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Introduction of non-native marine fish species to the Canary Islands waters through oil platforms as vectors

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ABSTRACT

This work documents the introduction of non-native fish species to the Canary Islands (central-eastern Atlantic) through oil rigs. Methodological approaches have included surveys by underwater visual censuses around and under oil platforms and along the docking area of rigs at the Port of Las Palmas. Eleven non-native fish species were registered. *Paranthias furcifer*, *Abudefduf hoefleri*, *Acanthurus bahianus*, *Acanthurus chirurgus*, and *Acanthurus coeruleus* are first recorded from the Canaries herein. Other three species could not be identified, although they have never been observed in the Canaries. *Cephalopholis taeniops*, *Abudefduf saxatilis*, and *Acanthurus monroviae* had been previously recorded. Native areas of these species coincide with the areas of origin and the scale of oil rigs with destination the Port of Las Palmas. The absence of native species in the censuses at rigs and their presence at rigs docking area, together with the observation of non-native species after the departure of platforms, reject the possibility that these non-native species were already present in the area introduced by another vector. *C. taeniops*, *A. hoefleri*, *A. saxatilis*, *A. chirurgus*, *A. coeruleus* and *A. monroviae* are clearly seafarer species. *A. bahianus* seems to be a potential seafarer species. *P. furcifer* is a castaway species. For the moment, the number of individuals of the non-native species in marine ecosystems of the Canaries seems to be low, and more investigation is needed for controlling these translocations.

1. Introduction

The presence of non-native marine fish species in ecosystems of biogeographical regions well separated from the giver region has been related with the natural population extensions, in many cases associated with climate change, habitat disturbance (Côté and Green, 2012; Mineur et al., 2012; Webber and Scott, 2012), and anthropological factors (Carlton, 1987, 1989). In response to warmer conditions, marine fishes tend to shift their distributions to higher latitudes and fish are predicted to keep shifting under climate change scenarios (Cheung et al., 2009; Nye et al., 2009). In the case of anthropological factors, the new distribution areas are linked to the transport vector of non-native fish species. In this sense, some vectors of introduction of non-native fish species have been described including, among others, ballast water transport (Carlton and Geller, 1993; Wonham et al., 2000), marine aquaculture (Liao et al., 2010; Grosholz et al., 2015), aquarium trade (Semmens et al., 2004), oil platforms (Foster and Willan, 1979; Friedlander et al., 2014), and movements through channels (Carlton, 1989; Mavruk and Avsar, 2008). Introduction and spread of non-native species are considered one of the main threats to biodiversity in the marine context (Molnar et al., 2008) and, in recent years, the level of interest in introduced species has increased worldwide (Lockett and Gomon, 2001; Molnar et al., 2008).

Many small benthic marine fishes introduced as eggs, larvae or juveniles are first recorded from regions with important commercial ports (Wonham et al., 2000; Lockett and Gomon, 2001), and the method of transport associated is via the large amounts of ballast water carried by international shipping. In this regard, the ships' ballast water has been considered to date as the principal vector for the transfer of non-native species among marine ecosystems. However, in recent years numerous occurrences of adult and subadult individuals of non-native species have been recorded in waters near commercial ports of the Canary Islands (Brito et al., 2011; Triay-Portella et al., 2015). In the case of one of them, *Cephalopholis taeniops*, Brito et al. (2011) hypothesized about the possibility of the arrival of large adult specimens through ballast water from oil platforms. However, results of research indicate that ships' ballast water is potentially an important vector for transferring just marine non-native species of algae, plankton, small-sized invertebrates and chordate species, but not adult fish individuals (Lockett and Gomon, 2001; Molnar et al., 2008).

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In recent years, special attention has been paid to oil rigs as input vector of non-native fish species (Ferreira et al., 2006; Wanless et al., 2010; Yeo et al., 2010; Friedlander et al., 2014; Triay-Portella et al., 2015). Oil platforms are among the largest artificial structures in the ocean where they act as artificial reefs and serve as important habitat for a number of species of fish populations (Atchison et al., 2008). These artificial habitats are colonized by diverse ecological communities that have been shown, in some instances, to enhance fisheries production and biodiversity, increasing the growth and survival of individuals, affording shelter for protection from predation and spawning substrate (Jørgensen et al., 2002; Macreadie et al., 2011; Friedlander et al., 2014). However, spread of non-native species has been described as some of the negative consequences associated with oil rigs (Page et al., 2006; Wanless et al., 2010; Friedlander et al., 2014).

The role of oil rigs as aggregating places and as a mechanism of dispersal of fish and other marine organisms is well known (Foster and Willan, 1979; Carlton, 1987, 1989; Bax et al., 2003; Wanless et al., 2010; Yeo et al., 2010; Friedlander et al., 2014). These platforms provide artificial hard substrates in places where do not exist naturally, exhibiting an extraordinary diversity and biomass of fishes and rocky invertebrates (Foster and Willan, 1979; Yeo et al., 2010; Friedlander et al., 2014). The majority of old oil platforms lack self-propulsion to navigate and are towed at low speed (1–6 knots) with one or two tugs (Foster and Willan, 1979; Yeo et al., 2010). Even modern oil platforms, which are equipped with engines to navigate, also move at very low speeds (<8 knots). The low speeds at which platforms are moved between areas reduce the loss of the fouling, which favours the maintenance of the community, making oil rig an artificial habitat moving slowly through the ocean (Yeo et al., 2010). In addition to the enormous hull columns, oil platforms have multiple submerged or semi-submerged structural elements (pontoon and tubular members as horizontal girders) whose main function is to favour buoyancy and stability. This submerged surface area of the oil rig is entirely covered with algae and sessile or sedentary organisms such as sponges, corals and bivalves (Wanless et al., 2010; Yeo et al., 2010). Under these favourable conditions, numerous and various fish species are attracted by these huge floating rigs for food or shelter, and many of them are able to travel to through hundreds or thousands of nautical miles (Foster and Willan, 1979; Carlton, 1987).

The aims of the present study are to identify arrivals of the non-native fish species associated to oil platforms, and to verify whether these oil rigs represent a primary input vector of adult and subadult individuals of non-native fish species in waters of the Canary Islands.

2. Material and methods

The Port of Las Palmas is a sheltered seaport in the northeastern coast of the island of Gran Canaria, Canary Islands (Fig. 1). It is the first port in the mid-Atlantic and offers excellent berthing piers for larger oil platforms, being able to berth up to six oil rigs at the time at the end of Pier Reina Sofía, where the depth is between 18 and 30 m (Fig. 1).

Traffic information of oil platforms at the Port and Bay of Las Palmas between 2010 and 2015 was obtained from various sources, including local newspapers, port logs of the Port of Las Palmas, and annual reports of activities of the Port Authority of Las Palmas. The information gathered allowed to build a map with the main routes of oil rigs with arrival to and departure from Gran Canaria.

Biogeographical information on detailed distribution tracking of those non-native fishes was added to specific maps and associated to present and past platforms travelling routes. A figure with maps combining this kind of information was used to discuss in light of biogeographic patterns and tropicalization event in the area.

To determine the occurrence of adult and subadult individuals of non-native fish species and indirectly verify whether oil platforms represent a primary input vector of introduction, underwater visual censuses by video-transects were carried out in both oil rigs and pier. Two semi-submersible drilling rigs (rig 1, December 2014; rig 2, April 2015) were sampled, around and under, a few hours after being docked at Pier Reina Sofía. The pontoons of the oil rigs surveyed were 90 m length, 12 m breadth and 10 m draught each one. The bottom area of the Pier Reina Sofía was also surveyed twice in the absence of oil platforms (four weeks after their departure), in order to detect the presence

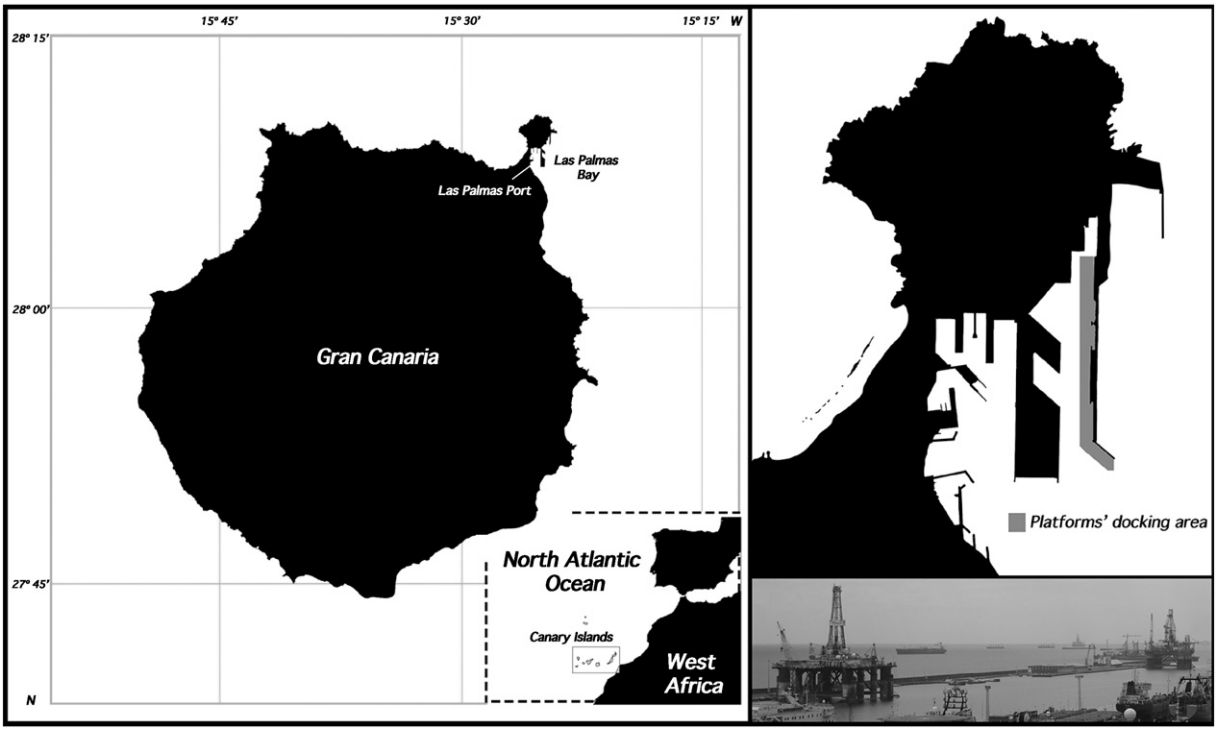

Fig. 1. Situation of the island of Gran Canaria (Canary Islands), showing the study area. Detail of the Port of Las Palmas, with the oil platforms' docking area. In the photograph, real picture of Pier Reina Sofía with the presence of semisubmersible oil rigs in April 2015.