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New record and range extension of the Deepsea Skate, *Bathyraja abyssicola* (Chondrichthyes: Arhynchobatidae), in the Galapagos Islands

FLORENCIA CERUTTI-PEREYRA [1]

ANA B. YÁNEZ [1]

DAVID A. EBERT [2,3,4]

CAMILA ARNÉS-URGELLÉS [1]

PELAYO SALINAS-DE-LEÓN [1,5]

[1]Charles Darwin Foundation, Av. Charles Darwin s/n, Puerto Ayora, Santa Cruz, Galapagos Islands, Ecuador
[2]Pacific Shark Research Center, Moss Landing Marine Laboratories, 8272 Moss Landing Rd., Moss Landing, CA 95039, USA
[3]Department of Ichthyology, California Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118, USA
[4]South African Institute for Aquatic Biodiversity, Private Bag 1015, Grahamstown 6140, South Africa
[5]Pristine Seas, National Geographic Society, 1145 17th St. NW, Washington, DC 20036, USA

corresponding author E-mail: florencia.cerutti@fcdarwin.org.ec

Abstract

Skates are a diverse group within the chondrichthyans and comprise a large component of the bycatch in many demersal fisheries. The distribution of the Deepsea Skate, *Bathyraja abyssicola*, is presently known to be limited to the northern temperate Pacific Ocean. We filmed *B. abyssicola* from a remote operated vehicle during surveys undertaken on a seamount located north of Darwin Island within the Galapagos Marine Reserve in 2015. This sighting represents the first record of *B. abyssicola* in the Galapagos Marine Reserve and the first record of the species from anywhere in the tropical eastern Pacific Ocean. The large range extension of this species to tropical low-latitude waters of the Pacific Ocean is a critical contribution to conservation biology of this poorly known species, especially since deepwater skates and rays are generally over-exploited. This new record also highlights our limited knowledge of unique deepwater ecosystems in general and those of the Galapagos Islands in particular.

Key words: fishes, seamounts, elasmobranchs, Elasmobranchii, rays, ichthyology, eastern Pacific Ocean, biogeography.

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Introduction

Skates (Chondrichthyes: Rajiformes: Arhynchobatidae: Rajidae: Rajoidei) represent approximately 25% of the described species of chondrichthyan fishes, with 245 species presently recognized worldwide (Ebert & Compagno 2007). Skates generally have K-selected life-history traits typical of elasmobranchs and deepwater skates tend to have later sexual maturity, lower metabolic rates and slower growth rates compared to species from shallow water (Frisk 2010, Kyne & Simpfendorfer 2010). Given their abundance and diversity and their role as large mesopredators, skates are an important component of demersal communities. They are directly targeted by deep-sea fisheries and comprise a significant amount of the bycatch from chondrichthyan landings in all oceans (Dulvy *et al*. 2000, Dulvy & Reynolds 2002, Gaichas *et al*. 2005, Vargas-Caro *et al*. 2017).

The genus *Bathyraja* (Ishiyama) belongs to the family of soft nose skates (Arhynchobatidae). It is known to occur predominantly on continental shelves and slopes from below 360 m to 2906 m depth in the northern Pacific Ocean from northern Japan to the Bering Sea, and southwards to off northern Baja California, Mexico (Ebert 2003, Cook & Zorzi 2017). *Bathyraja* is the most diverse genus of skates, with 41–45 species found in the North Pacific Ocean (Winton *et al*. 2014). Within the Arhynchobatidae family, the Deepsea Skate *Bathyraja abyssicola* (Gilbert, 1896) is one of the most broadly distributed species and has one of the deepest records known in the Pacific Ocean (Cook & Zorzi 2015). Although there are no studies on population trends of this species and it is considered 'data deficient' by the IUCN Red List (Cook & Zorzi 2015), *B. abyssicola* is known to get caught by deepwater fisheries in the northeast Pacific Ocean (Ormseth 2014). With no comprehensive life-history studies, it is unknown how susceptible to fishing pressure this species may be. However, skates in general are showing declines in their populations and local extirpations (Dulvy *et al*. 2000, Winton *et al*. 2014), particularly with the current trend for fisheries expansion into deeper waters (Frisk 2010, Winton *et al*. 2014).

The Galapagos Marine Reserve (GMR) was declared in 1998 aimed at protecting unique marine habitats and species, and including a total ban on industrial fishing. At present, there are a total of 570 recorded species of fishes within the reserve, including 59 confirmed chondrichthyan species (Tirado-Sanchez *et al*. 2016). The rate of endemism is relatively high, with about 14% of the fish species endemic to the archipelago (McCosker & Rosenblatt 2010). We document here the first photographic record for *Bathyraja abyssicola* in the GMR, which greatly extends the known range of the species into the tropical eastern Pacific region.

Methods

The Galapagos Archipelago consists of 13 major islands and over 100 islets and emerging rocks located about 1000 km west from the coast of Ecuador (Banks 2002). The archipelago is known for its unique ecosystems, high rate of endemism, and high diversity, largely explained by the merging of several major ocean currents: the warm Panama Current coming from the northeast, the cold Humboldt Current from the southeast, the South Equatorial current from the east, and the cold Cromwell under-current from the west (Houvenaghel 1984, Banks 2002).

A seamount located to the northwest of the northernmost island of the Archipelago, Darwin Island, was explored on 2 July 2015 during the dive #H1440 as part of cruise NA064 aboard the E/V *Nautilus* of the Ocean Exploration Trust (Carey *et al*. 2016). The seamount (located at 1.85°, -92.11°) has a base at 2500 m depth and a summit at around 900 m depth. The aim of the research expedition was to characterize the biological diversity of Galapagos deepwater ecosystems and collect biological and geological specimens. Deep-sea surveys were conducted using a two-bodied system comprising the Remote Operated Vehicle (ROV) *Hercules* and the tow-sled-style ROV *Argus* capable of exploring waters up to 4 km deep. Video was recorded using high-definition cameras mounted in the frame of the ROV.

The video frames were systematically analyzed at the Charles Darwin Research Station laboratories. The skate species was identified by an expert in deepwater elasmobranch taxonomy (D.A. Ebert).

Identification

A single male specimen of *Bathyraja abyssicola* was recorded at 1327.5 m depth over sandy bottom (Fig. 1). No additional individuals were encountered during the 14 h of the submarine exploration in the general vicinity of the initial observation.

The skate was identified as *Bathyraja abyssicola* based on a combination of characteristics (*sensu* Ebert 2003), including a moderately triangular anterior-disc margin, a broadly rounded posterior-disc margin, a disc width slightly greater than its length, rounded pectoral-fin apices, two relatively large dorsal fins, and a single median row of about 24 tail thorns (species range 21–31) along a moderately long, narrow, tapering tail. The color of the dorsum is a mostly uniform grayish purple, except for the whitish anterior pelvic tips.

Discussion

This is the first record of the Deepsea Skate, *Bathyraja abyssicola*, in the Galapagos Islands as well as in the tropical eastern Pacific Ocean in general, and greatly expands the known distribution of this species previously documented only from the northern temperate Pacific Ocean. The vast majority of species within the genus *Bathyraja* are poorly known, and most of the literature on the genus has focused on species targeted by fisheries or caught as by-catch (Kyne & Simpfendorfer 2010, Winton *et al*. 2014, Cook & Zorzi 2015). It is possible that this species ranges widely in deep water of the tropical Pacific Ocean.

The Galapagos Islands are well known for their high endemism and unusual marine communities (Edgar *et al*. 2004), however the deeper waters and seamounts are much less examined than shallower depths, despite their importance for local fisheries (Baque-Menoscal *et al*. 2012, Castrejón *et al*. 2014). Potential new deep sea species to science collected from deep waters and seamounts of the GMR during the same E/V *Nautilus* cruise NA064 are presently being described, including a potential new catshark species (Salinas-de-León, unpublished data). Additionally, during this cruise we also documented a new egg-case incubating behavior using hydrothermal

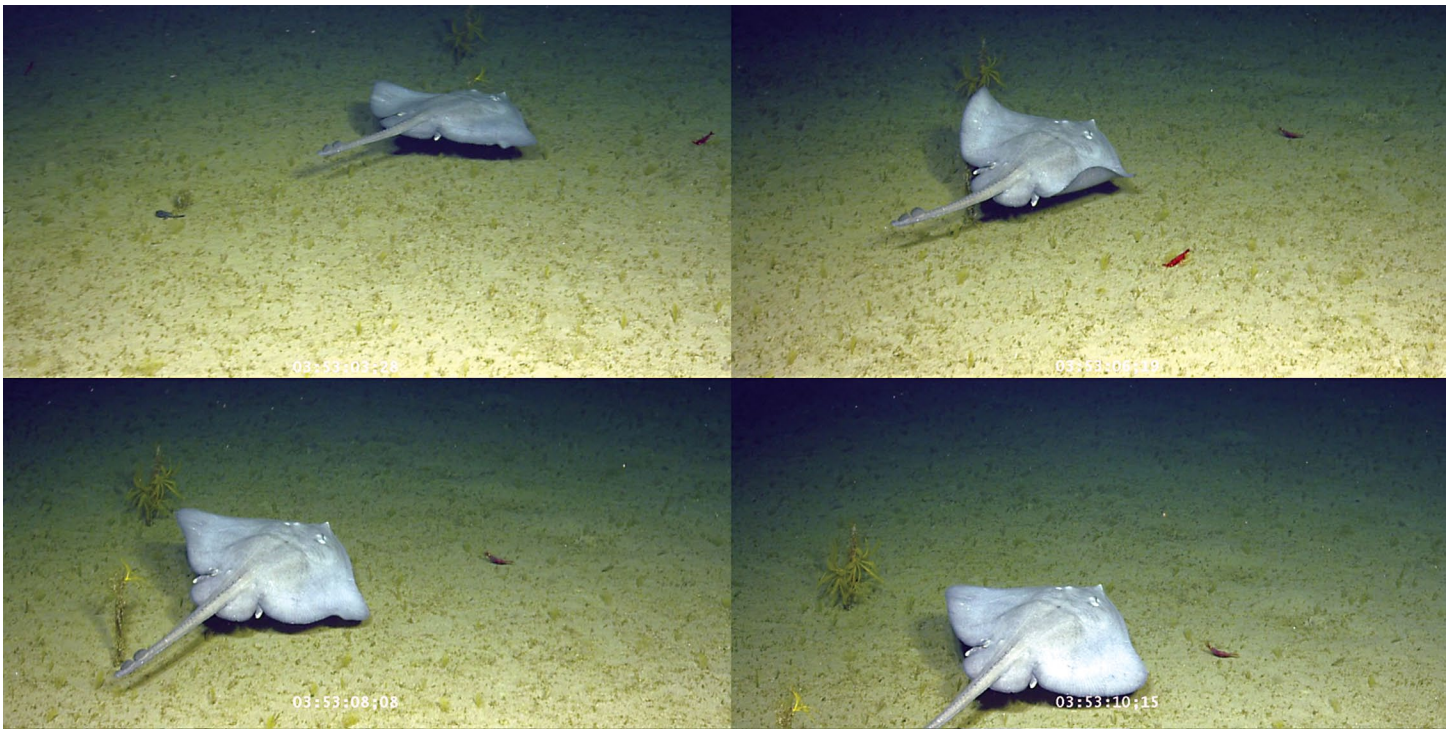

Figure 1. *Bathyraja abyssicola*, video frames of adult male specimen observed at 1327.5 m depth on dive #H1440 as part of cruise NA064 aboard the E/V *Nautilus* on a seamount northwest of Isla Darwin, Galapagos Marine Reserve, Ecuador.

vents in another deep-sea skate, *Bathyraja spinosissima* (Salinas-de-León *et al*. 2018). Furthermore, a number of species of elasmobranchs filmed by the ROV remain unidentified, supporting the need to further explore these unknown deepwater habitats.

There has been a widespread increase in the global catch of deepwater sharks and rays (Simpfendorfer & Kyne 2009), aggravated by the abundance of skates of all sizes in by-catch (Stevenson & Lewis 2010) and the broad expansion of deepwater fisheries worldwide as an alternative to exhausted shallow-water fisheries (Morato *et al*. 2006). Local extirpation of skates has already been documented in locations such as the northeastern Atlantic Ocean (Dulvy *et al*. 2000), and even if skate populations may persist in deeper waters, their limited capacity of dispersal may hinder any recovery by recolonization. Given the susceptibility of skates to deepwater fisheries and the current concerns regarding their conservation, documenting and defining their occurrence and ranges is vital for guiding management of the fisheries that may be affecting them and identifying key habitats for their survival.

It has been recommended that all deepwater chondrichthyans should be given high conservation priority due to their limited ability to recover from over-exploitation (García *et al*. 2008, Simpfendorfer & Kyne 2009). Exploration and documentation of fish species found on the deepwater seamounts of the Galapagos Archipelago contribute to the understanding of the biodiversity of these ecosystems, as well as highlight the importance of protective regulations in deeper waters of the GMR.

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