สัมมนาวิชาการนานาชาติพิพิธภัณฑ์ธรรมชาติวิทยาครั้งที่ 3: ความยั่งยืนทางด้านทรัพยากรธรรมชาติและความรับผิดชอบต่อสังคม, 1-23
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Literature Search Reveals Great Opportunities for Research on Diversity of the Fishes in the Family Carangidae in Thailand

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Abstract

Fishes in the family Carangidae, currently 147 species recognized worldwide, are commercially important representing high-value products. Their economic importance is also acknowledged in Thailand as the fishes are widely used and commonly found in markets. Unfortunately, few studies focus on the diversity of this family in Thailand. We performed a literature search on any studies of the family Carangidae in Thailand in the databases of Department of Fisheries (E-Library Department of Fisheries) and Department of Marine and Coastal Resources data center (DMCR data center) using genus names and Thai common names as keywords. We also explored SCOPUS database as well as the genetic records of carangid samples collected in Thailand in GenBank. In addition, we sequenced fragments of COI gene that served as DNA barcode of common carangid species obtained from five fish markets around the upper Gulf of Thailand and compared the results with GenBank records. The literature search revealed only 27 studies from Thai government databases and 25 articles from SCOPUS from 1960 to present. Variations in topics of studies on this family were limited to a few species. There were 52 species recorded in Thailand based on an article published in 2011. Since then, scientific names of some genera and species have been revised recently but not updated in Thai databases. Data on genetic diversity of carangid species in Thailand were even scarce as only information on three species, *Atule mate*, *Megalaspis cordyla*, and *Selar crumenophthalmus* were published in GenBank database. Our DNA barcoding results were based on only a small sample size revealed new haplotypes never reported, representing hidden genetic diversity awaiting discovery. These findings indicate vast opportunities for research on diversity of carangid fishes in Thailand.

KEYWORDS: DNA barcode SCOPUS DMCR data center E-library Department of Fishes

Introduction

Thailand is rich in marine resources contributing from the Gulf of Thailand and the Andaman Sea Thailand. The Andaman Sea recorded 1,746 fish species in 2011 (Satapoomin, 2000), and the Upper Gulf of Thailand had an estimate of 239 fish species (Chamason and Phenpraphai, 2020) while Yoshida *et al*. (2013) reported 372 commercial species. Most of the marine fishes are economically important and used for local consumption as well as high-value commercial products (Lymer *et al*., 2008). Value of marine fishery (fish only) was estimated to be greater than 30,000 million Baht during 2016–2020 (Department of Fisheries, 2020). Fishes in the family Carangidae present substantial portions. The family is very diverse including more than 30 genera and about 150 valid species worldwide (Smith-Vaniz *et al*., 1999; Smith-Vaniz, 2003; Nelson *et al*., 2016; Fricke *et al*., 2022). Such high diversity not only covers variations in species but also includes variations in morphological characteristics (Abdussamad *et al*., 2013) as well as genetic diversity (Reed *et al*., 2002). Although these fishes present high economic values, the studies regarding any biological aspects on these fishes are not as abundant. In Thailand, research specifically focusing on the family Carangidae are not publicly well-known. Furthermore, updated and reliable references are scattered and not easily assessed. This situation poses a problem for future management as there is insufficiency and discrepancy of essential information. The limited number of experts who are able to document diversity of carangid fishes even slows down the process of information acquisition as these fishes have various morphological characteristics, diverse life histories and habitats. The use of molecular technology, such as DNA barcoding, could help facilitate and accelerate the identification of species, which provides the crucial information towards management (Ward *et al.*, 2005; Bhattacharya *et al.*, 2016). However, the use of this tool has not been fully employed in Thailand.

To identify the problems of databases and potential research necessary for resource management in Thailand, this study aimed to examine diversity of publications regarding the family Carangidae and variations of research topics based on existing literature. In addition, we also illustrated our small finding that contributed more updated information of fishes in this family, which could be useful for future application at both national and regional scales.

Materials and Methods

Literature search

We explored existing information on the family Carangidae in Thailand from the Thai government organizations and international databases published from 1960 to June 2022. The government databases were from Department of Fisheries (E-Library Department of Fisheries) and Department of Marine and Coastal Resources data center (DMCR data center). We searched with keywords using genus names (such as *Megalaspis*, *Caranx*) and Thai common names. These same keywords were

also used in additional using Google Scholar, Fishbase.org, and other links connected to the DMCR data center. We searched SCOPUS database using keywords 'Carangidae' and 'Thailand' as well as using genus names and Thailand by limiting the search within article titles, abstracts, and keywords provided by authors. Textbooks and references for species checklists were not included but were explored for the number of carangid species reported in Thailand. Then, each research article was categorized into three groups, which were 'specific' = studies including and focusing specifically on carangid samples in Thailand, 'not specific' = studies including carangid samples in Thailand but not particularly focusing on these fishes, 'not involving' = studies not including carangid samples in Thailand.

Finally, we searched for genetic records of DNA barcoding of carangid samples collected in Thailand in GenBank by using genus names and looking for origins of samples. Samples without specified locations were not considered. Names of species and authors of the sequences were recorded.

DNA barcoding

Samples of carangid fishes were collected from five fish markets (Cha-am Fresh Market, Mahachai market, Talay Thai market, Trat fish market, and Baan Mai Rood fisherman village) around the upper Gulf of Thailand during October 2020–April 2022. The whole-body of 83 individuals was preserved in 10% formalin and further washed with water and stored in 70% ethanol for morphological records. Voucher specimens are kept at the Department of Biology, Faculty of Science, Mahidol University in Bangkok. In addition, the right pectoral fins were cut and preserved in absolute ethanol and stored at -20^{o}C for DNA barcoding analysis. DNA barcoding was performed by extracting genomic DNA from fin using NucleoSpin® tissue kit. The DNA samples of 62 specimens were amplified for fragments of the cytochrome c oxidase subunit I (COI). PCR protocol followed Torres & Santos (2020) with some modifications. The primers FishF2 (5' TCG ACT AAT CAT AAA GAT ATC GGC AC 3') and FishR1 (5' TAG ACT TCT GGG CCA AAG AAT 3') were used for amplification of COI (Ward *et al*., 2005). The PCR reaction of 12.5 µL consisted of 3 µL ultra-pure water, 1 µL (100 pmole) of FishF2 primer, 1 µL FishR1 primer, 5 µL of Supermix® containing Taq DNA polymerase, dNTP, PCR buffer, and 2.5 µL of DNA template. The PCR started with initial denaturation of 3 minutes at 94 °C, 35 cycles of denaturation of 30 seconds at 94 °C, annealing of 30 seconds at 52 °C, and Extension of one minute at 72 °C and then held at 10 °C. All PCR products were visualized using 1.5% agarose gel stained with Novel Juice (Sigma-Aldrich®). Gel electrophoresis was run for 30 minutes at 100 V. Expected length of COI bands was 650 bp. Purified PCR product using NucleoSpin® Gel and PCR Clean-up kit. Purified DNAs were sent to sequencing using Sanger method.

Sequences were edited using MEGA 11 (Tamura *et al*., 2021) and then blasted to find the closest match with sequences in GenBank. Careful alignment of sequences was performed

using MEGA 11 to look for non-reported haplotypes of our samples. Each sample was compared with the top ten sequences deposited in GenBank with best match considered by maximum score, query cover, and percent identity using the algorithm BLAST.

Results and Discussion

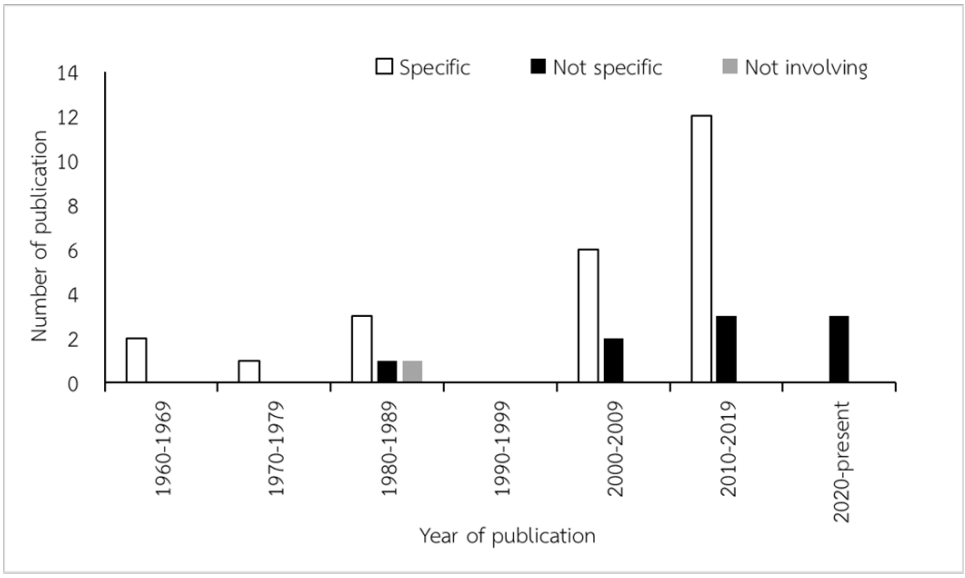
Literature search

All databases contained studies on carangid fishes in Thailand (Appendix A). E-Library Department of Fisheries showed 27 studies starting from 1983 to 2020 (Figure 1a). Approximately 75% of these studies were published more than ten years ago. Some used an old scientific name such as *Caranx leptolepis* whose current name is *Selaroides leptolepis*. Topics of studies were diverse such as diversity assessment, aquaculture, and population characteristics but only focused on a few species of carangids. The DMCR data center did not return any match for research articles because this database tends to publish reports and books rather than research articles. DMCR owns a journal "Phuket Marine Biological Center Research Bulletin," which can be searched using the SCOPUS database. The search in SCOPUS showed 25 studies (Figure 1b). Of these studies, 17 had contribution from Thai researchers. Only three studies were directly on carangid fishes, while others were either on parasites in fishes or on diversity assessment of marine fish communities. Generally, many studies on the family Carangidae in Thailand have been done more than ten years ago. Most articles were published during 2010 and 2019. Studies that actually used and focused on carangid samples or information in Thailand were conducted by the Department of Fisheries and published in its database, although the attention was limited to a few carangid species. On the other hand, information of carangid diversity and biology in Thailand rarely presented in SCOPUS considering its high diversity. Furthermore, many of the studies did not specifically focus on carangid species but included these fishes as parts of diversity surveys. The appearance of articles that did not include carangid samples in Thailand were studies conducted in countries in Southeast Asia that mentioned the distribution of these fishes in the region including Thailand.

The genetic records of DNA barcode or fragments of COI gene registered in GenBank had recorded only three species *(Atule mate*, *Megalaspis cordyla*, and *Selar crumenophthalmus*) from samples collected in Thailand. The first two authors of this work were a Japanese team with a Thai researcher as the third author.

The numbers of species in the family Carangidae recorded in Thailand were different among sources. The website FishBase.org documented 48 species, the study in the Andaman Sea reported 52 species (Satapoomin, 2011), and study in Inner Gulf of Thailand recorded 25 species (Chamason and Phenpraphai, 2020). Because species diversity of carangid fishes has never been particularly examined, the actual diversity of this family in Thailand remains uncertain. Moreover, as the names of several carangid fishes have been revised due advances in molecular phylogenet-

(a)



(b)

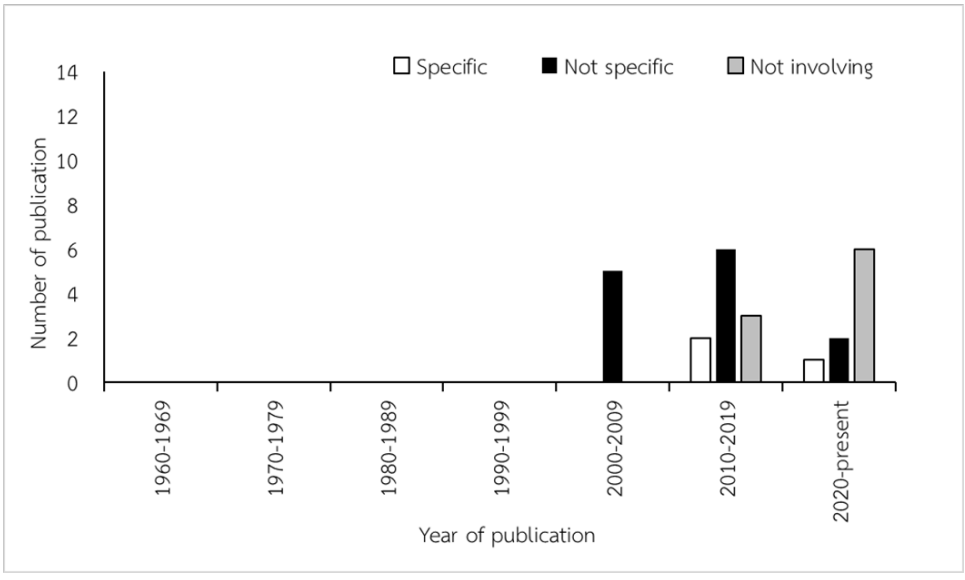


Figure 1. (a) Research articles on carangid fishes from E-Library Department of Fisheries; (b) research articles on carangid fishes from SCOPUS.

ic analyses (Kimura *et al*., 2022), the number of carangid species will require an update. In addition, the search for information, especially genetic data, would become more confusing and difficult as synonyms must be considered as keywords as well as the current valid names.

Even though there are only a handful of carangid studies in, the neighboring countries in the Southeast Asian region, especially Indonesia, Malaysia, and the Philippines, are more active in research of these fishes. Topics of studies focused on diversity and population genetics of carangid fishes (Halasan *et al*., 2021; Jamaludin *et al*., 2020; Mat Jaafar *et al*., 2012; Nur *et al*., 2022) as well as systematics and identification (Santos and Torres, 2020), which are crucial information for resource management. However, other topics such as life history and ecological data of fishes in this family are relatively few allowing an opportunity for board research fields, which will be useful for fishery management of these economic fishes.

DNA barcoding

Successful amplification of 43 COI fragments represented 17 nominal species corresponding to morphological examination and one species with uncertain identification (Table 1, appendix B). This single unknown species was a juvenile whose diagnostic characteristics were not obvious, and its DNA barcoding was inconclusive for either *Caranogides chrysophrys* or *C. malabaricus*. Of these COI fragments, there were nine new haplotypes not reported in the GenBank database, which accounted for 20% of our small sample size. Our carangid diversity record only accounted for 60% of the previous study in the inner Gulf of Thailand (Chamason and Phenpraphai, 2020). Since sample collection in this study was opportunistic, it did not sufficiently cover the diversity of fishes in this family in the region. However, there were a species, *Decapterus maruadsi*, found in this study but was not recorded in the inner Gulf of Thailand (Chamason and Phenpraphai, 2020; Satapoomin, 2000; Yoshida *et al*., 2013) but were reported in the Songkhla Lake Basin or lower Gulf of Thailand and Andaman Sea (Satapoomin, 2011; Wangwibulkit *et al.*, 2021; Chantrapornsyl, 2013). In fact, these species were common in the Upper Gulf of Thailand based on the communication with local people. The absence of these species in the government records could be a result of incomplete sampling and will require further studies.

Based on our data, the small sample size of carangids collected opportunistically yielded new haplotypes, which indicated a great potential to find distinct populations never reported. It is highly possible that additional sampling with systematic designs will reveal more diversity of fishes in this family in Thailand. The advance in carangid research in Southeast Asian and Asia Pacific regions based on genetic data allows the assessment of hidden diversity, such as two distinct lineages of *Atule mate* in Malaysian waters (Mat Jaafar *et al*., 2020), and cryptic diversity in *Decapterus maruadsi* (Jamaludin *et al*., 2020), the split of Asian and Australian populations of *Selaroides leptolepis* (Halasan *et al*. 2021), and potential cryptic species in the genus *Carangoides* (Mat Jaafar et al. 2012; Nur *et al*., 2022).

Table 1. Lists of carangid samples with successful COI amplification.

Species	**COI fragment length (base pairs)**	**Number of new haplotypes**
Scomberoidinae		
Scomberoides tol (N = 2)	630-680	-
Naucratinae		
Seriolina nigrofasciata (N = 1)	659	1
Caranginae		
Alectis ciliaris (N = 1)	665	-
**Alectis indica* (N = 2)	671-675	-
Alepes kleinii (N = 1)	672	1
Alepes melanoptera (N = 2)	671	-
Alepes vari (N = 11)	681	2
Atule mate (N = 5)	624-658	1
Carangoides armatus (N = 1)	653	1
Carangoides sp.† (N = 1)	644	-
***Carangoides malabaricus* (N = 1)	634	1
Carangoides praeustus (N = 1)	608	-
Caranx sexfasciatus (N = 4)	632-662	2
Decapterus maruadsi (N = 1)	635	-
Megalaspis cordyla (N = 3)	629-650	-
Parastromateus niger (N = 2)	677	-
Selar crumenopthalmus (N = 2)	636	-
Selaroides leptolepis (N = 2)	677-681	-

* Revised name: *Scyris indica*

** Revised name: *Platycaranx malabaricus*

† = Inconclusive species identification—sequence equally matched with 2 species and closer to *C. chrysophrys*, unclear morphological characteristics

Conclusion

Few studies on the economically important fishes of the family Carangidae have been conducted in Thailand. Variations in topics of studies as well as genetic information from samples collected in Thailand are also very limited to a few species. Assessment of carangid diversity in Thailand was usually parts of results in biodiversity research but never thoroughly examined. As taxonomic revision of this family has been suggested, the urgent need for biodiversity examination in various aspects including species diversity, population and genetic variation, life history and ecology.

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Appendix A. Lists of Articles from Literature Search.

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
E-library Department of Fisheries	1963	Naiyanetr*	The preliminary study on life history of scad (*Caranx leptolepis*) in the Gulf of Thailand	X		
	1967	Pannium*	The analysis of length and weight of black-banded trevally *Seriola nigrofasciata* (Ruppell) randomly sampled from Fish Marketing Organization in Bangkok from June to December 1966	X		
	1979	Chansri*	The study of age and growth of round scad *Decapterus maruadsi* Temminck & Schlegel in the Gulf of Thailand	X		
	1983	Termvidchakorn*	Studies on the development and distribution of the carangid fishes in the Kuroshio and adjacent regions			X
	1984	Wongchittsue*	The relationship between length and weight of round scad in western Thailand	X		

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	1987	Predalumpaburt*	Development distribution and abundance of leatherskin, *Scomberoides tol* (Cuvier), (Pisces: Carangidae) from the mouth of the Songkhla Lake	X		
	1989	Nootmorn*	Population dynamics of round scad (*Decapterus maruadsi*) Temminck & Schlegel,1842 in the Gulf of Thailand	X		
	1989	Premkit*	Abundance of parasites found in yellowtail scad (*Caranx mate*) in the Gulf of Thailand		X	
	2003	Bunluedaj*	Optimal harvest of round scad *Decapterus maruadsi* (Temminck and Schiegel, 1842) in the Andaman coast	X		
	2004	Premkit *et al.**	Biological aspects of one finlet scad (*Atule mate*) in the upper Gulf of Thailand	X		

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2004	Tossapornpitakul and Boonwanich*	Reproductive biology of the one-finlet (*Atule mate*) in the southern Gulf of Thailand	X		
	2008	Phuttharaksa *et al.**	Reproductive biology of bigeye scad (*Selar crumenopthalmus* (Bloch, 1793)) in the Gulf of Thailand	X		
	2008	Yakoh and Chalee*	Reproductive biology of yellowstripe scad, *Selaroides leptolepis* (Cuvier, 1833) in the Andaman sea along the coast of Thailand	X		
	2009	Songkaew*	Reproductive biology of Torpedo Scad (*Megalaspis cordyla* (Linnaeus, 1758) in the Gulf of Thailand	X		
	2010	Booksuk *et al.**	Stock assessment of round scad *Decapterus maruadsi* (Temminck & Schlegel, 1843) along the Andaman sea coast of Thailand	X		

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2011	Jaiyen *et al.**	Stock assessment of yellowstripe scad (*Selaroides leptolepis* (Cuvier, 1833)) along the Andaman sea coast of Thailand	X		
	2011	Keereerut *et al.**	Stock assessment of hardtail scad (*Megalaspis cordyla* (Linnaeus, 1758)) along the Andaman sea coast of Thailand	X		
	2012	Jitlang *et al.**	Reproductive Biology of Torpedo Scad (Megalaspis cordyla (Linnaeus,1758) in the Andaman Sea Coast of Thailand	X		
	2012	Sinanun *et al.* *	Stock assessment of torpedo scad (*Megalaspis cordyla* (Linnaeus, 1758)) in the Gulf of Thailand in 2007	X		
	2012	Sumontha *et al.**	Stock Assessment of Bigeye Scad (*Selar crumenophthalmus* (Bloch, 1793)) along the Andaman Sea Coast of Thailand)	X		

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2013	Chalee and Yakoh*	Reproductive biology of bigeye scad (*Selar crumenophthalmus* (Bloch, 1793)) in the Andaman sea coast of Thailand	X		
	2013	Saen-in *et al.**	Breeding and larval nursing of snubnose pompano, *Trachinotus blochii* (Lacepede, 1801)	X		
	2015	Hussadee *et al.**	Reproductive biology of round scad *Decapterus maruadsi* (Temminck & Schlegel, 1843) in the Gulf of Thailand	X		
	2015	Khemakorn *et al.**	Stock assessment of big eye scad (*Selar crumenophthalmus*) in the Gulf of Thailand	X		
	2016	Bunluedaj *et al.**	Stock assessment of yellowstripe scad (*Selaroides leptolepis* (Cuvier, 1833)) in the Gulf of Thailand	X		

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2017	Chatpoom *et al.**	Breeding and larval rearing of banded scad, *Alepes kleinii* (Bloch, 1793) from brood stock raised in water recirculation system	X		
	2020	Decharak*	Microbial reduction in the production of dried yellow-stripe scads		X	
Google	2013	Chantraporn-syl*	Status of Resources in the Important Coastal Ecosys-tems, Lower Gulf of Thailand		X	
	2013	Songkaew *et al.**	Seminar topic: the results of fishery re-source and environ-mental surveys in the middle Gulf of Thai-land by SEAFDEC vessels in 2013		X	
	2015	Songkaew *et al.**	Abundance and distribution of eco-nomically important juvenile fishes within 10 nautical miles from the coast in the Gulf of Thailand		X	

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2017	Chuapun *et al.**	Aquatic animal resources within 10 nautical miles in the Gulf of Thailand		X	
	2020	Chamason and Penpraphai*	Fishes in the Inner Gulf of Thailand based on the survey by fishery vessels 2		X	
	2020	Kongpornpratana *et al.**	Fisheries Resource Survey in the Gulf of Thailand (Thai waters and Cambodian waters) by Using Bottom Trawl		X	
SCOPUS	2002	Chotiyaputta *et al.**	Review of cephalopod fishery production and long-term changes in fish communities in the Gulf of Thailand		X	
	2004	Ho J.-S. and Kim I.-H.	Lernanthropid copepods (Siphonostomatoida) parasitic on fishes of the Gulf of Thailand		X	

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2006	Hajisamae *et al**	Feeding ecology of two sillaginid fishes and trophic interrelations with other co-existing species in the southern part of South China Sea		X	
	2007	Agusa *et al.*	Exposure assessment for trace elements from consumption of marine fish in Southeast Asia		X	
	2009	Purivirojkul	An investigation of larval ascaridoid nematodes in some marine fish from the Gulf of Thailand		X	
	2010	Hajisamae and Yeesin*	Patterns in community structure of trawl catches along coastal area of the South China Sea		X	
	2011	Chedoloh *et al.**	Fatty acid composition of important aquatic animals in Southern Thailand			X
	2011	Satapoomin*	The fishes of south-western Thailand, the Andaman sea-a review of research and a provisional checklist of species		X	

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2012	Arfat and Benjakul*	Gelling characteristics of surimi from yellow stripe trevally (*Selaroides leptolepis*)	X		
	2013	Noranarttragoon *et al.**	The FAD fishery in the Gulf of Thailand: Time for management measures		X	
	2013	Thanomsit *et al.**	Characterization of metallothionein from Asian sea bass (*Lates calcarifer*, bloch) and application as a biomarker for heavy metal exposure in Thailand			X
	2015	Kaewmanee *et al.**	Effects of fish species on the characteristics of fish cracker		X	
	2016	Intamong *et al.**	New locality record of *Monaxinoides austrosinensis* (Mazocraeidea, Monaxinoididae) of finlet crevalle, *Atule mate* (Perciformes: Carangidae) from the Gulf of Thailand		X	

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2017	Sa-Nguansil *et al.**	Coral reef fishes attracted by recreational feeding in Thailand		X	
	2018	Hue *et al.**	Physical properties of three Songkhla lagoon fish species in the lower gulf of Thailand during and after the monsoon season	X		
	2018	Sorphea *et al.*	A field survey of small scale cage and pond farming of Asian seabass (*Lates calcarifer*) in Cambodia			X
	2020	Chuan *et al.*	First record of jellyfish *Anomalorhiza shawi* Light, 1921 (Cnidaria: Scyphozoa) and its associated organisms in Sabah, Malaysia			X
	2020	Purivirojkul and Songsuk*	New records of fish parasitic isopods (Crustacea: Isopoda) from the Gulf of Thailand		X	
	2020	Van Nguyen and Mai	Reef fish fauna in the coastal waters of Vietnam			X

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2021	Chuen-Im *et al.**	Antibiotic-resistant bacteria in green turtle (Chelonia mydas) rearing seawater			X
	2021	Delloro *et al.*	First record of slender red scad, *Decapterus smithvanizi* (Actinopterygii: Perciformes: Carangidae), from the Philippines			X
	2021	Harvey *et al.* *	Fish Assemblages Associated With Oil and Gas Platforms in the Gulf of Thailand		X	
	2021	Julchoo *et al.**	Analysis of policies to protect the health of urban refugees and asylum seekers in Thailand: A qualitative study and delphi survey			X
	2022	Huong *et al.*	Marine protected areas ineffectively protect seagrass and coral reef fish communities in the Phu Quoc and An Thoi archipelago, Vietnam			X

Appendix A. Lists of Articles from Literature Search (continuous).

Database	Year of publication	Authors	Title of studies	Specific	Not specific	Not involving
	2022	Madgett *et al.**	Spawning aggregation of bigeye trevally, *Caranx sexfasciatus*, highlights the ecological importance of oil and gas platforms	X		

* = contribution from Thai researchers

GenBank records

2021 submission

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TITLE Comparative phylogeography of coastal fishes in the South China Sea

COI sequences of ***Atule mate*** from Phuket and Rayong—LC501792-LC501799

COI sequences of ***Megalaspis cordyla*** from Rayong—LC502621-LC502635

COI sequences of ***Selar crumenophthalmus*** from Phuket and Rayong—LC503245-LC503254

Appendix B. GenBank Accession Numbers of COI Sequences of Samples.

Species	Accession Numbers
Scomberoides tol	OQ165152, OQ165153
Seriolina nigrofasciata	OQ165127
Alectis ciliaris	OQ165138
Alectis indica	OQ165136, OQ165137
Alepes kleinii	OQ165128
Alepes melanoptera	OQ165129, OQ165130
Alepes vari	OQ179621, OQ179622, OQ179623, OQ179624, OQ179625, OQ179626, OQ179627, OQ179628, OQ179629, OQ179630, OQ179631
Atule mate	OQ155005, OQ155006, OQ155007, OQ155008, OQ155009

Appendix B. GenBank Accession Numbers of COI Sequences of Samples. (continuous).

Species	**Accession Numbers**
Carangoides armatus	OQ165131
Carangoides sp.	OQ165133
Carangoides malabaricus	OQ165134
Carangoides praeustus	OQ165132
Caranx sexfasciatus	OQ165149, OQ165150, OQ165155, OQ165156
Decapterus maruadsi	OQ165135
Megalaspis cordyla	OQ165124, OQ165125, OQ165126
Parastromateus niger	OQ165139, OQ165140
Selar crumenopthalmus	OQ165143, OQ165144
Selaroides leptolepis	OQ165141, OQ165142