

# A DNA Barcoding Species Identification of Fish Sold in New York City Markets as “Red Snappers”

Yaa Donkor <sup>1</sup>, Tova Kleiner<sup>2</sup>, Richard Li<sup>3</sup>

Manhattan Center for Science and Mathematics <sup>1</sup>, SAR High School<sup>2</sup>, John Jay College of Criminal Justice<sup>3</sup>

## Abstract

The red snapper fish, it would seem, that one may buy at his or her local market, may not be the fish that customer intends to spend their money on. In this study, we examine the possibility of this mislabeling occurring by extracting DNA from limited samples of fish that have been purported to be red snappers, sending the samples out for sequencing, and using the BLAST system to match the DNA sequences of our samples to that of the database. Through that process we identified some of the purported red snappers were in fact fake. There may be many reasons as to why a local shop would display false fish to be a red snapper, but we contend that the fish replacing the red snapper in stores are cheaper to buy than the red snapper.

## Introduction

Food misidentification is a common issue in multiple categories of food products. Waffles branded as “gluten-free” have recently been recalled because they contained wheat (USFDA, 2018). There have been many cases of misidentification of seafood as well, including red snapper (Marko 2014). The common name red snapper is classified as the species *Lutjanus Campechanus* by the FDA (USFDA, 2002). Accordingly, fish sold in markets as red snappers need to comply with the FDA’s classification. In past years, studies have shown that fish sold under the name red snapper in New York City markets have been mislabeled fish closely related to this species. (Hsieh et al., 1995; Jackson et al., 2017; Wong & Hanner, 2008). We have continued this research by collecting samples of alleged red snapper from New York City markets and identifying the species of these fish using DNA barcoding.

## Materials & Methods

Fish samples, labeled as red snapper, were collected from local fish markets in Brooklyn, Manhattan, and Queens. Eighteen samples were collected. The DNA was extracted from approximately 0.1 g of muscle specimen using the QIAamp DNA Micro Kit (QIAGEN) according to the manufacturer’s protocols. The extracted DNA was amplified with the CO1 primers (Baldwin primers) according to Baldwin et al. (2009). The amplified products were verified using gel electrophoresis using the UBRP procedures. The sample was sent to GENEWIZ for sequencing. The sequence analysis was performed using DNA Subway software.

## Results

Among the 18 fish samples sequenced, usable sequences were obtained from 16 fish samples. After barcoding, three fish species were identified among these 16 samples (Table 1). These included *Lutjanus Campechanus* (true red snapper; Figure 1). Additionally, mislabeled fishes were found: *Lutjanus Peru*, commonly known as Pacific red snapper; and *Lutjanus Synagris*, commonly known as lane snapper (Table 1). In particular, *Lutjanus Peru* was found among 78.60% of mislabeled fishes and *Lutjanus Synagris* were found among 21.40% of mislabeled fishes (Table 2). Sequence analysis revealed that these fishes were closely related species (Figure 2). Phylogenetic analysis indicated that *Lutjanus Peru* and *Lutjanus Synagris* were more closely related than *Lutjanus Campechanus* (Figure 3).

**Table 1.** The species identification of fish samples.

Species Identified	Number of Samples	Alignment Length (bp)	E Value	Miss Match (bp)
<i>Lutjanus Campechanus</i> (Red Snapper)	2	655-660	0	0-3
<i>Lutjanus Peru</i>	11	565-657	0	0-10
<i>Lutjanus Synagris</i>	3	649-654	0	0

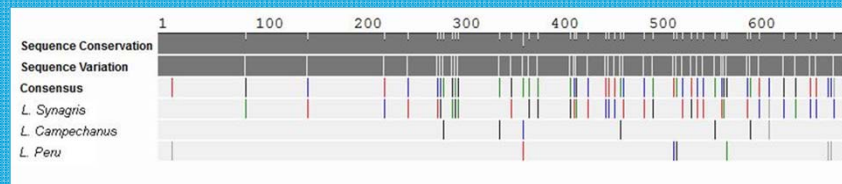
**Table 2.** The profiles of mislabeled red snapper fishes

	Species	Proportion
Mislabeled Fishes	<i>Lutjanus Peru</i>	78.60%
	<i>Lutjanus Synagris</i>	21.40%

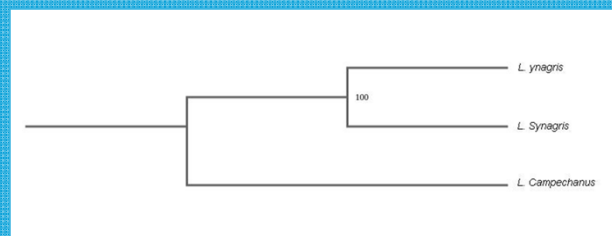
**Figure 1.** Morphology of *Lutjanus campechanus*.



**Figure 2.** Sequence comparison of the species closely related to *Lutjanus campechanus*.



**Figure 3.** Phylogenetic relationship of the species closely related to *Lutjanus campechanus*.



## Discussion

This recent study revealed that mislabeling of red snapper, sold in New York City markets, was observed. Although all our fish samples were of the snapper variety, only one was identified as the true red snapper (*Lutjanus Campechanus*). Our results were in agreement with the results of previous studies showing mislabeled red snappers (Jackson et al., 2017). Usually, small markets had significantly higher fraud than national or regional chain grocery stores. Additionally, red snappers that sold at low prices (less than \$15) usually were substituted by *Lutjanus peru* (pacific red snappers) and *Lutjanus synagris* (lane snappers). These species exhibit similar morphological characteristics, such as color and shape, of true red snappers. Thus, one may not be able to distinguish the substituted fishes from the *Lutjanus campechanus*. This study can potentially contribute to the investigation on the mislabeling of red snappers, and could also contribute to the study of mislabeling of other food groups.

## References

- Baldwin C, Mounts J, Smith D, Weigt L (2009) Genetic identification and color descriptions of early life-history stages of Belizean Phaeoptyx and Astrapogon (Teleostei: Apogonidae) with comments on identification of adult Phaeoptyx. Zootaxa: 1-22
- Hsieh YHP, Woodward BB, Blanco AW. 1995. Species substitution of retail snapper filets. J Food Qual 18:131-40.
- Jackson A, Huang D, Li R. (2017) Using DNA Barcodes to Identify Mislabeled Red Snappers Sold in New York City Fish Markets. Urban Barcode Research Program, Cold Spring Harbor Laboratory, Summary Report.
- Marko P. (2014) Facing an epidemic of mislabeled seafood. Los Angeles Times.
- USFDA (U.S. Food and Drug Administration). 2018. Van’s Foods Voluntarily Recalls Gluten Free Waffles Due to Gluten, Undeclared Wheat & Undeclared Milk. Available from: <https://www.fda.gov/Safety/Recalls/ucm606033.htm>
- USFDA (U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition). 2002. Seafood List. College Park, Md.: U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition. Available from: <http://www.cfsan.fda.gov/~frf/seaintro.html>. Accessed Nov 23, 2013.
- Wong EHK, Hanner RH. 2008. DNA barcoding detects market substitution in North American seafood. Food Res Int 41:828-37.

## Acknowledgements

This project was supported by Urban Barcode Research Program. We thank Dr. Christine Marizzi (DNA Learning Center, Cold Spring Harbor Laboratory) for helpful assistance.