ANCHORING BUOY SYSTEM FOR FISHING
IN THE DEEP GULF OFFSHORE OKALOOSA COUNTY

Feasibility Report

1.0 INTRODUCTION

Okaloosa County has requested that Taylor Engineering investigate the feasibility of placing anchoring (mooring) buoys in the Gulf of Mexico (GOM) approximately 50 – 100+ nautical miles south of the Florida Panhandle (**Figure 1**). The area of interest includes the West Florida Shelf in the areas of the De Soto Canyon and the intersection of the Canyon and the West Florida Escarpment. Depths in the area of interest range between 500 and 5,000 feet (ft) (150 – 1,500 meters [m]). The Loop Current, while variable, often extends to the south edge of the area of interest, creating favorable conditions for many highly migratory species (Roffs, 2014). The area also includes the northern portions of the Essential Fish Habitat areas for a wide range of highly migratory fishes, including most of the billfish and many of the tuna species that reside in the gulf (**Figure 2** and **Figure 3**).

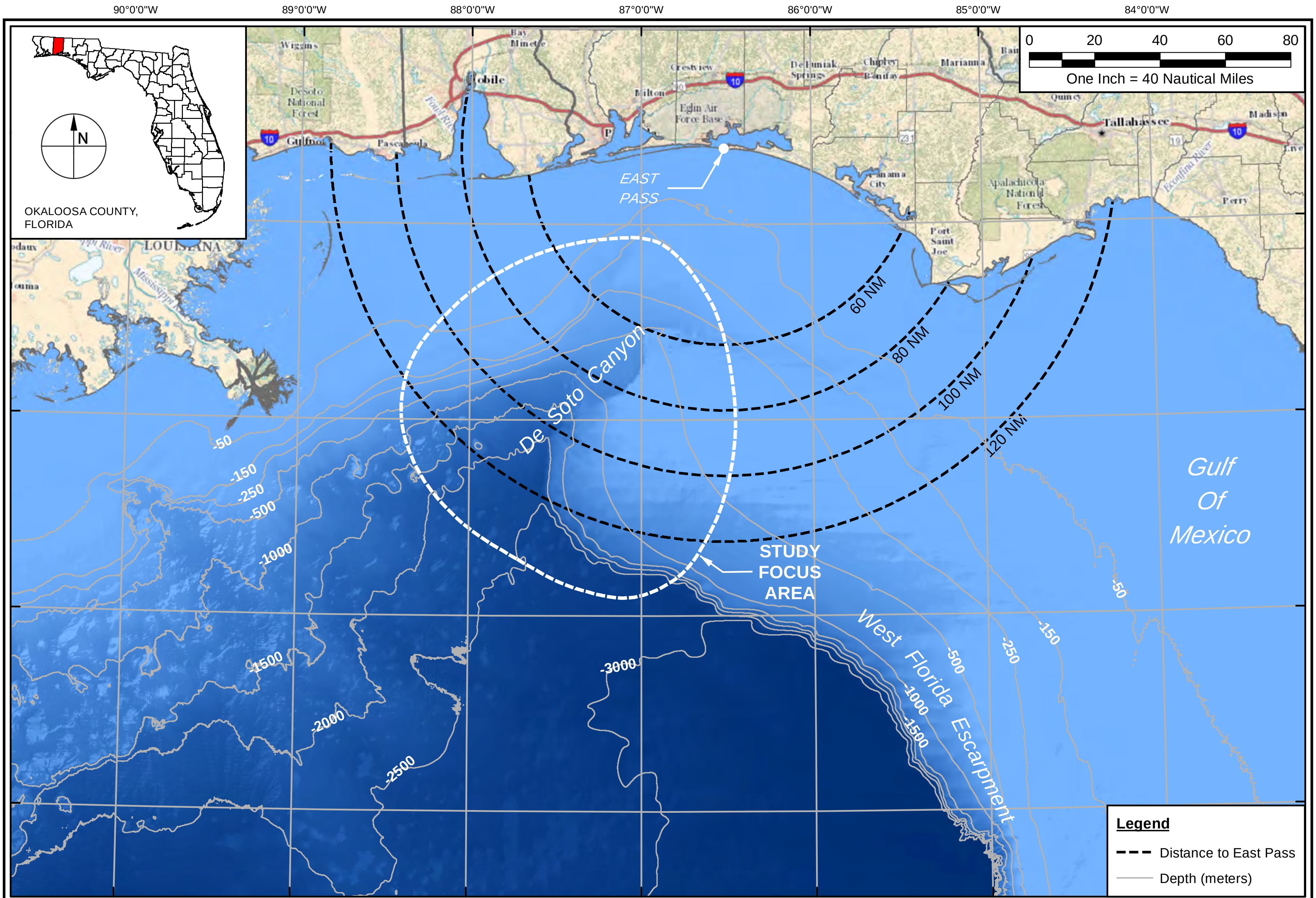
Okaloosa County proposes to deploy the mooring buoys to attract pelagic game fish and expand recreational and sport fishing opportunities for County visitors. Whether the County contemplates a single buoy or a network of buoys over many miles, the general principles of the buoy design and the expected biological responses remain the same.

Human fishing behavior has included construction and use of devices to attract fish in the open ocean near land for millennia (Dempster and Taquet, 2004). At the outset, it is important to recognize that the open ocean water column in general consists of a featureless desert of water with little or no structure. Any sort of floating material (e.g., logs, rafts of flotsam, drifting boats) will typically attract fish, and the longer that material remains, the more colonists (and prey items) will inhabit the floating material and the water column immediately adjacent to the structure. Through time, a diverse fish assemblage will visit the structure. This sequence of events lies at the heart of all attempts to attract fishes with structures.

This report will cover the following subjects: effectiveness of buoys in attracting fish; offshore buoy design, maintenance, and longevity; billfish habitat in the Gulf of Mexico; and regulatory steps necessary to permit buoy placement. We selected billfish as a focus because they comprise a primary interest of recreational and sport fishermen in the deep waters of the GOM. Tuna species, also of interest, have characteristics similar to billfish; thus, the discussion on billfish also generally applies to many of the tuna and other pelagic species.

2.0 OCEAN BUOYS AS FISH AGGREGATORS

As indicated in the introduction, structures, natural or artificial, attract many species of fish in freshwater, estuarine, and marine environments. This occurs in the nearshore and deep ocean marine environments. While the cause of this behavior remains unclear, the consistency of the effect (thigmotropism, the attraction to a solid object) yields sufficient confidence that artisanal fishermen, the commercial fishing industry, and recreational fishermen use such floating devices — either anchored or drifting, at the surface, midwater depths, or both, nearshore and offshore areas, and at a wide variety of water depths. Fish assemblages associated with floating objects are a common component of marine fisheries literature (e.g., Deudero et al., 1999) and there is considerable data that seasonal variation occurs in these assemblages. There is some evidence that different species are more and less attracted to FADS (Fish Aggregating Devices) [e.g., Deudero et al., 1999 (Mediterranean Sea); Nelson, 2003 (Pacific Ocean off Panama); and Dagorn et al., 2013(Indian Ocean, Wilkins and Goodwin, 19xx)]. FADs have also been recommended as a tool to assess fish diversity in the open ocean (e.g., Gaertner et al., 2008). Concerns about the potential biological impacts of FADs have been discussed for some time (Polovina, 1991; Sinopoli et al., 2007). In summary, floating buoys, whether anchored or drifting, aggregate fish, making them easier to catch. There is little evidence that they increase biomass / productivity, and there is concern regarding the relationship between these devices and the commercial exploitation of the ocean fish populations. Concerns expressed in the technical and more general interest literature and websites focus on the effects of aggregating devices and commercial-scale capture where the increased capture rates and extensive bycatch may severely impact target species, target species juvenile fish stocks, and other, non-target fish stocks that prior to the use of such devices were captured at a much lower rate or not captured. Notably, the potential impact on juvenile or non-target species is primarily a function of the catch methodology (i.e., net fishing poses increased impact potential to juveniles and non-target species whereas standard recreational fishing practices pose little threat to juvenile and by-catch or non-target species). The allowable catch methodology (fishing gear) and fishing areas are primarily regulated by NOAA’s Office of Sustainable Fisheries and the National Marine Fisheries Service (NMFS).



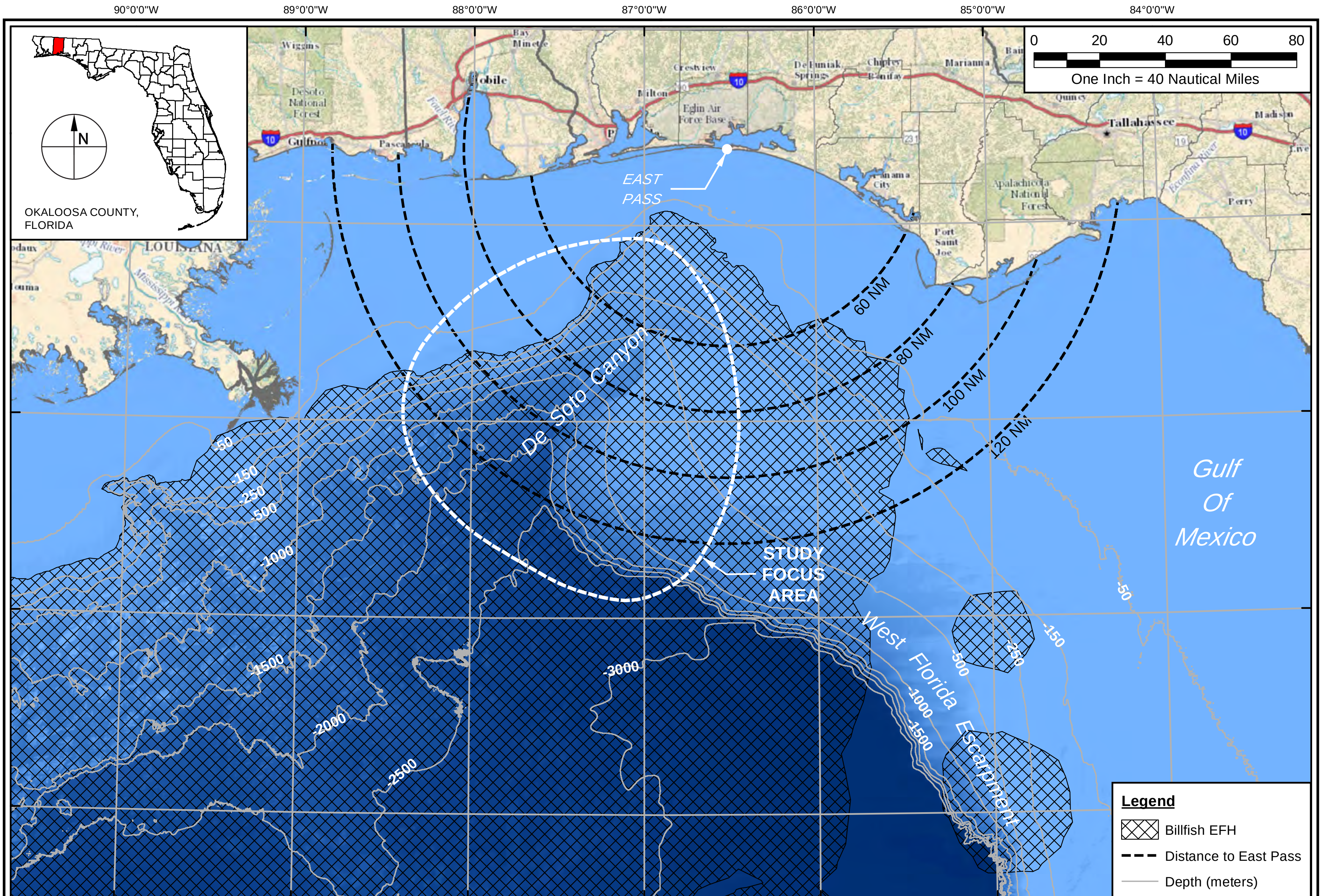
TAYLOR ENGINEERING INC.
1221 AIRPORT ROAD, SUITE 210
DESTIN, FL 32541
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 1
STUDY FOCUS AREA
OKALOOSA ABF STUDY
OKALOOSA COUNTY, FL

Notes:
1. Bathymetry Source: National Geophysical Data Center, NESDIS, NOAA, U.S. Department of Commerce
2. Basemap Source: USGS
3. Vertical Datum: MLLW Meters
4. Horizontal Datum: NAD 1983

PROJECT	C2014-042
DRAWN BY	PL
SHEET	
DATE	AUGUST 2014

\\NAS2K12\nass2\PROJECTS\C2014-042 Okaloosa ABF Study\GIS\MXDs\Figure 1 Overview Study Focus Area_NoHorseshoe.mxd



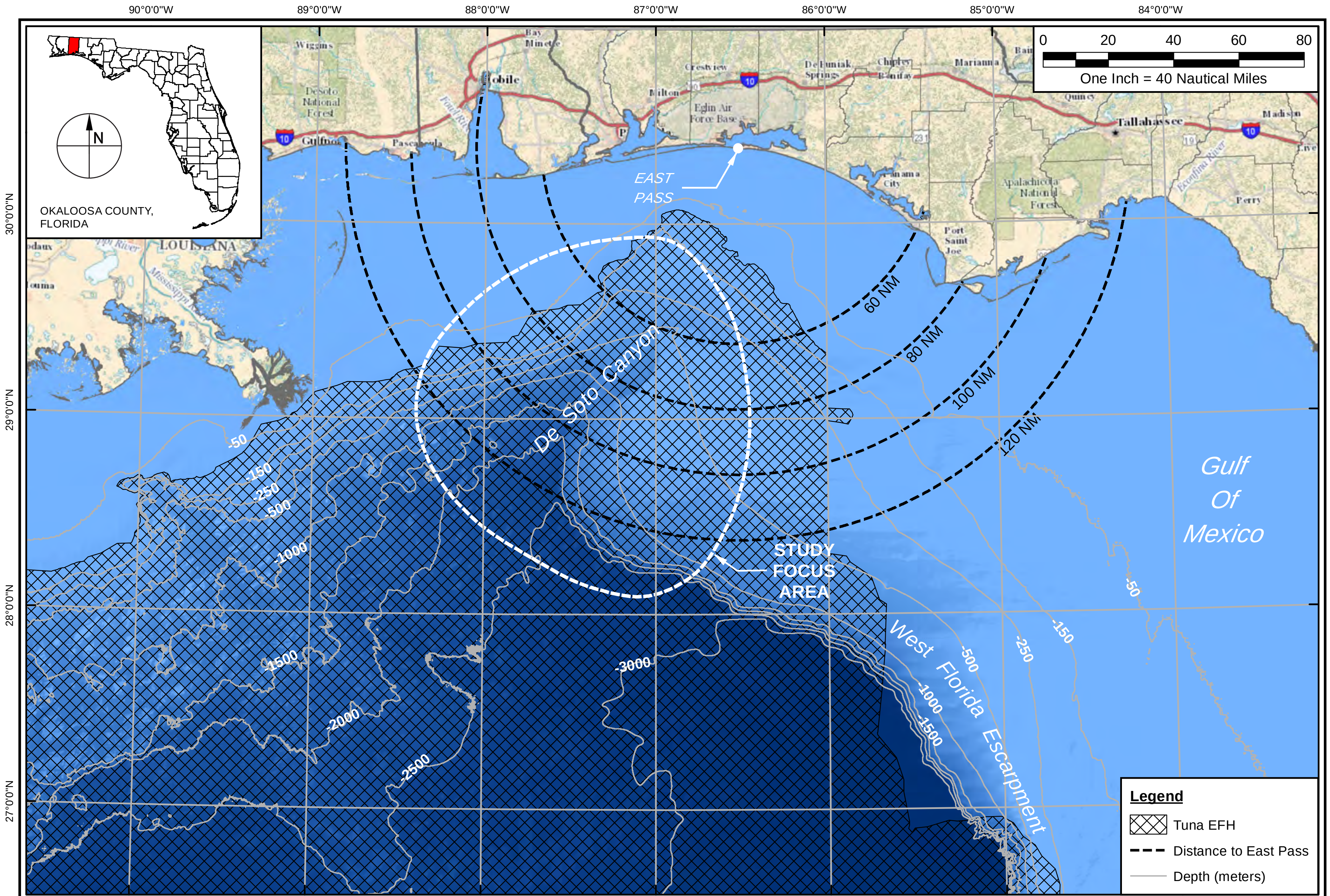
TAYLOR ENGINEERING INC.
1221 AIRPORT ROAD, SUITE 210
DESTIN, FL 32541
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 2
ADULT BILLFISH, ESSENTIAL FISH HABITAT (EFH)
OKALOOSA ABF STUDY
OKALOOSA COUNTY, FL

Notes:
1. Bathymetry Source: National Geophysical Data Center, NESDIS, NOAA, U.S. Department of Commerce
2. Basemap Source: USGS
3. Vertical Datum: MLLW Meters
4. Horizontal Datum: NAD 1983

PROJECT	C2014-042
DRAWN BY	PL
SHEET	
DATE	AIUGUST 2014

\\NAS2K12\nass2\PROJECTS\C2014-042 Okaloosa ABF Study\GIS\MXDs\Figure 2 Billfish.mxd



TAYLOR ENGINEERING INC.
1221 AIRPORT ROAD, SUITE 210
DESTIN, FL 32541
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 3
ADULT TUNA, ESSENTIAL FISH HABITAT (EFH)
OKALOOSA ABF STUDY
OKALOOSA COUNTY, FL

Notes:
1. Bathymetry Source: National Geophysical Data Center, NESDIS, NOAA, U.S. Department of Commerce
2. Basemap Source: USGS
3. Vertical Datum: MLLW Meters
4. Horizontal Datum: NAD 1983

PROJECT	C2014-042
DRAWN BY	PL
SHEET	
DATE	AUGUST 2014

\\NAS2K12\nass2\PROJECTS\C2014-042 Okaloosa ABF Study\GIS\MXDs\Figure 3 Tuna.mxd

3.0 MOORED BUOY LOCATIONS

Mooring and fishing buoys are in use around the world, in all major oceans and seas, in estuarine, nearshore, and deep ocean waters. Anchored buoys for artisanal / subsistence fishing occur around many Caribbean islands, Guam, West Indian Ocean islands (e.g., around the Seychelles, Comores Island, and Mauritius), Australia, New Guinea, the South Sea islands, etc.; however, very few documented fishing buoys occur in American waters. A very old technology, the use of buoys and other floating objects to attract fish has garnered a great deal of interest as expanding populations and industries continue to exploit ocean fisheries at an ever increasing rate, aided in part by these devices. The islands of Hawaii have an extensive anchored FAD system for recreational uses, in place for over 30 years (Holland et al., 2000). The Hawaii system is the only currently active FAD system in the United States. The State of Hawaii, University of Hawaii (which manages the FAD system), and NOAA are discussing a permit for the system, which was developed prior to a permitting requirement (personal communication, July 2014, Warren Cortez, University of Hawaii). The government of Guam, an American protectorate, began development of an anchored FAD system in 1979 (Torres, 2000) and has a system of 14 FADs in its program (Government of Guam, 2011). The FADs are part of a Marine Conservation Plan approved by the US National Marine Fisheries Service for the period 2011 – June 2014 (Government of Guam, 2011). The Caribbean Regional Fisheries Mechanism (CFRM), an organization of 20 Caribbean Island nations, is exploring the use of anchored FADs to increase sustainable fisheries and provide an economic boost to the member countries (CRFM, 2013). Given the lack of documented buoy systems within the United States and the limited information available on the above programs, the Hawaii program serves as a model for developing a similar program in Florida offshore of Okaloosa County.

4.0 BUOY DESIGNS AND ORDER OF MAGNITUDE COSTS

The state of Hawaii has maintained a FAD system since 1977. Following the success of a few experimental anchored rafts established by the Honolulu Laboratory (Southwest Fisheries Center) of the National Marine Fisheries Service, the state expanded the system in the 1980s and placed the program under the operational management of the Hawaii Institute of Marine Biology (HIMB), School of Ocean and Earth Science and Technology (SOEST) of the University of Hawaii in 1996. HIMB currently maintains 55 buoys statewide.

The Hawaii FADs lie in 700 – 10,000 ft (200 – 3,000 m) of water. Surface buoys (buoys floating on the surface) (**Figure 4**) maintain an average life span of 3 – 4 years (Holland et al., 2000; personal communication, July 2014, Cortez) and subsurface buoys (**Figure 4**) last 5 – 6 years. In comparison, deep ocean NOAA data buoys have a reliability of 50% (even odds of failure of the mooring system) in 1 – 3 years after deployment and a reliability of about 15% in 5 years (Maxwell et al., 2010).

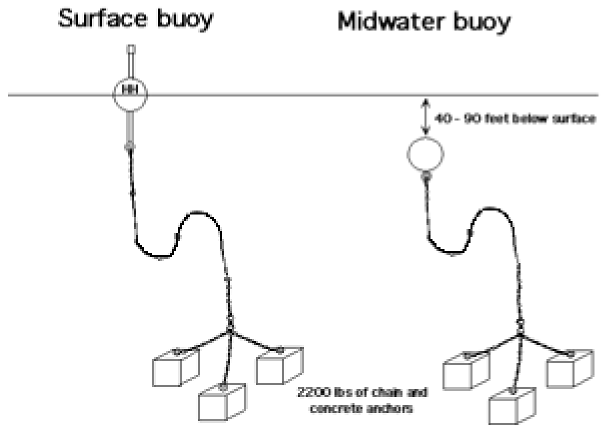


Figure 4. Surface and Subsurface Buoys (figure provided by HIMB, SOEST, University of Hawaii)

For the Hawaii system, depth does not affect buoy longevity; however, exposure to constant Trade Winds tends to shorten buoy longevity to the low end of the range. Typically, the Hawaii buoys experience conditions ranging from calm waters on the leeward side of the islands to 15 – 30 mph winds producing 5 – 6-ft short frequency waves with strong currents on the windward side. These “tradewind seas” with more rapid movements can significantly reduce buoy longevity. Generally, leeward buoys survive an average of 43 months while windward buoys survive an average of 25 months — a 40% reduction in expected longevity. One would anticipate that the periodic storm exposure with winds exceeding 40 mph in the GOM would further reduce buoy longevity. As such, the proposed program should implement design changes to account for the rougher conditions.

The Hawaii program found that the single spherical spar buoy design (**Figure 5**) provided the best performance while minimizing losses. **Figure 5** shows a typical Hawaii FAD surface buoy system. The system consists of a 200-lb (400 kg) 4.8-ft diameter steel spherical spar buoy with 3,000 lbs (1,400 kg) of positive displacement. The 3.5-ft mast atop the float holds a light system and 7-ft pipe welded below the float provides a counterweight to maintain the buoy upright. About 100 ft of 13 mm chain attaches the buoy to the rope mooring system. Sections of negatively buoyant and positively buoyant nylon rope provide an inverse catenary or “slack” (“S” shape) mooring system. The nylon rope and mooring system provide the slack needed to absorb cyclic loading on the mooring as the surface buoy heaves in the waves and ensures that the lower part of the mooring will not drag on the ocean bottom as might happen with a conventional catenary system. Three 1,700-lb concrete block anchors attached to 80 ft of 13 mm chain deployed in a tripod configuration provides the anchor system for the buoy.

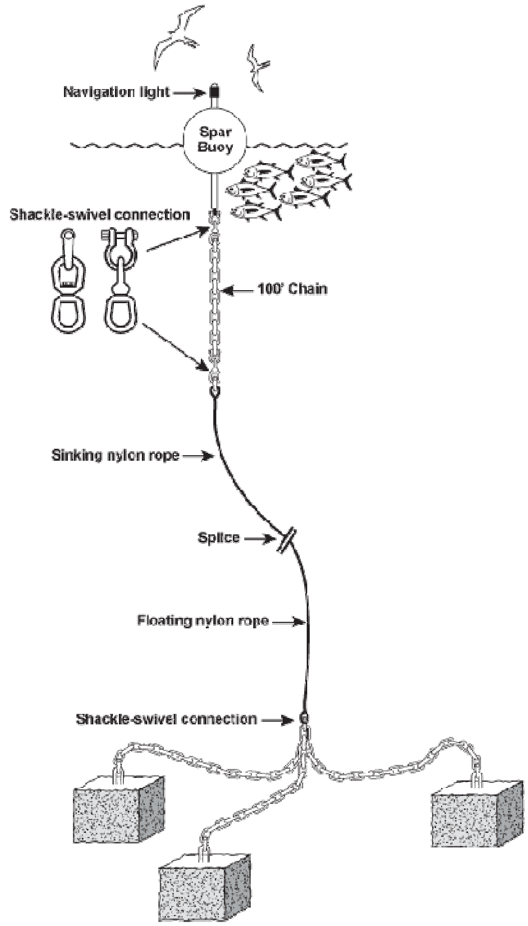


Figure 5. Single Spherical Spar Buoy Design (figure provided by HIMB, SOEST, University of Hawaii)

This buoy and anchor system typically costs an average of $8,000 – $9,000 to build and install offshore Hawaii with the nylon rope being the highest single component cost at approximately $2 per foot ($2,000 – $20,000 for 700 – 10,000 ft). Ship time for installation ranges from $7,000 – $8,000 per day. Simultaneous installation of multiple buoys allows significant cost savings resulting in the average cost of $8,000 – $9,000 to build and install. Notably, Hawaii buoy installation sites generally lay 5 – 20 miles from land, which reduces ship travel time for the installation. In comparison, a relatively small (3m) discus buoy (similar to the discus buoys used by NOAA to mount oceanographic instrumentation in the area of interest) may cost approximately $20,000 for just the buoy. The mooring system may cost between $10,000 – $50,000 depending on the water depth (200m – 800m) and installation in the proposed project area may cost approximately $20,000 – $40,000 depending on the total number of buoys proposed and the distance offshore. The increased mooring and installation costs primarily result from the larger buoy(s) imparting increased forces on the mooring system and requiring larger or more specialized vessels for deployment. From the information above, the water depth appears to be the greatest controlling factor for both the discus and spar buoy structures.

Based on the research cited, the typical failure mechanisms of the Hawaii buoy system result from near-surface shackle connections (i.e., failure due to the rapid movements and friction damage near the surface) or rope breakage. Rope breakage is believed to be caused by cyclical loading resulting from increased wave and currents, barnacle growth, and/or shark or other sharp-tooth fish biting the ropes. From conversations with Hawaii researchers, vessels mooring to the buoy system also decrease the structure life by increasing the loading on the mooring line and connection hardware. Notably, a correlation between depth and longevity was not apparent from the Hawaii FAD system. Similarly, typical failure mechanisms of NOAA buoys in the GOM generally result from severing of the synthetic line either through deliberate or accidental vandalism. In fact, from discussions with the National Data Buoy Center (NDBC) staff, they have begun installing camera systems on the frequently damaged buoys to deter vessels from mooring to the buoy. Connection hardware failure is generally less of a concern because the buoys and/or mooring systems are typically replaced every 3 – 5 years.

Equipping the surface buoy with a GPS tracking system will allow easy relocation of the equipment should the connection system fail. However, the anchoring system can only be reused if it is retrieved from the bottom using specialized surface vessels equipped with cranes and underwater autonomous vehicles. Given the proposed water depth of 1,000 ft or greater, the cost of retrieving the anchoring system will likely be cost prohibitive.

A small-scale (1 – 3 buoys) installation in the GOM (~40 – 60 miles to the site) with a more robust buoy system designed to survive moderate GOM storms may cost $20,000 – $30,000 per buoy (to build and install). This estimate is primarily based on a preliminary scaled-up version of the Hawaii system (larger anchors, chain, and rope) with a large diameter, round (spar) buoy. The availability of large-scale commercial vessels (capable of performing multiple deployments in a single trip) may greatly affect the cost estimate. Designing the structure to provide a platform for scientific instrumentation or vessel mooring (larger discus buoy and mooring system) presents additional design challenges. Given the distance offshore, the vessels mooring to the structure will likely be 50+ ft in length and the County will have little to no control over the number or size of vessels mooring to the structure. Such vessels may also attempt to anchor to the structure during increased wave/current events exponentially increasing the loading on the structure and connection hardware. Vessels moored to the structure also pose increased damage potential to any equipment that may be mounted on the surface buoy (e.g., solar panels, navigation lights, scientific/environmental monitoring equipment, etc.). Designing the structure to withstand the potential loading cases associated with vessel mooring will greatly increase the structure cost and increase the potential for structure failure (reduced structure life). The increased damage potential with a mooring structure will also likely require additional monitoring and buoy inspections, increasing the maintenance costs of the structure(s). Comparing the relatively simplistic, low-cost Hawaii buoy system with typical (higher-cost) NOAA buoys, the County should first install a small-scale buoy network similar to the Hawaii system. The County can make design modifications to future deployments based on 1 – 2 years of monitoring data from the original system. Further, because deep-water buoy systems are prone to failure, the County should consider the purchase of a buoy system (buoy, mooring, and anchor) designed as a unit. This may provide the greatest amount of confidence in optimal buoy lifespan.

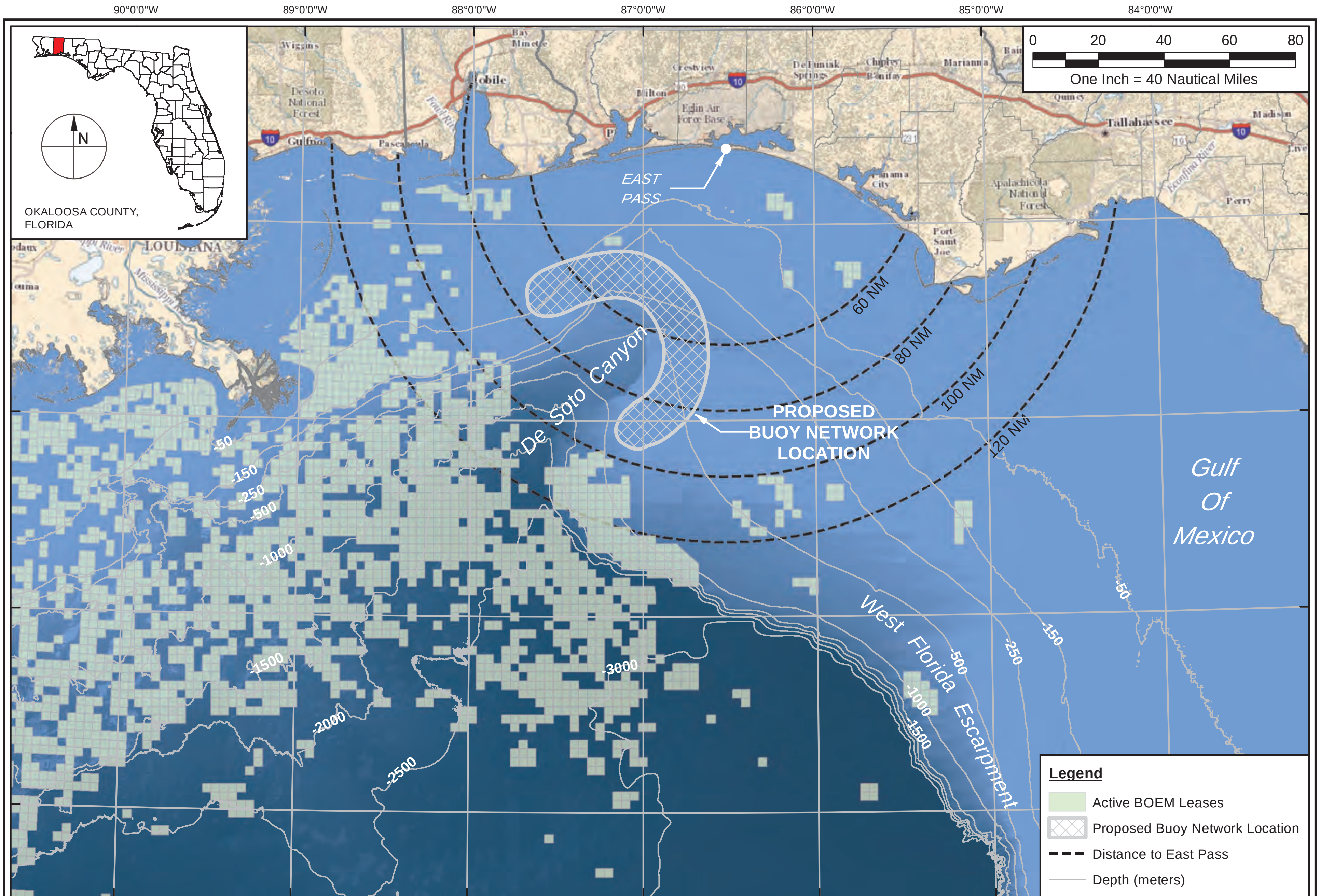
5.0 BUOY LOCATIONS

Given the scope of this preliminary study, we do not propose specific locations for a proposed buoy system. However, we provide the following items for consideration when planning the proposed buoy network.

- Target Fish Species — Figures 2 and 3 provide essential fish habitat maps for two primary target species (billfish and tuna). Additionally, available literature indicates these species prefer variations in water temperature and depth that typically occur along and within the De Soto Canyon.
- Water Depth — based on information presented in the previous section, the depth of water will likely greatly affect the initial material costs.
- Distance Offshore — the County should consider the distance offshore of the buoy system, specifically for proposed use (e.g., recreational fishing), installation and maintenance costs, local preference, etc.
- Bureau of Ocean Energy Management (BOEM) lease areas — as discussed below, placing the buoys in offshore federal waters will likely require a permit and/or consent of use agreement from BOEM. If the proposed buoy area is already leased, obtaining additional use agreements from the BOEM leasee may present additional difficulties for installation and maintenance of the system. However, relatively few active leases exist in the area of interest for placing buoys.
- Buoy spacing — technical literature suggests 4 – 8-mile spacing between buoys in the Hawaiian system has been successful for effective fish attraction. Some research (reported in Dempster and Kingsford, 2003) indicates that fish orient to FADs spaced up to 18 km (approx. 12 miles) apart. Tuna may orient to anchored buoys from a distance of 10 km (Leroy et al., 2013).
- Additional uses — the County should also consider utilizing the buoys (or a single buoy) as a platform for oceanographic or ecological monitoring equipment. Utilizing the buoy(s) as a research platform may reduce the initial and maintenance costs through research partnerships; however, including this equipment may also increase the overall cost of the buoy and mooring structures (i.e., larger buoy and anchoring system).

Much of the deeper GOM bottom has been leased to members of the energy industry for oil, gas, and other mineral exploration and extraction. BOEM manages these leases and regulates mineral resources in Federal waters. Many active leases exist in the northern Gulf of Mexico, but relatively few lie within the project area of interest and should be easily avoidable (**Figure 6**). Regardless, the County will still likely be required to coordinate with BOEM regarding the installation of the buoy system.

Considering only the target fish species and water depth, the County should consider placing buoys near the northern tip of the De Soto Canyon and atop the West Florida Shelf along the eastern edge of the De Soto Canyon.



TAYLOR ENGINEERING INC.
1221 AIRPORT ROAD, SUITE 210
DESTIN, FL 32541
CERTIFICATE OF AUTHORIZATION # 4815

FIGURE 6
BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM) LEASES
OKALOOSA ABF STUDY
OKALOOSA COUNTY, FL

Notes:
1. Bathymetry Source: National Geophysical Data Center, NESDIS, NOAA, U.S. Department of Commerce
2. Basemap Source: USGS
3. Vertical Datum: MLLW Meters
4. Horizontal Datum: NAD 1983

PROJECT	C2014-042
DRAWN BY	PL
SHEET	
DATE	AUGUST 2014

J:\PROJECTS\C2014-042 Okaloosa ABF Study\GIS\MXDs\Figure 4 BOEM Leases.mxd

6.0 BUOY MANAGEMENT CONSIDERATIONS

A buoy management plan should consider periodic (e.g., twice yearly and after major storm events) examination to verify that the buoys remain in place and that any equipment on the buoys (lights or signaling devices) function properly. Notably, regulatory authorizations for buoy installation (further discussed below) may require more frequent observations and will likely require a regular monetary commitment from the project sponsor for monitoring. The County should also consider hosting a website for recreational fishermen to report observed damage or a missing buoy. The website could also serve as a platform for fishermen utilizing the buoy network to report their catches, observations, uses, etc. Replacement of failed buoys should occur on a scheduled basis. Buoys that have survived a 3 – 5-year period should be assumed at the end of their lifespan and replaced before they fail. Okaloosa County should consider placement of a signal device (Global Positioning System Signal generator) on each buoy so that in case of buoy mooring failure, the County can track and recover the float and any trailing line. A specific signal for each buoy and a publicized reward for return of the buoy when buoy failure occurs may provide a means to allay concerns that in the long-term the buoys would contribute additional floating marine debris or navigational hazards when they fail. The County should also consider public-private partnerships to help support the buoy system construction and maintenance, because a relatively select group of stakeholders will benefit from the project.

While the County can implement the recommendations above to manage the proposed buoy system, regulating the use of the buoys will likely prove very difficult given the distance offshore and potential use by both commercial and recreational fishermen from the Gulf of Mexico states and elsewhere. From discussions with Warren Cortez (Hawaii FAD system supervisor), Hawaii allows all legal fishing at the FAD network and the buoys are heavily used by both recreational and commercial fishermen. In Hawaii, large-scale commercial fishing (long-lining, seining, etc) is not allowed around the buoy system since the buoys are relatively close to shore (3 – 15 nautical miles). The far offshore location of the Okaloosa County-proposed buoys and the likely use of the buoy system by both commercial and recreational fishermen may be cause for concern with federal regulators. Okaloosa County has no formal responsibility or authority to regulate fishing activities in the offshore US waters.

7.0 BUOY PERMITTING PROCESS

Placement of a buoy or buoy network in the Gulf of Mexico would require a federal permit from the U.S. Army Corps of Engineers (USACE). The USACE would likely depend heavily on the opinions of and recommendations from its federal sister agencies, particularly the National Oceanographic and Atmospheric Administration Fisheries division (NOAA Fisheries). The USACE would likely request the Coast Guard review the buoy and buoy mooring system engineering design and make recommendations to minimize potential impacts to navigation. BOEM will likely review the permit application regarding the specific location proposed and active mineral leases and pipelines (**Figure 6**). Given the unprecedented nature of the proposed project, it is uncertain whether BOEM will require a permit or a letter of consent for the installation of a single buoy or buoy network.

7.1 Permit Application Components

A USACE permit application for a moored buoy or buoy network installation and operation in the area of interest would most likely take the form of an application for individual 404/401 ("dredge and fill") permit. A USACE Nationwide Permit (NWP) Type 27 "Aquatic Habitat Restoration, Establishment, and Enhancement Activities" might apply to the project, but NWP 27, which generally includes placement of devices to enhance fishing, specifically excludes the use of this permit type for placement of FADs in Florida. Whether or not a buoy proposed by an entity in the state of Florida for placement in federal waters would also fall within the prohibition is a matter to discuss at a pre-application meeting (see below). In any case, the lack of previous construction of this type of structure in the region and the consequent lack of federal agency knowledge of such activities will likely cause the USACE to require an individual permit.

A permit application would require some or all of the following.

- A detailed description of the project including the project location or locations, the project purpose, engineering designs and construction methods, and maintenance plans.
- Demonstration that the project is in the public interest.
- Demonstration that the applicant has the means to fully support the project for the project lifespan (including commitments from the applicant for required maintenance and monitoring, and possibly removal).
- An Environmental Assessment (EA) to characterize the affected environment and potential effects of the proposed project on the environment and ecosystem.
- A cumulative impact analysis to assess the "reasonable and foreseeable" actions that may occur as a result of the proposed action.
- A Biological Assessment (BA), as the Bluefin Tuna has been nominated for Threatened and Endangered species status.

The first three bullet items would be required for any permit type. The last three bullet items are associated with National Environmental Policy Act (NEPA) consultations that the USACE will undertake with NOAA Fisheries and possibly other federal agencies. The NEPA-related documents are developed as part of the consultation between federal agencies. In reality, the federal agencies are hard pressed to develop these documents and may require long timeframes to complete the analyses for Environmental Assessments, Biological Assessments, and Cumulative Impact Assessments. Applicant-submitted documents are often accepted as at least a basis for development of the final documents required for a formal consultation. Producing these documents for the federal agencies may greatly increase the speed with which the consultation process occurs; however, applicant permitting costs will increase because the County will bear the cost of document preparation. Once the agencies determine that a file is complete, the NEPA consultation process begins.

Because of the expected level of interest in the permit application and the complicated fisheries concerns associated with the project, the USACE may require a sophisticated, expert analysis of the natural resource issues. A nationally known, experienced marine fisheries expert would likely provide the most accurate and cost-effective environmental assessment and cumulative effects assessments. The expert opinions may also find more acceptance with agency reviewers. An expert should also be consulted to identify the number of buoys and buoy placement locations that would best achieve the County's desired results and reduce unintended impacts.

7.2 Initial Permit Application Planning and Pre-application Meeting

Prior to permit application, we recommend a pre-application meeting with USACE to solicit feedback, identify agency concerns, and obtain agency recommendations for permit application package components. An initial submittal to the agency in advance of the pre-application meeting should provide the location, purpose, conceptual designs, and any already identified management plans and public support for the project. The USACE expects that the plan presented at the pre-application meeting is the one that they will see in the submitted application package. Because the proposed project will be new to the federal agencies offices in Florida, and probably the southeast U.S., the meeting request may also suggest participation by USACE, NOAA Fisheries staff, and other USACE commenting agencies who may review the permit application.

7.3 Application Package Development

The permit application will identify the overall design, the buoy system manufacturer or fabricator, the maintenance plan, a commitment to the necessary budget to execute the plan, and the expected project lifespan. Other application components such as monitoring plans, environmental assessments, etc. will be identified at the pre-application meeting.

Demonstration that the project is in the public interest is an important application component. Letters of support from as broad a range of individuals and organizations will help resolve this component of the permit application review. Letters of support may derive from Okaloosa and neighboring County governments or organizations (Boards of County Commissioners, Tourist Development Departments, Economic Development Center, etc.); County non-profit groups (Gulf Coast Marine Life Center, Destin Charter Boat Association, etc.); local and state Sportfish Associations (Florida Sport Fishing Association, Florida Sports Foundation, Emerald Coast Blue Marlin Classic, etc); and/or academic partners (University of Miami, etc.).

A permit application without detailed natural resource analyses could be developed and submitted in 2 – 3 months after the pre-application meeting. Development of a permit application including NEPA documents will likely require 4 – 6 months after a pre-application meeting, depending on the level of detail required by USACE and other commenting agencies.

7.4 Permit Application Review Process

Initial USACE review would determine what additional information it requires to consider the package complete. Assuming the USACE initial review concludes the application package sufficient to submit to other federal agencies for review, the other review agencies would make a similar initial review and provide the USACE reviewer with any additional information requirements. Notably, no timeframe exists for any of these federal review processes. As part of its NEPA responsibilities, the USACE would consult with NOAA Fisheries. Groups within NOAA Fisheries engaged in review might include the Habitat Conservation Division, and possibly the Protected Species Division and Sustainable Fisheries

Division. Fisheries staffs would consider potential effects of the buoys on the pelagic and highly migratory fish populations that the buoys are expected to attract, and to be fished for by the recreational fishermen using the buoy network. Fisheries staff will also consider the potential effects of the buoys in relation to commercial fishing. The Protected Species Division will review the project for potential effects on marine sea turtles and/or right whales and possibly the Bluefin tuna due to the current petition to place the species on the endangered species list. In addition, the U.S. Coast Guard would review the design of the buoy and buoy anchoring system for navigation concerns.

Federal permit application review timeframes depend on the level of detail the USACE and its sister federal agencies require before it is willing to undertake consultation, the type of consultation required (informal or formal), and the level of uncertainty identified for the proposed action. Given the potential issues surrounding the proposed project and the regulatory agencies' general unfamiliarity with such a project, a 12 – 18-month permit review period would not be unusual.

Assuming a formal (as opposed to informal) NEPA consultation is required, the consultation process has a 135-day schedule. After that schedule is complete and assuming that the agencies reach a positive conclusion regarding the project, the USACE may require another three months to complete and authorize the permit. An informal consultation may require less time; however, the agencies are not held to a fixed time schedule. The actual processing/review time depends on the reviewer's availability to complete the necessary work.

7.5 Interviews with NOAA Fisheries

The permit application for the proposed project may receive considerable scrutiny as the use of FADs are the subject of extensive discussion in the United States and around the world. The dramatic decline of pelagic and highly migratory fish stocks in the past 30 years has caused the U.S. and other national governments, and many of the major international conservation organizations, to focus on the level of fishing and the means of fishing for these species, including the use of floating or drifting buoys. These buoys, released by the dozens or hundreds at a time, allow commercial fishermen (typically net fishermen) to more effectively catch the species they desire, but also more effectively trap "bycatch" — fishes that are not the target species — as a result of the broad thigmotropic effect of buoys in the open ocean. The bycatch (typically juveniles of many species) may be partially responsible for the observed population declines. Thus placement of such devices in an area known for highly desirable commercially-exploited fish species may result in additional fishing activity not only by recreational fishermen but also by commercial fishermen from small businesses to very large international fishing corporations. Because of the heightened attention that such devices are receiving, Taylor Engineering interviewed NOAA Fisheries staff to assess their knowledge about buoys anchored in the deep ocean and to elicit their concerns about such activity.

Interviews with members of NOAA Fisheries Regional Headquarters Habitat Conservation Division and Sustainable Fisheries Division in St. Petersburg, Florida and Gloucester, Massachusetts suggested to the interviewer that these offices of NOAA Fisheries has relatively little experience in reviewing and considering the type of moored buoy project envisioned by Okaloosa County. The concerns identified in the relatively short (1/2 hr – 1 hour) telephone interviews included the following.

- What is the expected lifespan of the proposed buoy?
- How often will buoys be replaced?
- If a buoy is lost will the rest of the gear (anchor line and anchor) be retrieved?
- Will each new buoy be placed in the same location as the lost or replaced buoy?
- Will buoys that become separated from their moorings be tracked and picked up by the project owner? Does the owner have the capacity for this action?
- Will the buoys be installed permanently or placed and removed seasonally?
- Will a research / monitoring program be included as part of the project?

The last question was often repeated, because any information on deep ocean fish communities would be very valuable both in a regulatory context and as basic scientific information. County support (not necessarily monetary) and encouragement of a fish monitoring component may become another means of providing the regulatory agencies some level of comfort that they are meeting their charge to manage the national resources responsibly.

In addition to the questions above, Taylor Engineering also discussed allowable commercial fishing activities in the proposed project area (De Soto Canyon). Interestingly, the proposed project area is closed to commercial long-lining for highly migratory species and the NMFS staff interviewed were unaware of any migratory species purse seiners operating within the Gulf of Mexico. However, as many commercial fishermen currently operate within this area of the Gulf with non-restricted gear and would likely utilize the proposed buoy(s), fisheries staff did indicate concern over the potential increase in both commercial and recreational fishing activities in the area and the potential impact to species of concern.

This is certainly not an exhaustive list of questions that the agency might consider; the staffs interviewed indicated that they did not have much experience considering this sort of project and would likely identify other questions as they consulted with the USACE and reviewed submitted materials.

7.6 Other Interviews

In addition to the interviews with NOAA Fisheries staff, Taylor Engineering also interviewed Florida Fish and Wildlife Conservation Commission (FWC) staff. While FWC is primarily a State agency, it is also federally funded and comments on fisheries projects (artificial reefs, etc.) in both State and Federal waters. Concerns identified by FWC were very similar to those expressed by NOAA and included the following.

- Line entanglement on the buoy or cable(s)
- Potential effects on threatened or endangered marine mammals (marine turtles, right whales, etc.)
- Maintenance requirements and frequency
- Increased marine debris potential from “lost” buoys or components (rope, plastics, etc.)
- Navigation concerns resulting from the deployed buoy or lost buoy materials
- The structure is short-term and will likely not provide any long-term habitat/benefit for marine life

As previously mentioned, the majority of these concerns result from the agency's unfamiliarity with such structures and should be thoroughly addressed at the pre-application meeting.

Interestingly, FWC staff mentioned a research component of the project may be available for grant funding from the Florida Fish and Wildlife Research Institute (FWRI). The FWRI research programs focus on obtaining data and information needed by natural resource managers and stakeholders, specifically monitoring marine resources, wildlife, and habitat (myfwc.com). Regarding the proposed project, FWRI receives grant funding specifically for sportfish and pelagic research. As such, any biological monitoring required by federal regulators or proposed by the applicant (or research partners) may be partially funded by this grant.

Taylor Engineering also interviewed University of Miami (UM) academic staff to discuss potential fisheries research projects and environmental monitoring programs that may be utilized for regulatory monitoring compliance. Given the lack of research data on pelagic fisheries stock enhancements, University staff proposed a fisheries monitoring program to track hatchery-produced and tagged pelagic species (e.g., mahi-mahi, etc.) to assess the success of stock enhancement within the region. The monitoring program would track the capture of these animals, initially released within the proposed project area, over time to better understand the benefits and success of stock enhancements. The buoy network could also incorporate a single or multiple buoys with environmental monitoring equipment to track sea surface and sub-surface temperatures, chlorophyll concentrations, currents, etc. and correlate this information with fisheries data. Notably, the Hawaii FAD system currently performs similar research. Pelagic fish movements around the islands are tracked utilizing sonic tags and recording instruments on the buoys. In summary, numerous fisheries monitoring projects are plausible; however, planning such programs for such a unique project without having an idea of regulatory goals and requirements proves difficult.

Taylor Engineering also discussed the issue of increased landing potential for bycatch and target species resulting from the installation of the buoys with UM staff. While the buoy or buoy network will likely attract fish and therefore increase the effectiveness of the catch, the total catch quota of commercial fisheries will remain the same. Essentially, the fish catch efficiency will increase, but the total catch is limited by total landing quotas set by the Federal agencies. However, because the proposed buoys will lie within a central portion of the northern Gulf of Mexico, the proposed project may result in increased commercial fishing pressure in the area of interest from Florida, Alabama, and Louisiana fishermen. Additionally, issues of bycatch primarily result from the fishing methodology. Because commercial fishing techniques (e.g., long-lines, net seining, etc.), regulated by the federal government, typically result in increased bycatch as compared to recreational fisherman, the increased commercial-scale capture rates and related bycatch may impact target species, target species juvenile fish stocks, and other, non-target fish stocks.

8.0 CONCLUSIONS

Placement of a buoy system in the deeper portions of the Gulf of Mexico is technically feasible. Available data suggest an order of magnitude \$20,000 – \$30,000 per buoy constructed and installed cost and a 3 – 5 year buoy lifespan. Notably, this cost is for a simple buoy system (spar buoy and concrete or steel anchor) modeled after the Hawaii buoy systems. Construction and installation of a larger-scale buoy capable of serving as a mooring structure or data platform will likely increase the cost and installation of the structure by an order of magnitude. The County should first install a small-scale buoy or small network (1 – 3 buoys) similar to the Hawaii system and make design modifications to future deployments based on 1 – 2 years of monitoring data from the original system. Further, because deep-water buoy systems are prone to failure, the County should consider the purchase of a buoy system (buoy, mooring, and anchor) designed as a unit. This may provide the greatest amount of confidence in an optimal buoy lifespan.

Buoy placement would most likely require a USACE individual permit, a process that could take two or more years with no guarantee of success. Our review of regulatory guidelines and discussion with regulatory staff revealed no apparent reasons why a buoy system could not be permitted. However, no other similar permits are available to identify what conditions might be required for such a permit. If approved, the permit would likely include a County commitment to an ongoing maintenance and monitoring program and annual budget for the activity. A pre-application meeting with the USACE and other involved agencies might help clarify some of these unknowns and help the County reach a decision regarding the project. An environmental and/or biological (fish) monitoring program for the buoy system could help the agencies recommend the project for approval. Such a program may potentially be funded through existing sportfish restoration and environmental monitoring grants supported by FWC or other state or federal agencies. Based on conversations with academic researchers, the buoys present a unique opportunity to provide currently unavailable fisheries data. Finally, while the proposed project will likely provide increased recreational sportfishing opportunities for Okaloosa County tourists, the buoys will likely be utilized by all northern Gulf of Mexico fishermen (recreational and commercial) and may result in increased commercial and recreational fishing pressure in the area of interest. The County will not be able to regulate the use of the proposed buoy network and federal fisheries staff did indicate concern over the potential recreational fishing pressure and commercial-scale capture rates and related bycatch that may adversely impact target species, target species juvenile fish stocks and other, non-target fish stocks. Such concerns may result in a very time-consuming and challenging regulatory permitting process.

9.0 REFERENCES

CRFM, 2013. Report of the CRFM - JICA CARIFICO / WECAFC - IFREMER MAGDELESA Workshop on FAD Fishery Management, 09 – 11 December 2013, St. Vincent and the Grenadines. *CRFM Technical & Advisory Document*, No. 2013 / 9. 42p.

Dagorn, Laurent, Nicolas Bez, Thomas Fauvel, and Emily Walker. 2013. How much do fish aggregating devices (FADs) Modify the Floating Object Environment in the Ocean? Fisheries Oceanography 22:3 147-153, 2013.

Dempster, Tim and Michael J. Kingsford. 2003. Homing of Pelagic Fish to Fish Aggregation Devices (FADs): the role of sensory cues. Marine Ecology Progress Series 258:213-222.

Dempster, Tim and Marc Taquet. 2004. Fish Aggregation Device (FAD) Research: Gaps in Current Knowledge and Future Directions for Ecological Studies. Reviews in Fish Biology and Fisheries 14(1): 21-42. March 2004.

Deudero, S., P. Merella, B. Morales-Nin, E. Massuti, and F. Alemany. 1999. Fish Communities Associated with FADs. Scientia Marina 63(3-4) 199-207).

Gaertner1, J. C., M. Taquet, L. Dagorn, B. Mérigot, R. Aumeeruddy, G. Sancho, and D. Itano. 2008. Visual censuses around drifting fish aggregating devices (FADs): a new approach for assessing the diversity of fish in open-ocean waters. Marine Ecology Progress Series 366:175-186 August 29, 2008.

Government of Guam 2011. Marine Conservation Plan. Accessed at the following website June 2014: http://www.bsp.guam.gov/Guam%20Marine%20Conservation%20Plan%202011.pdf

He, R., and R. H. Weisberg (2003), A Loop Current intrusion case study on the West Florida Shelf, Journal of Physical Oceanography 33, 465–477.

Holland, Kim N., Adam Jaffe, and Warren Cortez. 2000. The Fish Aggregating Device System of Hawaii. Pêche thonière et dispositifs de concentration de poissons, Caribbean-Martinique, 15-19 Oct 1999. http://archimer.ifremer.fr/doc/00042/15280/

Kaieteur News 2014. CRFM exploring use of Fish Aggregating Devices in 2014. Online February 27, 2014 at: http://www.kaieteurnewsonline.com/2013/12/18/crfm-exploring-use-of-fish-aggregating-devices-in-2014/

Leroy, Bruno A,, Joe Scutt Phillips, SimonNicol, GrahamM. Pilling, Shelton Harley, Don Bromhead, SimonHoyle, Sylvain Caillot, Valerie Allain and John Hampton 2013. A critique of the ecosystem impacts of drifting and anchored FADs use by purse-seine tuna fisheries in the Western and Central Pacific Ocean. Aquatic Living Resources 26:49-61.

Matsumoto, Walter M., Thomas K. Kazama, and Donald C. Aasted. 1981. Anchored Fish Aggregating Devices in Hawaiian Waters. Marine Fisheries Review 43(9): 1-13.

Maxwell, Douglas J., Theodore Mettlach, Brett Taft, and Chung-Chu Teng. 2010. The 2010 National Data Buoy Center (NDBC) Mooring Workshop. 01/2010; DOI:10.1109/OCEANS.2010.5664068. Accessed June 2013 at: http://wenku.baidu.com/view/a7e66e6ef5335a8102d220d4.html

Nelson, Peter A. 2003. Marine fish assemblages associated with fish aggregating devices (FADs): effects of fish removal, FAD size, fouling communities, and prior recruits. Fishery Bulletin 101(4). National Marine Fisheries Service

Polovina, Jeffery J. 1991. Assessment of Biological Impacts of Artificial Reefs and FADS. In: Pietersz, V.L.C. Symposium on Artificial Reefs and Fish Aggregating Devices as Tools for the Management and Enhancement of Marine Fishery Resources, 14-17 May 1990, Colombo, Sri Lanka. Regional Office for Asia and the Pacific, United Nations Food and Agriculture Organisation, Bangkok, pp. 258-263.

Roffs 2014. 2014 Seasonal Fishing Forecast for the Gulf of Mexico - Looking Very Good and Likely to Get Better. Roffer's Ocean Fishing Forecast Service, Inc. April 15, 2014. http://www.roffs.com/2014/04/2014-seasonal-fishing-forecast-gulf-mexico-looking-good-likely-get-better/

Sinopoli M, G. D'Anna, F. Badalamenti, and F. Andalor. 2007. FADs Influence on Settlement and Dispersal of the Young-of-the-Year Greater Amberjack (*Seriola dumerili*). Marine Biology 150:985-991 July 2006.

Torres, Andrew. 2000. Guam Fish Aggregating Device programme. *In*: Le Gall J.-Y., Cayre P. and Taquet M. (eds), *Peche thoniere et dispositifs de concentration de poisons*. Ed. Ifremer, Actes Colloq. 28, 304-318.

Wilkins, Ralph M. and Melvin H. Goodwin. 19xx. Progress Report on the Evaluation of Fish Aggregating Devices for the Eastern Caribbean. 39th Annual South Carolina Sea Grant Consortium