Journal of Environmental Management 207 (2018) 262–268

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

An evaluative tool for rapid assessment of derelict vessel effects on coastal resources

Caitlin C. Wessel [a, b, *], Ashley McDonald [a, b], Just Cebrian [a, b]

[a] Dauphin Island Sea Lab, 101 Bienville Blvd., Dauphin Island, AL 36528, USA
[b] University of South Alabama, Marine Science Department, 307 North University Blvd., Mobile, AL 36688, USA

ARTICLE INFO

Article history:
Received 6 July 2017
Received in revised form
16 October 2017
Accepted 16 November 2017

Keywords:
Derelict vessel evaluation tool
DVET
Pollution
Marine debris
ADV
Gulf of Mexico

ABSTRACT

Derelict vessels impact coastal and estuarine habitats, fisheries resources, are aesthetically unappealing, and may be a hazard to navigation and recreation. The Government Accountability Office estimated in 2013 over 5600 derelict vessels existed throughout the coastal United States. Considering the large number of derelict vessels present in coastal areas, effective tools are needed to assess the environmental damage exerted by derelict vessels and aid in management strategies for their removal. After carefully reviewing regulations, we developed a 100-point scoring rubric (DVET) to evaluate damage by derelict vessels to natural resources with minimal field effort. The DVET's ability to rapidly assess a derelict vessel's impact on surrounding natural resources was confirmed with additional rigorous sampling and suggest environmental enhancement following vessel removal. The DVET shows promise for informing derelict vessel removal strategies, although more work is needed to quantify environmental benefits of derelict vessel removal and establish guidelines for removal prioritization.

1. Introduction

Anthropogenic litter is found throughout the ocean, even in remote areas far from human contact and obvious sources of pollution (Barnes et al., 2009; Derraik, 2002). Marine debris constitutes a serious problem with economic, environmental, human health and aesthetic ramifications, thus posing a complex international challenge. Among the most seriously affected are coastal communities because of increased expenses for beach cleaning, public health and waste disposal, as well as a loss of income from tourism (Smith et al., 1997; EPA, 2012). Shipping costs can be increased, due to fouled propellers and damaged engines, and anglers may suffer reduced or lost catch and damaged nets or lines (EPA, 2012). Marine debris can also harm wildlife, lead to loss of biodiversity and alter ecosystem function (Derraik, 2002; Islam and Tanaka, 2004; EPA, 2012).

One type of marine debris is abandoned or derelict vessels (ADVs), which are aground, broken apart, sunken, show no sign of maintenance, use, or are otherwise dilapidated in their condition. An all too common practice in the Gulf of Mexico (GoM) region by boat owners is to anchor vessels in river systems prior to hurricane landfalls- a misunderstood, unlawful act (Phillip Hinesley, pers.com.). These boats often lose their mooring and then drift into marshes and stream banks on both public and private property (Helton, 2003). Vessels may also be abandoned by their owners to save on disposal expenses and allow the owner to collect on insurance. ADVs remain along the rivers and tributaries that drain into coastal waters, impacting estuarine fisheries resources, are aesthetically unappealing, and may be a hazard to navigation and recreation (Helton, 2003; Smith et al., 2003). Bank erosion/stability, water quality (i.e. flow restriction), marsh growth, and submerged grasses can also be affected by ADVs (Smith et al., 2003).

However, some ADVs may be more harmful than others, some may do little damage, and it is possible that some may even have an overall positive effect on the environment (Jensen et al., 2012). For instance, the federal and state governments around the GoM frequently recycle old ships and sink them to create artificial reefs. Prior to scuttling careful attention is taken to remove anything that could pose a harm to the marine environment (e.g. oil/gas tanks, batteries, hydraulic fluids, paint, etc.). . Today hundreds of ships have been intentionally sunk in offshore GoM waters to create artificial reefs and promote wreck diving (Fikes, 2013). Likewise, ADVs in rivers and estuaries could act as valuable reef habitat if they have no harmful or toxic substances, do not smother any other

* Corresponding author. Dauphin Island Sea Lab, 101 Bienville Blvd., Dauphin Island, AL 36528, USA.
E-mail address: cwessel@disl.org (C.C. Wessel).

https://doi.org/10.1016/j.jenvman.2017.11.046
0301-4797/

valuable habitat, and do not pose any navigational hazard or aesthetic displeasure.

After Hurricanes Ivan in 2004 and Katrina in 2005, the Federal Emergency Management Agency (FEMA) set priorities for debris removal in coastal waterways of GoM including navigation channels and areas that posed a threat to public safety. A lot of debris was removed with these efforts but many ADVs remain in GoM waters. Currently, there are no clear laws in many states to deal with the removal of derelict vessels and responsibility often falls to affected private land- owners (GAO, 2017). Some federal, state or local funds may be available for vessel removal, but the process is expensive and funds are often limited (GAO, 2017). In 2013 an estimated 5600 derelict vessels existed throughout the coastal United States and between 2005 and 2015 the federal government spent $53.8 million to remove 1321 ADVs (GAO, 2017). Thus, there is a need to render the process cost-effective. Towards this end, the most damaging vessels should be prioritized for removal and selectively disposed of. Targeting the most damaging ADVs specifically, while leaving those with potentially less damaging or even beneficial effects, would allow for effective use of limited funds in remediating the problem and contributing to watershed improvement. Here we present a derelict vessel evaluation tool (DVET) that, based on few metrics, can be easily and quickly obtained, assesses ADV condition, and potential damage to the environment. The tool is easy to adopt, helps identify vessels that could potentially cause the most damage, and may facilitate decisions on removal prioritization for environmental managers and planners.

2. Methods

2.1. Study area

This study was conducted in the Dog River watershed located on the northwest side of Mobile Bay (Alabama, USA). Dog River is approximately eight miles long (not including its tributaries and bayous) and typically shows estuarine features (Bowden and Gilligan, 1971). The watershed drains approximately 233 km^2 and includes neighborhoods (37%), forests (36%), farmland (16%), and marinas, parks, schools, and businesses (10%, Scanlan and Wallace, 2000). Approximately 25 endangered, threatened, or of-concern species occur in the watershed, including two species of crawfish (*Cambarellus diminutus* and *Procamberus evermanni*), one fish (*Leptolucania omnatta*), and several species of amphibians, reptiles, birds, and mammals including the west indian manatee (*Trichechus manatus*) whose food sources are vulnerable to large debris deposition and environmental degradation (Scanlan and Wallace, 2000; IUCN, 2013).

2.2. Derelict vessel identification

In July of 2013, 54 sunk, derelict or abandoned vessels were located and identified in the Dog River watershed by local volunteers (Rob Nykvist, pers. com.). The ADVs and surrounding habitat were photographed, any identifying information (e.g. registration number, decals, boat name, etc.) recorded, and their position marked with GPS. In October and November of 2013, our team of researchers visited the area to confirm the location and identity of the ADVs. We confirmed 23 vessels out of the initial list were actually abandoned or derelict. In addition to those 23 we discovered six additional vessels for a total of 29 ADVs (Fig. 1). All these ADVs were surveyed using the evaluative tool presented below.

2.3. Evaluative tool

To help evaluate environmental damage and prioritize what derelict vessels should be removed first, we developed a decision support tool (i.e. the Derelict Vessel Evaluation Tool or DVET) based on a number of metrics that quantify potential vessel damage. Ultimately our goal is to help determine which vessels may potentially exert more damage and, thus, may pose a larger threat to the environment and locals. This information can help managers strategize effective removal plans given limited resources and funding. The DVET consists of ten metric categories including damage to habitat, vessel state of decay, navigation hazard, ease of removal, stability, eyesore, water quality, flora and fauna present, and remaining vessel materials (Table 1). These categories were

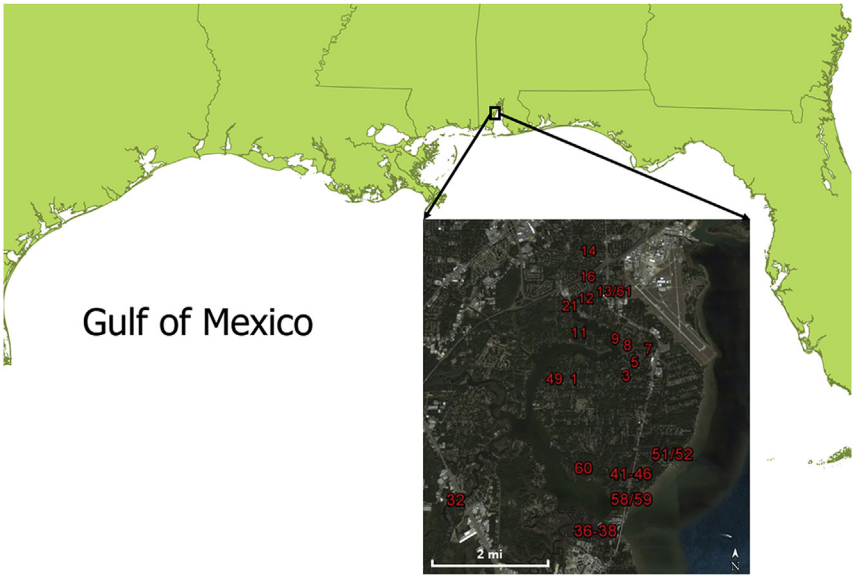

Fig. 1. Map of the Dog River watershed identifying the location of the 29 ADVs assessed for this study.