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Jellyfish fisheries in southern Asia

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Abstract – Southern Asia, encompassing countries marginal to the north Indian Ocean, represents nearly one-third of the jellyfishing grounds in Asia. Despite this, a comprehensive understanding of its fisheries has been limited. To address this gap, the present study conducted a detailed meta-analysis of jellyfish landings, exports, and imports in southern Asia, utilising published literature, FAO reports, and communications with industry stakeholders for the period of 2000 to 2022. The present study introduced a conversion factor of 10 to estimate jellyfish landings from available export data. The findings reveal that India is the leading contributor, with an average landing per production year of ~16,988 tonnes (~41%), followed by Pakistan (12,212 tonnes, ~30%), Bahrain (6,285 tonnes, ~15%), Sri Lanka (3,604 tonnes, ~9%), and Iran (2,170 tonnes, ~ 5%). Bangladesh's contribution was minimal, at just 3.5 tonnes (~0.01%), resulting in a total regional landing of ~713,652 tonnes, with an average of ~31,000 tonnes per production year. This amount annually contributes about 10% of the global capture production of jellyfish, with a recurring trend in peak jellyfish landings every nine years (2003, 2012, and 2021). The predominant species landed are *Catostylus perezi* (~55%), *Crambionella orsini* (~23%), and *Crambionella annandalei* (~17%), whereas *Rhopilema hispidum*, *Lobonema smithii*, and *Lobonemoides gracilis* collectively account for less than 6% of cumulative landings. Jellyfish are mainly processed into dried and semi-dried products, with exports primarily directed to Southeast Asia and China. Recently available jellyfish export data (2000 to 2022) indicate an average export of ~2,786 tonnes, with an average revenue of ~3.9 million US dollars per trade year from southern Asia.

Keywords: Asia / Edible jellyfish / Fisheries statistics / Northern Indian Ocean / Seafood exports

1 Introduction

Humans have utilised jellyfish for centuries (Omori and Nakano 2001), and the global demand for jellyfish has increased in recent decades (Brotz 2016a). Jellyfish have diverse applications across multiple fields, including biotechnology (Zimmer 2009); animal feeds in livestock and aquaculture (Barbier and Milo 2010; Brotz 2016a); live bait in trap fisheries (Karunarathne and de Croos 2021; Karunarathne et al., 2021); pesticides (Hossain et al., 2013; Hussein and Saleh 2014) and fertilisers in agriculture (Chun et al., 2011; Emadodin et al., 2020; Borchert et al., 2021). They are also used as ornaments in the aquarium industry (Aquatic Invertebrate TAG 2013); as a collagen source (Cho et al., 2014) in the cosmetic industry (Kim et al., 2016); and in biomedical applications (Ames 2018) and pharmaceutical applications (Elliot et al., 2017). Additionally, they serve as microplastic filters in wastewater treatment plants (Freeman et al., 2020; Lengar et al., 2021). However, the primary use of jellyfish remains as a food source for humans, with reports indicating the consumption of ~35 species worldwide (Brotz et al., 2017: Tab. 2). Beyond their economic and culinary value, jellyfish also play a significant ecological role in marine ecosystems (Lüskow et al., 2021; Karunarathne et al., 2024a).

The global market for processed jellyfish remains robust, with China importing ~3,000 (range: 2,000–4,000) forty-foot containers of processed jellyfish belonging to 4 or 5 commercial types (Catostylidae; Lobonemidae; Rhizostomatidae; Stomolophidae) from about 15 nations (Philippines, Pakistan, Russia, South Korea, Malaysia, USA, Mexico, Japan, Sri Lanka, Thailand, Singapore, Iran, India, Indonesia, and China Hong Kong) (Wang Rongbin, pers. comm.). Recent statistics show that five continents (except Africa and Antarctica) contribute to commercial fisheries of jellyfish, whereas the global capture production (as *Rhopilema* spp. and *Stomolophus meleagris* Agassiz, 1860) was estimated at 255,000 tons in 2020 (FAO 2022a, 2023). The global annual average production of jellyfish from 2000 to 2020 was reported to be 291,600 tonnes, while its value was 10.7 million US dollars (FAO 2023). The highest annual jellyfish catch occurs

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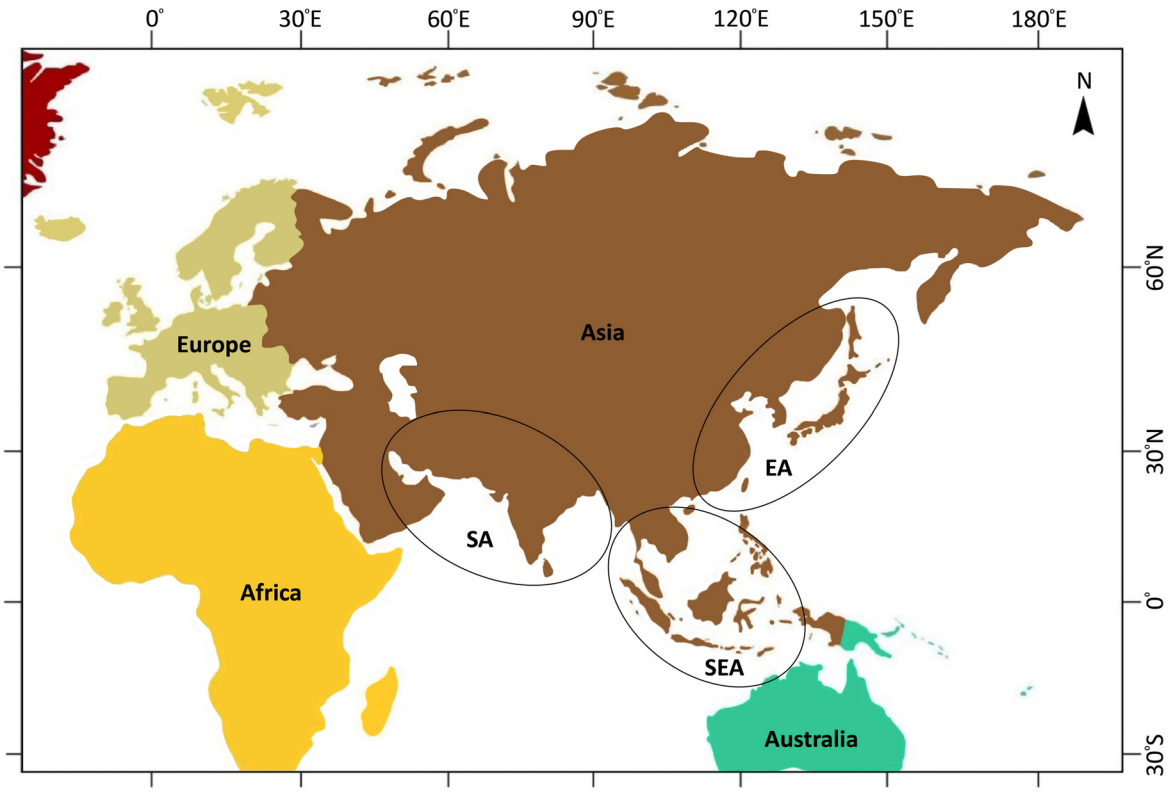

Fig. 1. Three major regions (circles) where commercial jellyfish fishery takes place in Asia: Southern Asia (SA); Southeast Asia (SEA); and Eastern Asia (EA). Note: The Catostylidae, Lobonemidae, and Rhizostomatidae are the jellyfish families primarily targeted in the regions SA, SEA, and EA, respectively.

in Asia, followed by the Americas, Australia, and Europe (Brotz 2016b: Fig. 10.1).

Three major geographic regions are identifiable from Asia where commercial jellyfish fisheries take place: 1) Southeast Asia (SEA), 2) Eastern Asia (EA), and 3) Southern Asia (SA) (Fig. 1). The major fisheries for jellyfish are in EA (particularly China, Japan, South Korea and the Russian Federation) and SEA (particularly Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam), but increasing demand has led to small-scale fisheries in other areas (Brotz 2016a). China continues to dominate worldwide in the production, consumption, and aquaculture of jellyfish (Dong et al., 2018), and Chinese emigrants likely introduced jellyfish fisheries to Malaysia and Indonesia in the mid-twentieth century, followed by Thailand and the Philippines in the 1970s. Later, other Asian countries, including Myanmar, Vietnam, India, Sri Lanka, and Russia, initiated jellyfish fisheries to meet the demand for jellyfish as a human food source (Pauly et al., 2009; Brotz 2016b). Omori and Nakano (2001) comprehensively studied the jellyfish fishery of SEA, and the average annual catch of jellyfish in SEA was estimated at 169,000 tonnes (wet weight) between 1988 and 1999. During this period, the global jellyfish catch was ~321,000 tonnes (Omori and Nakano 2001), thus, it is clear that almost half of the global jellyfish production was from SEA. This catch has since almost tripled, reaching 900,000 tonnes by 2016, harvested by 19 countries, predominantly in SEA (Brotz and Pauly 2017). Although the jellyfish fisheries in SEA have already been studied, there has been no appraisal of the other two Asian regions. In this context, we attempt to draw an overall picture of jellyfish fisheries in SA by identifying their present status and trends. Although Türkiye is an Asian country, it was not counted in the present study, as its jellyfishing grounds are in European waters (refer to Edelist et al., 2021), and its jellyfish fishery ceased after 2006 (FAO 2024a).

2 Jellyfish fisheries in SA

So far, six countries, namely Bahrain, Bangladesh, India, Iran, Pakistan, and Sri Lanka are known to be involved in jellyfish fisheries in SA region (Tab. 1) occupying fishing grounds in the northern Indian Ocean and adjacent seas (Fig. 2). Reliable data on jellyfish fisheries are lacking for other nations in this region, i.e., Iraq, Kuwait, Maldives, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE).

***Bahrain*:** Jellyfish, locally termed "*meduzot*" (Picow 2010), were fished for the first time in Bahrain in 2003, with significant developments and contributions to the local fishing industry (Erftemeijer and Langenberg 2010; TradeArabia 2011). The annual jellyfish catch has shown remarkable growth, comprising 37% of the total commercial fisheries catch in Bahrain in 2009 (Ali and Abahussain 2013). By 2009, the fisherfolk community benefiting (local fishers and their families) from Bahrain's jellyfish fishery included 385 people (RECOFI Fisheries Reports 2012). A seafood processing

Table 1. Fishing areas, seasons, and fishing methods for jellyfish species in southern Asian counties. Note: Each number in the second column correspondence to Fig. 2.

Country	Fishing grounds and relevant landing sites		Target species	Fishing season	Fishing method	Remarks on catch
Bahrain	01	Gulf of Bahrain (RECOFI Fisheries Reports 2012; FAO 2020) off the Northern Bahrain coast (RECOFI Fisheries Reports 2012)	*Catostylus perezi* (present study)	April to September (TradeArabia 2011)	Using ladles to pick jellyfish from the sea up to 10 m deep, and 35-speed fiberglass boats (*Tarad*) with an outboard engine (RECOFI Fisheries Reports 2012)	1,759 tonnes of jellyfish were landed in 2007 (RECOFI Fisheries Reports 2010); about 3,340 tonnes valued at approximately 6.738 million US dollars (2.533 million BD) were landed in 2009 (RECOFI Fisheries Reports 2012); The average annual landing was 2,764.4 tonnes between 2004 and 2021 (FAO 2024a)
Iran	02	Abadan at Khuzestan coast (present study)	*Catostylus perezi* (present study)	April to September (present study)	Jellyfish collection from nearshore areas is done using scoop nets and small fiberglass boats with outboard engines, while offshore fishing is conducted using larger wooden vessels equipped with pelagic trawls (present study)	The average annual landing was 2,229.5 tonnes [regardless of landing site] between 2010 to 2012 and 2015 and 2019 (FAO 2024a)
	03	Bandar Bushehr at Bushehr coast (present study)	[as above]	[as above]	[as above]	[see above]
Pakistan	04	Balochistan coast: Sonmiani Bay (Muhammed and Sultana 2008), Damb Bandar, Gadani, Hingol, Jiwani, Kalmat, Ormara and Pasni (Gul et al., 2015)	*Catostylus perezi* (Muhammed and Sultana 2008 [as *Catostylus mosaicus*]; Tahera and Kazmi 2008 [as *C. mosaicus*]; Gul et al., 2015 [also as *Catostylus* sp., and 'Banana Jellyfish']; Psomadakis et al., 2015)	February/March to July/ August (the peak season is June and July) (Muhammed and Sultana 2008; Gul et al., 2015)	Gillnets, pelagic trawls (Psomadakis et al., 2015), and hand nets, with traditional wooden fishing boats equipped with diesel engines (Gul et al., 2015)	The annual estimated total catch at Sonmiani Bay in the peak season (June and July) of each year, 2005 and 2006 was 762.5 tonnes (10 to 15 tonnes per day during peak seasons at each location [data from Muhammed and Sultana 2008]); in 2015, fishers sold the oral arms of *C. perezi* at approximately 40 to 50 PKR (0.38 to 0.48 US dollars) per kilogram (Gul et al., 2015)
	05	Sindh coast: Gharo Creek, Mirpur Sakro and Keti Bandar (Muhammed and Sultana 2008)	*Catostylus perezi* (Muhammed and Sultana 2008 [as *Catostylus mosaicus*])	[as above]	[as above]	Annual estimated total catch at Gharo Creek, Mirpur Sakro, and Keti Bandar in the peak season (June and July) of each year, 2005 and 2006 was 1,906.25 tonnes (10 to 15 tonnes per day during peak seasons at each location [data from Muhammed and Sultana 2008])

Table 1. (continued).

Country		Fishing grounds and relevant landing sites	Target species	Fishing season	Fishing method	Remarks on catch
		Sindh coast: Kemari (Muhammed and Sultana 2008), Keti Bandar (Muhammed and Sultana 2008; Gul et al., 2015), Clifton, Ibrahim Haideri, Keti Bandar, Manora, Char creek, Chhan Waddo creek, Dabbo creek, Gharo creek, Kharo Chan creek, Kajar creek, Khuddi creek, and Sir creek (Gul et al., 2015)	*Rhopilema hispidum* (Muhammed and Sultana 2008 [as *Rhizostoma pulmo*]; Gul et al., 2015 [also as 'Flower Jellyfish']; Psomadakis et al., 2015 [as *R. pulmo*])	[as above]	Gillnets, pelagic trawls (Psomadakis et al., 2015), set nets (*Bhoola*), and hand nets, with traditional wooden fishing boats equipped with diesel engines (Gul et al., 2015)	Annual estimated total catch at Kemari and Keti Bandar in the peak season (June and July) of each year, 2005 and 2006 was 1,143.75 tonnes (10 to 15 tonnes per day during peak seasons at each location [data from Muhammed and Sultana 2008]); in 2015, fishers sold the oral appendages of *R. hispidum* at 30 PKR (0.28 US dollars) per kilogram (Gul et al., 2015)
India	06	Jakhau and Okha in the Gulf of Kutch, Gujarat (Kumawat et al., 2023)	*Catostylus perezi* (Behera et al., 2022; Kumawat et al., 2023 [also as 'Banana-*jhar*'])	March to May and October to December (CMFRI 2010; Kumawat et al., 2023)	Fibreglass canoes with inboard engines (*Odi*) engage using primarily multifilament gillnets (CMFRI 2010) and scoop nets, usually at a depth of 10 to 30 m (Kumawat et al., 2023); more than 100 fishing vessels are engaged in the fishery (Kumawat et al., 2023)	The recorded total jellyfish landings from November 2017 to February 2020 amounted to about 11,140.93 tonnes, contributed by Jakhau (67.37 %) and Okha (32.63%) (Kumawat et al., 2023); fishers gained an average of 12 INR (0.17 US dollars) kilogram^{-1} at the first sale for oral arms (Kumawat et al., 2023)
			Rhopilema hispidum (Kumawat et al., 2023 [also as 'Flower-*jhar*'])	March to May (Kumawat et al., 2023)	Fibreglass canoes with inboard diesel engines at a depth of 10 to 30 m, primarily using scoop nets (Kumawat et al., 2023)	The recorded total jellyfish landings from November 2017 to February 2020 amounted to about 2,429.02 tonnes, which were contributed by Jakhau (67.37%) and Okha (32.63%) (Kumawat et al., 2023); fishers gained an average of 12 INR (0.17 US dollars) kilogram^{-1} at the first sale for oral appendages (Kumawat et al., 2023)
	07	Porbandar, Veraval and Navabandar (Kumawat et al., 2023) along the Saurashtra coast of Gujarat	*Catostylus perezi* (Kumawat et al., 2023 [also as 'Banana-*jhar*'])	March to May and October to December (Kumawat et al., 2023)	[as above]	[no data]
	08	Udupi coast (present study) of Karnataka (HFS 2005; Riyas and Biju Kumar 2021)	*Crambionella orsini* (present study)	August to December (present study)	Beach seines, gillnets, and scoop nets (present study)	Respectively 27,837 tonnes and 14,524 tonnes of jellyfish landings were reported from Karnataka in 2002 and 2003 (HFS 2005)

Table 1. (continued).

Country	Fishing grounds and relevant landing sites		Target species	Fishing season	Fishing method	Remarks on catch
	09	Neendakara Fisheries Harbour, Sakthikulangara Fisheries Harbour, Azheekal Fisheries Harbour, and Vaddy Fisheries Harbour (Sreeram et al., 2021) in Kollam coast of Kerala (Chinnadurai et al., 2021; Riyas and Biju Kumar 2021; Sreeram et al., 2021); labourers gathered oral arms from jellyfish bycatch discards on the beaches of Kovalam and Puthenthope in Thiruvananthapuram (Trivandrum), some trawlers from Thengapattinam and Neendakara operated on the Trivandrum coast for fishing jellyfish, and sold the catch to intermediaries who transport them to Thengapattinam, but there hasn't been any organized fishery reported from the coast of Trivandrum (Sreeram et al., 2021)	*Crambionella orsini* (Chinnadurai et al., 2021; Riyas and Biju Kumar 2021; Sreeram et al., 2021)	August/September (Sreeram et al., 2021) to December/ January (Chinnadurai et al., 2021; Sreeram et al., 2021)	Using various gears such as ring seines, beach seines, gillnets, scoop nets (Riyas and Biju Kumar 2021), and hundreds of single-day trawler units (Chinnadurai et al., 2021; Sreeram et al., 2021) and a few multi-day trawlers at a depth of 15 to 20 m (Sreeram et al., 2021)	500 tonnes of jellyfish were landed in 2018 (Riyas and Biju Kumar 2021); an estimated 453.16 tonnes of jellyfish were landed at Neendakara and Sakthikulangara fishing harbours during a 44-day fishery in 2020–21, and the average landing in December 2020 was 1,129.54 kilograms per boat and in January 2021, 577.61 kilograms per boat (Sreeram et al., 2021); according to Chinnadurai et al., (2021), about 2,500 tonnes of jellyfish were landed on the Kollam coast of Kerala from December 2020 to January 2021, but this datum is doubtful when compared to data from Sreeram et al. (2021); in 2020, the landing centre or harbour price for *C. orsini* ranged 5–10 INR per kilogram (Sreeram et al., 2021), and the average price of *C. orsini* at the landing centre of Kerala was low compared to the average price of *C. annandalei* from Andhra Pradesh (Riyas and Biju Kumar 2021)
	10	Arokiyapuram, situated in the eastern part of Kanyakumari; in the western part, i.e. Muttom and Colachel; and further north, Melmidalam, Enayam, Ramanthurai, Thoothur, and Poothurai, with the catch being landed in the Thengapattanam Fishing Harbour (Sreeram et al., 2021)	*Crambionella orsini* (Sreeram et al., 2021)	October to January, with peak landings between October and December (Sreeram et al., 2021)	Shore seines, gillnets, and modified gillnets with an increased number of floats were used for the fishery, which was mainly concentrated in inshore waters utilising Fibreglass Reinforced Plastic (FRP) boats up to a depth of 6 to 12 m (Sreeram et al., 2021)	Catches were made from dense swarms of jellyfish that appeared in 2020–21 (Sreeram et al., 2021), while there were no specific landing data; the landing centre or harbour price for *C. orsini* ranged 5–10 INR per kilogram in 2020 (Sreeram et al., 2021)

Table 1. (continued).

Country	Fishing grounds and relevant landing sites	Target species	Fishing season	Fishing method	Remarks on catch
	11 Tharuvaikulam (Murugan and Durgekar 2008) at the Tuticorin coast (Manickaraja and Balasubramanian 2006; present study) of the Gulf of Mannar, Tamil Nadu	*Lobonema smithii* (Manickaraja and Balasubramanian 2006 [as '*Aluvai Chori*']; Murugan and Durgekar 2008)	June to October (Murugan and Durgekar 2008) or to December (Manickaraja and Balasubramanian 2006)	Fishers employed motorised crafts (*Vallam*) with scoop nets (Murugan and Durgekar 2008)	Tharuvaikulam reported the average jellyfish landing of 33.5 tonnes (range from 20 to 55 tonnes) per day, likewise, in total about 5,125 tonnes were landed from June to October in 2007 (data from Murugan and Durgekar 2008: Fig. 5.1); in 2008, about 250 tonnes of jellyfish were landed on the Tuticorin (present study)
	12 Valinokkam, Ervadi and Keelakarai (Murugan and Durgekar 2008) at the Ramanathapuram coast of the Gulf of Mannar, Tamil Nadu (present study)	*Lobonema smithii* (Murugan and Durgekar 2008)	June to October (Murugan and Durgekar 2008)	[as above]	The estimated mean landing of jellyfish at three sites, Valinokkam, Ervadi, and Keelakarai, was 38.1 tonnes (ranging from 4 to 32 tonnes) per day, likewise, in total about 5,830 tonnes were landed from June to October in 2007 (data from Murugan and Durgekar 2008: Fig. 5.1); in 2008, about 250 tonnes of jellyfish were landed on the Ramanathapuram coast (present study)
	13 Thirumullaivasal (Kuthalingam et al., 1989), Pondicherry and adjacent coasts (Chidambaram 1984; Kuthalingam et al., 1989)	*Crambionella orsini* (Chidambaram 1984 [as *Rhizostoma* sp., and '*Muttai Chorri*' in Tamil]; Kuthalingam et al., 1989 [as *C. stulhmanni*])	January to June (Chidambaram 1984)	By hand-picking or by using scoop nets (Chidambaram 1984)	[no data]
	14 Marakkanam Beach, Ekkikuppam (Kuthalingam et al., 1989) and Alambaraikuppam (near Alamparai Fort), south of Mahabalipuram (James et al., 1985; Kuthalingam et al., 1989)	*Crambionella orsini* (James et al., 1985 [as *C. stulhmanni*]; Kuthalingam et al., 1989 [as *C. stulhmanni*])	July to September (Kuthalingam et al., 1989)	Using traditional vessels (*Catamaran*) with scoop nets (*Nandu Katcha*) (Kuthalingam et al., 1989)	A single vessel brought in 300 to 1,000 jellyfish per day (2,000 to 3,000 individuals in good seasons); likewise, up to 13,000 jellyfish were landed at Alambaraikuppam per day (Kuthalingam et al., 1989)
	15 Lake waters off Pulicat landing centre (CMFRI 2009; Mohan et al., 2011; Kannappan et al., 2013;	*Crambionella annandalei* (present study)	November (present study)	By scoop nets and motorised traditional crafts (*Vallam*) (present study)	A small quantity of jellyfish was landed in 2023, but no precise data is available (present study)

Table 1. (continued).

Country		Fishing grounds and relevant landing sites	Target species	Fishing season	Fishing method	Remarks on catch
		present study) on the Thiruvallur coast of Tamil Nadu, with the involvement of fishers from fishing villages such as Pasiavaram (Chaturvedi 2004), Arangamkuppam, Kottaikuppam, Vairavankuppam, Sathankuppam, Lighthousekuppam, Thirumalnagarkuppam, Sempasapalallikuppam, Gunamkuppam, Andikuppam, Kavimanalkuppam, Nadukuppam (Mohan et al., 2011), and Thoniraevu (Kannappan et al., 2013)	*Crambionella orsini* (CMFRI 2009 [as *C. stulhamani*, and *'Muttai Chorri'* in Tamil]; Mohan et al., 2011 [as *C. stulhamani*, and '*Muttai Chorri'* in Tamil]; Kannappan et al., 2013 [sp. not clearly mentioned])	August (CMFRI 2009; Mohan et al., 2011) to October (Kannappan et al., 2013)	Jellyfish were collected into gunny bags by using scoop nets (CMFRI 2009; Mohan et al., 2011) and mechanised boats (Kannappan et al., 2013) within a depth of about 11 to 13 m (Mohan et al., 2011)	Approximately 540 tonnes of jellyfish were landed in 2009 (Mohan et al., 2011); the fishers sold oral arms of the jellyfish for 500 INR per gunny bag (60 kilograms) at the Pulicat landing centre in 2009 (CMFRI 2009)
	16	Nizampatnam Harbour, Vodarevu in Ongole (CMFRI 2007; present study) and Chirala (Behera et al., 2020a) at Prakasam coast of Andhra Pradesh	*Crambionella annandalei* (CMFRI 2007 [as *Munthakayalu* in Telugu]; Behera et al., 2020a [also as *Munthakaya* / *Neetikaya* in Telugu]; present study)	March to July, peaking in June and July (Behera et al., 2020a)	Jellyfish brought in by about 100 (20 at Nizampatnam and 80 at Vodarevu) traditional crafts (*Catamarans*) operating the net *Chanduvala Valu* (CMFRI 2007; present study), and by motorised fishing crafts operating gillnets (*Polusuvala*) at a water depth of 10 to 40 m during daytime (Behara et al., 2020a)	In 2007, unusual landings of jellyfish were recorded from Ongole, while the estimated total landing at Nizampatnam and Vodarevu in a 22-day fishery was 1,210 tonnes (catches ranged from 300 to 800 kilograms per unit per day [data from CMFRI 2007]); in 2018, 1,100 tonnes of oral arms valued at 385 lakhs INR (540,000 US dollars) were landed at Chirala (Behera et al., 2020a)
	17	Machilipatnam at Krishna coast of Andhra Pradesh (Nitin and Ranipeta 2018; Behera et al., 2020a)	*Crambionella annandalei* (Nitin and Ranipeta 2018 [sp. not mentioned]; Behera et al., 2020a [also as *Munthakaya* / *Neetikaya* in Telugu])	March to July (Behera et al., 2020a), peaking in June and July (Nitin and Ranipeta 2018; Behera et al., 2020a)	Gillnets (*Polusuvala*) were operated from motorised fishing crafts at a water depth of 10 to 40 m during the daytime (Behera et al., 2020a)	A total of 3,000 tonnes of oral arms valued at 1,050 lakhs INR (1,470,000 US dollars) were landed in 2017 and 2018 (Behera et al., 2020a); on a good day, fishers manage to catch 1.2 to 2 tonnes of jellyfish on each trip (Nitin and Ranipeta 2018) and they can even makeover 1 lakh INR

Table 1. (continued).

Country		Fishing grounds and relevant landing sites	Target species	Fishing season	Fishing method	Remarks on catch
	18	Kakinada Fisheries Harbour (Naik et al., 2016; Nitin and Ranipeta 2018) and Uppada at East Godavari coast of Andhra Pradesh (Behera et al., 2020a)	*Crambionella annandalei* (Naik et al., 2016 [as *Crambionella* sp., and as '*Muntha Kaya / Neeti Kaya*' in Telugu]; Behera et al., 2020a [also as *Munthakaya / Neetikaya* in Telugu])	March to July, peaking in June and July (Naik et al., 2016; Behera et al., 2020a)	Gillnets (*Jogavala / Naravala / Polusuvala*) were employed from mechanised and non-mechanised boats at a water depth of 10 to 30 m during the daytime (Naik et al., 2016; Behera et al., 2020a)	In 2013, mechanised boats landed approximately 540 tonnes of jellyfish, while non-mechanised boats landed about 1,345 tonnes at Kakinada Fisheries Harbour (Naik et al., 2016); a total of 3,647 tonnes of oral arms valued at 1,469 lakhs INR (2,060,000 US dollars) were landed during 2017 to 2019 (Behera et al., 2020a)
	19	Pudimadaka, Bangarammapalem, Revupolavarem, Rajanagaram, and Venkatanagaram at Visakhapatnam coast of Andhra Pradesh (Behera et al., 2020a)	*Crambionella annandalei* (Behera et al., 2019, 2020a [also as *Munthakaya / Neetikaya* in Telugu])	March to July, peaking in June and July (Behera et al., 2020a)	Gillnets (*Polusuvala*) were operated from motorised fishing crafts at a water depth of 10 to 40 m during the daytime (Behera et al., 2020a)	In 2017 to 18, the total estimated landing of oral arms valued at 3,618 lakhs INR (5,040,000 US dollars) was 8,808 tons, while Pudimadaka recorded the highest landing of oral arms in 2018, reaching 1,825 tonnes (Behera et al., 2020a)
	20	Pentakota, Chandrabhaga, and Arakhakuda on the Puri coast (Roul et al., 2021a) of Odisha (Roul et al., 2021a, b)	*Crambionella annandalei* (Roul et al., 2021a, b)	December to March / April (Roul et al., 2021a, b)	Using gillnets from motorised and non-motorized fishing crafts (nearly 70 to 100 boats, 2 to 3 hauls per boat) up to depths 5 to 12 m (Roul et al., 2021a, b)	In 2020–2021, each fishing boat typically brought in approximately 20 to 500 kilograms of oral arms per trip, and they were then sold to local traders at landing centres for 15–20 INR (0.21 to 0.30 US dollars) per kilogram (Roul et al., 2021a, b); the estimated landings in December 2020 were 93.5 tonnes and were 280.5 tonnes from January to March 2021 (data from Roul et al., 2021a, b)
	21	Digha coast (present study) of West Bengal (HFS 2005; Riyas and Biju Kumar 2021)	*Crambionella annandalei* (present study)	December to March / April (present study)	Using gillnets and scoop nets (present study)	Landings were 2,010 tonnes and 5,000 tonnes in 2002 and 2003, respectively (HFS 2005)
Bangladesh	22	Cox's Bazar (present study) on the southwest coast (Das et al., 2023)	*Crambionella annandalei* (Das et al., 2023 [also as '*Surjomukhi Nuinna'* in Bengali])	November to March (Das et al., 2023)	By artisanal fishing trawlers (Das et al., 2023)	About 3.5 tonnes of oral arms were landed in 2019 (present study)

Table 1. (continued).

Country	Fishing grounds and relevant landing sites		Target species	Fishing season	Fishing method	Remarks on catch
			Lobonemoides gracilis (Das et al., 2023 [as *L. robustus*])	[no data]	By artisanal fishing trawlers (Das et al., 2023)	[no data]
Sri Lanka	23	Southeast coast from Hambantota to Batticaloa via Kirinda (Karunarathne and de Croos 2023b, 2025)	*Crambionella orsini* (Perera 2008 [sp. not mentioned]; Karunarathne and de Croos 2023b [also as 'Ball type'], 2025 [also as 'Ball type']; Karunarathne et al., 2024b [also as 'Ball type'])	June to September (Karunarathne and de Croos 2023b, 2025)	Scoop nets with mechanised day boats (Karunarathne and de Croos 2023b, 2025)	During 2004, 2007, 2008, 2010, and 2017, the estimated average landing per production year was 4,958 tonnes, with an average of 800 kilograms (range 400 to 1,200 kilograms) of jellyfish being landed per single fishing trip (data from Karunarathne and de Croos 2025); in the jellyfish fishing season of 2008, 100 to 150 tonnes of jellyfish were processed daily (Perera 2008)
	24	Northwest coast from Chilaw to Mannar via Puttalam (Karunarathne and de Croos 2023b, 2025)	*Lobonemoides gracilis* (Karunarathne and de Croos 2023b [also as 'White type'], 2025 [also as 'White type']; Karunarathne et al., 2024b [also as 'White type'])	June to September (Karunarathne and de Croos 2023b, 2025)	Hand fishing, scoop nets, and gillnets, with non-mechanised vessels (small fibreglass day boats or traditional crafts) (Karunarathne and de Croos 2023b, 2025)	During 2008, 2011, 2015, and 2017, the estimated average landing per production year was 110 tonnes, with an average of 200 kilograms (100 to 300 kilograms) of jellyfish being landed per single fishing trip (data from Karunarathne and de Croos 2025)

Note: Data obtained from jellyfish industry stakeholders through personnel communications and/or authors' observations are denoted as "present study".

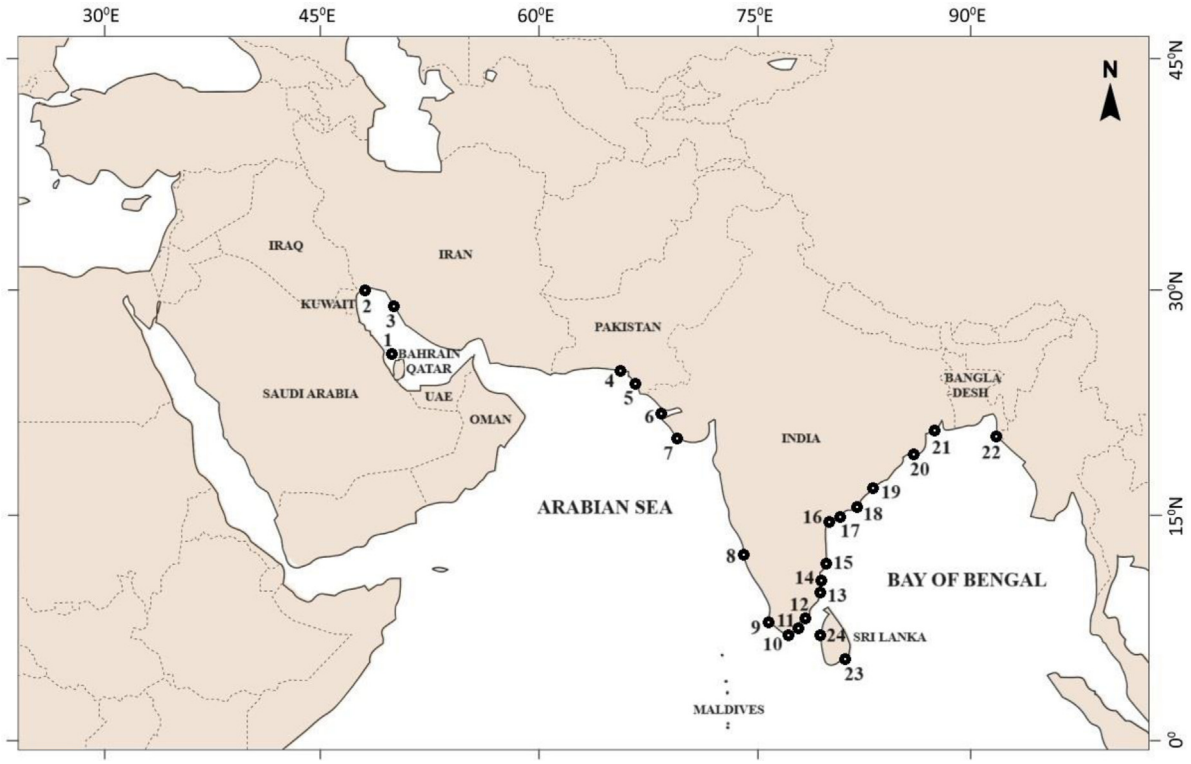

Fig. 2. Jellyfishing grounds in southern Asia (SA; 1, Bahrain; 2 and 3, Iran; 4 and 5, Pakistan; 6 to 21, India; 22, Bangladesh; 23 and 24, Sri Lanka): 1. Northern Bahrain coast (Gulf of Bahrain); 2. Khuzestan coast; 3. Bushehr coast; 4. Balochistan coast, 5. Sindh coast; 6. Kutch coast of Gujarat (Gulf of Kutch); 7. Saurashtra coast of Gujarat; 8. Udupi coast of Karnataka; 9. Kollam coast of Kerala; 10. Kanyakumari coast of Tamil Nadu; 11. Tuticorin coast of Tamil Nadu; 12. Ramanathapuram coast of Tamil Nadu; 13. Nagapattinam-Puducherry coast of Tamil Nadu; 14. Viluppuram-Chengalpattu coast of Tamil Nadu; 15. Thiruvallur coast of Tamil Nadu; 16. Guntur-Prakasam coast of Andhra Pradesh; 17. Krishna coast of Andhra Pradesh; 18. East Godavari coast of Andhra Pradesh; 19. Visakhapatnam coast of Andhra Pradesh; 20. Puri coast of Odisha; 21. Digha coast of West Bengal; 22. Cox's Bazar coast; 23. Hambantota-Batticaloa coast; 24. Chilaw-Mannar coast.

company paid local fishers around 8 US dollars (3 BD) for every 40 to 50 kilograms of jellyfish they caught (TradeArabia 2011). The target species was the catostylid *Catostylus perezi* Ranson, 1945 (Bahrain seafood exporters, pers. comm.), and the management authority for the jellyfish fishery in Bahrain is the "Public Commission for the Protection of Marine Resources, Environment and Wildlife" (RECOFI Fisheries Reports 2012).

***Bangladesh*:** Das et al. (2023) confirmed occasional harvesting and processing (semi-dried, salted products) of small amounts of brown and white jellyfish species, respectively, known as the catostylid *Crambionella annandalei* Rao, 1931 and the lobonemid *Lobonemoides gracilis* Light, 1914 [reported as *Lobonemoides robustus*], for export to the Chinese market. From 2000 to 2006, jellyfish blooms were relatively common in the marine waters of Bangladesh and its neighbouring Myanmar, leading to some fishing vessels engaging in harvesting and processing along the southwest coast (Das et al., 2023). Despite jellyfish being a significant component of seafood export in neighbouring countries, a lack of information, awareness, and processing facilities has hindered the development of the jellyfish fishery in Bangladesh. Commercial harvesting requires dedicated processing facilities, and an understanding of distribution, occurrence, and seasonality is crucial for profitable investment (Das et al., 2023).

***India*:** India has harvested edible jellyfish since the 1980s, mainly for export (Govindan 1984; Krishnan 1984; Prabhu et al., 1987, 1988; Kuthalingam et al., 1989). In 1984, 1985, and 1988, India exported 18 tonnes, 14 tonnes, and 10 tonnes of processed jellyfish, respectively (FAO 2024b). Except for Maharashtra and Goa, the other three states on the west coast of India, namely Gujarat (Kumawat et al., 2023), Karnataka (HFS 2005) and Kerala (Chinnadurai et al., 2021; Sreeram et al., 2021), are known to be involved in jellyfish fisheries, while on the east coast of India, all four coastal states, namely Tamil Nadu (Chidambaram 1984; Murugan and Durgekar 2008), Andhra Pradesh (Behera et al., 2020a), Odisha (Roul et al., 2021a) and West Bengal (HFS 2005), have contributed to this fishery (Riyas and Biju Kumar 2021). Currently, active jellyfish fisheries are found along the coasts of Andhra Pradesh, Kerala, and Gujarat only. The reported catch during the jellyfish seasons in Gujarat (April/May and November/December) was ~250 tonnes in 2009 and 800 tonnes in 2010 (CMFRI 2010). It has been estimated that the potential jellyfish fisheries resources in the Indian Exclusive Economic Zone amount to 200,000 tonnes (HFS 2020), whereas the potential species are the catostylids *Crambionella orsini*

Table 2. Jellyfish processing and exporting in southern Asia.

Jellyfish family	Jellyfish species	Harvesting country	Targeted body part/s of jellyfish	Processing	Exports	Market/s
Catostylidae	*Catostylus perezi* (Banana type)	Bahrain (Mohammed 2008, as cited in Brotz 2016a; Erftemeiger and Langenberg 2010 [sp. not mentioned]; RECOFI Fisheries Reports 2010 [as a Rhizostomid sp.]; FAO 2011 [sp. not mentioned]; TradeArabia 2011 [sp. not mentioned]; López-Martínez and Álvarez-Tello 2013 [sp. not mentioned]; Globefish 2023 [sp. not mentioned]; present study)	Oral arms (present study)	Processed into dried jellyfish (TradeArabia 2011)	Bahrain exported 1,260 tonnes of processed jellyfish in 2007 (Mohammed 2008, as cited in Brotz 2016a) and 7,000 tonnes [this datum is doubtful] to China in 2012 (López-Martínez and Álvarez-Tello 2013); in 2020, Bahrain earned 2,040,210 US dollars by exporting hundreds of tonnes of processed jellyfish (Globefish 2023)	Asia (Erftemeiger and Langenberg 2010; RECOFI Fisheries Reports 2010) particularly South Korea (FAO 2011), China (FAO 2011; López-Martínez and Álvarez-Tello 2013; present study), and Malaysia (present study)
		India (Behera et al., 2022; Kumawat et al., 2023 [also as 'Banana-*jhar*'])	Primarily oral arms, but if there is a demand, bells are also collected (Kumawat et al., 2023)	Oral appendages are processed into a semi-dried product, with alum/salt mixture in a stepwise, but no processing is done for bells (Kumawat et al., 2023)	This species was exported from Mundra and Pipavav ports of Gujarat to China with an initial 200 tonnes in 2005 and was valued at an export price of 106–111 INR (1.54 to 1.62 US dollars) kilogram^{-1} during 2017–20 depending on the destination country (Kumawat et al., 2023)	The majority (65 %) of processed jellyfish was exported to China, and the rest to other Asian countries like Thailand, South Korea, Malaysia, Vietnam, Japan, and Indonesia (Kumawat et al., 2023)
		Iran (López-Martínez and Álvarez-Tello 2013 [sp. not mentioned]; present study)	Oral arms (present study)	Salted (López-Martínez and Álvarez-Tello 2013)	Iran supplied 300 tonnes of processed jellyfish products to China in 2012 (López-Martínez and Álvarez-Tello 2013)	China (López-Martínez and Álvarez-Tello 2013)
		Pakistan (Muhammed and Sultana 2008 [as *C. mosaicus*]; Tahera and Kazmi 2008 [as *C. mosaicus*]; Gul et al., 2015 [also as 'Banana Jellyfish']; Psomadakis et al., 2015)	Oral arms (Gul et al., 2015)	Jellyfish were processed into dried/salted (in brine) form (Tahera and Kazmi 2008) after being treated with salt and alum (Psomadakis et al., 2015)	In 2005, 27 tonnes were exported to Japan, worth approximately 8.2 million US dollars (Tahera and Kazmi 2008)	Southeast Asian countries (Muhammed and Sultana 2008), particularly Japan (Tahera and Kazmi 2008) and China (Psomadakis et al., 2015)
	Crambionella annandalei (Sunflower type)	Bangladesh (Das et al., 2023 [also as '*Surjomukhi Nuinna'* in Bengali]; present study)	Oral arms (Das et al., 2023)	Cleaned, and salt-cured at nearby landing stations for about a week before final packaging (Das et al., 2023)	About 0.35 tonnes of processed oral arms were exported in 2019 (present study)	China (Das et al., 2023)

Table 2. (continued).

Jellyfish family	Jellyfish species	Harvesting country	Targeted body part/s of jellyfish	Processing	Exports	Market/s
		India (CMFRI 2007 [as '*Munthakayalu*' in Telugu]; Naik et al., 2016 [as *Crambionella* sp., and as *'Muntha Kaya / Neeti Kaya'* in Telugu]; Behera et al., 2018 [also as '*Munthakaya*' in Telugu], 2019, 2020a, b [also as '*Munthakaya / Neetikaya*' in Telugu]; Nitin and Ranipeta 2018 [sp. not mentioned]; Roul et al., 2021a, b; present study)	Usually oral arms are targeted (CMFRI 2007; Behera et al., 2018, 2019, 2020a; present study), but fishers bring the whole medusa to shore when the catches are poor (Behera et al., 2018; Roul et al., 2021a)	Production of salted, semi-dried oral arms follows a stepwise procedure (Behera et al., 2018, 2019, 2020a; Nitin and Ranipeta 2018) including cleaning, first soaking, second soaking, grading, and packing (Roul et al., 2021a, b) and processed jellyfish retaining 7 to 10 % of their original weight (Naik et al., 2016)	Exports mainly from the Chennai port (Nitin and Ranipeta 2018) at a price ranging 500–550 INR (6.88 to 7.57 US dollars) per kilogram (Roul et al., 2021a, b)	Southeast Asian countries (Nitin and Ranipeta 2018), particularly China (Naik et al., 2016; Behera et al., 2018, 2020a; Roul et al., 2021a, b), Vietnam, Japan, Thailand, and Indonesia (Naik et al., 2016)
	Crambionella orsini (Ball type)	India (Chidambaram 1984 [as *Rhizostoma* sp., and as '*Muttai Chorri*' in Tamil]; Kuthalingam et al., 1989 [as *C. stulhmanni*]; CMFRI 2009 [as *C. stulhmanni*, and as '*Muttai Chorri*' in Tamil]; Mohan et al., 2011 [as *C. stulhmanni*, and as '*Muttai Chorri'* in Tamil]; Kannappan et al., 2013 [sp. not clearly mentioned]; HFS 2014 [sp. not mentioned]; Saravanan et al., 2018 [as *Crambionella* sp.]; Chinnadurai et al., 2021; Riyas and Biju Kumar 2021; Sreeram et al., 2021; present study)	Bell (Chidambaram 1984; Kuthalingam et al., 1989; HFS 2014; Kannappan et al., 2013) and oral arms (Chidambaram 1984; CMFRI 2009; Mohan et al., 2011; Kannappan et al., 2013; Chinnadurai et al., 2021; Riyas and Biju Kumar 2021; Sreeram et al., 2021)	The processing at Pondicherry involved 7 stages for the umbrella and 6 stages for the oral arms using the Indonesian processing methods (Chidambaram 1984), while at Pulicat, it involved either 4 stages, 1) Cleaning; 2) Pressing; 3) Salting; 4) Packaging (Mohan et al., 2011), or 8 to 9 stages (Kannappan et al., 2013); in the southwest coast of India, the whole jellyfish is usually landed, oral arms are separated from the bell, and only the oral arms are exported after salt curing (Riyas and Biju Kumar 2021; Sreeram et al., 2021)	In 1984, 21 tonnes of processed jellyfish were reported to be exported from Pondicherry and South Arcot in Tamil Nadu (Chidambaram 1984); an average of 14 tonnes of jellyfish were reported to be produced per production year from 1984 to 1988 in Alambaraikuppam, south to Mahabalipuram (Kuthalingam et al., 1989); in 2009, the quantity of processed jellyfish in Pulicat [was mistakenly recorded as in Tripura] and was reported to be 52 tonnes (HFS 2014); 25 tonnes of processed jellyfish were exported from Tuticorin port in 2018–19 (present study; also see Sreeram et al., 2021: Tab. 2)	Southeast Asian countries (Saravanan et al., 2018; Riyas and Biju Kumar 2021), primarily export to Japan, Thailand (Kannappan et al., 2013; Chidambaram 1984), Hong Kong (Chidambaram 1984), Taiwan (Kannappan et al., 2013), China (Kannappan et al., 2013; Chinnadurai et al., 2021; Riyas and Biju Kumar 2021), and Singapore (Kuthalingam et al., 1989)
		Sri Lanka (Karunarathne and de Croos 2023b [also as 'Ball type'], 2025 [also as 'Ball type'];	Bell and oral arms (Karunarathne and de Croos 2023b, 2025)	The processing involves a five-step procedure, including cleaning, first curing, second curing,	22.5 tonnes of processed oral arms were exported in 2004, while during 2007, 2008, 2010, and 2017, the	India, Maldives, Taiwan, Thailand, China Vietnam (Karunarathne and de Croos 2023b, 2025)

Table 2. (continued).

Jellyfish family	Jellyfish species	Harvesting country	Targeted body part/s of jellyfish	Processing	Exports	Market/s
		Karunarathne et al., 2024b [also as 'Ball type')		sorting, and packing (Karunarathne and de Croos 2023b, 2025)	average export quantity and value per trade year were 614.11 ± 584.78 tonnes and 0.910 ± 0.904 million US dollars, respectively (Karunarathne and de Croos 2023b, 2025)	
Lobonemidae	*Lobonema smithii* (White type)	India (Manickaraja and Balasubramanian 2006 [as '*Aluvai Chori*']; Murugan and Durgekar 2008; Go4WorldBusiness 2009 [as White type]; present study)	Bell (Manickaraja and Balasubramanian 2006)	The processing involves a six-step procedure, including cleaning, curing, and packing (Manickaraja and Balasubramanian 2006)	100 tonnes of processed jellyfish were ready to be exported from Chennai in 2009 (Go4WorldBusiness 2009; present study)	[no data]
	Lobonemoides gracilis (White type)	Bangladesh (Das et al., 2023 [as *Lobonemoides robustus*]; present study)	Bell and oral arms (Das et al., 2023)	Cleaned, and salt-cured at nearby landing stations for about a week before final packaging (Das et al., 2023)	[no data]	China (Das et al., 2023)
		Sri Lanka (Karunarathne and de Croos 2023b [also as 'White type'], 2025 [also as 'White type']; Karunarathne et al., 2024b [also as 'White type'])	Bell and oral arms (Karunarathne and de Croos 2023b, 2025; Karunarathne et al., 2024b)	The processing involves a five-step procedure, including cleaning, first curing, second curing, sorting, and packing (Karunarathne and de Croos 2023b, 2025)	In 2008, 2011, 2015, and 2017, the average export quantity and value per trade year were 10.98 ± 2.08 tonnes and 0.016 ± 0.002 million US dollars, respectively (Karunarathne and de Croos 2023b, 2025)	Singapore, Vietnam, Taiwan (Karunarathne and de Croos 2023b, 2025)
Rhizostomatidae	*Rhopilema hispidum* (Sand type)	India (Kumawat et al., 2023 [also as 'Flower-*jhar*'])	Separated oral arms, scapulets, and the fused portion of oral arms (Kumawat et al., 2023)	Oral appendages are processed into a semi-dried product, with an alum/salt mixture in a stepwise manner, but no processing of bells (Kumawat et al., 2023)	The processed (semi-dried) jellyfish were valued at an export price of 106–111 INR (1.54 to 1.62 US dollars) kilogram^{-1} during 2017–20 depending on the destination country (Kumawat et al., 2023)	65 % of processed jellyfish were exported to China, and the rest to other Asian countries. like Thailand, South Korea, Malaysia, Vietnam, Japan, and Indonesia (Kumawat et al., 2023)
		Pakistan (Muhammed and Sultana 2008 [as *Rhizostoma pulmo*]; Gul et al., 2015 [also as 'Flower Jellyfish']; Psomadakis et al., 2015 [as *R. pulmo*])	Separated oral arms, scapulets, and the fused portion of the oral arms (Gul et al., 2015)	Oral appendages are treated with salt and alum (Psomadakis et al., 2015)	[no specific data]	Southeast Asian countries (Muhammed and Sultana 2008), particularly China (Psomadakis et al., 2015)

(Vanhöffen, 1888) (Chinnadurai et al., 2021; Sreeram et al., 2021), *C. annandalei* (Behera et al., 2020a) and *C. perezi* (Kumawat et al., 2023), the lobonemid *Lobonema smithii* Mayer, 1910 (Murugan and Durgekar 2008), and the rhizostomatid *Rhopilema hispidum* (Vanhöffen, 1888) (Panda and Madhu 2009 [as *Rhopilema esculentum*]; Kumawat et al., 2023).

Iran: The Islamic Republic of Iran is one of the main fishery producers in the region, benefitting from its extensive coastline stretching along the Persian Gulf and the Gulf of Oman, and along the southern part of the Caspian Sea. Jellyfish are harvested in Iranian waters using different methods (Roshan Moniri et al., 2013), but detailed information on the fishery remains scarce. According to Iranian seafood exporters, no jellyfish fishery exists along the Caspian Sea coast of Iran. The main fishing grounds are located off the coasts of Khuzestan Province and Bushehr Province, in the Persian Gulf, but jellyfish are occasionally collected in waters of other coastal provinces as well. Three edible species of jellyfish, namely *R. hispidum*, *C. perezi* (see Jafari et al., 2019: Fig. 1), and *C. orsini*, occur in the coastal waters of Iran. However, so far, only *C. perezi* has been known to be harvested for export (Iranian seafood exporters, pers. comm.).

***Pakistan*:** Fisheries for jellyfish were established in Pakistan in 2003, with the appearance of huge blooms of jellyfish (Psomadakis et al., 2015). Currently, only two species of jellyfish, *C. perezi* and *R. hispidum* are harvested along the Balochistan coast and the Sindh coast of Pakistan (Gul et al., 2015). As there is no domestic consumption of jellyfish in Pakistan, the entire catch is exported to EA and SEA countries after processing (Muhammed and Sultana 2008). According to the (WWF 2020), about 2,500 tonnes of processed jellyfish are exported from Pakistan annually, and a peak export was noticed during 2005–2007 when about 4,000 tonnes of jellyfish products were exported to China and Vietnam annually. However, this data is yet to be verified. It is estimated that more than 10,000 people are engaged in jellyfish fisheries in Pakistan, and this provides an additional source of income especially for small-scale fishers in coastal areas of the country (WWF 2020).

***Sri Lanka*:** Sri Lanka entered the jellyfishing industry in the 1980s (Anonymous 1986) and became one of the major suppliers by the 2000s exporting processed jellyfish in large quantities (Anonymous 2007; Kuruwita 2008; Naalir 2008; Perera 2008). Sri Lanka is home to four commercially harvestable edible jellyfish species (Karunarathne and de Croos 2023a), but despite the availability of resources, the country currently exports only the processed products of two types of jellyfish (El Gamal 2015), specifically known as *C. orsini* and *L. gracilis*, which are harvested at the southeast coast and northeast coast of the country, respectively (Karunarathne et al., 2024b). A recent comprehensive survey spanning from 2016 to 2020, conducted by Karunarathne and de Croos (2023b, 2025), revealed that the jellyfish fishery in Sri Lanka is a highly seasonal activity done by artisanal fishers, but it has not continued after 2017 due to a lack of sufficient jellyfish blooms around the country.

2.1 Estimated jellyfish landings

There were several challenges in estimating jellyfish landing volumes in SA. One such challenge was the lack of reliable landing data before 2000. Therefore, to derive the final landing volumes, the present study considered all available data such as literature data and FAO (2024a, b) data [FAO estimated data are denoted by E^F], published from 2000 onwards, up to 2022, the latest year of data available. Another challenge was that even though some scattered data were available after 2000, unlike export volumes, the accuracy level of landing volumes was lower. Therefore, to strengthen the accuracy of the landing volumes, the present study also considered the estimated landing values derived from the highest estimated export data (from literature or FAO) multiplied by the conversion factor 10 [Landing data estimated with conversion factor 10 are denoted by E^C]. The original literature and FAO landing (capture production) values were then compared with E^C values (country-specific, on a yearly basis). Next, the highest recorded values (original literature, FAO, or E^C) from the comparison were used for the final landing calculations. Here, we assume that the raw materials of a particular bulk of exports were landed in the same year.

According to Pauly et al. (2022), the conversion factor of dried jellyfish to raw jellyfish is 5. However, a conversion factor of 5 seemed to be too conservative when considering data from different sources (Hsieh et al., 2001; Kannappan et al., 2013; El Gamal 2015; Riyas and Biju Kumar 2021). Therefore, export data with a conversion factor of 10, derived from the mean of available conversion factors, were considered for the present study by incorporating the authors' insights from India and Sri Lanka. For example, in 2005, it is estimated that 2,000E^C tonnes of *C. perezi* were landed in Gujarat, based on a conversion factor of 10 (data from Kumawat et al., 2023). Additionally, India and Pakistan exported 300 tonnes and 1,600 tonnes of processed jellyfish to China in 2012 (López-Martínez and Álvarez-Tello 2013), suggesting an estimated landing of 3,000E^C tonnes and 16,000E^C tonnes, respectively. In 2014, Pakistan exported processed jellyfish to SA, notably Vietnam, with a peak export quantity of ~1,400 tonnes (Gul et al., 2015), corresponding to an estimated landing of 14,000E^C tonnes.

A meta-analysis revealed a significant variation in jellyfish landings with periodical peaks by country across SA during 2000 to 2022, probably due to the specific periodical blooming pattern of the catostylid species. India is the leading contributor with a total of 390,716.7 tonnes (54.8%) [16987.7 tonnes per production year (PPY)], with peak years in 2003 (55,560E^C tonnes) and 2013 (41,030E^C tonnes). Pakistan follows with 158,757.6 tonnes (22.3%) [12,212.1 tonnes PPY], peaking in 2012 (16,000E^C tonnes) and 2021 (52,240E^C tonnes). Bahrain contributed 119,414.3 tonnes (16.7%) [2,285.0 tonnes PPY], with peaks in 2007 (12,600E^C tonnes) and 2012 (70,000E^C tonnes). Sri Lanka reported 25,228.5 tonnes (3.5%) [3,604.1 tonnes PPY], peaking in 2007 (9,564.4E^C tonnes) and 2008 (12,661.1E^C tonnes). Iran reported lower cumulative landings of 19,531.0 tonnes (2.7%) [2,170.1 tonnes PPY], peaking in 2010 (7,918E^F tonnes). Bangladesh reported only 3.5 tonnes in 2019, and for the remaining years, landings data were not available, making it the least contributor in SA. This may indicate either a lack of a jellyfish fishery during this time or potential data collection and reporting issues. Overall, the cumulative landing for the entire SA region during 2000 to 2022 was 713,651.6 tonnes [31,028.3 tonnes PPY] (Supplementary Tab. 1).

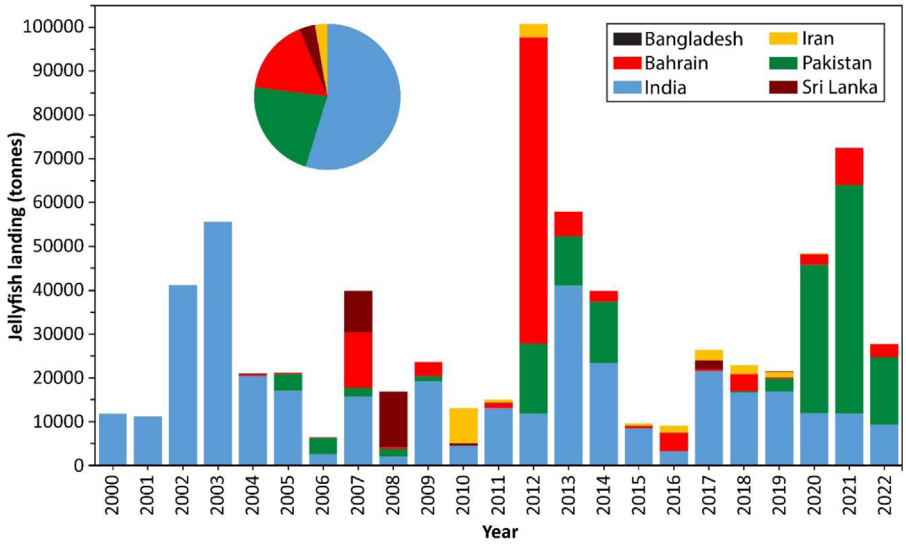

Fig. 3. The country-wise jellyfish landings (quantity) in southern Asia from 2000 to 2022 (the cumulative landings in each country, as a percentage, are indicated in the pie chart). Source of data: Supplementary Tab. 1.

From 2000 to 2003, only India contributed significantly to jellyfish landings in SA as a dominant player. Jellyfishing operations in Gujarat harvested 7,723 tonnes in 2000 and 10,281 tonnes in 2001, and Andhra Pradesh harvested 11,342 tonnes annually in both 2002 and 2003 (HFS 2005). Likewise, periodic reporting of jellyfish landings in India from 2000 to 2003 ranged from 7,723 to 30,866 tonnes annually, with an average of 22,515 tonnes (HFS 2005). Until 2003, although several countries in SA already started their jellyfish fishery, only India had recorded accurate data. However, from 2004 onwards, other countries also began to contribute significantly to the jellyfish fishery in SA and quantitative values became available, underscoring the growing importance of these countries in the industry (Fig. 3).

The species-specific analysis of jellyfish landings in SA from 2000 to 2022 reveals that *C. perezi* led with the highest total landings at 162,411.7 tonnes (54.6%) [8,548.0 tonnes PPY], followed by *C. orsini* with 68,643.4 tonnes (23.1%) [7,627.0 tonnes PPY], *C. annandalei* with 49,721.5 tonnes (16.7%) [5,424.6 tonnes PPY], *L. smithii* with 11,455.0 tonnes (3.9%) [5,727.5 tonnes PPY], *R. hispidum* with 4,716.5 tonnes (1.6%) [786.1 tonnes PPY], and *L. gracilis* with 439.3 tonnes (0.1%) [109.8 tonnes PPY]. The highest recorded species-specific landings included the years 2007 and 2012 for *C. perezi*; 2002–2003 and 2007–2008 for *C. orsini*; and 2002–2003 and 2017–2018 for *C. annandalei. Lobonema smithii* was recorded only in 2007 and 2008, with a peak of 10,955 tonnes in 2007. The highest species diversity was noted in 2017, with five out of six species contributing to the jellyfish fishery (Fig. 4). Overall, *C. perezi*, *C. orsini*, and *C. annandalei* were consistently prominent, whereas *R. hispidum*, *L. smithii*, and *L. gracilis* had more sporadic landings. Thus, the comparative analysis highlights that catostylids are the main species contributing to the jellyfish fishery in SA, whereas the other species contribute less (Fig. 5). Here, we have assumed that all the jellyfish fisheries data from Bahrain and Iran are related to a single species, *C. perezi*.

2.2 Jellyfish processing

Jellyfish processing (pre-processing and processing) in SA is a stepwise procedure (Tab. 2), as in many other parts of Asia. Pre-processing includes the separation of the bell (umbrella) from the oral arms on board, with the parts used in the jellyfishery retained and the unused or low-valued portions discarded into the sea (Riyas and Biju Kumar 2021; Karunarathne and de Croos 2025). For example, oral arms from most jellyfish, e.g., catostylids, are processed in India, but in the case of *L. smithii*, only the bell portion is selected for processing (Riyas and Biju Kumar 2021). In Pakistan, the oral appendages of *C. perezi* and *R. hispidum* are used for processing, and bell parts are discarded at sea (Gul et al., 2015). However, on some occasions, both the bell and oral appendages are taken to the landing site. For example, in Odisha (India) fishers generally transport only the oral arms to shore but may bring the entire medusa if catches are poor (Roul et al., 2021a). Also, in Bangladesh (Das et al., 2023) and Sri Lanka (Karunarathne and de Croos 2025), the whole medusa of *L. gracilis* is utilised for processing. As the next main step after pre-processing, to minimise losses, fishers in SA practice post-harvest measures by ensuring that marketable portions are stored until reaching the landing site (Karunarathne and de Croos 2023b, 2025). Processing usually occurs at temporary huts near landing sites, which also helps to ensure a minimal post-harvest loss.

After pre-processing and post-harvest measures, usable jellyfish parts are processed through further sub-steps. The processing methods can vary slightly based on the region and species. For example, in Sri Lanka, *L. gracilis* (Lobonemidae) is processed with alum [$KAl(SO_4)_2$] and common salt [NaCl] following a five-step procedure: cleaning, first curing, second curing, sorting, and packing (Karunarathne and de Croos 2023b, 2025). In Pakistan, a different approach is followed; the oral appendages of *R. hispidum* (Rhizostomatidae) are further

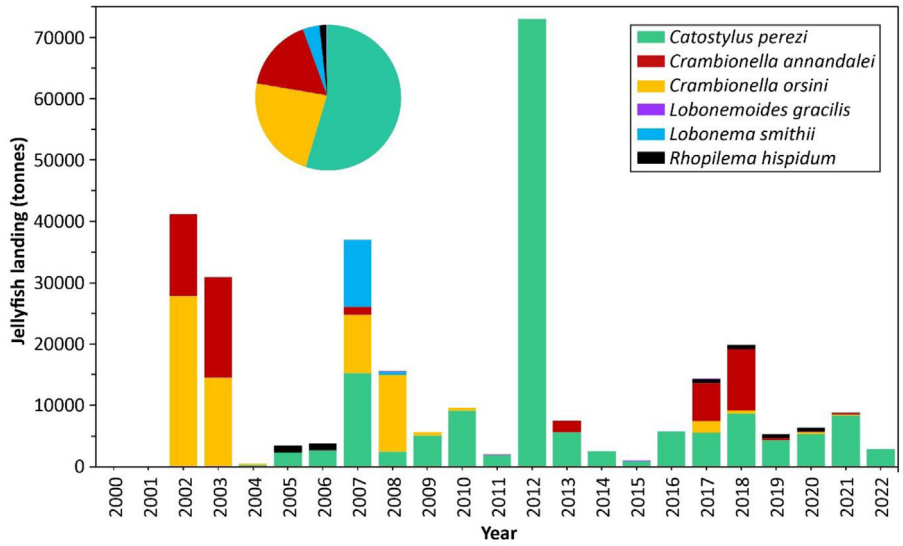

Fig. 4. The annual species-wise jellyfish landings (quantity) in southern Asia from 2000 to 2022 (the cumulative landings of each species, as a percentage, are indicated in the pie chart). Source of data: Supplementary Tab. 1.

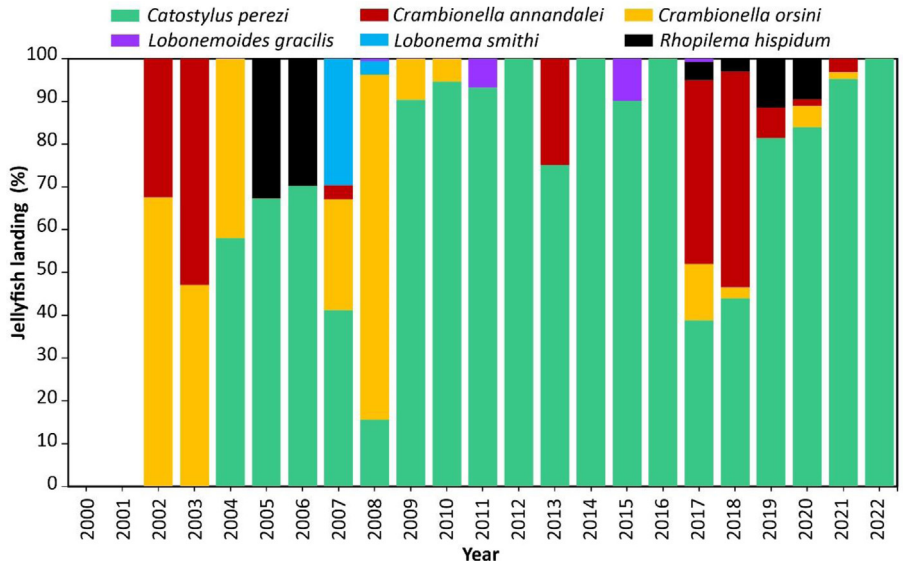

Fig. 5. The annual species-wise jellyfish landings (percentage) in southern Asia from 2000 to 2022. Source of data: Supplementary Tab. 1.

separated into scapulets, oral arms, and fused portions, each processed individually, with alum/salt (Gul et al., 2015). The processing of *C. annandalei* (Behera et al., 2020a) and *C. perezi* (Kumawat et al., 2023) oral arms follows a methodical procedure, which is mostly similar to the processing of *C. orsini* (Catostylidae). To process *C. orsini*, 1.5 kilograms of alum and 50 kilograms of common salt are added for every 100 kilograms of oral arms into the tank and thoroughly centrifuged (Riyas and Biju Kumar 2021). Likewise, the oral arms of jellyfish undergo a stepwise processing procedure, involving soaking in various mixtures of salts and alum to create a semi-dried product. After processing, the semi-dried oral arms are graded into different export categories based on their size before being packed into 20-litre containers. Each bucket contains 16 kilograms of oral arms. The processed oral arms of jellyfish find a good market in SEA and EA countries, particularly China (Roul et al., 2021a, b).

The processing results in significant shrinkage of raw jellyfish, with 3 to 20 kilograms of raw material required to obtain 1 kilogram of processed jellyfish (data from Kannappan et al., 2013; El Gamal 2015; Riyas and Biju Kumar 2021), depending on the species and processing formula (Hsieh et al., 2001). The colour of freshly processed jellyfish is creamy white but gradually turns yellowish as the product ages. In the

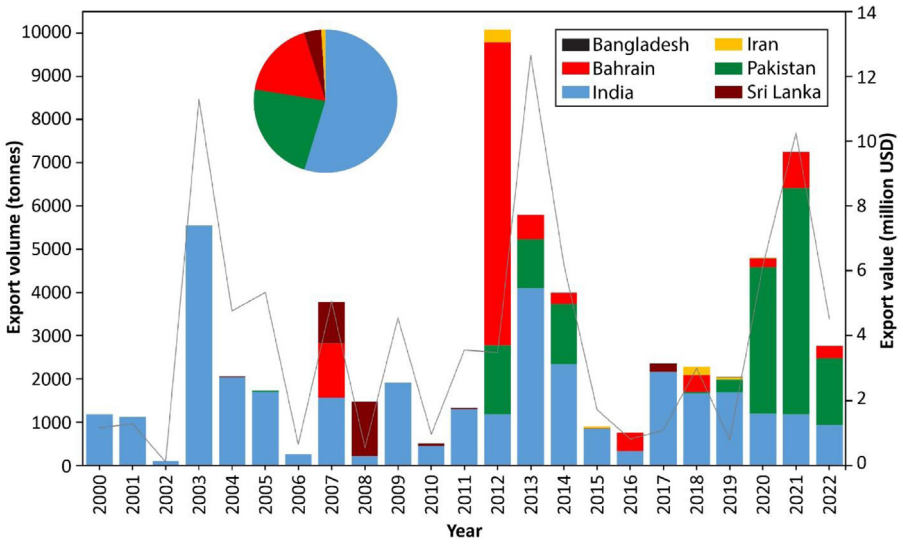

Fig. 6. The country-wise jellyfish export quantities (bars) and values (line) in southern Asia from 2000 to 2022 (the cumulative exports from each country as a percentage are indicated in the pie chart). Source of data: Supplementary Tab. 2. Note: The highest cumulative quantities, generated from the literature/FAO data for each year, were utilised to develop this graph.

Asian jellyfish market, a paler-coloured product has a higher retail value. Yellow, but not brown colour, is acceptable. The longer the sample remains, the darker it becomes. If it remains too long, it turns brown, and the product is unacceptable (Hsieh et al., 2001).

2.3 Jellyfish exports and imports

A significant discrepancy among the values were observed when examining the export data from the published literature (Tab. 2) and FAO (2024b) concerning SA countries during 2000–2022. To address this, the highest cumulative value generated either from the published literature or the FAO (Supplementary Tab. 2) for a marketing (trade) year was considered in the analysis (Fig. 6). However, the original or estimated landing data were not used for back-calculation of missing export values due to uncertainty of the fact that whether the landings by a country in a particular year were exported in the same year after processing.

The country-wise export diversity of jellyfish began to increase slightly from 2004 to 2011, and after 2012, export diversity in SA has been much higher, continuing up to the most recent data available for 2022. From 2000 to 2022, the highest jellyfish export was recorded from India, with a cumulative export of 35,051.77 tonnes [1,523.99 tonnes per trade year (PTY)]. However, in many cases, jellyfish export data in SA are not species-specific. For example, in 2016, about 70 tonnes of jellyfish were exported from India to Thailand and Vietnam (Seair 2016, as cited in Chinnadurai et al., 2021), but the relevant species name was not given. Additionally, 378 tonnes of dried (salted) jellyfish (2016–2017) valued at 0.62 million US dollars, 1,667 tonnes (2017–2018) valued at 3.75 million US dollars, 1,689 tonnes (2018–2019) valued at 3.90 million US dollars, and 1,195 tonnes (2019–2020) valued at 1.60 million US dollars were exported from Indian ports including Tuticorin, Chennai, Vizag, Pipavav, Mundra, Krishnapatnam, and Kattupalli/Ennore to China, SEA, and some other countries (Sreeram et al., 2021), but the relevant species were not known. The total jellyfish exports (dried, salted, or in brine) from Tamil Nadu, India in 2017 were 1,781.9 tonnes (HFS 2019 [assuming mistakenly reported as 17,819 tonnes]).

After India, the second-highest jellyfish exporter was Pakistan, with a cumulative export of 14,641.46 tonnes [1,626.83 tonnes PTY]. The third highest exporter was Bahrain, with a total of 11,245.34 tonnes [1,249.48 tonnes PTY]. Also, in 2018, there was a jellyfish re-export of 185 tonnes recorded from Bahrain, which may have been received from Iran. Sri Lanka recorded a cumulative of 2,522.85 tonnes [360.41 tonnes PTY]. Other countries such as Iran and Bangladesh recorded minor cumulative amounts of 607.33 tonnes [121.47 tonnes PTY] and 0.35 tonnes, respectively. From the entire SA region, about 64,000 tonnes were exported over the period from 2000 to 2022, with an average annual export volume of ~2,786 tonnes.

Total export income over this period amounts to ~90 million US dollars [~3.9 million US dollars PTY]. India emerges as the predominant contributor (~80%), with a significant portion of the total at 71.86 million US dollars. Other countries such as Pakistan, Bahrain, Iran, and Sri Lanka contribute about 14.41 million US dollars, 3.14 million US dollars, 0.33 million US dollars, and 0.26 million US dollars, respectively. Despite fluctuations, the overall trend highlights a robust engagement in jellyfish exports within SA, underscoring its economic significance in the region.

In SA, countries such as Iraq, Kuwait, Maldives, Oman, Qatar, Saudi Arabia, and the UAE did not contribute significantly to the jellyfish fishery and lack export data in the published literature and FAO (2024b) [except for (López-Martínez and Álvarez-Tello 2013), as the given account on the UAE (reported as EUA) is doubtful; and additionally, one export has been recorded for the UAE, including 1 tonne in 2014 by gaining of 7,000 US dollars and a few re-export records (1 tonne per year in 2012, 2013, and 2015, with ~zero

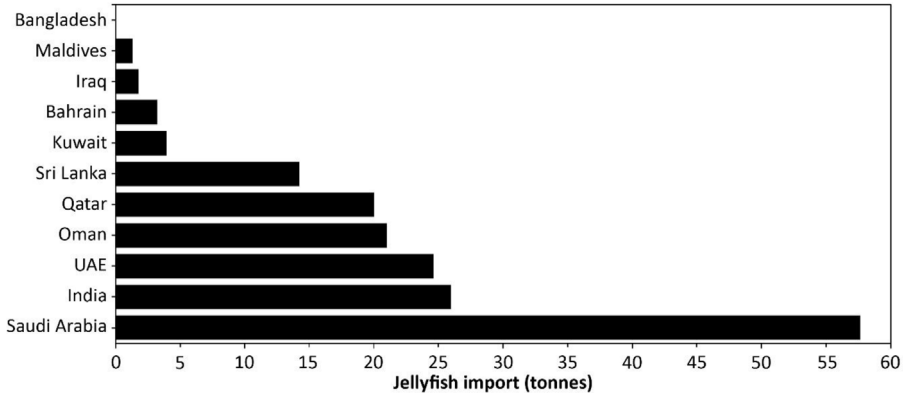

Fig. 7. The country-wise contribution (cumulative percentage) of jellyfish imports in southern Asia from 2000 to 2022. Source of data: Supplementary Tab. 3.

E^F in 2017 and 2018. Similarly, exports from Oman were recorded as ~zero E^F in 2013 and ~zero E^F in 2017 (FAO 2024b)]. However, accurate and sufficient data are lacking to support the presence of a jellyfish fishery in Oman and the UAE at present. Despite this, these countries have sporadically imported small quantities of jellyfish from 2011 onwards.

During the 2000 to 2022 period, Saudi Arabia remained the largest importer of jellyfish in the SA region, with a total volume of 57.64 tonnes [11.528 tonnes PTY], recording the highest single-year import in 2019 at 56.88 E^F tonnes. Other moderate importers included India 26 tonnes [6.5 tonnes PTY], followed by the UAE 24.62 tonnes [2.462 tonnes PTY], Oman 21 tonnes [10.5 tonnes PTY], Qatar 20 tonnes [6.667 tonnes PTY], and Sri Lanka 14.23 tonnes [3.558 tonnes PTY]. Additionally, Kuwait 3.93 tonnes [0.491 tonnes PTY], Bahrain 3.24 tonnes [0.324 tonnes PTY], Iraq 1.78 tonnes [0.254 tonnes PTY], and the Maldives 1.33 tonnes [0.121 tonnes PTY] were among the least importers. Bangladesh has ~zero imports (0.01 tonne in 2019). Notably, most jellyfish imports in the region began after 2012 (Supplementary Tab. 3).

A key trend observed is that the Maldives holds a record for the highest number of consecutive years as a jellyfish importer, with uninterrupted imports over 11 years (2012 to 2022). This indicates a sustained and stable demand for jellyfish over the years, making the Maldives the most consistent importer in the region. According to the above records, even countries with established jellyfish industries in the SA region occasionally imported jellyfish from 2004 onwards. These imports were likely intended to cater to the food preferences of tourists in the region (Fig. 7).

2.4 Future fisheries potentials

Over the past two and a half decades, there has been an apparent increase in the quantity of bycatch reported along various locations on the coast of SA, resulting in significant adverse effects. For instance, in 2002, a huge bloom of *C. orsini* occurred across the Persian Gulf and the Gulf of Oman, adversely affected both artisanal and industrial fisheries in Iran (Daryanabard and Dawson 2008) as well as in Pakistan (Psomadakis et al., 2015). This species has appeared periodically off the Sistan and Baluchestan province of Iran, during 2002–2003, 2009–2010, and 2019–2020 (Iranian Fisheries Science Research Institute 2024), and the *C. orsini* bloom that appeared in 2019–2020 seriously affected the major fishing operations, including tuna gillnetting, shrimp trawling, and fish trawling, and the livelihood of thousands of fishers along the Sindh and Balochistan coasts of Pakistan (The News International 2020; WWF 2020). Jellyfish blooms have adversely affected multiple locations along the Indian (Shiledar 2013; Mohan 2021) and Sri Lankan (Karunarathne et al., 2024b) coastlines too. Most of such jellyfish blooms belong to harvestable species, but they remain untapped.

Currently, a fishery for *C. orsini* operates only in India and Sri Lanka, but there is potential for harvesting this highly marketable species in Iran and Pakistan as well. A seafood company specialising in harvesting, processing, and exporting jellyfish collected samples of *C. orsini* from Char Dhoro along the coast of Pakistan in February 2020 for preliminary inspection regarding its fishery potential, and the abundance of this species along the coast of Pakistan may soon lead to the establishment of a fishery (Gul 2020).

Another edible catostylid species, *Crambione mastigophora* Maas, 1903, was reported off the southeast coast of India (Haldar 2001) and off the northeast coast of Sri Lanka (Karunarathne and de Croos 2023a), but its stock status remains unknown. Karunarathne and de Croos (2023a) suggest a novel fishing ground (Jaffna-Mullaitivu coast) and a fishing season (June and July) for *C. mastigophora* in Sri Lanka, and currently there are records of *C. mastigophora* nowhere else in SA.

There was a fishery for *L. gracilis* in Bangladesh (Das et al., 2023 [as *L. robustus*]) and Sri Lanka (Karunarathne et al., 2024b). Murugan and Durgekar (2008) reported that ~7 million tonnes of *L. smithii* were landed on the southeast coast of India in 2007 [this quantity is doubtful according to Riyas and Biju Kumar (2021)]. These two lobonemids might not be distinct species, but possibly synonyms (Karunarathne et al., 2024b), and no other fishing ground is identifiable for the lobonemids in SA, as their geographic distribution does not extend from the Bay of Bengal towards the Arabian Sea.

Currently, in SA, *R. hispidum* is harvested from the Sindh coast of Pakistan and the northwest coast of India. Although

there is no fishery for this species in Sri Lanka, Karunarathne and de Croos (2023a) proposed a new fishing ground (Puttalam-Mannar coast), and a fishing season (June to September) based on its abundance. *Rhopilema* cf. *hispidum* has also been reported on the coast of Bangladesh (Rumman et al., unpublished) and Iran (Jafari et al., 2019), though stock data are lacking. A population of *R. hispidum* was observed along the southwest coast of India (authors' observations), suggesting the potential to identify new fishing grounds and to estimate their population size. In Israel, about 100 kilograms of another *Rhopilema* species was harvested in 2018 as part of a pilot project for export to China (Edelist et al., 2021), but there is no evidence of a commercial fishery.

A cepheid jellyfish, *Netrostoma coerulescens* Maas, 1903 (in Malayalam: *Ona Chori, Neela Chori, Krishna Chori*) blooms annually along the southwest coast (around Shanghumughom Beach) of Kerala, India from June to September (Biju Kumar 2012; Abdul Riyas, pers. comm.), and there may be potential to harvest this species as food. This robust medusa also occurs with *C. orsini* among the islands of the Maldives during the Southwest Monsoon (Authors' unpublished data). However, to meet the demand in Maldivian hotels catering to tourists, processed jellyfish are imported from Sri Lanka (Karunarathne and de Croos 2025) and other Asian countries. Since these species could be an alternative for local consumption rather than importing, conducting a feasibility study to explore the potential for utilising these existing species for local consumption, even on a small scale, seems crucial.

Without being restricted to SA and other Asian regions, jellyfish fisheries could be extended towards Africa to minimise the over-exploitation of Asian species. About a decade ago, local seafood processors in Mozambique, operating under Chinese administration, successfully processed a small quantity of the catostylid *Crambionella stuhlmanni* (Chun, 1896) harvested from Maputo Bay, demonstrating its suitability as a food product (Wang Rongbin, pers. comm.). However, no fishery was developed on a commercial scale. Adongo (2019) identified jellyfish from four families caught incidentally in artisanal net fishery landings in Ghana as a potential resource. The FAO reports jellyfish catches in Namibia, but these are likely discarded bycatch from other fisheries (Brotz 2016a). While there is no evidence of commercial-scale fisheries occurring in these countries to date, there is a possibility of such fisheries emerging in the future, driven by increasing demand for jellyfish products in Asian markets.

2.5 Managing the jellyfish industry in SA

There is an inverse relationship between the jellyfish fishing season and the monsoon (Omori and Nakano 2001). In SA, jellyfish fishery is highly seasonal and practiced according to the monsoonal pattern. Seasonal currents in the northern Indian Ocean exhibit distinct patterns: during winter (October to March), they predominantly flow westward near the Malay Archipelago towards the Arabian Sea; conversely, in summer (April to September), the currents reverse direction, carrying an eastward flow from Somalia into the Bay of Bengal (Schott et al., 2009; Rizal et al., 2012; Peng et al., 2015). The occurrence and distribution of jellyfish blooms in SA waters could take place due to the influence of these monsoon currents (Das et al., 2023), whereas the population size may depend on multiple physico-chemical factors. Human activities such as land reclamation, pollution, and overfishing have further impacted jellyfish populations in SA (Brotz 2011). For example, there was a population reduction of harvestable jellyfish off Karachi, Pakistan between 2006 and 2011, probably due to overfishing (Roghay 2011).

Focusing on specific species for exploitation may not be environmentally sustainable and could lead to overfishing if not managed properly (FAO 2022b). Therefore, Heller (2007) advocated for legal measures to regulate the jellyfish fishery in Odisha (India) citing the burgeoning demand for jellyfish in foreign markets as a threat to the survival of endangered Olive Ridley turtles along the Odisha coast. In 2008, the Forest and Wildlife Department of India directed divisional forest officials in coastal areas of Odisha State to submit a comprehensive report on jellyfish catching and selling practices to safeguard jellyfish populations (Anonymous 2008). A group of members of the Bahrain Parliament also advocated banning the export of jellyfish to international markets, citing concerns over the detrimental impact on Bahrain's marine biodiversity. They argued that the current rate of jellyfish harvesting is causing significant damage to the local ecosystem, potentially leading to the extinction of edible jellyfish within three decades if the practice continues unchanged (Al A'Ali 2021). However, no limitations have been imposed on jellyfish fishery in Bahrain (Bahrain News Agency 2024) or any other country in SA thus far.

The jellyfish industry in SA faces several other challenges. Typically, the jellyfish fishery emerges as a potential alternative option when there is a decline in fish catches (e.g., Sreeram et al., 2021). Although the jellyfish fishery is important to the livelihood along the coast of SA (e.g., Swathilekshmi 2011), it remains as a small-scale commercial fishery (e.g., Muhammed and Sultana 2008; Kumawat et al., 2021), and it is still not well-organised (Sreeram et al., 2021). The rapid expansion of the jellyfish fishery on the Pulicat and Pondicherry coasts of India in 2003 led to significant conflict as merchants and fishers vied for dominance in the fishery, and pollution from jellyfish processing huts exacerbated the situation (Magesh and Coulthard 2004). Natural factors may also adversely affect the jellyfish industry; for example, in 2004, the tsunami inflicted severe damage to the jellyfish fishery infrastructure in India (CMFRI 2009). By 2015, many processing facilities for jellyfish in India had closed due to a lack of buyers for the exported product (Brotz 2016a).

To strengthen this industry, optimising harvesting and processing techniques through research and development is crucial, focusing on maximising jellyfish utilisation, including low-demand parts (e.g., bells of catostylids). To maximise economic benefits for local fishers, it is recommended that Pakistani companies process the entire jellyfish, including the bell, as current practices that omit the bell result in nearly a 50% profit reduction. Enhancing salting/processing techniques and promoting jellyfish bell marketing would significantly contribute to industry development (Gul et al., 2015). Strengthening market connections, implementing stringent quality control measures, and exploring value-added products are critical. Capacity building through training programmes will empower stakeholders, supporting sustainable growth and

meeting global market demands effectively. These efforts aim to enhance local economies dependent on jellyfish fisheries, ensuring stable incomes for coastal communities and fostering industry resilience in the region.

Effective jellyfish fishery management in SA necessitates a balanced approach that minimises environmental impacts and ensures sustainability within carrying capacities. To achieve this, robust management plans are essential, incorporating comprehensive regulations to prevent overexploitation (Kingsford et al., 2000). Various strategies are employed globally to manage jellyfish fisheries. For instance, Australia introduced a precautionary approach of setting 'Total Allowable Catches' (TACs) (Fisheries Victoria 2002, 2006). Additionally, some countries, including Australia, Mexico, and the USA, have implemented 'Minimum Size Limits' (MSLs) on medusae to prevent the capture of immature specimens. This approach not only conserves juvenile populations, but allows jellyfish to grow to larger sizes, thereby increasing profitability due to higher market prices (Brotz et al., 2017). Moreover, implementing seasonal and/or area-specific fishing closures can aid in allowing populations to recover during critical breeding periods. Effective jellyfish fishery management in SA should include rigorous monitoring of jellyfish populations to establish sustainable catch limits based on scientific data and models (e.g., Asrial et al., 2015; Raoult and Goston 2018; Lüskow 2020). Promoting selective fishing techniques that minimise bycatch and ecosystem disruption is also essential.

Effective management of the jellyfish fishery requires strong communication and coordination among the government authorities, fishers, collectors, processors, buyers, the export market, and the scientific community. This ensures sustainable harvesting, efficient processing, and a stable supply chain that meets both local and international demand (Brotz et al., 2021). By prioritising sustainability and adopting proactive measures, SA can safeguard its jellyfish fisheries for future generations, while preserving marine biodiversity and ecosystem health. However, further research is necessary to identify the most suitable management techniques for jellyfish fisheries in the SA region.

3 Conclusion

Currently, jellyfish fisheries in southern Asia are primarily contributed to by six countries: Bahrain, Bangladesh, India, Iran, Pakistan, and Sri Lanka, with India being the leading contributor. The current fishery involves five/six species, represented by three jellyfish families, with catostylids being the most commercially significant. This region accounts for ~ one-tenth of the global average annual jellyfish capture production, generating about one-third of the global jellyfish industry's average annual revenue. Processed jellyfish products, treated mainly with salt and alum, are reduced to nearly one-tenth of their wet weight and are predominantly exported to Southeast Asian markets and China. A recurring trend in significant jellyfish landings, with peak occurrences ~ every nine (range: 8–10) years, has been observed, consistently persisting over multiple decades.

Southern Asia still holds considerable potential for identifying new commercially important jellyfish species, exploring additional fishing grounds, and expanding the trade market. If managed sustainably, the next major jellyfish fishery —projected to peak around 2030—could result in a substantial surge in both jellyfish capture production and export trade, substantially benefiting the regional economy and meeting growing market demands.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Authors' contribution

Karunarathne AD [preparation of the original draft; data analysis], Karunarathne KD [preparation of the original draft; final editing].

Data availability statement

The data used to support the findings of this study are included within the article and in the supplementary tables.

Supplementary material

Table S1. Jellyfish landings (capture production) in southern Asia from 2000 to 2022 (in tonnes) based on the published literature and the FAO (2024a).

Table S2. Jellyfish exports in southern Asia from 2000 to 2022 (volumes in tonnes; values in 1000 US dollars) based on the published literature and the FAO (2024b).

Table S3. Jellyfish imports in southern Asia from 2000 to 2022 (volumes in tonnes; values in 1000 US dollars) based on the FAO (2024b).

The Supplementary Material is available at https://www.alr-journal.org/10.1051/alr/2025005/olm.

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