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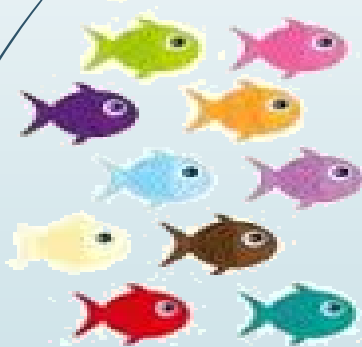
Evolution of hake mislabeling niches in commercial markets

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Mislabeling in seafood

- Many fisheries are in declined or overexploited worldwide
- Misidentification of fish species
 - At catch or landings → inadvertent overexploitation of some species
 - More frequently in species distributed worldwide and when there are economic benefits from the exchange



- Processed products more susceptible



Case of hake trade

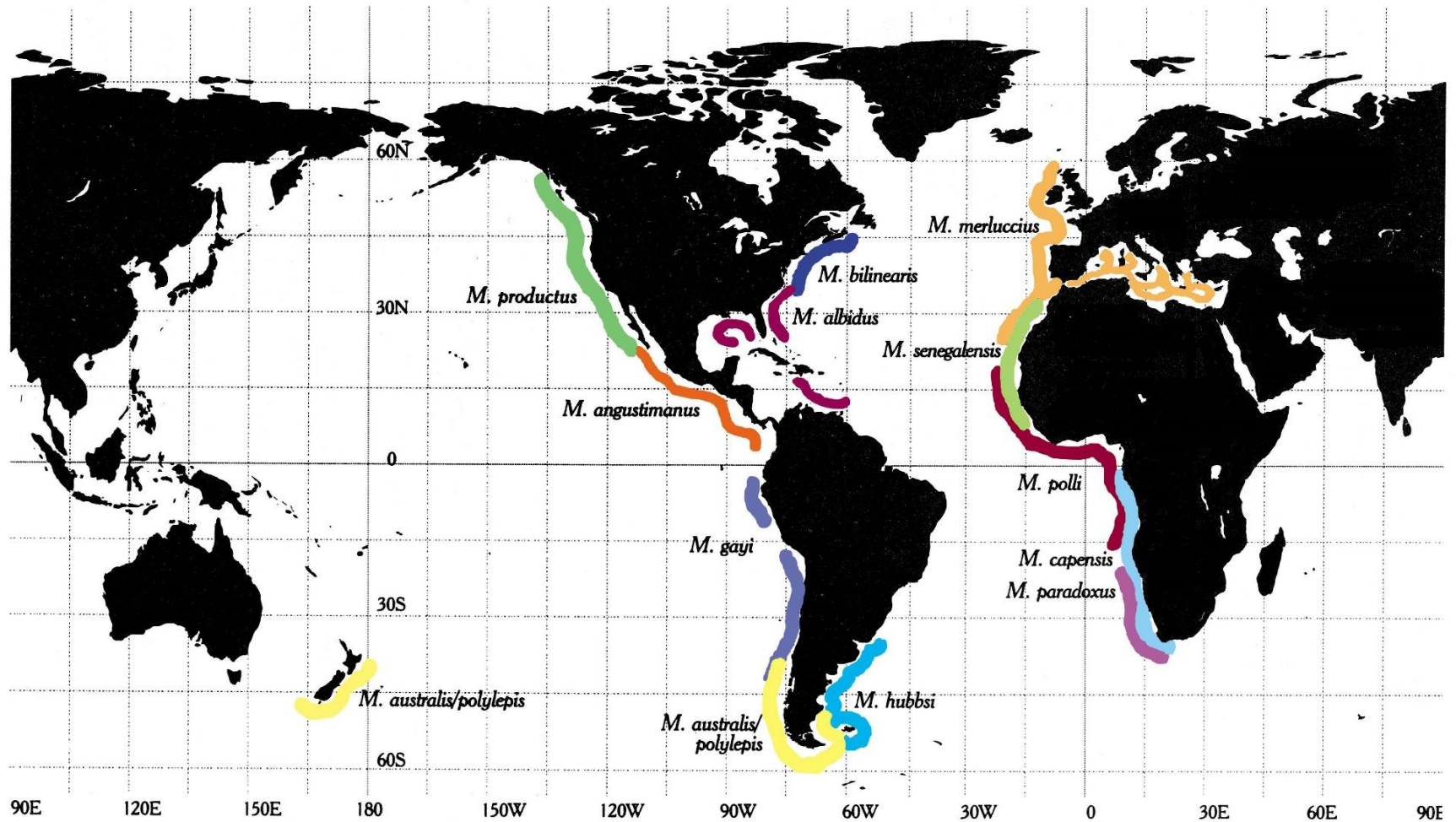


Fig 1.1 World map showing distributions of the major hake species. Latitudes are approximately correct; longitude and offshore

- Between 12-13 species depending on the authors

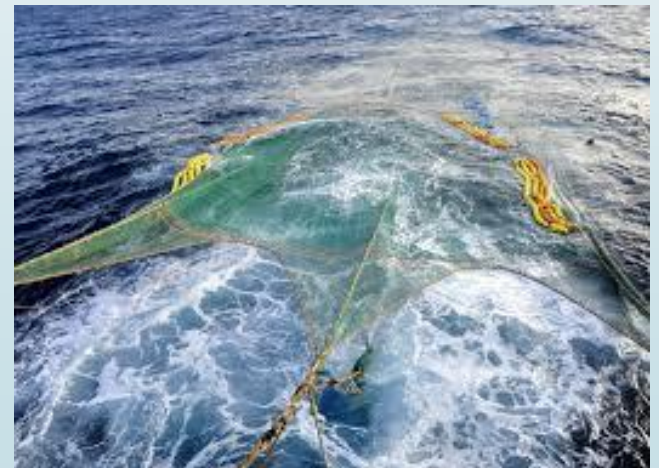
Case of hake trade

- Spain is the main hake market in the world (imports > 700,000 tons/year)
- Not all species are equally preferred by consumers:
 - *M. merluccius* and *M. australis* are the most appreciated
 - Pacific species have a difficult marketing in Europe due to their high content of parasites.



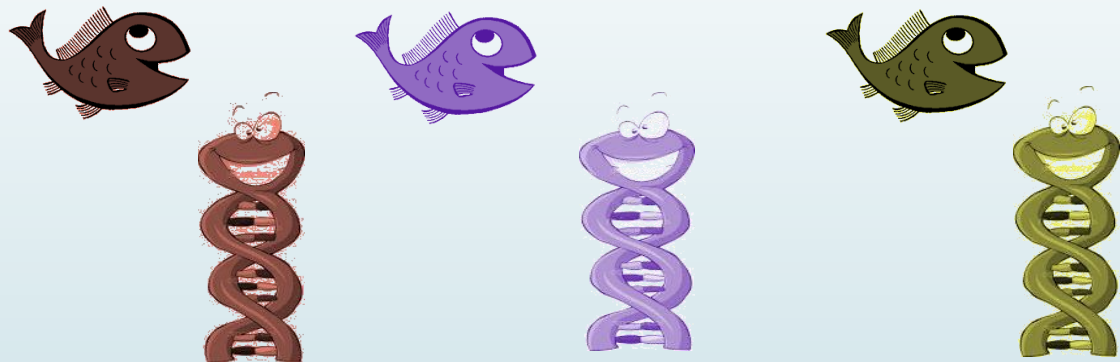
Case of hake trade

- **Mislabeleding has been reported at international level in different studies about hakes** (Quinteiro et al., 2011; Pepe et al., 2007; von der Heyden et al., 2010; ...).
- Some cases were suspected to be commercial fraud
- Other cases were considered likely unnoticed in mixed fisheries



Hakes: identification based on DNA

- For unambiguous identification molecular tools based on DNA analysis have proven to be very effective (Dawnay et al., 2007; Kochzius et al., 2010; García-Vázquez et al., 2011; ...)
- **Mitochondrial genes as Cyt b or COI** show enough interspecific variation to distinguish related species



In our study

- Proportion of wrong labels
 - Mislabeling between different products
 - Current mislabeling vs. previous studies
- Identify main potential niches of mislabeling
 - Make recommendations to reinforce quality controls

Samples analyzed



	N	Frozen		Fresh		
		Whole piece	Unrecognizable	Whole piece	Unrecognizable	
2004-2006	89	58.43%	41.57%	-	-	García-Vázquez et al., 2011 (5S rDNA & RFLP of Cit b)
2007	40	7.5%	92.5%	-	-	Machado-Schiaffino et al., 2008 (SNPs Control region)
2010	18	-	100%	-	-	García-Vázquez et al., 2011 (5S rDNA & RFLP of Cit b)
2011-2013	234	3.42%	60.68%	30.34%	5.56%	<i>New samples</i> (Muñoz-Colmenero et al., 2015) (COI & Cit b)
TOTAL	381					

Economic parameters

-The average selling price of hake products/period
(http://www.mercabarna.es/estadistiques/es_index.html)

-Price/Kg in different retail stores and markets of Spain (17 market chains).



Identification and mislabeling

- Identified by comparison with GenBank database (>98%) & Barcode of Life (BOLD)

• 8 species from the labels

- *M. merluccius*
- *M. senegalensis* & *M. polli*
- *M. capensis* & *M. paradoxus*
- *M. bilinearis*
- *M. australis* & *M. hubbsi*

• 9 species from the DNA analyses

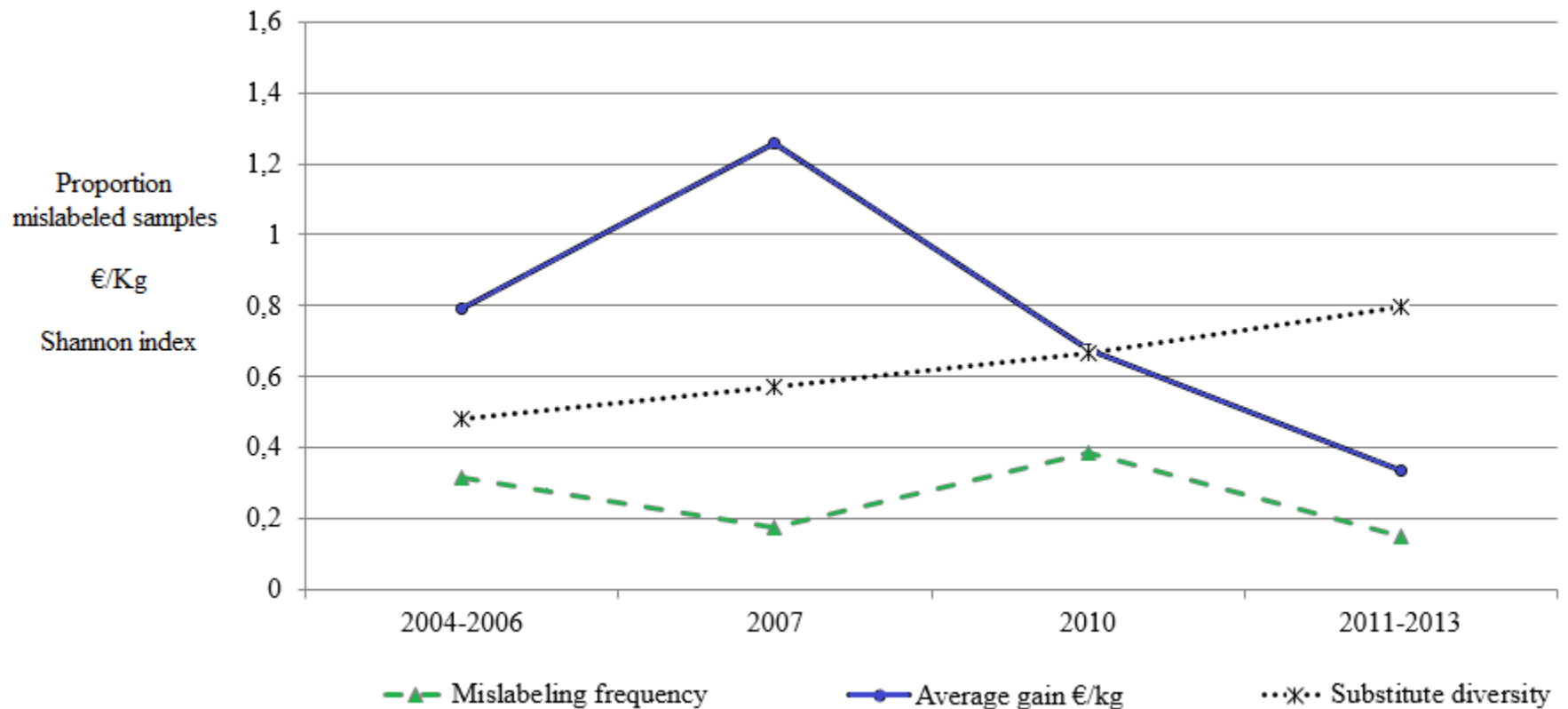
- *M. merluccius*
- *M. polli*
- *M. capensis* & *M. paradoxus*
- *M. australis* & *M. hubbsi*
- *Macruronus magellanicus*
- *Pangasianodon hypophthalmus*
- *Coryphaenoides acrolepis*



• 14,9% of mislabeling in new samples (2011-2013)

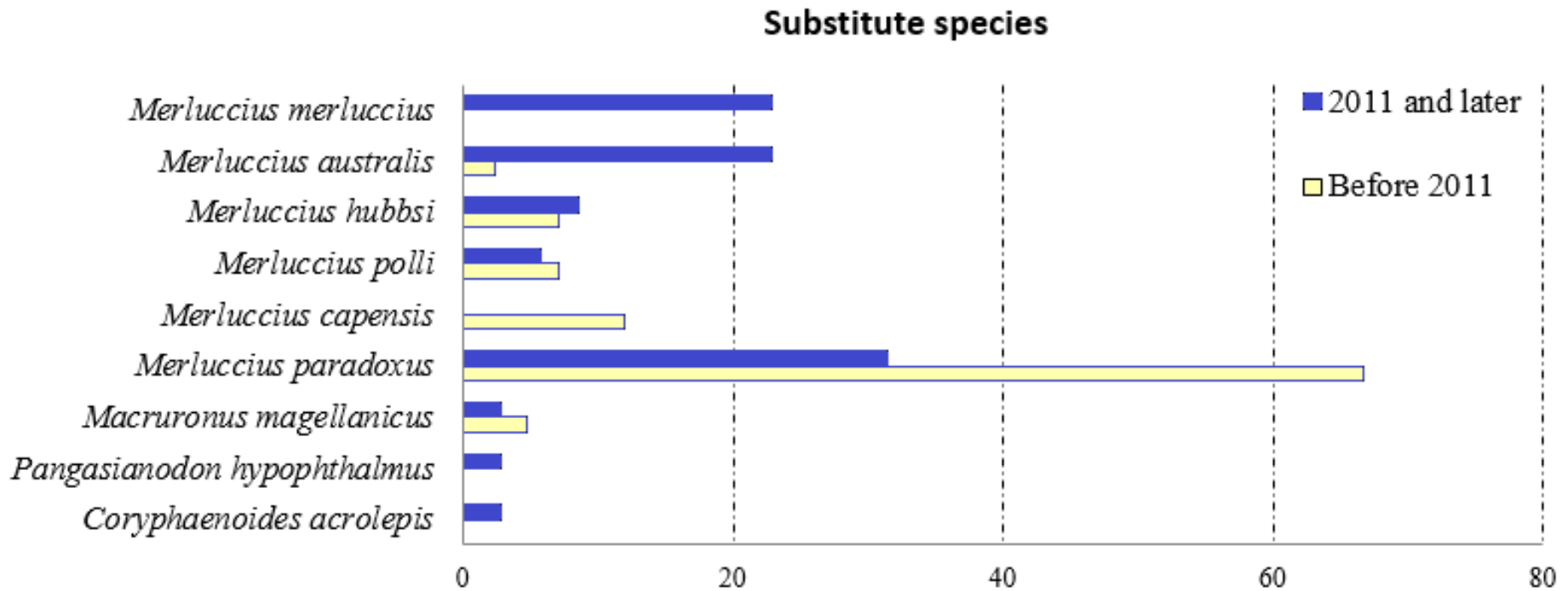
- 38.8% in 2010
- 17.5% in 2007
- 31.5% in 2004-2006

Oscillation of mislabeling



- Mislabelling oscillates in the hake trade
- The net outcome resulted in an economic loss for the consumer
- The diversity of substitute species has increased along these years.

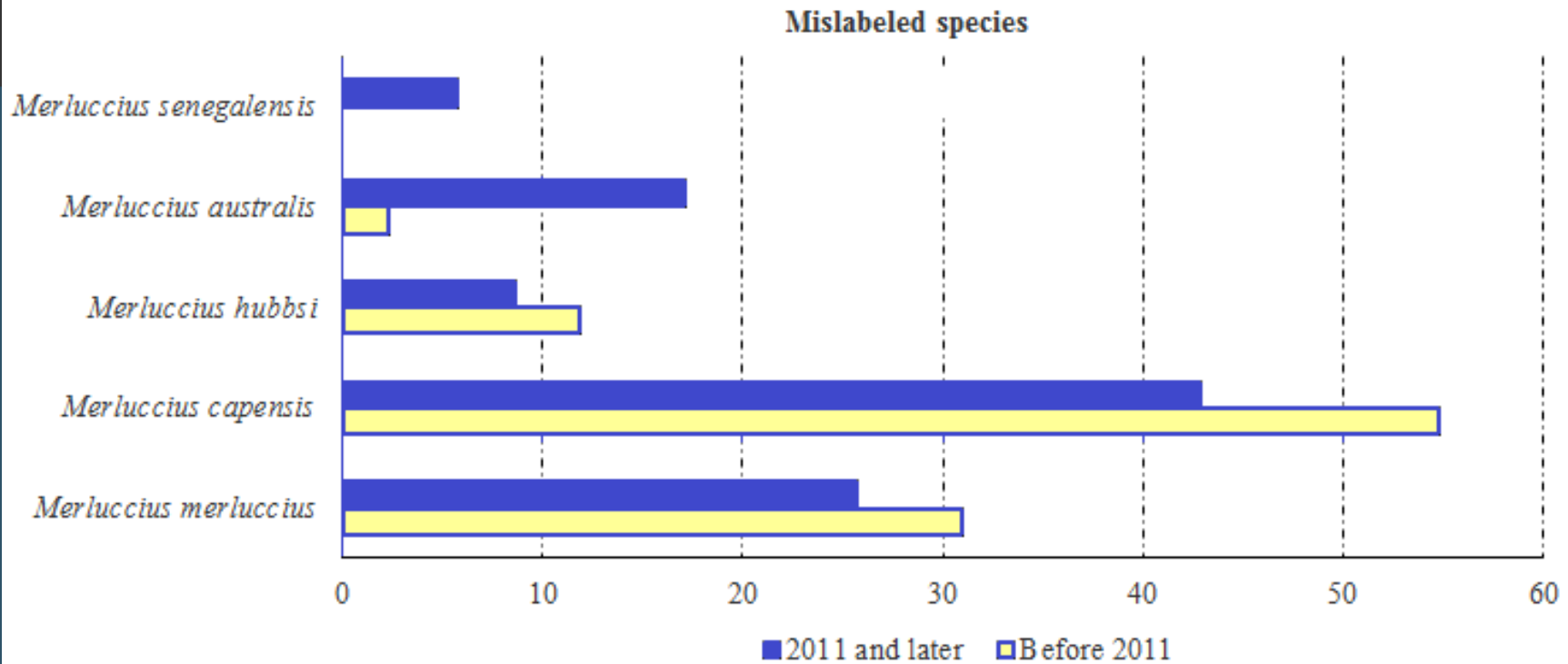
Substitute species



- Species of genus *Merluccius* from different oceans
- Species of the same family but different genus (i.e.: *Macruronus*)
- Non-hake species (i.e.: *Pangasianodon*)

Current globalized market with exchanges of food varieties among countries

Mislabeled species



- However, the species being replaced were similarly distributed between periods
- Non significant differences

Mislabeling per type of product

	Frozen			
	Whole piece		Unrecognizable	
	Possibly at landing	Processing	Possibly at landing	Processing
2004-2006	0%	15.4%	32.4%	21.6%
2007	0%	0%	10.8%	8.1%
2010	-	-	22.2%	16.7%
2011-2013	12.5%	0%	7.0%	7.7%
	Fresh			
	Whole piece		Unrecognizable	
	Possibly at landing	Processing	Possibly at landing	Processing
	0%	11.3%	0%	38.5%

- Significant higher proportion of mislabeling of unrecognizable vs. whole pieces
- Significant higher mislabeling in frozen products
- Within frozen products for 2011-2013 non-significant differences between whole pieces and processed products

Focus of mislabeling

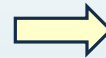
Fresh samples

- **Majority of the substitutions probably occurs during the distribution chain or processing:**

- Exchanges between allopatric species



European hake

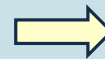


South African hake

- Some cases represent an economic loss for the seller, selling the expensive species labeled as the cheaper → May be for undermining the catch limits.



South African hake



European hake

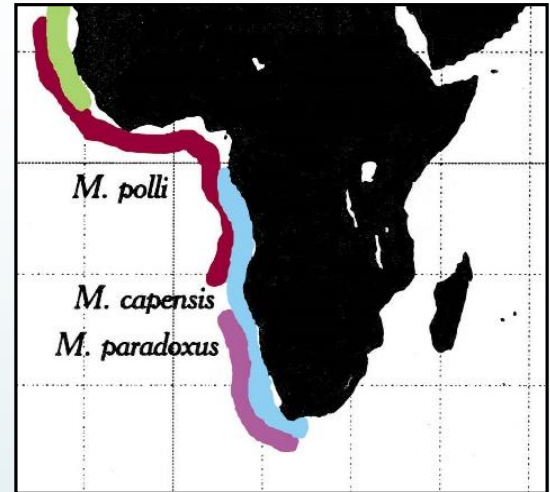
Focus of mislabeling

Frozen samples

- Many sympatric substitutions



need of more careful species identification
at landing or during fishing.



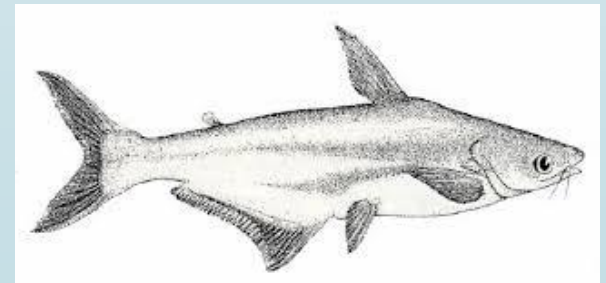
- Other cases delibetared frauds



cheaper allopatric or non-*Merluccius*
species are sold as expensive *Merluccius*
species



need of more distributed controls along the
hake market chain.



Conclusions

- The mislabeling in hake trade is a current problem.
- Is necessary reinforce the **quality controls along the market chain** at different points, **based on the species and type of products**.
- Reliable quality controls are important to:**
 - prevent fraud
 - guarantee the free-choice for the consumer
 - have correct catch reports for sustainable fisheries management



Acknowledgments



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Thank you for your
attention