wildlife and Fisheries, but few management regulations have been put in place. The fishery is small and has a moderate impact on the habitat and ecosystem.

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1: Impacts on the Species	CRITERION 2: Impacts on Other Species	CRITERION 3: Management Effectiveness	CRITERION 4: Habitat and Ecosystem	OVERALL RECOMMENDATION
Red Swamp Crayfish Louisiana/Atchafalaya Basin | Traps (unspecified) | United States of America	Yellow (2.644)	Green (2.986)	Red (2.000)	Yellow (3.000)	**Good Alternative (2.623)**

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

- **Best Choice/Green** = Final Score >3.2, and no Red Criteria, and no Critical scores
- **Good Alternative/Yellow** = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern[2], and no more than one Red Criterion, and no Critical scores
- **Avoid/Red** = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This report evaluates the sustainability of the wild crayfish (or crawfish) trap fishery in the Atchafalaya Basin in Louisiana, USA. The Louisiana fishery accounts for the majority of the wild caught crayfish in the U.S.

Species Overview

Crayfish are found worldwide in freshwater swamps, marshes and slow flowing rivers, with the majority of their distribution resulting from human introduction (Crandall 2010, Global Trust Certification 2011). They are nocturnal animals with little migration, emerging from burrows at night to forage. Although during some periods of their lives, particularly the breeding season, these animals have a "wandering phase" (Global Trust Certification 2011). Environmental conditions (temperature and wet/dry periods) affect reproduction and growth rates (Romaire et al. 2004, McClain et al. 2007, Alford and Walker 2011, Global Trust Certification 2011).

Crayfish are native to Louisiana and are a cultural and culinary icon. Best known for its use in jambalaya and traditional crayfish boils, this shellfish is a staple of Creole cuisine. Louisiana's commercial crayfish fishery is concentrated in the Atchafalaya Basin, a freshwater system connected with the Mississippi River, and is the region of focus for this report. Wild crayfish are caught using baited coded-wire mesh traps that rest on the substrate. The wild crayfish fishery is managed by the Louisiana Department of Wildlife and Fisheries (LDWF).

Production Statistics

Annual catches of wild crayfish in Louisiana have ranged from 30,000 lbs in 1950 to 50 million lbs in 1993 and have remained under 20 million lbs since 1999 (NMFS 2013). The wild fishery averages around 11% of Louisiana's crayfish production, with the remainder coming from aquaculture operations. In 2012, nearly 100 million pounds of crayfish were produced by Louisiana; the wild crayfish fishery accounted for 8.7 million pounds (9.6%) (LSUAC 2012, USDOC 2012, NMFS 2013). The number of participants in the Louisiana crayfish fishery has varied. Of the 1,756 commercial crayfish licenses issued in 2008, only 1,142 reported catching crayfish (LDWF 2010).

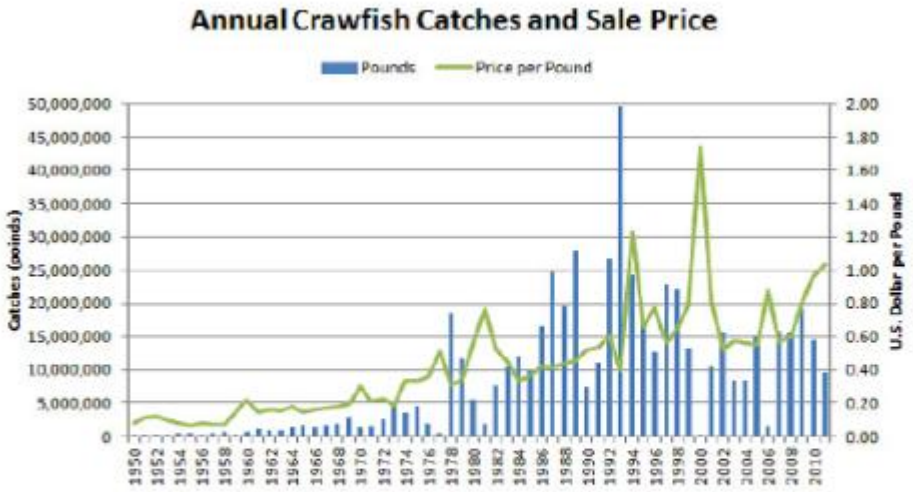

Figure 1 Annual commercial catches of wild crawfish in Louisiana and reported annual sales.

Importance to the US/North American market.

Louisiana crayfish comprises 95% of the domestic crayfish market sold in the United States (Romaire et al. 2005, Gillespie et al. 2012). Other states known for producing crayfish include California and Oregon (NMFS 2013). The amount of crayfish imported has varied from 5 to 20 million pounds since 2010, and typically comprises 10 - 20% of the U.S. market(LSUAC 2010, 2011, 2012). In 2012, the U.S. crayfish market was comprised mainly of farmed crayfish (90,900,000 lbs), followed by imported (20,400,000 lbs), and then wild caught (8,700,000 lbs) (LSUAC 2012, USDOC 2012, NMFS 2013).

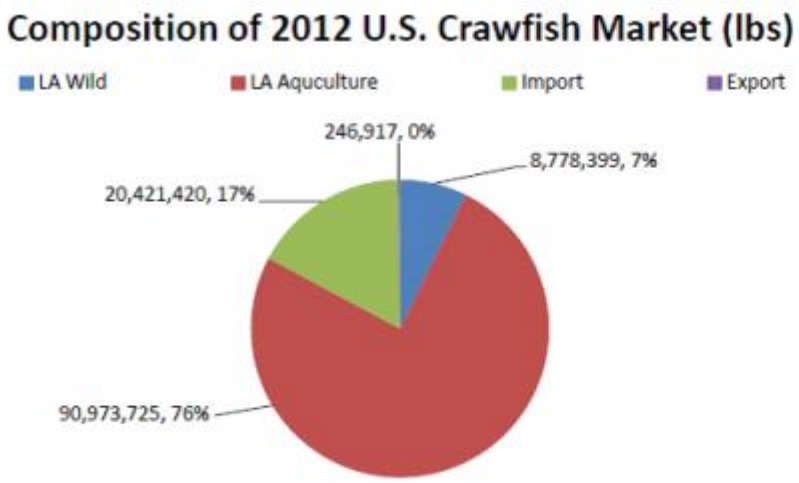

Figure 2 Presence of Louisiana crawfish in 2012 U.S. crawfish market (lbs).

Common and market names.

Crawfish, Crayfish, Red Swamp Crawfish, Crawdaddy

Primary product forms

Crayfish is marketed in the U.S. mainly as live product, with the highest demand in the Southeast. Small markets exist for whole fresh cooked, frozen tail-only meat, frozen cooked tail meat, and bait (McClain and Romaire 2004, Romaire et al. 2005, McClain et al. 2007, Gillespie et al. 2012). The frozen tail-only market is reserved for small crayfish during the peak season (April-May) and is largely dominated by imports from China (Romaire et al. 2005, McClain et al. 2007, Gillespie et al. 2012).

Figure 3 Distribution of live crawfish is concentrated in Louisiana and southeastern United States, ensuring the freshness of the product (Image from Mc Clain et al. 2007).

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at http://www.seafoodwatch.org.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown.

The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical

Criterion 1 Summary

RED SWAMP CRAYFISH				
Region | Method	**Inherent Vulnerability**	**Abundance**	**Fishing Mortality**	**Score**
Louisiana/Atchafalaya Basin | Traps (unspecified) United States of America	3.00: Low	3.00: Moderate Concern	2.33: Moderate Concern	Yellow (2.64)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Inherent Vulnerability

- *Low—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing).*
- *Medium—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).*
- *High—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator). Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.*

Factor 1.2 - Abundance

- *5 (Very Low Concern)—Strong evidence exists that the population is above target abundance level (e.g., biomass at maximum sustainable yield, BMSY) or near virgin biomass.*
- *4 (Low Concern)—Population may be below target abundance level, but it is considered not overfished*
- *3 (Moderate Concern) —Abundance level is unknown and the species has a low or medium inherent vulnerability to fishing.*
- *2 (High Concern)—Population is overfished, depleted, or a species of concern, OR abundance is unknown and the species has a high inherent vulnerability to fishing.*
- *1 (Very High Concern)—Population is listed as threatened or endangered.*

Factor 1.3 - Fishing Mortality

- *5 (Very Low Concern)—Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY), OR fishery does not target species and its contribution to the mortality of species is negligible (≤ 5% of a sustainable level of fishing mortality).*
- *3.67 (Low Concern)—Probable (>50%) chance that fishing mortality is at or below a sustainable level, but some uncertainty exists, OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible, OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught).*
- *2.33 (Moderate Concern)—Fishing mortality is fluctuating around sustainable levels, OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery and, if species is depleted, reasonable management is in place.*
- *1 (High Concern)—Overfishing is occurring, but management is in place to curtail overfishing, OR fishing mortality is unknown, species is depleted, and no management is in place.*
- *0 (Critical)—Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.*

RED SWAMP CRAYFISH

Factor 1.1 - Inherent Vulnerability

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Low

Crayfish are short-lived and fast growing animals. Their lifespan is no more than several years and they sexually mature within their first year of life. They can grow up to 12 cm (4.7 in) in length and can exceed 50 g (Global Trust Certification 2011). Crayfish are brooders and females produce 250 or more eggs (McClain and Romaire 2004)(McClain et al. 2007)(Global Trust Certification 2011). Given these life history characteristics, crayfish are considered to have a low vulnerability to fishing.

Justification:

Resilience Attribute	Louisiana Crawfish Data	Score
Average age at maturity	< 1 year	3
Average maximum age	2-3 yrs	3
Fecundity	> 250 eggs	N/A
Reproductive strategy	Brooder	2
Density dependance	No depensatory or compensatory dynamics demonstrated or likely	2
Average overall score	Low Vulnerability	2.5

Figure 4 Results from Seafood Watch vulnerability rubric.

Factor 1.2 - Abundance

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderate Concern

The abundance of crayfish in the Atchafalaya Basin of Louisiana is unknown because population assessments and abundance surveys have not been conducted. Crayfish are sensitive to environmental parameters, particularly water levels in the rivers and swamps they reside in. When water levels are low due to drought there is less habitat available, which can lead to reduced reproductive success and a reduction in abundance. Typically, higher water levels lead to higher abundances, however, during warm months low oxygen (hypoxic) conditions can occur in the water causing stress, burrowing, or death and as a result lower catches (McClain and Romaire 2004)(McClain et al. 2007)(Global Trust Certification 2011)(Bonvillain et al. 2012)(Alford and Walker 2013). Since abundance of crayfish is unknown and crayfish have a low vulnerability to fishing, abundance is rated a moderate concern.

Factor 1.3 - Fishing Mortality

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderate Concern

The fishing mortality on Louisiana crayfish is unknown because a population assessment has not been performed on the species. Annual catches tend to fluctuate with abundance levels. When abundance is low (due to low water levels) catches are lower, while higher abundances (when water levels are higher) lead to higher catches. There are no management practices in place to limit the fishing mortality on crayfish (Global Trust Certification 2011)(LDWF 2013). It has been suggested that at present the market demand limits the fishery and prevents overexploitation (Global Trust Certification 2011). Due to insufficient data a moderate concern score is given to the fishery.

Criterion 2: Impacts on other species

All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing.

To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Criterion 2 Summary

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

RED SWAMP CRAYFISH Louisiana/Atchafalaya Basin | Traps (Unspecified) | United States Of America					
Subscore:	**3.318**	**Discard Rate:**	**0.90**	**C2 Rate:**	**2.986**
Species | Stock	**Inherent Vulnerability**	**Abundance**		**Fishing Mortality**	**Subscore**
Benthic inverts	2.00:Medium	3.00:Moderate Concern		3.67:Low Concern	Green (3.318)
Finfish	2.00:Medium	3.00:Moderate Concern		3.67:Low Concern	Green (3.318)

Information on non-target or bycatch species caught in the Louisiana crayfish fishery is not available. The traps used to catch crayfish are selective for small animals and their stationary open-mesh design allow for some bycatch to escape and others to be released by the fishermen. The freshwater habitat where crayfish are caught is inhabited by other commercially important fish including sunfish, shad, buffalo fish, catfish, and drum. Several of these species rely on small crustaceans, including crayfish, as a food source. The species that are most likely to interact with the crayfish fisheries include benthic invertebrates and small or juvenile finfish; therefore, we assessed these general species groups. Due the limited information, bycatch is scored according to the Seafood Watch unknown bycatch matrix, based on a synthesis of peer reviewed literature and expert opinion on the bycatch impacts of each gear type (see appendix 3 in the Seafood Watch Wild Fisheries Assessment Criteria). Overall, trap fisheries are considered to have a low impact on non-target species. Discards in the fishery are considered low, but the amount of bait used in this fishery is unknown. We have conservatively considered bait use to range from 40-60% of the targeted catch.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Inherent Vulnerability
(same as Factor 1.1 above)

Factor 2.2 - Abundance
(same as Factor 1.2 above)

Factor 2.3 - Fishing Mortality
(same as Factor 1.3 above)

BENTHIC INVERTS

Factor 2.1 - Inherent Vulnerability

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Medium

The species of benthic invertebrates affected by the crayfish fishery is unknown, but most benthic invertebrates have a medium inherent vulnerability to fishing.

Factor 2.2 - Abundance

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderate Concern

Because the specific species of benthic invertebrates caught in the crayfish trap fishery are unknown, their population status cannot be determined. Seafood Watch awards a moderate concern score for "unknown" invertebrate species caught with this type of gear

Factor 2.3 - Fishing Mortality

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Low Concern

The amount and species of benthic invertebrates caught in the crayfish trap fishery is unknown. However, in general traps are considered to have a low impact on other species, and most species are likely able to be released unharmed (Morgan and Chuenpagdee 2003)(Kelleher 2005). Seafood Watch awards a low concern score for "unknown" invertebrate species caught with this type of gear.

Factor 2.4 - Discard Rate

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

40-60%

Information on discards (non-retained catches) is not available for the crayfish fishery. Only catches that are sold are documented on trip tickets (LDWF 2013). The traps used to catch crayfish are selective for small

animals and their stationary open-mesh design allow for some bycatch to escape and others to be released by the fishermen. In general, trap and pot fisheries are considered to have low discards and a low impact on non-target species (Morgan and Chuenpagdee 2003)(Kelleher 2005). Bait in this fishery is comprised of mainly of menhaden, and gizzard shad, but can also include carp, buffalo fish, herring, and catfish (McClain et al. 2007). The commonly used menhaden bait is caught by East coast and Gulf of Mexico fisheries and purchased by crayfish fishermen. It is possible that fishermen use bycatch caught in their traps to bait the trap, but there is no reporting system to know how often this occurs; however, this is thought to be minimal. It is recommended that 0.25 - 0.33 lbs of bait be used per trap per day in farmed ponds, but there is no published information on bait use in the wild crayfish fishery or on the number of traps used in the fishery (McClain et al. 2007). We have conservatively considered bait use to range from 40-60% of the targeted catch based on other crustacean trap fisheries (LDWF 2011).

FINFISH

Factor 2.1 - Inherent Vulnerability

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Medium

The freshwater habitat where crayfish are caught is inhabited by other commercially important fish including catfish, buffalo fish, sunfish, drum and shad (Fontenot et al. 2001)(USFWS 2006). The species of finfish affected by the crayfish fishery is unknown, but most finfish have a medium inherent vulnerability to fishing.

Factor 2.2 - Abundance

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderate Concern

The specific species on finfish caught in the crayfish trap fishery is unknown. Therefore their population cannot be determined. Seafood Watch awards a moderate concern score for "unknown" finfish species caught with this type of gear.

Factor 2.3 - Fishing Mortality

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Low Concern

The amount and species of finfish caught in the crayfish trap fishery is unknown. However, in general traps are considered to have a low impact on other species, and most species are likely able to be released unharmed (Morgan and Chuenpagdee 2003)(Kelleher 2005). Seafood Watch awards a low concern score for "unknown" finfish species caught with this type of gear.

Factor 2.4 - Discard Rate

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

40-60%

Information on discards (non-retained catches) is not available for the crayfish fishery. Only catches that are sold are documented on trip tickets (LDWF 2013). The traps used to catch crayfish are selective for small animals and their stationary open-mesh design allow for some bycatch to escape and others to be released by the fishermen. In general, trap and pot fisheries are considered to have low discards and a low impact on non-target species (Morgan and Chuenpagdee 2003)(Kelleher 2005). Bait in this fishery is comprised of mainly of menhaden, and gizzard shad, but can also include carp, buffalo fish, herring, and catfish (McClain et al. 2007). The commonly used menhaden bait is caught by East coast and Gulf of Mexico fisheries and purchased by crayfish fishermen. It is possible that fishermen use bycatch caught in their traps to bait the trap, but there is no reporting system to know how often this occurs; however, this is thought to be minimal. It is recommended that 0.25 - 0.33 lbs of bait be used per trap per day in farmed ponds, but there is no published information on bait use in the wild crayfish fishery or on the number of traps used in the fishery (McClain et al. 2007). We have conservatively considered bait use to range from 40-60% of the targeted catch based on other crustacean trap fisheries (LDWF 2011).

Criterion 3: Management Effectiveness

Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).

The final score for this criterion is the geometric mean of the two scores. The Criterion 3 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern*

Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.

Criterion 3 Summary

Region | Method	Harvest Strategy	Bycatch Strategy	Score
Louisiana/Atchafalaya Basin | Traps (unspecified) United States of America	2.000	2.000	Red (2.000)

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Harvest Strategy

Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.'

- *5 (Very Low Concern)—Rated as 'highly effective' for all seven subfactors considered*
- *4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective.'*
- *3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'*
- *2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated 'ineffective.'*
- *1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated 'ineffective.'*
- *0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.*

Factor 3.1 Summary

FACTOR 3.1 - MANAGEMENT OF FISHING IMPACTS ON RETAINED SPECIES							
Region | Method	**Strategy**	**Recovery**	**Research**	**Advice**	**Enforce**	**Track**	**Inclusio**
Louisiana/Atchafalaya Basin | Traps (unspecified) United States of America	Moderately Effective	N/A	Ineffective	Ineffective	Moderately Effective	Moderately Effective	Moderat Effective

Subfactor 3.1.1 – Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? To achieve a highly effective rating, there must be appropriate management goals, and evidence that the measures in place have been successful at maintaining/rebuilding species.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderately Effective

The crayfish trap fishery is managed by the Louisiana Department of Wildlife and Fisheries. Management measures for this fishery are minimal. Commercial fishermen are required to have a commercial fishing license to catch crayfish and catches that are sold are reported via trip tickets. Mesh traps are used to catch crayfish and a minimum mesh size of 1.91 cm x 1.75 cm (0.75 in x 0.69 in) is required (LDWF 2013). There are no restrictions on when crayfish can be caught, no limits on the amount that can be caught, no restrictions on minimum size of catch, and no restrictions on number of traps that can be used (Global Trust Certification 2011). A few years ago, the Louisiana Department of Wildlife and Fisheries conducted a survey to see if crayfish fishermen were interested in establishing additional regulations for the fishery; the majority of respondents were not interested, and so additional measures have not been put in place (LDWF 2010). There are no defined target abundance or fishing level goals. However, fishing is not thought to have a large affect on crayfish abundance. Instead, fluctuations in the population over the years appear to be a response to environmental conditions (Global Trust Certification 2011). Research has shown that crayfish growth, reproductive success, and annual catches rely heavily on seasonal flooding (McClain and Romaire 2004)(Lutz et al. 2011)(LSUAC 2012b)(Alford and Walker 2013). Fisheries biologist and fishermen can make general predictions on recruitment (i.e. amount of new fish entering the population) and catches, such as a high or low year, based on the previous seasons flood patterns and water conditions (Romaire et al. 2004)(McClain et al. 2007). Currently, fishing pressure is thought to be kept in check by market demand (Global Trust Certification 2011)(Lutz et al. 2011). Although there is limited management in place for the crayfish fishery, we have awarded a moderately effective score since there are no signs of resource depletion or overexploitation.

Subfactor 3.1.2 – Recovery of Species of Concern

Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/ endangered species or to limit fishery's impact on these species and what is their likelihood of success? To achieve a rating of Highly Effective, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

N/A

The abundance of crayfish in the Atchafalaya basin is unknown because routine population surveys have not been performed. However, fluctuations in the population over the years are not the result of fishing pressure, but a response to environmental conditions (Global Trust Certification 2011). Crayfish are not thought to be overfished or depleted and thus no recovery plans are needed.

Subfactor 3.1.3 – Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species? To achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Ineffective

All information on commercial crayfish catches is collected through trip tickets, a reporting mechanism used by the Louisiana Department of Wildlife and Fisheries, which documents the sale of catches. These tickets contain information on species caught, where caught, who caught (including permit number), and who purchased the seafood. There is currently no method to document discards, catch used for bait, unsold catch, or catch retained for personal consumption (Global Trust Certification 2011). Besides the catch data, no other information on crayfish is collected (Global Trust Certification 2011) and there are no plans to implement new data collection programs. Recently a study by scientists at Louisiana State University examined the ecological interactions that impact crayfish abundance and catch rates. This study further supported the relationship between flood regime and annual abundance and thus annual catches (Bonvillain et al. 2012).
Because scientific research and monitoring is sparse in this fishery, we have rated it ineffective.

Subfactor 3.1.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Ineffective

It is unclear whether management follows scientific advice and what scientific input is sought/provided. A recent independent evaluation of Louisiana's Department of Wildlife and Fisheries crayfish management practices, suggested that the agency develop plans to limit over harvesting of crayfish and determine metrics (create goals) to maintain a sustainable reproductive population (Global Trust Certification 2011). However, no new regulations have been established. Since there is no evidence that management follows scientific advice, we have rated it as ineffective.

Subfactor 3.1.5 – Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderately Effective

The Louisiana Department of Wildlife and Fisheries (LDWF) has clear enforcement for the type and design of gear that can be used to catch crayfish and how catch sales should be reported (LDWF 2013). There are clear descriptions of the types of permits needed to participate in the commercial fishery, including vessel and commercial fishing licenses (LDWF 2013). Within the Louisiana Department of Wildlife and Fisheries there is a law enforcement division (LED) whose sole function is to enforce the commercial and recreational fishing regulations (Global Trust Certification 2011). An independent evaluation of the agency's enforcement framework and penalties for violations, deemed the agency highly adequate (Global Trust Certification 2011). However, it is unclear how active this enforcement and monitoring is in the crayfish fishery. We have therefore rated this factor moderately effective.

Subfactor 3.1.6 – Management Track Record

Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderately Effective

Commercial fishing for crayfish in Louisiana began in the late 1800's (Lutz et al. 2011). Since the 1950's, the Louisiana Department of Wildlife and Fisheries has been managing the wild crayfish fishery. Annual catches have fluctuated over the years as a result of fluctuations in crayfish abundance and to some extent consumer demand. Abundance fluctuations result from environmental parameters, including the flood regime of the Atchafalaya River Basin (McClain and Romaire 2004)(McClain et al. 2007)(Lutz et al. 2011)(LSUAC 2012b) (Alford and Walker 2013). While management of the fishery is minimal, the population appears to support the commercial fishery. However, no conservation goals have been established. We have therefore rated the management track record moderately effective.

Subfactor 3.1.7 – Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent and includes stakeholder input.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of AmericaY

Moderately Effective

There are many stakeholders vested in the crayfish fishery, such as the Louisiana Crawfish Promotion and Research Board, Louisiana Seafood Promotion and Marketing Board, Louisiana Department of Natural

Resources, Louisiana State University Agricultural Center research and extension, Louisiana Crawfish Producers Association-WEST, and crayfish retailers/restaurants. The level of input stakeholders have in the management of the fishery is unclear. The wild-caught crawfish task force was established in 2005 with the purpose of stakeholders providing advice to the Louisiana Department of Wildlife and Fisheries (LDWF) on management, marketing and development of the fishery. Unfortunately, this task force does not appear to be active in 2013. In 2009, all registered crayfish fishermen were invited by Louisiana Department of Wildlife and Fisheries to participate in a survey seeking opinions on crayfish regulations (LDWF 2010). Since managers have sought stakeholder input, but the current level of participation in the management process is unclear, we have ranked stakeholder inclusion as moderately effective for this fishery.

Factor 3.2 - Bycatch Strategy

SCORING GUIDELINES

Four subfactors are evaluated: Management Strategy and Implementation, Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.' Unless reason exists to rate Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations differently, these rating are the same as in 3.1.

- *5 (Very Low Concern)—Rated as 'highly effective' for all four subfactors considered*
- *4 (Low Concern)—Management Strategy rated 'highly effective' and all other subfactors rated at least 'moderately effective.'*
- *3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'*
- *2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy but some other factors rated 'ineffective.'*
- *1 (Very High Concern)—Management exists, but Management Strategy rated 'ineffective.'*
- *0 (Critical)—No bycatch management even when overfished, depleted, endangered or threatened species are known to be regular components of bycatch and are substatntially impacted by the fishery*

FACTOR 3.2 - BYCATCH STRATEGY

Region | Method	All Kept	Critical	Strategy	Research	Advice	Enforce
Louisiana/Atchafalaya Basin | Traps (unspecified) United States of America	No	No	Moderately Effective	Ineffective	Ineffective	Moderately Effective

Subfactor 3.2.2 – Management Strategy and Implementation

Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and how successful are these management measures? To achieve a Highly Effective rating, the primary bycatch species must be known and there must be clear goals and measures in place to minimize the impacts on bycatch species (e.g., catch limits, use of proven mitigation measures, etc.).

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderately Effective

Bycatch is relatively low in the crayfish trap fishery due to small mesh openings mandated by gear restrictions (LDWF 2013). The trap design and mesh size is intended to target the most marketable size of

crayfish (McClain et al. 2007). However, the gear is not species specific and there are no regulations on species or quantity of bycatch that can be caught in this fishery; nor do managers attempt to document bycatch in this fishery (Global Trust Certification 2011)(LDWF 2013). However, since the impact of the trap fishery on non-target species is thought to be low, the bycatch management strategy and implementation is scored as moderately effective.

Subfactor 3.2.3 – Scientific Research and Monitoring

Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery's impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Ineffective

The Louisiana Department of Wildlife and Fisheries does not have an observer program or dock checks for this fishery. Bycatch is not documented or monitored in the crayfish fishery (Global Trust Certification 2011). Since research and monitoring programs do not exist, we have rated this factor ineffective.

Subfactor 3.2.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Ineffective

It is unclear whether management follows scientific advice. A recent independent evaluation of Louisiana's Department of Wildlife and Fisheries (LDWF) crayfish management practices, suggested that the agency develop plans to monitor and evaluate bycatch in the crayfish fishery (Global Trust Certification 2011). There have not been any changes in trip ticket reporting nor has LDWF announced any plans to evaluate bycatch. Since there is no evidence that management follows scientific advice, we have rated it as ineffective.

Subfactor 3.2.5 – Enforcement of Management Regulations

Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen's compliance with regulations? To achieve a Highly Effective rating, there must be consistent enforcement of regulations and verification of compliance.

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderately Effective

Enforcement of fisheries regulations by the Louisiana Department of Wildlife and Fisheries is considered moderately effective. See enforcement factor under management of retained species.

Criterion 4: Impacts on the habitat and ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment.

The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the Ecosystem Based Fishery Management score. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region | Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Louisiana/Atchafalaya Basin | Traps (unspecified) United States of America	3.00: Low Concern	0.00: No Effective Mitigation	3.00: Moderate Concern	Yellow (3.000)

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

- *5 (None) - Fishing gear does not contact the bottom*
- *4 (Very Low) - Vertical line gear*
- *3 (Low)—Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom occasionally (*
- *2 (Moderate)—Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine except on mud/sand*
- *1 (High)—Hydraulic clam dredge. Dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 (Very High)—Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl) Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.*

Factor 4.2 - Mitigation of Gear Impacts

- *+1 (Strong Mitigation)—Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.*
- *+0.5 (Moderate Mitigation)—20% of habitat protected from fishing with gear or other measures in place to*

limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.

- *+0.25 (Low Mitigation)—A few measures are in place (e.g., vulnerable habitats protected but other habitats not protected); there are some limits on fishing effort/intensity, but not actively being reduced*
- *0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats*

Factor 4.3 - Ecosystem-Based Fisheries Management

- *5 (Very Low Concern)—Substantial efforts have been made to protect species' ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area is protected with marine reserves, and abundance is maintained at sufficient levels to provide food to predators)*
- *4 (Low Concern)—Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. Measures are in place to minimize potentially negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.*
- *3 (Moderate Concern)—Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species, OR negative ecological effects from hatchery supplementation or FADs are possible and management is not place to mitigate these impacts*
- *2 (High Concern)—Fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.*
- *1 (Very High Concern)—Use of hatchery supplementation or fish aggregating devices (FADs) in the fishery is having serious negative ecological or genetic consequences, OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.*

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Low Concern

Crayfish are fished in the Atchafalaya Basin using traps. How, where, and when traps are used determine the environmental impacts of the gear (Eno et al. 2001)(NREFHSC 2002). These traps are baited with attractants and set on the swamp floor to attract crayfish. The swamp floor consists of submerged grass, mud, sand, and tree bases, and is not constructed of any biogenic habitat (i.e. corals, sponges, etc.) (LA DNR 2013). The traps are constructed from coated wire with a minimum mesh size of 1.9 cm x 1.75 (0.75 in. x 0.6875 in.) and a maximum top opening of 5.08 cm (2 in.) (LDWF 2013). Traps remain in the water for 1-2 days before fishermen haul them up to retrieve the catch. The traps could disturb the plants (grass, algae, etc.) and animals (snails, worms, etc.) that live on the bottom. However, potential damage is much less when compared to marine trap fisheries where traps are mechanically pulled from the water and scrape along the ocean floor (Eno et al. 2001)(NREFHSC 2002)(Morgan and Chuenpagdee 2003). Overall, damage to the habitat and ecosystem by trap fishing in the Atchafalaya Basin is considered a low concern.

Factor 4.2 - Mitigation of Gear Impacts

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

No Effective Mitigation

Currently the Louisiana Department of Wildlife and Fisheries does not limit the number of traps used by commercial fishermen in the crayfish fishery (LDWF 2013). Additionally, there are no areas where trap use is

restricted in the Atchafalaya Basin. There are no studies documenting the impact of crayfish traps on the benthic habitat and no management is in place to mitigate any adverse effects. Therefore a score of 'no effective mitigation' is awarded.

Factor 4.3 - Ecosystem-Based Fisheries Management

LOUISIANA/ATCHAFALAYA BASIN
Traps (Unspecified) | United States Of America

Moderate Concern

Crayfish play several roles in the ecosystem including scavenger (eats dead material and leaf litter) and omnivore (eats plants and meat) and are known to increase the availability of nutrients in the system through digestion and burrowing (Taylor et al. 1996)(Gutiérrez-Yurrita et al. 1998)(McClain et al. 2007). Crayfish serve as food for larger fish (Taylor et al. 1996)(Gutiérrez-Yurrita et al. 1998)(McClain et al. 2007). The damage and pressure that the crayfish fishery has on the ecosystem and food web is thought to be minimal based on the fishing gear, life history of crayfish, and habitat used by crayfish (Global Trust Certification 2011). However, there are no environmental assessments of the fisheries impact. Since there is no management and assessment of ecosystem impacts, but crayfish are not considered a species of 'exceptional ecological importance', we have rated this factor a moderate concern.

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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Appendix A: Updates to Louisiana Wild Crayfish Report

This report was reviewed for any significant stock status and fishery management updates on August 5, 2020. No new information were found that would indicate the final rating is no longer accurate.

Appendix B: Review Schedule

The fishery should be reviewed in two years to ensure the fishery has not expanded to the point where additional management is required to maintain healthy crayfish populations.