DNA Barcoding Fishery Resources:

A case study in Shandong Costal Water

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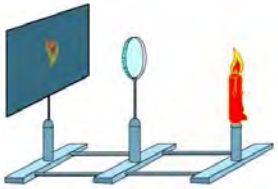
Natural Science
(from 19 century to 21 century)

Space Science (Cosmos)

Telescope,1850s

Hubble Space Telescope

Material Science (Matter)



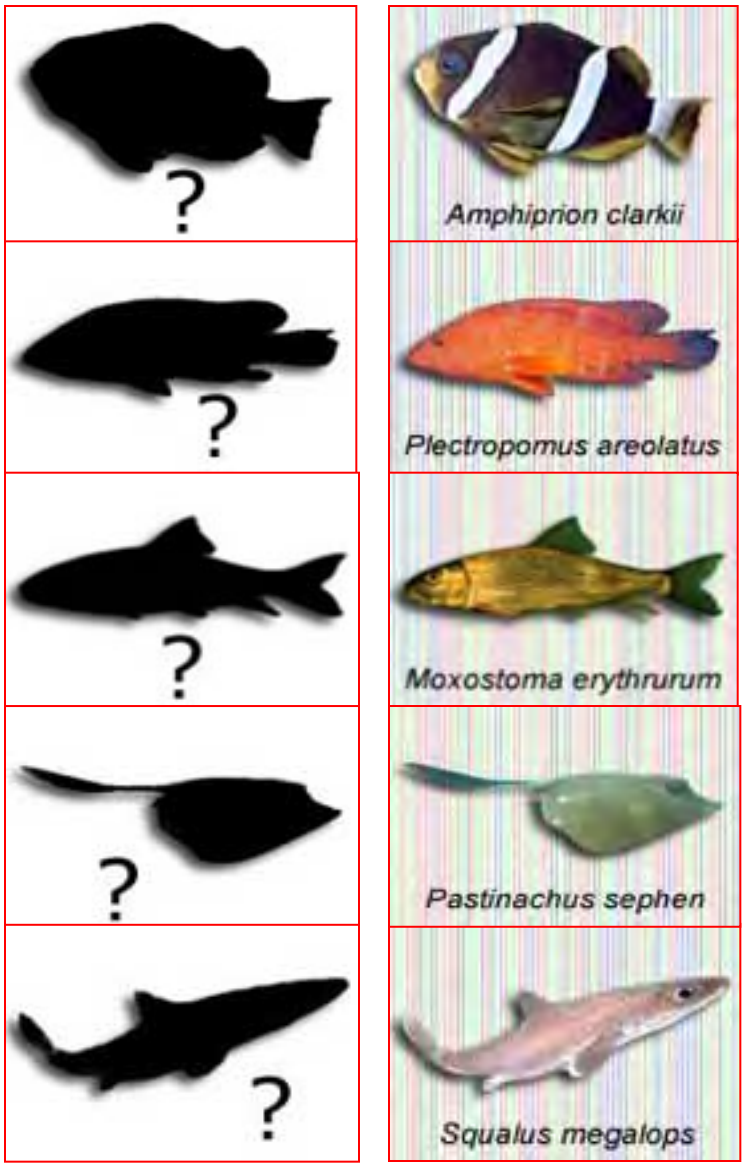
Particle Accelerator

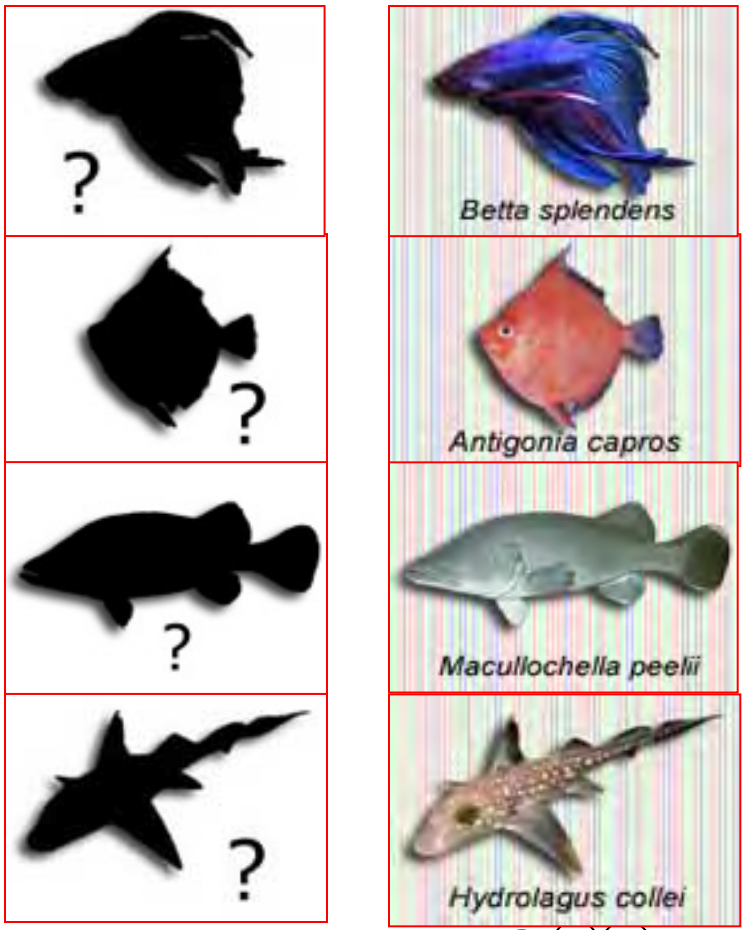
Life Science (Charles, Darwin)

Question: How many biological species are there in the ocean?

The traditional classification of organisms (specimen taxonomy) and species record (species documentation) is a research model that requires a lot of time and effort, which makes the biodiversity found too slow.

DNA barcoding——A digital future for biodiversity





What is DNA barcoding?

- Definition: Derivation of a short DNA sequence(s) that enables species identification or recognition in a particular domain of life (eucaryotes).
- Focus to date—in animals—has been on a 658 base-pair (bp) fragment of the mitochondrial gene, cytochrome oxidase subunit I (COI).
- The Barcode of Life Initiative (BOLI) would resolve barcodes for named species and use a barcoding approach to assess undescribed biological diversity.
- Very controversial!

Strengths

- Offers alternative taxonomic identification tool for situations in which morphology is inconclusive.
- Focus on one or a small number of genes provides greater efficiency of effort.
- Cost of DNA sequencing is dropping rapidly due to technical advances.
- Potential capacity for high throughput and processing large numbers of samples.
- Once reference database is established, can be applied by non-specialist.

Uses of DNA Barcodes

Research tool for improving species-level taxnonomy:

- **Associating all life history stages, genders**
- **Testing species boundaries, finding new variants**

“Triage” tool for flagging potential new species:

- **Undescribed and cryptic species**

Applied tool for identifying regulated species:

- **Invasives**
- **Environmental indicators, protected species**
- **Using minimal samples, damaged specimens, gut contents, droppings**

Fisheries Applications

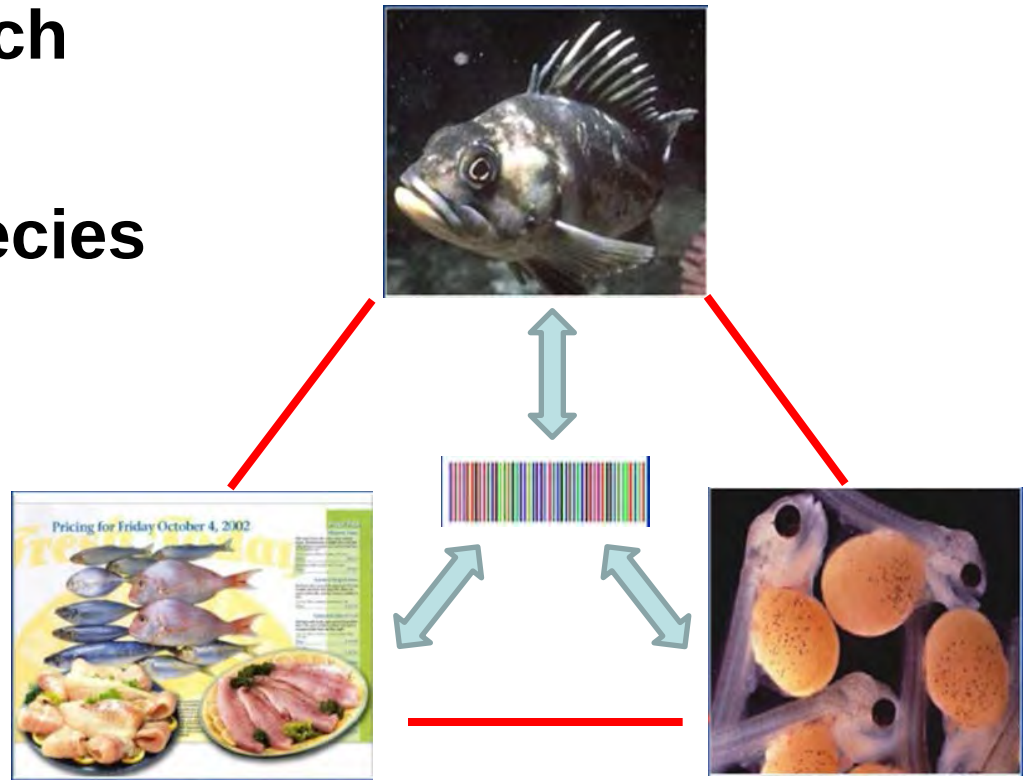
Improving stock assessments

- **Better taxonomy and distribution maps**
- **Food chain analysis from gut contents**
- **Spot-checking bycatch**
- **Larval fish**

Validation of import species

- **Filets**
- **Caviar**
- **Processed products**

Ballast water



Progression

Target waters:

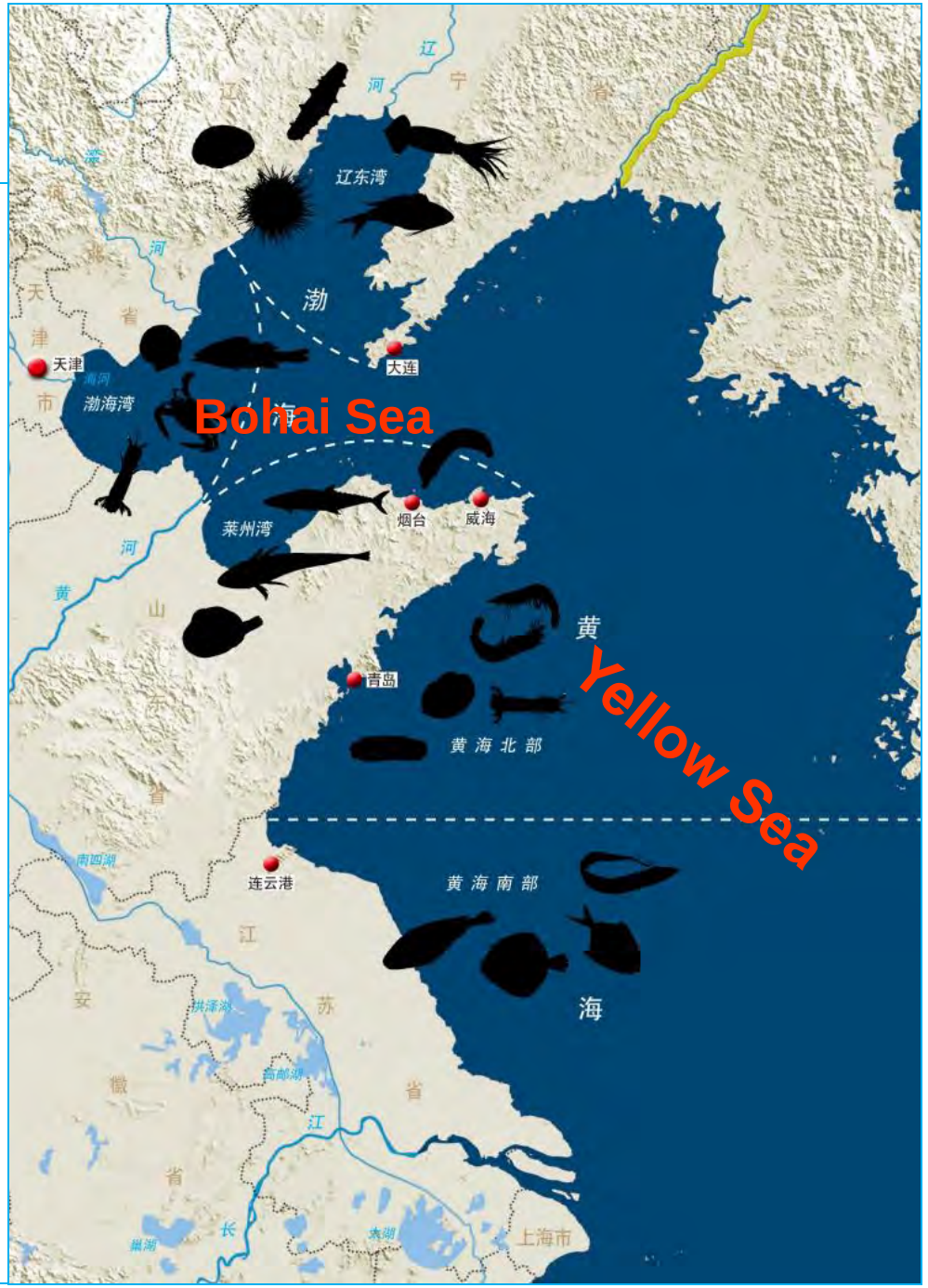
Shandong Costal Waters, the main breeding grounds for Bohai and Yellow Sea fisheries resources.

Object:

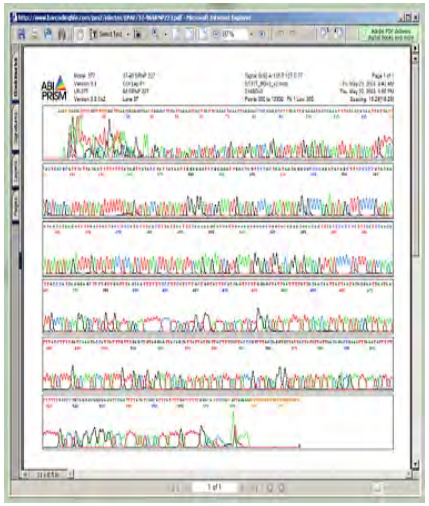
Fishery organism

Theme:

How to more effectively reveal the marine biodiversity.



Technical process:



Progression

Fishery voucher specimen bank and DNA barcode database

- Fishery species: 152
- Fishery specimens: 1403
- Fishery voucher specimens: 104
- Fishery organism DNA barcodes: 1052

Progression

Specimen bank: Fishes, crustaceans, shellfish, algae

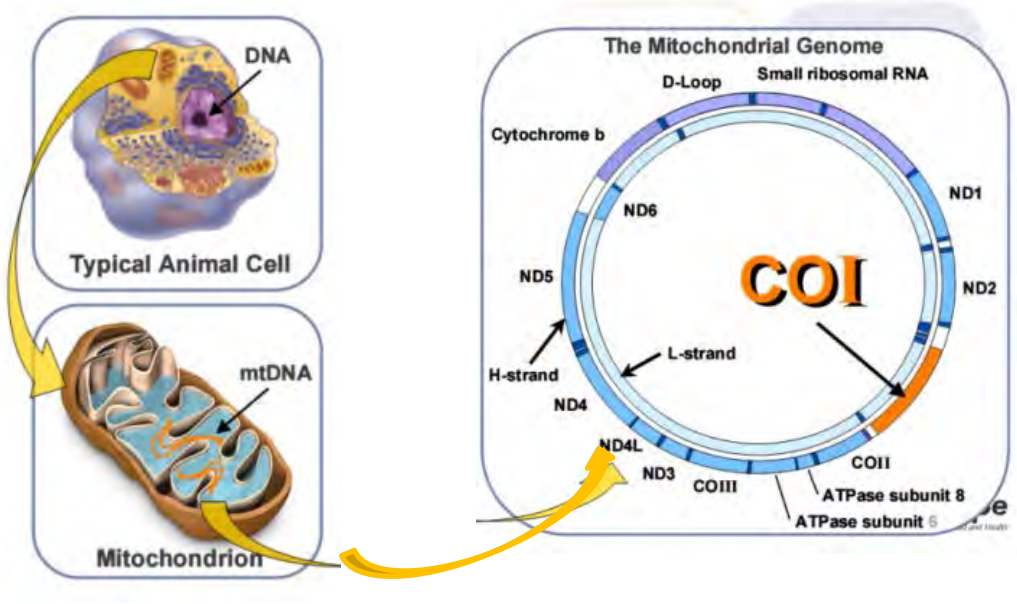
Progression

DNA barcode database (www.fisherybarcodes.com)

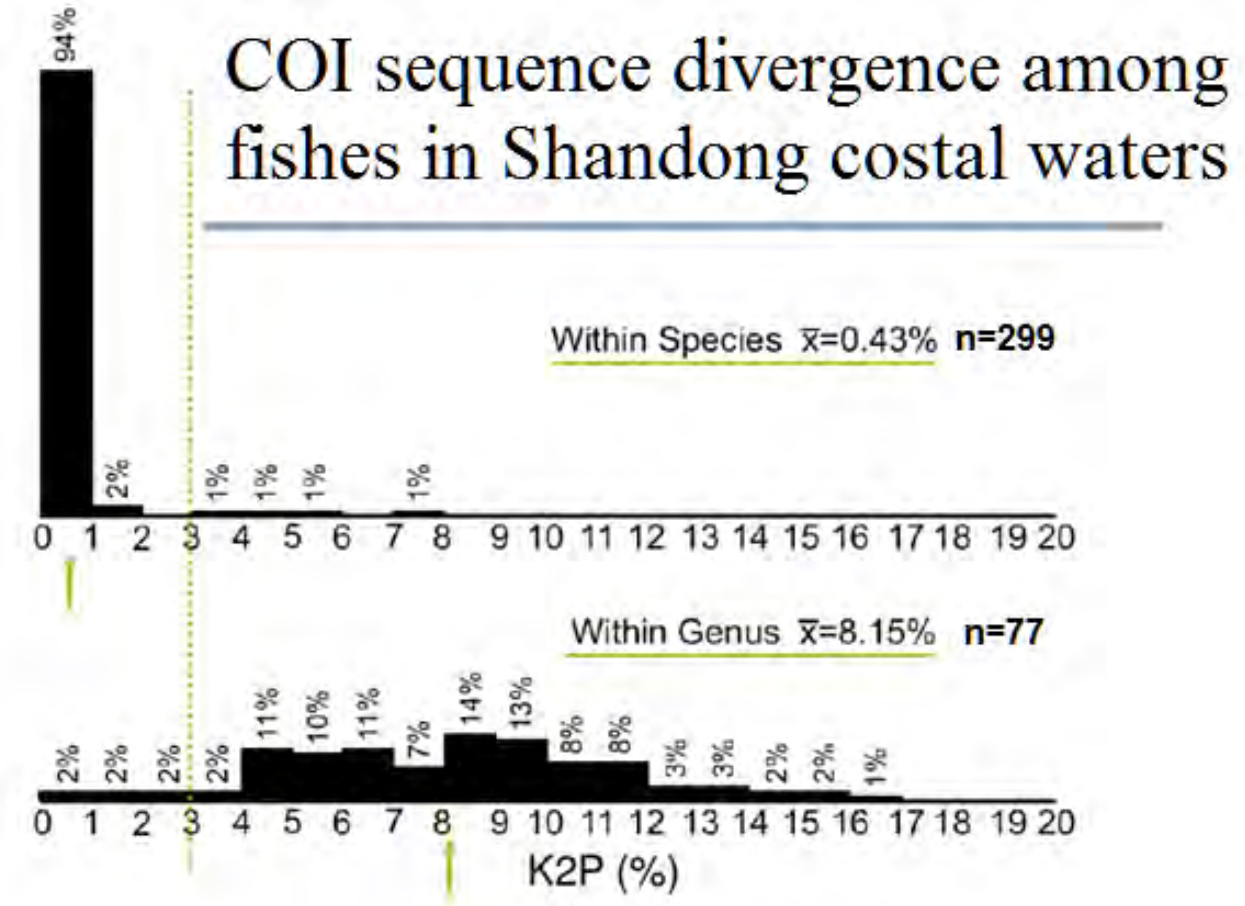
Progression

Standard gene of DNA barcoding for teleost fish:

Gene	Primers	Primer sequences
CO I	F1	TCA ACC AAC CAC AAA GAC ATT GGC AC
	R1	TAG ACT TCT GGG TGG CCA AAG AAT CA
	F2	TCG ACT AAT CAT AAA GAT ATC GGC AC
	R2	ACT TCA GGG TGA CCG AAG AAT CAG AA



Results



299 DNA sequences of the cytochrome oxidase subunit I (*COI*) gene from 77 common marine fish species in 73 genera, 50 families, 13 orders from offshore of Shandong were analyzed to test the efficacy of species identification using a DNA barcode microarray.

Results

- The results showed that interspecific genetic distance was larger than intraspecific distance.
- All 77 sequences formed species units in a neighbor-joining tree, indicating that DNA barcodes can be used to identify these 77 species.

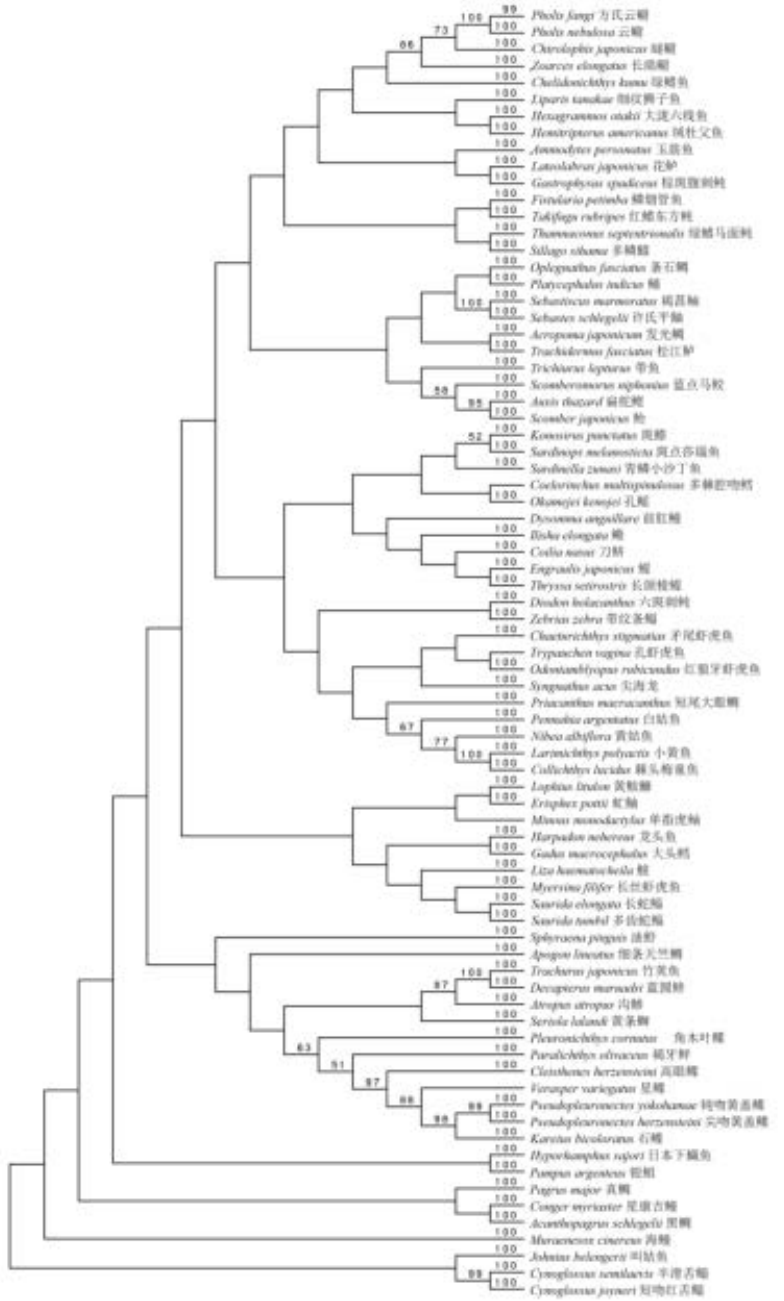


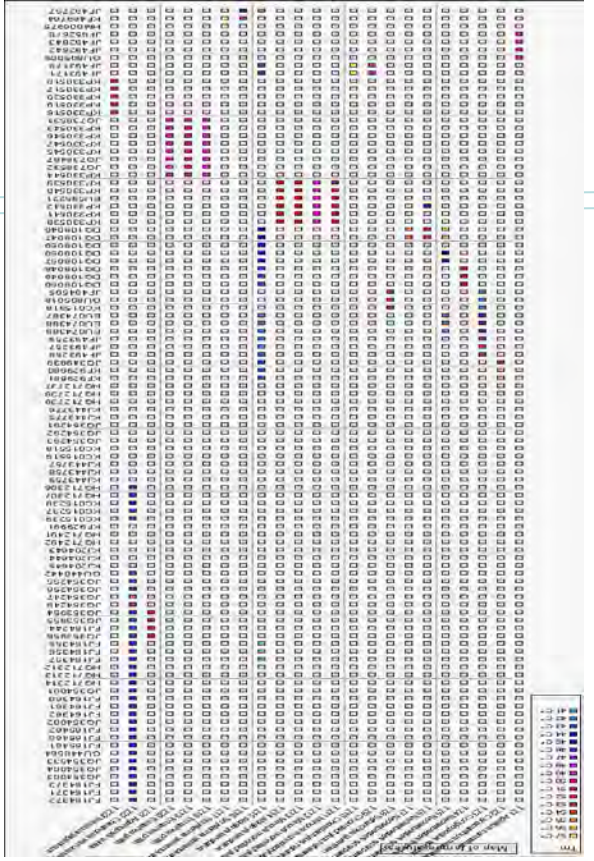
图 1　基于 *CO* I 基因构建的 NJ 系统进化树

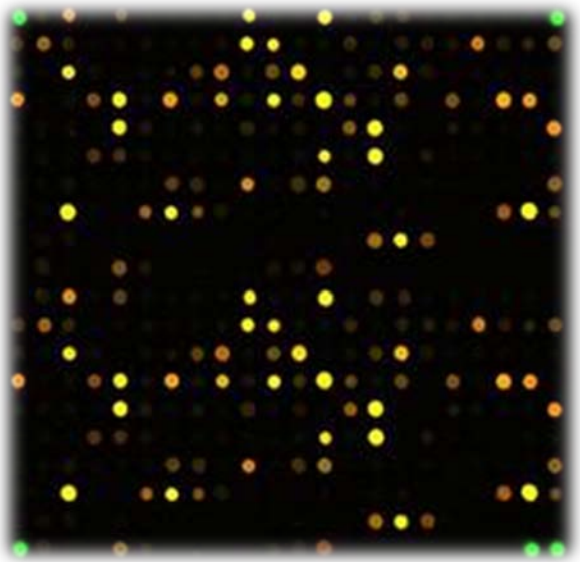
Fig. 1　NJ tree resulting from analysis of *CO* I gene data

Results

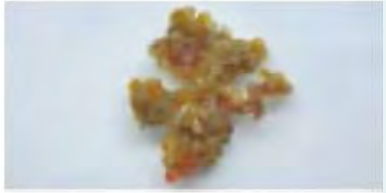
- Sixty-four specific probes were screened to identify the corresponding species among the 77 species based on the COI genes and accounted for **83.1%.**

- The DNA barcode microarray provided technical support and a new way to identify fish species in the coastal waters offshore of Shandong.





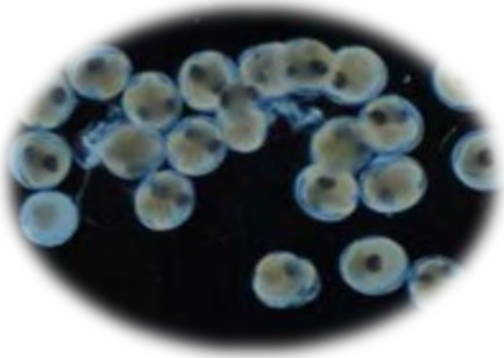
Food chain analysis from gut contents

	Morphological analysis	DNA barcoding
	Unidentified fish	*Liparis sp.*
		*agrammus*
	Unidentified fish eggs	*Hexagrammos otakii*
	Unidentified crab	*Xanthidae sp.*

DNA barcoding opens up new ways for food analysis and description of food webs in ecosystems.

DNA barcodes for fish eggs and lavae

- **Combining the DNA barcoding with the traditional morphological classification, established the identification methods of difficult species (fish eggs, larvae and juveniles).**
- **146 fish eggs were examined by DNA barcoding and identified as 20 species.**



Conclusion

- **DNA barcodes are useful tools to accelerate species-level analysis of marine biodiversity and to facilitate conservation efforts.**
- **DNA barcode technology alone can not replace traditional taxonomy, but as a useful tool to effectively identify unknown species.**

Future direction

- There are important scientific issues that need to be more precise, such as distinguishing the genetic distance of species, the description and nomenclature of new species.

- A handheld device instead of the PCR instrument in the laboratory. You can identify all the species around you.

Acknowledgement

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