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Size Distribution and Economic Status of Sea Bass in the Gulf of Mottama Wetland (GoMW) in Myanmar

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Abstract

The present study was conducted the status of sea bass from Kokko and Kyuntone of The Gulf of Motttama Wetland (GoMW) area in Thanatpin Township in Bago Region Myanmar from September 2019 to August 2020. Fifty specimens were monthly collected, measured and weighed. Invoices of sea bass were collected for the depot and fish sellers by monthly. In Kokko, mean value of standard length and body weight were highest in March (32.70±1.58, 660.7±112.23). The mean value of standard length was peak in January (31.39±7.16) but peak of body weight was in March (963.24±280.86) in Kyuntone villages. The lowest mean value of standard length and body weight were found in June at both study areas. According to the invoice data revealed that monthly catch weight of sea bass is the most abundance in October (829.92) kg in Kokko, (339.12) kg in Kyuntone. Based on price of relations to size group, small size C < 300g (41%) was mostly abundance in Kokko Tan and in Kyuntone small size C < 300g (35%) was second abundance. Specimens were not landed in April and May. In June, young specimens were very rarely seen in both study sites. The important roles of wetland fishes, the economic valuation of GOMW in Myanmar and samples of fishing gear and value chain of sea bass in Myanmar was expressed in this study.

Keywords

The Gulf of Mottama Wetland, Morphometric Measurement, Catch Weight, Size Group

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1. Introduction

Sea bass fishes are family Latidae of the order Perciformes. Sea bass are found in coastal waters, estuaries and fresh streams. They are catadromous in that they migrate from freshwater back to estuaries and oceanic water to spawn and then return to fresh water [1-9, 113]. Lates uwisara (Barramudi) are valuable both as recreational and commercial fish with a high fairly stable price. They are

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stocked in lake and ponds for recreational fishery and are also fished in freshwater creeks and estuaries [1-15, 112]. In Myanmar, sea bass has both domestic and international demand and can be grown in fresh, salt or seawater. Over the past decade, the market for sea bass has markedly in the Myeik archipelago in Tanintharyi Region as well as in Yangon and also Ayeyarwady regions. Myeik has been commercially breeding sea bass for 10 years [16, 17, 72]. Along the Gulf of Mottama (GoMW), see bass species can be found. The Gulf of Mottama wetland (GoMW) conservation area was declared the sixth Ramsar Site in Myanmar on Wednesday, on 10 May 2017 [18-25, 88, 89, 99, 100, 102, 103, 105, 106]. The Gulf of Mottama Wetland (GoMW) of which situated at the mouth of Sittaung River is considered a unique estuarine mudflat environment that is home to a great variety of flora and fauna [23, 26, 27, 73, 78, 81- 83, 114, 116-120, 126, 127]. This Gulf supports a large number of species such as marine avifauna, invertebrates and up to 150,000 migratory water birds in non- breeding season [18, 19, 28-30, 51, 52, 65, 78, 132, 134]. The gulf of Mottama wetland (GoMW) also supports thousands of local and regional people by providing fishes and vegetation [31-35, 139-141, 153-155]. On the world, one billion people rely on fishes as sole source of protein and 35 million people are directly engaged with fisheries and 95% of them live in developing countries and the majority are small-scale fishers [23, 36-39]. In Myanmar, wetland fishes are vital role of wetland economic valuation and ecosystem of wetland [40-43, 124, 135,159]. The direct value of wetland fishes is local trading and international trading in Myanmar wetland areas. Ecosystem of Wetlands support resident fishes that both play vital roles in the aquatic –terrestrial trophic web [41, 44-46, 151] and provide recreational and commercial fisheries harvests worth billions of foreign currencies annually [46-48]. The community structure of fishes can predict important informations for climatic signals [22, 23, 57, 60, 76, 85, 105, 144] and also provide information about wetland conditions and health [67, 68, 70, 75]. During the last decade, a great deal of studies have addressed a diversity of topics concerning with wetland fish communities including species coexistence and dispersal [19, 21, 35, 38, 56], the value of fishes as prey for wetland predators [28, 77], effect of wetland connectivity on assemblage composition, nursery value and fisheries harvests [16, 58, 63, 128, 132], seasonal use of wetlands as dry-season refugia [123], flooding [34, 91], hypoxia [90], responses to human perturbation [59, 114, 147] and relationship with physicochemical characteristics such as salinity [77, 79, 86, 92, 110]. The former studies demonstrated that the key roles of wetland fish communities and nature and variability of environmental factors, fish species distributions and community composition [18, 67]. Among much wetland fish species, the present study was conducted the status of sea bass from Kokko and Kyuntone of The Gulf of Mottama wetland (GoMW) area in Thanatpin Township in Bago Region with the following objectives. The scope of this study recorded the morphometric measurement of sea bass in the study area, observed the catch rate of sea bass and also investigated the prices according to sea bass sizes and value change of sea bass. The correlation between length and weight of sea bass and the utilizing of fishing gear were analyzed in this study.

1.1. Background of Study

Wetland ecosystem and economic valuation can support much benefits to humans and their environment. In Myanmar, conservation of wetlands cannot sustain due to poor environmental conservation knowledge of residents who live near wetland areas, insufficient staffs, low budgets and other statements of problems [12, 66, 69]. In wetland areas, trading fishes are becoming first highest earning income, cultivations of paddy, peas and vegetation are second highest earning income and resorts, travel and tours are third highest earning income. During COVID-19 global pandemic periods, the economic status of our world evidently decrease especially aspects of travel and tours. The numbers of ecotourism and local visitors of wetlands have started decreasing since COVID-19 pandemic and then, unfortunately, Myanmar met in political conflicts, income of wetlands are evidently decreasing in travel and tours sessions. However, trading fish can sustain economic valuation of wetland areas and the income of cultivation session of wetlands are decreasing in a few percentage. By observing those conditions, trading of fish is key income of wetlands. This study emphasized local income of sea bass and value change in local areas of Myanmar. In the scope of this study, the Gulf of Mottama wetland (GoMW) was chosen and the GoMW is one of most important and unique wetland systems on the world [4, 29, 65, 137]. One of the greatest challenges in wetlands of Myanmar is under threat and pressure by uncoordinated governance and unstainable use of coastal and wetland natural resources, overfishing and habitat destruction of fauna [54, 55]. The Gulf of Mottama (GoM) is situated along Mon State and Bago City and fisheries are primarily fresh water, while coastal fisheries are much more important in Mon State [93, 94, 137]. This study focused on morphological study of sea bass fish and economic value change in local area of Myanmar. By length and body weight of sea bass can generally obtain highest prices and the demands of sea bass in local area are increasing more and more. [6, 8, 10, 70, 115]. The more abundance populations of sea bass can be found in Kokko and Kyuntone villages than other villages along The Gulf of Mottama Wetland (GoMW). Even if there is no fish trading internationally, the economic valuation of wetland fish trading

can support earning for residents of wetland areas and illegal fishing can even be decreased, however, population of people are daily increasing and the demand of fish product can increase relating to human populations and so, the sustainability of biodiversity is necessary to control not to be declining of ecosystem services and environmental conservation [56, 57, 133]. Studying of fish can be divided into two categories, (i) quantitative fish sampling method and (ii) qualitative fish sampling method. Quantitative fish sampling methods aim to study measure of fish abundance concerning with relative abundance for communities or mark-recapture estimate for specific taxa, biomass, diversity with inter values concerning with counts and ages, direct measurement of fish concerning with fish length and body weight, habitat characteristics concerning with water temperature, depth of water, inhabiting territorial waters, assemblage, community metrics concerning with indices of diversity, similarity or dissimilarity and ratios concerning with catch-per-unit-effort [67]. Qualitative sampling method targets on fish sex, species lists, descriptions of frequency of occurrence in term of rare uncommon, common and ubiquitous [67]. In this study, data included direct measurements of fish such as fish length and body weight by using quantitative sampling method.

1.2. Behaviors and Habitats of Sea Bass

A diverse group of common names of sea bass are "Barramundi perch" in Australia, Giant sea perch" in Papua New Guinea, "Sea bass" in South-east Asia and also known as "Ka-kadit" in juvenile state in Myanmar and "Ka-tha- baung" in adult state or in female status in Myanmar also [42-49, 121, 129, 136, 143, 157, 158]. The taxonomy of sea bass is complicated by the existence of several nominal species presently relegated to its synonymy [43, 74, 129]. The localities and specimens of sea bass are L. heptadactylus [72, 107], (unknown locality and unknown type); L.vacti [56, 107], no types, type locality Ganges River, Bengal, India; L. nobilis [31, 107], syntypes frommultiple localities, type locality Pondicherry, India; L. cavifrons [5, 107], type lost, type locality "somewhere in Torres Straits or the coast of New Guinea" and L. darwiniensis [84, 107], type in poor condition, type locality "Darwin, Australia"; L calcarifer [13-17, 42, 107, 150, 157, 158], type Lates, type locality "Myanmar and Sri Lanka, from Queensland coast of Australia westwards at least to India [109, 112, 113, 125, 157], from tropical Austria through Indonesia, from Persian Gulf to China, Singapore and Thailand" and L. uwisara [107], type Lates, type locality " Eastern Myanmar" [41-48, 161]. In GoMW area, L. uwisara and L. calcarifer have been observed. According to the research of Rohan Pethiyagoda & Anthony C. Grill (2012), Lates uwisara can be distinguished from L. calcarifer [107, 108, 115, 142] by possessing scales between the base of the third dorsal- fin and lateral line; and having a lesser eye diameter of Lates uwisara in 4.4-4.7% SL and that of L. calcarifer in 4.8-6.9% SL.

1.2.1. Systematic Position of Lates Uwisara

Figure 1. Lates uwisara (Sea bass).

Kingdom: Animalia

Phylum: Chordata

Class: Actinopterygii

Order: Perciformes

Family: Latidae (Lates perches)

Genus: Lates (Cuvier and Valenciennes, 1828)

Species: Lates uwisara (Pethiyogod and A.c.Gill, 2012)

Common name: Barramundi/ Sea bass

Myanmar name: Ka-kadit (Ka-tha-baung)

1.2.2. Systematic Position of Lates Uwisara

Figure 2. Lates calcarifer (Sea bass).

Kingdom: Animalia

Phylum: Chordata

Class: Actinopterygii

Order: Perciformes

Family: Latidae (Lates perches)

Genus: Lates (Cuvier and Valenciennes, 1828)

Species: L. calcarifer (Bloch, 1790)

Common name: Barramundi/ Sea bass/ giant perch

Myanmar name: Ka-kadit (Ka-tha-baung)

Indonesia name: Ikan kakap putih (Irmawati et al., 2020)

Oldest name: Holocentrus heptadactylus (Lacepède, 1802), Coius vacti (Hamilton, 1822)

The representatives of sea bass are catadromous and they are born in sea water and then they spend most of their time in fresh water [10, 18, 95, 96, 150]. Sea bass inhabits freshwater, brackish, marine habitats such as streams, lakes, estuaries and coastal water [42, 62, 80, 104, 128, 150, 158]. The newly-hatched larvae are distributed along the coastline of brackishwater estuaries while 1cm size larvae can be found in freshwater bodies [11]. Under natural condition, sea bass grows in fresh water and migrates to more saline water for spawning. The sea bass is one of the species with a high potential for cultivation. Sea bass is widely commercial in South East Asia, it is popular marine food fish of high market value and culture of sea bass has been successful in coastal regions in Myanmar [111, 145, 146, 158]. Sea bass spawn naturally in captivity [145] and it is used to migrate sea only to breed, a task achieved by its ability to tolerate the complete range of salinities [95, 96]. Alternatively, sea bass can be induced to spawn by hormonal or environmental manipulations [49, 50, 70]. Smaller fishes of sea bass can be found in rivers and streams and lager fishes in the ocean and estuaries [42, 109] and sea bass is dermersal and it is serially hermaphroditic meaning that it can transform from male to female at three to eight years of age [42, 53] and its sex ratio is 3.8 males: 1female [42, 53, 95, 96, 109, 148, 149] with males reaching 37 to 72 cm and then, they are changing into females starting at 73 cm, at around five years, three to five years, or six to eight years depending on the source [40, 53, 95, 96].

2. Materials and Methods

2.1. Study Area

The present study was conducted from Kokko Tan and Kyuntone villages of Thanatpin Townships in Bago region. These villages are located in the coast of Gulf of Motamma wetland area, Kokko Tan (point 9) is situated between 17° 12′ 16.38″ N and 96° 47′ 23.82″ E, Kyuntone (point 10) is 17° 12′ 35.76″ N and 96° 48′ 2,64″E. The following figure 3 shows the map of study area.

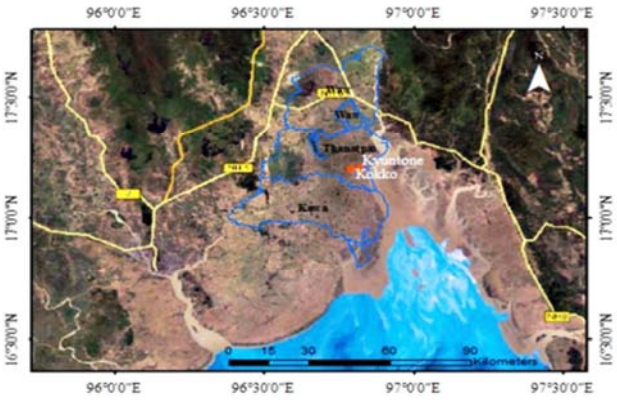

Figure 3. Location map of study area.

2.2. Study Period

Study period was lasted from September 2019 to August 2020.

2.3. Method

Fifty Specimens were randomly collected and measured total length, standard length and body weight from Kokko Tan and Kyuntone villages by monthly. Invoice of sea bass were collected monthly from the depot and fish sellers of two study area. Collected data were entered into micro-soft excel for calculations and analyzed. Data is presented in the following section using photographs, table, graph and histogram. And then the data of two study areas were compared and discussed.

3. Results

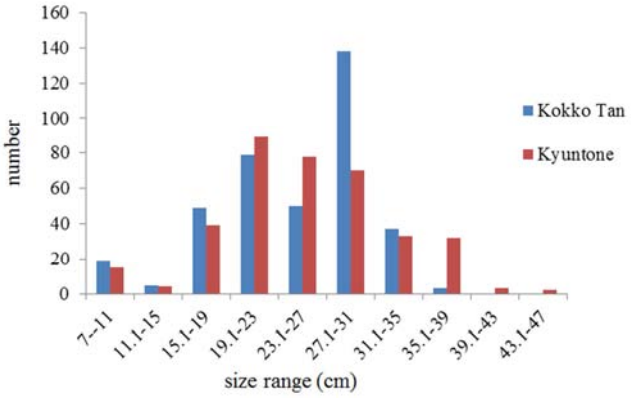

Figure 4. Comparison of size range of Sea bass between Kokko Tan and Kyuntone.

Table 1. Size range (cm) of sea bass in Kokko Tan and Kyuntone during the study period.

Cm	7-11	11.1-15	15.1-19	19.1-23	23.1-27	27.1-31	31.1-35	35.1-39	39.1-43	43.1-47
Kokko Tan	19	5	49	79	50	138	37	3	0	0
Kyuntone	15	4	39	89	78	70	33	32	3	2

Table 1 and figure 4 show the standard length frequencies of sea bass sample at the two villages. In general, the sizes are similar with the exception of the 27.1- 31 category where the fish landed at Kokko were almost double the number at Kyuntone, and Kyuntone had more fish in the 35.1-39 category and a few large fish in the 39 - 47 cm, that will not found at Kokko Tan.

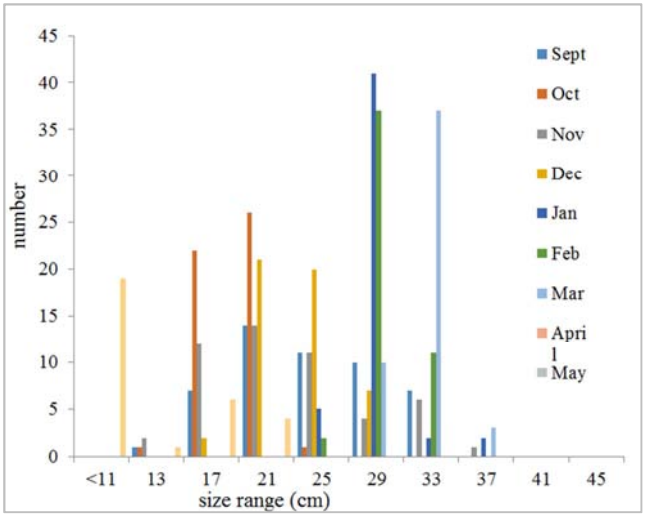

Figure 5. Comparison of size range of Sea bass in Kokko Tan by month.

Figures 5 and 6 indicate that only in June were smal sizes < 11 cm (SL) found, while no fish were landed during April and May. Larger sized fish in the 29 size category where found in larger number in January & February in Kokko Tan and during March at both villages. The largest number of fish in the 33 cm category was in Kyuntone in January to March while very few were found in Kokko. Fish > 35cm were found in Kyuntone during January to March, while only a very few where found in Kokko Tan. The largest sizes 41cm and 45cm were not found at Kokko Tan.

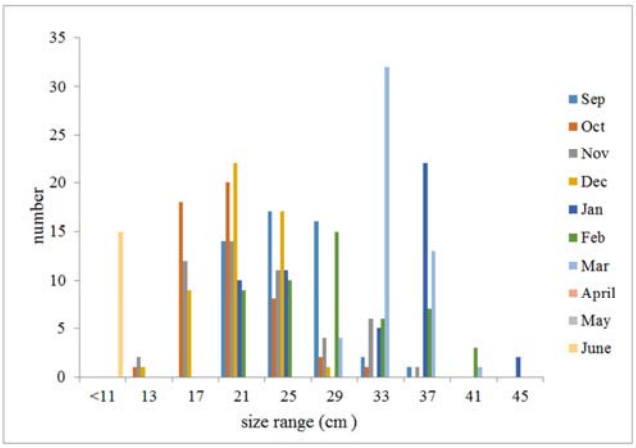

Figure 6. Comparison of size range of Sea bass in Kyuntone by month.

Table 2. Monthly mean value of standard length and body weight of sea bass at Kokko and Kyuntone.

Month	KK	KK	KK	KT	KT	KT
	TL (Mean±SD)	SL (Mean±SD)	BW (g) (mean±SD)	TL (Mean±SD)	SL (Mean±SD)	BW (g) (mean±SD)
Sep	29.55±6.6	25.04±5.31	428.7±278.09	29.68±3.95	26.24±3.65	389.98±175.3
Oct	22.5±2.13	19.43±2.07	180.1±44.23	24.39±4.07	20.83±3.63	237±146.88
Nov	26.87±6.44	23.41±5.71	352.1±255.41	26.85±6.45	23.41±5.71	339.3±239.73
Dec	27.09±3.37	23.72±3.13	279.42±95.45	25.12±3.75	21.74±3.40	231.6±100.44
Jan	33.22±2.32	28.92±2.04	584.26±116.69	35.93±8.00	31.39±7.16	644.58±380.48
Feb	34.99±2.21	30.02±1.81	655.16±132.03	34.08±5.85	29.4±5.54	630.32±319.16
Mar	35.43±2.96	32.70±1.58	660.7±112.23	35.26±2.56	29.93±2.18	963.24±280.86
June	14.64±5.73	12.62±4.78	87.33±66.62	10.32±0.93	9.07±0.85	43.97±16.66

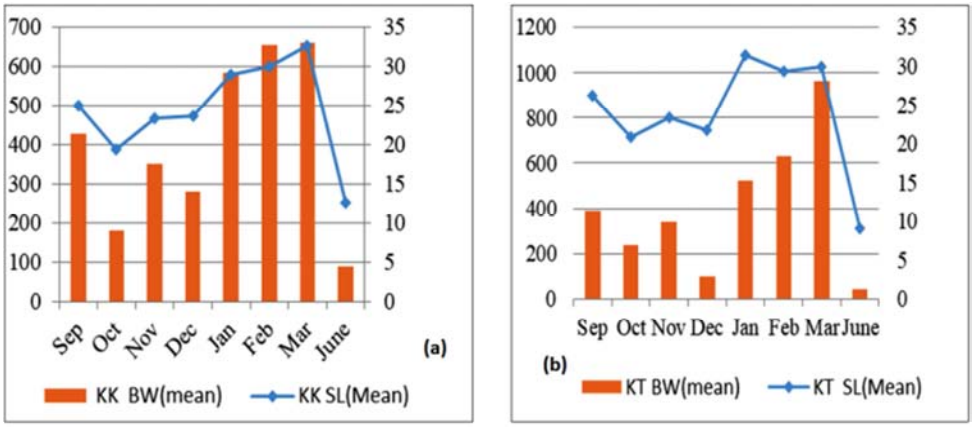

Figure 7. Relation of standard length and body weight in Kokko Tan and Kyuntone.

In Kokko Tan, mean value of standard length and body weight were highest in March (32.70±1.58, 660.7±112.23) and followed by February (30.02±1.81, 660.7±112.23) and January (28.92±2.04, 584.26±116.69). In Kyuntone, mean value of standard length was peak in January (31.39±7.16). February (29.4±5.54) and March (29.93±2.18) were higher than the other months but mean value of body weight were peak in March (963.24±280.86). January (644.58±380.48) and February (630.32±319.16) were higher than the other month. The lowest mean value of standard length and body weight were found in June (12.62±4.78, 87.33±66.62), (9.07 ±0.85, 43.97 ±16.66) at both study areas (Table 2, Figure 7).

Table 3. Monthly catch weight of Sea bass in Kokko Tan and Kyuntone.

Months	Kokko Tan Total sum (Kg)	Kyuntone Total sum (Kg)
August	171.67	197.08
September	255.79	267.12
October	829.92	339.12
November	191.92	119.15
December	100.54	403.6
January	50.46	159.15
February	65.58	127.04
March	22.4	48.52

Specimens were not found in April and May. Because all channel, creek and wild pond had no water and dried. Some local fishermen told that they caught very small fry specimen from the sea in these month. But, very small specimens were recorded in June.

According to the invoice data, monthly catch weight of sea bass is most abundance in October (829.62) kg in Kokko Tan and (339.12) kg in Kyuntone. The lowest catch weight of sea bass in March (22.4) kg in Kokko Tan and (48.52) kg in Kyuntone (Table 3, Figure 8).

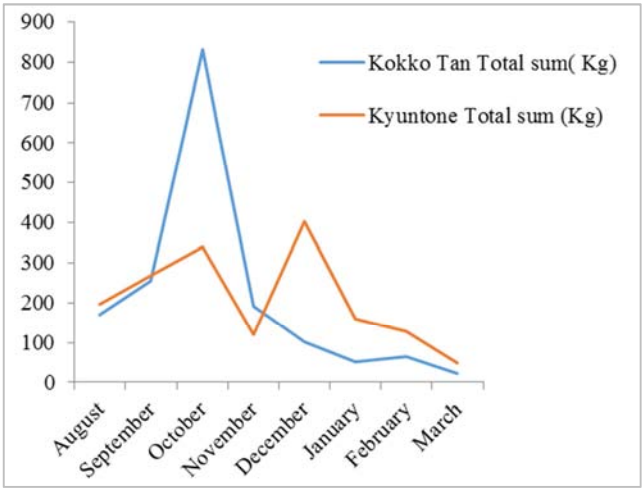

Figure 8. Total catch weight of Kokko Tan and Kyuntone.

Table 4. Monthly recorded catch weight (kg) by size groups at Kokko Tan and Kyuntone.

Month	Kokko Tan			Kyuntone		
	A (large)	B (Medium)	C (Small)	A (large)	B (Medium)	C (Small)
August	65.85	66.15	39.62	84.12	75.98	36.99
September	66.69	110.13	78.97	44.44	121.38	101.29
October	125.08	269.77	435.08	68.96	145.46	124.7
November	65.96	71.15	58.62	24.93	52.38	41.85
December	22.13	33.23	45.08	80.77	136.77	186.06
January	10.85	17.23	22.38	42.62	66.08	45.08
February	35.43	18.6	11.55	46.04	45.54	35.46
March	11.85	8.6	1.95	11.51	32.42	4.59
Total	403.84	594.86	693.25	403.39	676.01	576.02

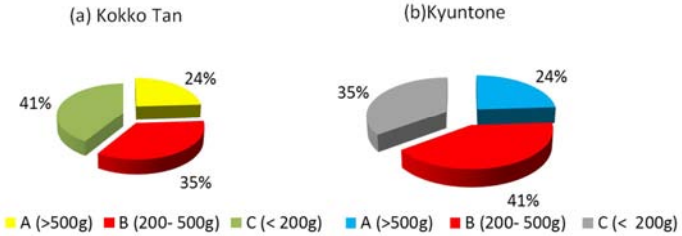

Figure 9. Percentage of size groups in Kokko Tan and Kyuntone.

According to the invoice, catch weight by price size were classified into Large (A>600g), Medium (B 300-600g), Small (C<300). Based on the price size, price group small (C) was most abundance in Kokko Tan 41% and followed by medium (B) 35% and large (A) 24%. All price size groups were most abundance in October at Kokko Tan. Although price group (B) was most abundance 41% and followed by size group small (C) 35% and size group (24) 28% in Kyuntone. Price group (A) and (B) were more abundance in October; price group (C) was more abundance in January (Table 4, Figure 9).

Table 5. Monthly price size group (MMK/kg) of Sea bass in Kokko Tan and Kyuntone.

Months	Kokko Tan			Kyuntone		
	A (Large)	B (Medium)	C (Small)	A (Large)	B (Medium)	C (Small)
August	5930	4422.5	3236.32	4940	3855.17	3099.69
September	5228.26	3789.26	2693.89	5066.9	4074.47	3254.06
October	4296.72	3224.67	2441.11	4056	3405	2511.36
November	4474.17	3410.79	2739.29	3705	2502.5	1755
December	4571.67	3778.13	2949.38	4416.18	3791.67	3460.3
January	4940	4069	3129.29	5107.14	4242.73	3788.57
February	6229.17	5362.5	4503.57	5158.64	4468.75	3900
March	6825	5958.33	4875	7280	6120.83	5281.25

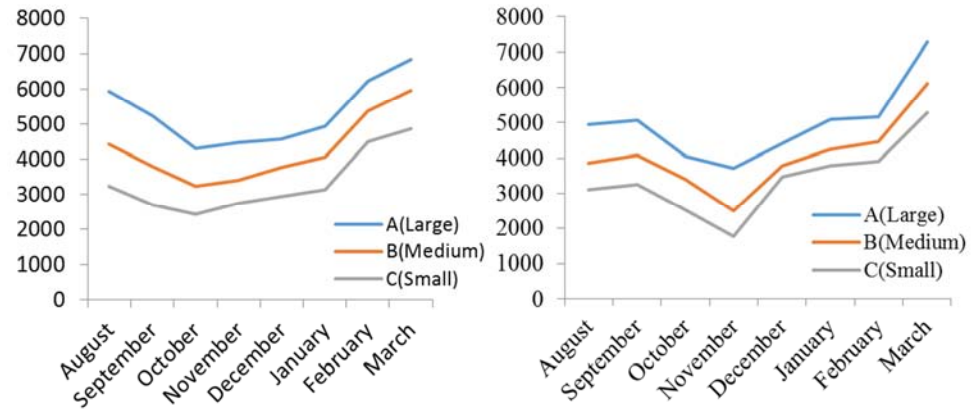

Figure 10. Relation of price sizes in sea bass at Kokko Tan and Kyuntone.

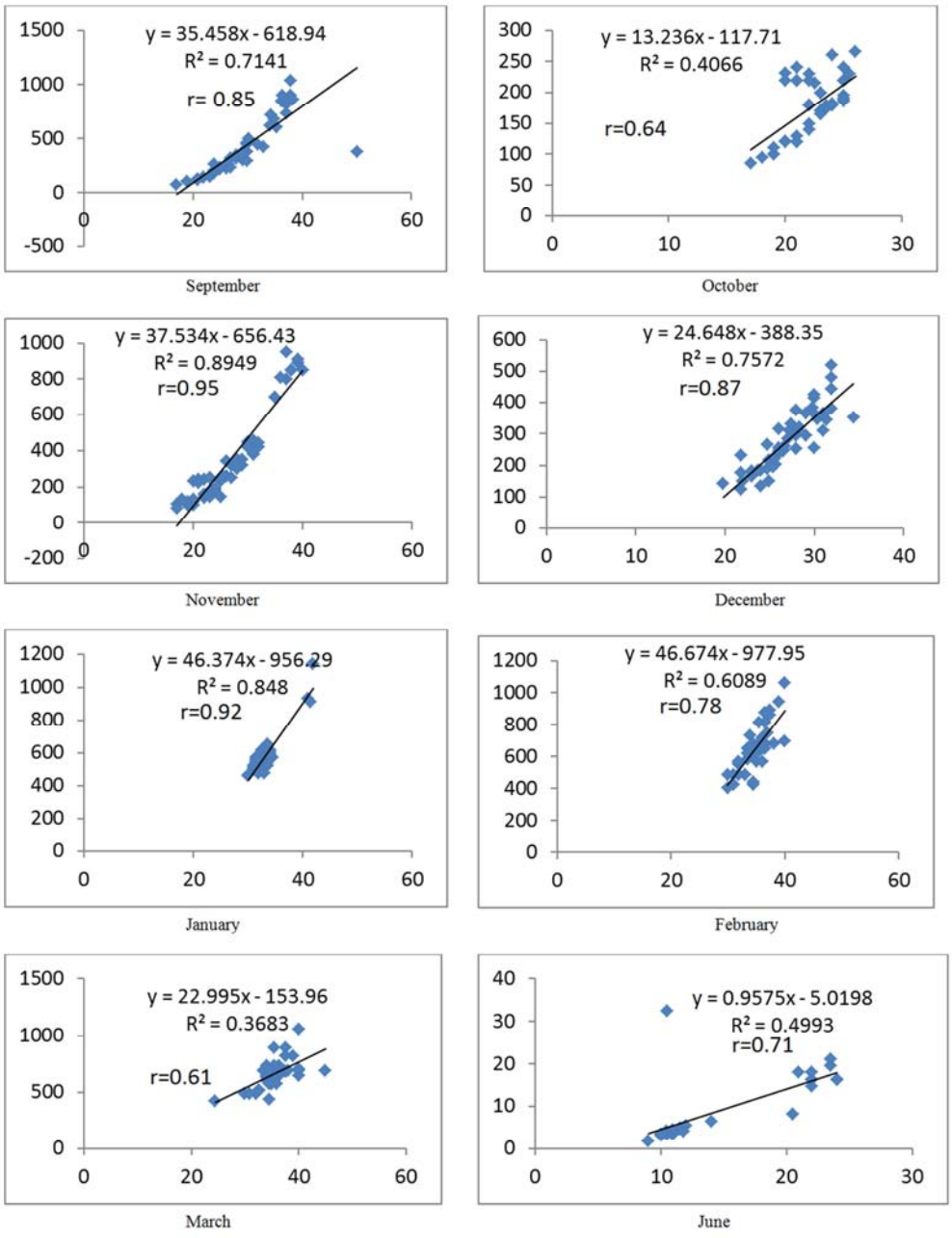

Figure 11. Relation between total length and body weight of sea bass in Kyuntone.

According to the recorded data, prices relation to all size groups A, B, C were highest in March (6825, 5958.33, 48750) MMK/kg in Kokko Tan and (7280, 6120, 5281.25 MMK/kg in Kyuntone. Lowest price of A, B, C were observed in October (4296.72, 3224.67, 2441.11) MMK/kg in Kokko Tan and (3075, 2502.5, 1755) MMK/kg in November respectively. Price sizes of Kokko Tan and Kyuntone were fluctuated for every month. Specimens were not landed in April and May. Very small specimens were often observed with tides informed by local fisherman in these months. In June, young specimens were very rarely seen in both study sites and no invoice was got until June (Table 5, Figure 10-a).

According to the recorded data, prices relation to all size groups A (A>500g), B (200-500g), C (C<200g) were highest in March (6825, 5958.33, 48750) MMK/kg in Kokko Tan and (7280, 6120, 5281.25) MMK/kg in Kyuntone. Lowest price of A, B, C were observed in October (4296.72, 3224.67, 2441.11) MMK/kg in Kokko Tan and (3075, 2502.5, 1755) MMK/kg in November respectively. Price sizes of Kokko Tan and Kyuntone were fluctuated for every month. Specimens were not landed in April and May. Very small specimens were often observed with tides informed by local fishermen in these months. In June, young specimens were very rarely seen in both study sites and no invoice was got until June (Table 5, Figure 10-b).

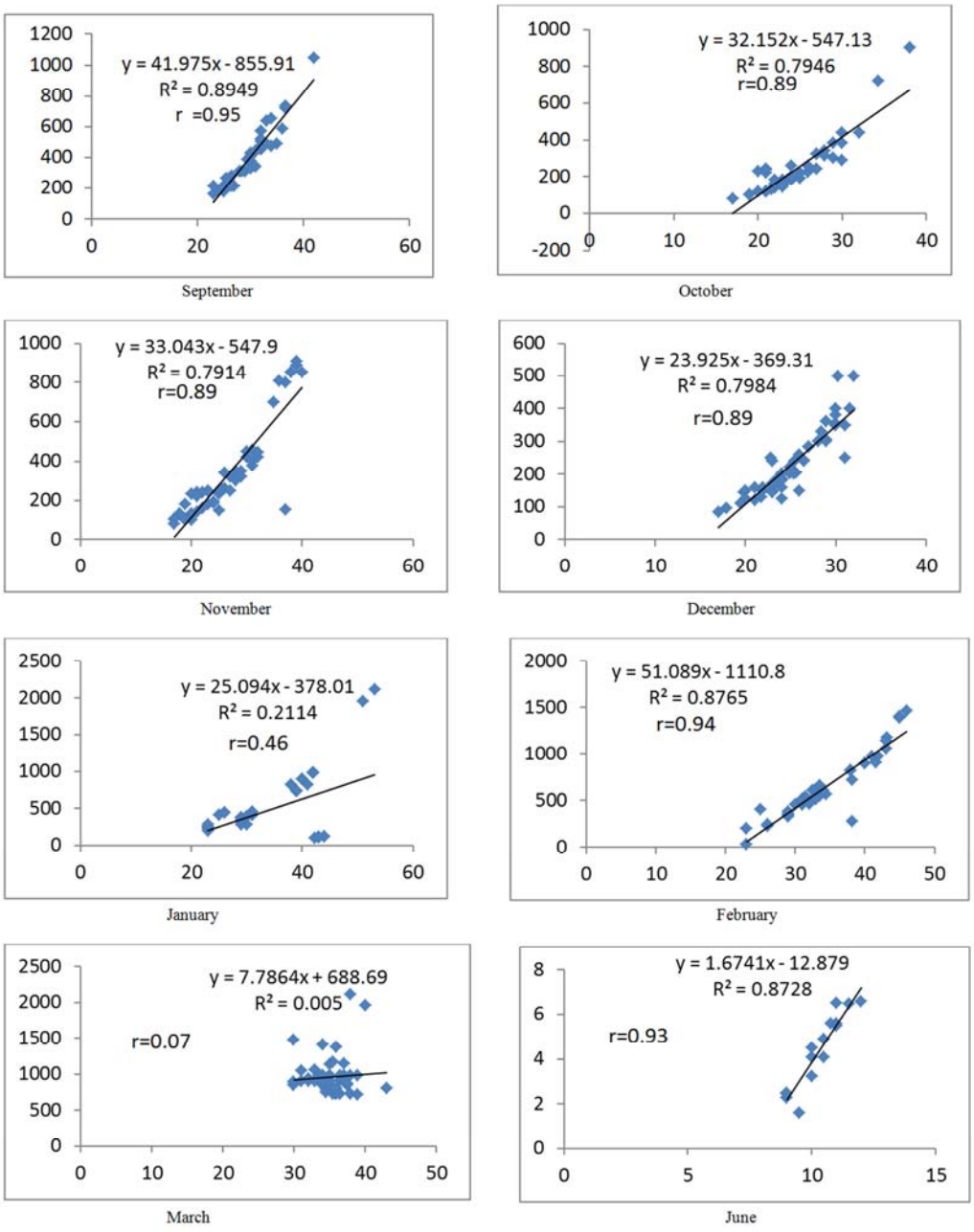

Figure 12. Relation between total length and body weight of sea bass in Kokko Tan.

Table 6. Correlation coefficient of sea bass in Kokko Tan and Kyuntone.

Months	KK		KT	
	Coefficient of determination	Coefficient of correlation	Coefficient of determination	Coefficient of correlation
Sept	0.71	0.85	0.89	0.95
Oct	0.41	0.64	0.79	0.89
Nov	0.89	0.95	0.79	0.89
Dec	0.76	0.87	0.79	0.89
Jan	0.84	0.92	0.21	0.46
Feb	0.61	0.78	0.81	0.94
March	0.37	0.61	0.01	0.07
June	0.50	0.71	0.87	0.93

The length weight relationship of sea bass in Kokko Tan of September, October, November, December, January, February, March and June revealed the coefficient of determination (R^2) were (0.71), (0.41), (0.89), (0.76), (0.84), (0.61), (0.37) and (0.50) with the coefficient of correlation (r) were (0.85), (0.64), (0.95), (0.87), (0.92), (0.78), (0.61) and (0.71). Therefore, September, November, December, January, February were strong positive correlation and October, March and June were moderately positive correlation between length and body weight of sea bass (Table 6 and Figure 11).

In Kyuntone, length weight relationship of sea bass in September, October, November, December, January, February, March and June revealed the coefficient of determination (R^2) were (0.89), (0.79), (0.79), (0.79), (0.21), (0.88), (0.01) and (0.87) with the coefficient of correlation (r) were (0.95), (0.89), (0.89), (0.89), (0.46), (0.94), (0.07) and (0.93). So, September, October, November, December, February and June were strong positively correlated. January was moderately positive correlation and March was very weak positively correlated (Table 6 and Figure 12).

Figure 13. Utilizing fishing gear of sea bass in study areas.

In figure 13, utilize fishing gear of sea bass in both villages were stow net (Kyar pa zat pike) with 5 - 15 cm, set gill net (Tar pike) with 5 - 12.5 cm, drift gill net (Hmaw pike) 5 - 12.5 cm, cast net (lat pyit kyun) 2.2 - 5.5 cm of raining season (June - August). In cold season of (Sept - Dec) utilize the gill net (swae pike) 5 - 15 cm. In dry season, fisher were moved to the joint area of Sittaung river and in the shallow water of near the Gulf area utilize fishing gear are depend on the water level such as cast net (lat pyit kyun) 2.2 - 5.5 cm and set gill net (Tar pike) with 5 - 12.5 cm,gill net (swae pike) 5 - 15 cm (Figure 13).

4. Sea Bass Trading and Value Chain

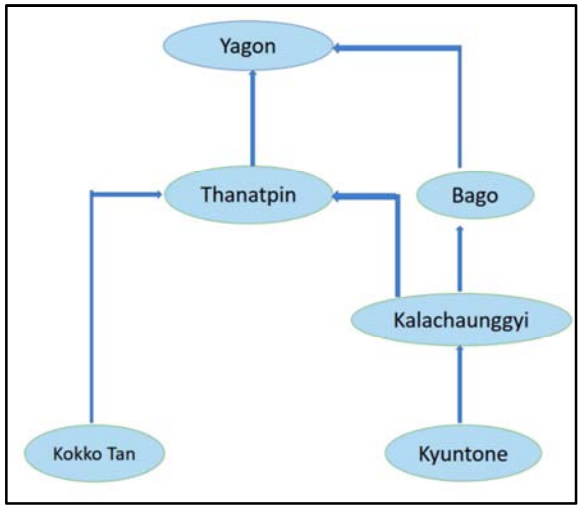

Figure 14. Value Chain of Sea bass.

Fishermen daily catch fish in GoMW to sell their local dealers in their village, or neighbouring villages. Among many species of wetland fishes, Sea bass (Ka-kadit) is the high price fish in Myanmar and 87% of fish eater are favor to eat sea bass (ka-kadit) due to its yummy taste and thus sea bass becomes one of the important commercial fish species for increasing demand of fish eaters. Moreover, sea bass or barramundi or Lates calcarifer [14, 35, 61, 64, 74, 84-87, 97, 122, 125, 156,160] is a commercially valuable, carnivorous, marine teleost fish, the largest order of vertebrates, comprising ~40% of all bony fishes (e.g., cichlids, sunfishes/bluegills,

damselfishes, basses, and perches) and a wide geographic distribution [101, 150, 158]. Dealers usually give advances money and in this way the fishers are fixed with their dealer. Although the fishermen were sometime sell to the other dealers. The small-scale village dealers buy the sea bass from regular of about 20 fishers in Kokko Tan that operates on a large scale sending to their fishes to Bago Division. The next way is sent to Yangon Division, the main international trading place of Myanmar. In time of wild pond harvest, some fish owner directly sent to Bago Division or Yangon Division. There is no small scale fish collector in Kyuntone. So, the small-scale neighbouring villages of Kalachaungyi dealers were buys sea bass and others fishes from approximately 15 fisher regularly in kyuntone. The next way is Kyuntone to Thanatpin Township and Bago Division. The third way is Thanatpin and Bago sell to Yangon (Figure 14). Sea bass is the highest price in Yangon.

5. Discussion

During the study period, the largest number of fish in the 31-35 cm category were found in Kyuntone in January to March while very few were found in Kokko Tan. Fish > 35cm were found in Kyuntone during January to March, while only a very few where found in Kokko. The largest size 39-47 cm that will not found at Kokko Tan. This may be suggest that size range of sea bass in Kyuntone was larger than in Kokko Tan (Table 1, Figures 4, 5, 6).

In Kokko Tan, mean value of standard length and body weight were highest in March (32.70±1.58, 660.7±112.23). The mean value of standard length was peak in January (31.39±7.16) but mean value of body weight were peak in March (963.24±280.86) in Kyuntone. According to this point, sea bass were nearly mature and migrate to spawning ground. The lowest mean value of standard length and body weight were found in June (12.62±4.78, 87.33±66.62), (9.07 ±0.85, 43.97 ±16.66) in Kokko Tan and Kyuntone. This may be due to young specimens were returned from sea to freshwater to spend most of their lives (Table 2, Figure 7).

According to the invoice data revealed that monthly catch weight of sea bass is most abundance in October (829.92) kg in Kokko, (339.12) kg in Kyuntone. October was nearly end of the raining season, in all channels, creeks and lakes were shallow water. So, fishes are caught more readily in October when the water level is low. Moreover, Wild ponds were start harvest in this month. The lowest in March (22.4) kg in Kokko and (48.52) kg in Kyuntone. It may be due to migrate to the sea to breed (Table 3, Figure 8).

Based on price of relations to size group, small size C < 300g (41%) was mostly abundance in Kokko and in Kyuntone small size C< 300g (35%) was second abundance. Size group C included very small specimens of under 165g. This size is prohibited by Department of fishery therefore this size should not be catched and follow the law of fisheries especially during the breeding season of April to July (Table 4, Figure 9).

According to the recorded data, prices of all size groups A>600g, B300-600g, C <300 were highest in March (6825, 5958.33, 48750) MMK/kg in Kokko and (7280, 6120, 5281.25) MMK/kg in Kyuntone. Lowest price of A, B, C were observed in October (4296.72, 3224.67, 2441.11) MMK/kg in Kokko and (3075, 2502.5, 1755) MMK/kg in November, respectively. Price sizes of Kokko and Kyuntone were fluctuated for every month. This may be dependent on daily catch weights of two villages (Table 5, Figure 10).

Specimens were not landed in April and May. They migrate to spawn to the sea in these months [48-50, 71, 98, 138]. Very small specimens were often observed with tides in April and May informed by local fisherman. In June, young specimens were very rarely seen in both study sites.

Lates calcarifer is Catadromous migrating to the mouth of the river and estuaries in order to breed [95, 96, 109, 131, 152]. There is one spawning season per year towards the end of the dry season and the beginning of raining season in the period from October to February [96]. In this study, the findings are not coincide with the finding of above authors. This may be due to the environmental difference of studied areas.

April and May is the onset of breeding season in sea bass and June is start growing months; onset of the raining season and coincide with the spawning period. For the sustainability of sea bass, should be aware of knowledge sharing to local people especially fisherman focus on breeding season to follow ‘the fishery act’ by Department of fishery and participate in conservation management.

6. Conclusions

Sea bass is the most popular commercial fish in South East Asia and the Gulf of Mottama Wetland (GoMW) is suitable habitat for sea bass. In this study, Kokko Tan village is nearer GoMW than Kyuntone village and both villages are prior to fishery and cultivation on farmland. Wetland fish species are valuable for both conservation ecosystem service and commercial status and they are main sources of food. In Myanmar, see bass is one of highest price fishes and this see bass species have traded internationally. During the study period in the study place, five kinds of fishing gears were founded. The population of see bass in Kokko Tan village is higher than in Kyune Tone village. In October, the catch weight of see bass is the highest abundance along the Gulf of Mottama in Myanmar.

Author Contributions

Conceptualization, P. M.; methodology, P. M. and S. M. H.; software, P. M.; validation, K. S. W and N. N. M; resources, P. M. and K. S. W.; data curation, S. M. H, C. H and H. L.; writing—original draft preparation, P. M.; writing—review and editing, P. M and C. H.; supervision, C. H and K. S. W. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declared that there is no potential conflicts of interest with this research, authorship and publication of this article. The authors took the responsibilities, concerning with our research.

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References

[1] Aarif, K. M.; Nefla, A.; Muzaffar, S. B.; Musammilu, K. K and Prasadan, A. 2017. Traditional fishing activities enhance the abundance of selected waterbird species in a wetland in India. *Avian Res* 8: 1-10, doi: https://doi.org/10.1186/s40657-017-0073-6

[2] Abraha, B.; Admassu, H.; Mahmud, A.; Tsighe, N.; Shui, X. W and Fang, Y. 2018. Effect of processing methods on nutritional and physico-chemical composition of fish: a review. MOJ Food Process Technol 6 (4): 376-382, doi: 10.15406/mojfpt.2018.06.00191.

[3] Alain Lambert, Economic Valuation of Wetlands: an Important Component of Wetland Management Strategies at the River basin Scale, May 2003, 1-10, Available online: http://webcache.googleusercontent.com/search?q=cache:p3FNj8UQjFcJ:www.unepscs.org/Economic_Valuation_Training_Materials/06%2520Readings%2520on%2520Economic%2520Valuation%2520of%2520Coastal%2520Habitats/07-Economic-Valuation-Wetlands-Management.pdf+&cd=1&hl=en&ct=clnk&gl=mm&client=firefox-b-d, (accessed on 18 February 2021).

[4] A. Lawrence Kolz and J. B. Reynolds. Electrofishing, January 2012, Available online: https://www.researchgate.net/publication/280600972_Electrofishing, (accessed on 18 February 2021).

[5] Alleyne, H. G and Macleay, W. 1877. The ichthyology of the Chevert expedition. Proceedings of the Linnean Society of NewSouth Wales 1: 261–281, 321–359, Pls. 3–9, 10–17, doi: https://doi.org/10.5962/bhl.part.12420

[6] Al-Tobasei, R., Ali, A., Garcia, A. L. S., Lourenco. D., Leeds. Tim., and Salem. M. 2021. Genomic predictions for fillet yield and firmness in rainbow trout using reduced-density SNP panels. *BMC Genomics* 22, 92, doi: https://doi.org/10.1186/s12864-021-07404-9, Available on: https://bmcgenomics.biomedcentral.com/articles/10.1186/s12864-021-07404-9

[7] Angela H. Arithington, Nicholas K. Dulvy, William Gladstone, Ian J. Winfield. 2016. Fish conservation in freshwater and marine realm: status, threats and management, 28, September, 2016, 26 (5): 838-857, doi: https://doi.org/10.1002/aqc.2712, Available online: https://onlinelibrary.wiley.com/doi/full/10.1002/aqc.2712

[8] Asian Biodiversity outlook 2, 14, August, 2017, Available online: https://issuu.com/acb_abo2/docs/asean_biodiversity_outlook_2_b1e2a2a6646bd6 (accessed on 18 February 2021).

[9] Barrett, R. D. H and Hebert, P. D. N. (2005). Identifying spiders through DNA barcodes. *Can. J. Zool* 83: 481–491, doi: 10.1139/z05-024.

[10] Basheer, V S and Vineesh, N and Bineesh, K K and Kumar, Rahul G and Mohitha, C and Venu, S and Kathirvelpandian, A and Gopalakrishnan, A and Jena, J K. 2017. Mitochondrial signatures for identification of grouper species from Indian waters. Mitochondrial DNA, 28 (4): 451-457, Available online: http://eprints.cmfri.org.in/view/creators/Basheer=3AV_S=3A=3A.html

[11] Bhatia, U and Kungvankij, P. 1971. Distribution and abundance of seabass fry in coastal area of the province facing Indian Ocean. *Annual report*, Phuket Marine Fisheries Station. 14p

[12] Bishnu B. Bhandari Reiko Nakamura Amado S. Tolentino and Jr. Shiina Suzuki. 2014. Catalyzing the Wise Use of Wetlands in Myanmar: Efforts and Ways Forward, Ramsar Center Japan, Available online: http://rcj.o.oo7.jp/english/Myanmar%20Report.pdf, (accessed on 18 February 2021).

[13] Bloch, M. E. (1787) Naturgeschichte der ausländischen Fische, vol. 3. Berlin, i–xii + 1–146, Pls. 181–216.

[14] Bloch, M. E. (1790) Naturgeschichte der ausländischen Fische. Morino, Berlin. Vol. 4, i–xii+1–128, Pls. 217–252. Bloch, M. E. (1797) Ichthyologie, ou Histoire naturelle, générale et particulière des poissons. Avec des figures enluminées dessinées d'apres nature, part 7. Published by the author, Berlin

[15] Bloch, M. E. & Schneider, J. G. (1801) M. E. Blochii, Systema Ichthyologiae iconibus cx illustratum. Post obitum auctoris opus inchoatum absolvit, correxit, interpolavit Jo. Gottlob Schneider, Saxo. Berolini, lx + 584 pp., 110 pl

[16] Bouvier LD, Cottenie K, Doka SE. 2009. Aquatic connectivity and fish metacommunities in wetlands of the lower Great Lakes. Can J Aquat Sci 66: 993-948, doi: https://doi.org/10.1139/F09-050

[17] Bruton, M. N and Jackson, P. B. N. 2010. FISH AND FISHERIES OF WETLANDS, Journal of the Limnological Society of Southern Africa, Oct 2010, 123-133, doi: 10.1080/03779688.1983.9632865.

[18] CCFFRR Program, Available online: http://www.phys.ocean.dal.ca/ccffr/images/CCFFR-SCL%20abstracts.doc (accessed on 18 February 2021).

[19] Charles A. Rewa. 2007. Fish and Wildlife Benefits Associated with Wetland Establishment Practices, The Wildlife Society Technical Review 07 (1): 71-82, Available online: https://www.fsa.usda.gov/Internet/FSA_File/chap_5.pdf

[20] Charlie, What does Sea bass Taste like?, 2, March, 2021, Available online: https://preparedcooks.com/what-does-sea-bass-taste-like/

[21] Chassaing, O., Hanni, C., and Berrebi, P. (2011). Distinguishing species of European sturgeons *Acipenser spp*. using microsatellite allele sequences. *J. Fish Biol* 78: 208–226. doi: 10.1111/j.1095-8649.2010.02852.x

[22] Chen, I.-C., Hill, J. K., Ohlemüller, R., Roy, D. B and Thomas, C. D. 2011. Rapid range shifts of species associated with high levels of climate warming. Science 333 (6045): 1024–1026, doi: https://doi.org/10.1126/ science.1206432.

[23] Chen, W.-J., and Mayden, R. L. 2010. A phylogenomic perspective on the new era of ichthyology. *BioScience* 60: 421–432, doi: 10.1525/bio.2010.60.6.6

[24] Chou, R., and Lee, H. B. 1997. Commercial marine fish farming in Singapore. *Aquacult. Res* 28: 767–776, doi: 10.1111/j.1365-2109.1997.tb01001.x

[25] Christoph Zöckler, Enhancing the conservation of wetlands in Myanmar: the government designates part of the Gulf of Mottama [EAAF117] in Mon State as Myanmar's fourth Ramsar site, January 2017, Available online: https://www.m-h-s.org/media/gom_ramsar_designation_article.pdf (https://www.eaaflyway.net/enhancing-the-conservation-of-wetlands-in-myanmar-the-government-designates-part-of-the-gulf-of-mottama-eaaf117-in-mon-state-as-myanmars-fourth-ramsar-site/, (accessed on 18 February 2021).

[26] Christoph Zöckler. Nature-tourisms in Myanmar, Arccona Consulting, Retrieved from: https://www.ltandc.org/wp-content/uploads/2015/01/Myanmar-nature-tourism1.pdf

[27] Co- Chair of the working group, 2020. Scientific Publications, Available online: https://www.ccacoalition.org/en/content/co-chairs-working-group, (accessed on 18 February 2021).

[28] Collazo, Jaime A., James F. Gilliam, and Leopoldo Miranda-Castro. 2010. "Functional Response Models to Estimate Feeding Rates of Wading Birds." Waterbirds: The International Journal of Waterbird Biology 33 (1): 33-40. Accessed March 8, 2021. Available online: http://www.jstor.org/stable/40660949

[29] Constantinos C. Mylonas, Fernando De La Gándara, Aldo Corriero & Antonio Belmonte Ríos, Atlantic Bluefin Tuna (Thunnus Thynnus) Farming and Fattening in the Mediterranean Sea, Available online: https://www.researchgate.net/publication/232733763_Atlantic_Bluefin_Tuna_Thunnus_Thynnus_Farming_and_Fattening_in_the_Mediterranean_Sea, (accessed on 18 February 2021).

[30] Cuvier, G. 1816. Le Règne Animal distribu d'après son organisation pour servir de base l'histoire naturelle des animaux et d'introduction l'anatomie comparée. Les reptiles, les poissons, les mollusques et les annélides. Deterville, Paris. Vol. 2, i–xviii+1–532

[31] Cuvier, G. & Valenciennes, A. 1828. Histoire naturelle des poissons. Tome second. Livre Troisième. Des poissons de la famille des perches, ou des percoïdes. Levrault, Paris. i–xxi+2+1–490.

[32] Cynthia A, Paszkowski, William M. Tonn. 2000. Community concordance between the fish and aquatic birds of lakes in northern Alberta, Canada: the relative importance of environmental and biotic factors 43 (3): 421-437, doi: https://doi.org/10.1046/j.1365-2427.2000.00512.x

[33] Danone, World Wetlands Day 2007- Fish For Tomorrow, Retrieved From: https://www.ramsar.org/sites/default/files/documents/library/wwd2007_leaflet_e.pdf.

[34] da Silva, H. P., Petry, A. C and da Silva, C. J. 2010. Fish communities of the Pantanal wetland in Brazil: evaluating the effects of the upper Paraguay river flood pulse on baía Caiçara fish fauna. Aquat Ecol 44: 275–288, doi: https://doi.org/10.1007/s10452-009-9289-9

[35] DeAngelis, D. L., J. C. Trexler and W. F. Loftus. 2005. Life history trade-offs and community ddynamics of small fishes in a seasonally pulsed wetland. Canadian Journal of Fisheries and Aquatic Sciences 62 (4): 781-790, Available online: https://digitalcommons.fiu.edu/fce_lter_journal_articles/71/

[36] Deepikaawasthi, The variety of Flora and Fauna in an area, 31, August, 2020, Available online: https://brainly.in/question/21885611, (accessed on 18 February 2021).

[37] Digital Collection, Course booklet, Portal Arizon. 2011, Available online: https://digital.lib.usf.edu/SFS0046442/00001, (accessed on 18 February 2021).

[38] Dr. Bishnu B. Bhandari, Ms. Reiko Nakamura, Mr. Kimihiko Maekawa and Dr. Pyae Phyo Aung. 2017. Rapid Assessment of the Gulf of Mottama (East Coast), Ramsar Center Japan & Biodiversity & Nature Conservation Association 2017, 1-20, Available online: https://cdn.myanmarseo.com/file/client-cdn/banca/wp-content/uploads/2018/05/rapid-assessment-of-the-gulf-of-mottama.pdf

[39] Dr. Panwad Wongthong and Dr. James True. 2015. Community-Led Coastal management in the Gulf of Mottama Project (CLCMGoMP), Updated situation analysis of the Gulf of Mottama, Based on the rapid socio-ecological assessment, September, 2015, 1-40, Available online: https://themimu.info/sites/themimu.info/files/assessment_file_attachments/CLCMGoMP_IUCN_O3_Ecology_Assessment_Report_FinalDraft_Sep2015.pdf, (accessed on 18 February 2021).

[40] Ecosystem and Human Well-Being: Wetlands and Water Synthesis. 2005. A Report of the Millennium Ecosystem Assessment Hardcover, Available online: https://www.amazon.com/Ecosystems-Human-Well-Being-Millennium-Assessment/dp/1569735972, (accessed on 18 February 2021).

[41] EPA, May 2006, Economic Benefits of Wetlands, United States Environmental Protection Agency, Available online: https://www.epa.gov/sites/production/files/2021-01/documents/economic_benefits_of_wetlands.pdf, (accessed on 18 February 2021).

[42] ERSS, Barramundi (Lates calcarifier), U.S. Fish and Wildlife Service, Ecological Risk Screening Summary, 13, Sep, 2017, Retrieved from https://www.fws.gov/fisheries/ans/erss/uncertainrisk/Lates-calcarifer-ERSS-FINAL.pdf, (accessed on 18 February 2021).

[43] Eschmeyer, W. N. (ed.), 2011, Catalog of Fishes, electronic version. Retrieved from: http://www.fao.org/fishery/culturedspecies/Lates_calarifer/en, (accessed on 18 February 2021).

[44] Family Latidae – Lates perches, Available online: https://www.fishbase.se/summary/FamilySummary.php?ID=631, (accessed on 18 February 2021).

[45] Fishbase.org. summary. *Lates-calcarifer,* Barramundi: Fisheries, aquaculture, game fish.... Fish base, Available online: https://www.fishbase.se/summary/Lates-calcarifer.html

[46] Fishbase References Starting with 'M', Available online: http://wpbp.sinica.edu.tw/ListByLetter/FBReferencesM.htm, (accessed on 18 January 2021).

[47] Fulton-Howard, B. 2008. "Lates calcarifer" (On-line), Animal Diversity Web. https://animaldiversity.org/accounts/Lates_calcarifer/, (accessed on 18 January 2021).

[48] Grace Mathew. 2009. Taxonomy, identification and biology of Seabass (Lates calcarifer), National Training on 'Cage Culture of Seabass' held at CMFRI, Kochi, 38-43, Available online: http://eprints.cmfri.org.in/6062/1/7._Gra.pdf

[49] Garcia, L. M. B. (1989a). Dose-dependent spawning response of mature female seabss, *Lates calcarifer* (Bloch), to pelleted luteinizing hormone-releasing hormone analogue (LHHa). *Aquaculture* 77: 85-96

[50] Garcia, L. M. B. (1989b). Spawning response of mature female seabass, *Lates calcarifer* (Bloch, 1790) to a single injection of luteinizing hormone releasing hormone analogue and methyltestosterone. *Journal of Applied Icthyology* 5: 155-184.

[51] GRENADA, Economy, Citizenship by investment. Available online: https://www.cbi.gov.gd/why-grenada/economy/, (accessed on 18 January 2021).

[52] Global New Light of Myanmar, Article, 10 May 2007, Myanmar, Available online: https://issuu.com/myanmarnewspaper/docs/10_may_17_gnlm, (accessed on 18 January 2021).

[53] Guiguen, Y., C. Cauty, A. Fostier, J. Fuchs, and B. Jalabert. 1993. Reproductive cycle and sex inversion of the seabass, Lates calcarifer, reared in sea cages in French Polynesia: histological and morphometric description. Environmental Biology of Fishes 39 (3): 231- 247

[54] Gulf of Mottama Project (GoMP), Sustainable and wise use of wetland area for benefits of community livelihoods and conservation of coastal natural resources in the Gulf of Mottama, Myanmar, Helvetas Swiss Intercooperation: the international Union for Conservation of Nature (IUCN), Network Activities Group (NAG), Biodiversity and Nature Conservation Association (BANCA), Available online: https://www.eda.admin.ch/dam/countries/countries-content/myanmar/en/helvetas-gulf-of-mottama-2018.pdf, (accessed on 18 January 2021).

[55] Gulf of Mottama, Management Plan, May, 2019, Available online: https://rsis.ramsar.org/RISapp/files/39465170/documents/MM2299_mgt191206.pdf, (accessed on 18 January 2021).

[56] Hamilton, F. 1822. An account of the fishes found in the river Ganges and its branches. Edinburgh & London, i–vii+1–405, pls. 1–39, doi: https://doi.org/10.5962/bhl.title.6897

[57] Hamre, J. 1994. Biodiversity and exploitation of the main fish stocks in the Norwegian - Barents Sea ecosystem. Biodivers Conserv 3: 473–492, doi: https://doi.org/10.1007/BF00115154

[58] He-Bo Peng.; Guy Q. A.; Anderson., Qing Chang.; Chi-Yeung Choi.; Sayam U. Chowdhury.; Nigel A. Clark.; Xiaojing Gan.; Richard D. Hearn.; and et al. 2017. The intertidal wetlands of southern Jiangsu Province, China – globally important for Spoon-billed Sandpipers and other threatened waterbirds, but facing multiple serious threats, Bird Conservation International 27 (3): 305–322, doi: https://doi.org/10.1017/S0959270917000223, Available online: https://www.researchgate.net/publication/318594457_The_intertidal_wetlands_of_southern_Jiangsu_Province_China_-_globally_important_for_Spoon-billed_Sandpipers_and_other_threats.

[59] Hickling, R.; Roy, D. B.; Hill, J. K.; Fox, R and Thomas, C. D. 2006. The distributions of a wide range of taxonomic groups are expanding polewards. Global Change Biology 12 (3): 450–455. doi: https://doi. org/10.1111/j.1365-2486.2006.01116.x

[60] Husson Bérengè.; Certain Gregoire and Filin Anatoly. 2020. Planque Benjamin Suitable habitats of fish species in the Barents Sea. BioRxiv IN PRESS. Publisher's official version: https://doi.org/10.1101/2020.01.20.912816, Open Access version: https://archimer.ifremer.fr/doc/00605/71682/

[61] Hu, Q.; Wen, Y.; Yu, G.; yin, J.; Guan, H.; Lv, L.; Wang, P.; Xu, J.; Wang, Y.; Zhand, Z and *et al.* 2020. Research activity does not affect nest predation rates of the Silver-throated Tit, a passerine bird building domed nests. *Avian Res* 11, 28: 1-10, doi: https://doi.org/10.1186/s40657-020-00214-9, Available on: https://avianres.biomedcentral.com/articles/10.1186/s40657-020-00214-9

[62] Irmawati Irmawati1.; Moh. Tauhid Umar1.; Aidah Ambo Ala Husain.; Asmi Citra Malina.; Nadiarti Nurdin Kadir and Alimuddin Alimuddin, 2020. Distribution and characteristics of Asian seabass (Lates calcariferBloch, 1790) in South Sulawesi, The 3rd International Symposium Marine and Fisheries (ISMF) 2020, IOP Conf. Series: Earth and Environmental Science564 (2020) 012011: 1-8, doi: 10.1088/1755-1315/564/1/012011

[63] Jan-Olaf Meynecke.; Geoffrey C. Poole.; Jonathan Werry and Shing Yip Lee. 2008. Use of PIT tag and underwater video recording in assessing estuarine fish movement in a high intertidal mangrove and salt marsh creek, Estuarine, Coastal and Shelf Science 79 (1): 168-178, ISSN 0272-7714, doi: https://doi.org/10.1016/j.ecss.2008.03.019 Available on: https://www.sciencedirect.com/science/article/pii/S0272771408001406.

[64] Jeffery A. Zinn and Claudia Copeland, CRS Report for Congress, Wetlands: An overview of Issues, Congressional Research Service, 26, July, 2007, Available online: https://www.countyofsb.org/ceo/asset.c/508, (accessed on 18 January 2021).

[65] Jerome J. Lorenz.; Brynne Langan-Mulrooney.; Peter E. Frezza.; Rebecca G. Harvey and Frank J. Mazzotti. 2008. Roseate spoonbill reproduction as an indicator for restoration of the Everglades and the Everglades estuaries, 9 (6): S96-S107, doi: 10.1016/j.ecolind.2008.10.008, Available on: https://www.researchgate.net/publication/222430492_Roseate_spoonbill_reproduction_as_an_indicator_for_restoration_of_the_Everglades_and_the_Everglades_estuaries

[66] Jérôme Pelenc and Jérôme Ballet. 2015. Strong sustainability, critical natural capital and the capability approach (2015) *Ecological Economics* 112: 36-44, doi: https://doi.org/10.1016/j.ecolecon.2015.02.006, Available on: https://www.researchgate.net/publication/284078771_Strong_sustainability_and_critical_natural_capital

[67] Kaller M. D.; Kelso W.E and Trexler J. C. 2013. Wetland Fish Monitoring and Assessment. In: Anderson J., Davis C. (eds) Wetland Techniques. Springer, Dordrecht 197-263, doi: https://doi.org/10.1007/978-94-007-6931-1_6

[68] Kelvin S. H. Peh.; Jennifer C. Merriman.; Thiri Dae We Aung.; Saw Mon Theint.; Natsuki Murata and Keiko Suzue. 2015. Economic Valuation of Moeyungyi Wetland, Rapid ecosystem services assessment of Moeyungyi Wetland, Myanmar, BirdLife International, Tokyo, Japan, March, 2015, Available online: https://cdn.myanmarseo.com/file/client-cdn/banca/wp-content/uploads/2020/09/Economic-Valuation-of-Moeyungyi-Wetland-Myanmar_compressed.pdf, (accessed on 18 December 2020).

[69] Kewal Prasad Bhandari (2018), Development Partner Profile 20180406054531 Available online: https://www.scribd.com/document/396881379/Development-Partner-Profile-20180406054531, (accessed on 18 February 2021).

[70] Kungvankij (1981). Seed production of seabass. *Satun Fisheries Station. Contribution* No. 1. Satun, Thailand. 15p

[71] Kungvankij, P. 1987. Induction of spawning of seabass (Lates calcarifer) by hormone injection and environmental manipulation. In: J. W. Copland and D. L. Grey (eds.). Management of Wild and Cultured Seabass / Barramundi (Lates calcarifer). Australian Centre for International Agricultural Research, Canberra, 120-122.

[72] Lacepède, B. G. E. 1802. Histoire naturelle des poissons. Paris, Plassan. Vol. 4, i–xliv+1–728, Pl. 1–16

[73] Lakerveld, J.; van der Ploeg, H. P.; Kroeze, W and *et al.* 2014. Towards the integration and development of a cross-European research network and infrastructure: the DEterminants of DIet and Physical ACtivity (DEDIPAC) Knowledge Hub. *Int J Behav Nutr Phys Act* 11: 143: 1-10, doi: https://doi.org/10.1186/s12966-014-0143-7, Available online: https://ijbnpa.biomedcentral.com/articles/10.1186/s12966-014-0143-7

[74] Lates, Entymology, Scientific classification, Available online: https://www.h4ckerz.com/Lates, (accessed on 18 February 2021).

[75] Lin, Y.-A.; Chu, P.-Y.; Ma, W.-L.; Cheng, W.-C.; Chan, S.-T.; Yang, J.-C and Wu, Y.-C. 2021. Enzyme-Digested Peptides Derived from Lates calcarifer Enhance Wound Healing after Surgical Incision in a Murine Model. Mar. Drugs2021, 19 (3): 154, 1-13 doi: https://doi.org/10.3390/md19030154, Available online: https://www.mdpi.com/1660-3397/19/3/154/pdf

[76] Lenoir, J.; Bertrand, R.; Comte, L.; Bourgeaud, L.; Hattab, T.; Murienne, J and Grenouillet, G. 2020. Species better track climate warming in the oceans than on land. Nature Ecology & Evolution 4: 1044-1059, doi: https://doi.org/10.1038/s41559-020-1198-2

[77] Lorenz, J. J and Serafy, J. E. 2006. Subtroprical wetland fish assemblages and changing salinity regimes: Implications for everglades restoration. Hydrobiologia 569: 401–422. doi: https://doi.org/10.1007/s10750-006-0145-9

[78] L Venkatachalam. 2004. Contingent valuation method: a review: Environmental Impact Assessment Review [Environ. Impact Assess. Rev.] 24 (1): 89-124, doi: 10.1016/S0195-9255(03)00138-0, Available online: https://www.researchgate.net/publication/222433375_The_contingent_valuation_method_a_review_Environ_Impact_Asses s_Rev

[79] Madhu Rao.; Alan Rabinowitz and Saw Tun Khaing. 2002. Status Review of the Protected-Area System in Myanmar, with Recommendations for Conservation Planning, Conservation Biology 16 (2): 360-368, doi: 10.1046/j.1523-1739.2002.00219.x, Available online: https://www.researchgate.net/publication/229556820_Status_Review_of_the_Protected-Area_System_in_Myanmar_with_Recommendations_for_Conservation_Planning

[80] Mauricio A Urbina.; Malcolm E Forster and Chris N Glover. 2011. Leap of faith: voluntary emersion behavior and physiological adaptations to aerial exposure in a non-aestivating freshwater fish in response to aquatic hypoxia, 3, May, 2011; 103 (2): 240-7, doi: 10.1016/j.physbeh.2011.02.009. Available online: https://www.researchgate.net/publication/49831520_Leap_of_faith_Voluntary_emersion_behaviour_and_physiological_adaptations_to_aerial_exposure_in_a_non-aestivating_freshwater_fish_in_response_to_aquatic_hypoxia

[81] MC Cormier-Salem and J Panfili. 2016. Mangrove reforestation: greening or grabbing coastal zones and deltas? Case studies in Senegal, African Journal of Aquatic Science, 41 (1): 89-98, doi: 10.2989/16085914.2016.1146122, Available online: https://www.researchgate.net/publication/299416773_Mangrove_reforestation_greening_or_grabbing_coastal_zones_and_deltas_Case_studies_in_Senegal

[82] Myat Moe Aung, 3, February 2020, EPA, Gulf of Mottama Wetland more than triples in size as newest Ramsar. Available online: https://www.mmtimes.com › news, https://www.mmtimes.com/news/gulf-mottama-wetland-more-triples-size-newest-ramsar-site.html, (accessed on 18 February 2021).

[83] Myat Moe Aung, Our Wetlands are worth saving, Available online: https://www.mmtimes.com/news/our-wetlands-are-worth-saving.html, (accessed on 18 February 2021).

[84] Macleay, W. 1878. The fishes of Port Darwin. Proceedings of the Linnean Society of New South Wales, 2, 344–367, Pls. 7–9

[85] Matishov, G.; Moiseev, D.; Lyubina, O.; Zhichkin, A.; Dzhenyak, S.; Karamushko, O and Frolova, E. 2012. Climate and cyclic hydrobiological changes of the Barents Sea from the twentieth to twenty-first centuries. Polar Biol 35: 1773-1790. doi: https://doi.org/10.1007/s00300-012-1237-9, Available online: https://link.springer.com/article/10.1007/s00300-012-1237-9

[86] MacKay KT. 2017. Introduction and review of research on the Gulf of Mottama: Environment and Fishery. Community-Led Coastal Management in the Gulf of Mottama Project, Available online: https://nagmyanmar.org/wp-content/uploads/2020/09/Paper-on-Co-Management-in-GOM_-full-version.pdf, (accessed on 18 February 2021).

[87] MacKay KT and Soe Min Oo. 2017. Illegal fishing with small mesh stake nets (Than Za Gar Pike) catching small fish: A case study. Community-Led Coastal Management in the Gulf of Mottama Project. Available online: http://webcache.googleusercontent.com/search?q=cache:vI6Jh40Acj8J:themimu.info/sites/themimu.info/files/assessment_file_attachments/GoMP_Report0617_Illegal_Fishing_with_Small_Mesh.pdf+&cd=1&hl=en&ct=clnk&gl=mm&client=firefox-b-d, (accessed on 18 February 2021).

[88] MatAmin, A. R.; Ahmad, F.; Mamat, M.; Abdullah, K and Harun, S. 2015. Remote sensing of suspended sediment over Gulf of Martaban. Ekológia (Bratislava) 34 (1): 54-64.

[89] Millennium Ecosystem Assessment (Ed). 2005. Ecosystems and human well-being: wetlands and water synthesis: a report of the Millennium Ecosystem Assessment. Washington, DC: World Resources Institute, Corup ID: 131450815, doi: 10.1515/eko-2015-0006, (accessed on 18 February 2021).

[90] McNeil DG and Closs GP. 2007. Behavioral responses of a south-east Australian floodplain fish community to gradual hypoxia. Freshw Biol 52: 412-420. doi: https://doi.org/10.1111/j.1365-2427.2006.01705.x

[91] MDFRC (2013) Long-term Intervention Monitoring - Generic Cause and Effect Diagrams Final Report prepared for the Commonwealth Environmental Water Office by The Murray-Darling Freshwater Research Centre, MDFRC Publication 01.5/2013, May, 163pp. Available online: https://www.environment.gov.au/system/files/resources/5c555077-ecca-4e3d-8f15-87f9d17bd75c/files/ltim-project-cause-and-effect-diagrams.docx

[92] Melissa Nursey-Bray, Research Profile, Available online: https://researchers.adelaide.edu.au/profile/melissa.nursey-bray, (accessed on 18 February 2021).

[93] Michael Sinclair.; M. K. Vishnu Sagar.; Camilla Knudsen.; Joseph Sabu and Andrea Ghermandi. 2021. Economic appraisal of ecosystem services and restoration scenarios in a tropical coastal Ramsar wetland in India, February, 2021, 47: 1-12, doi: https://doi.org/10.1016/j.ecoser.2020.101236, Available online: https://www.sciencedirect.com/science/article/pii/S2212041620301789

[94] Min Moe, Myanmar- Scoping paper, Myanmar Coastal Zone Management 21113 96dpi, Available online: https://www.scribd.com/document/252202262/Myanmar-Scoping-Paper-Myanmar-Coastal-Zone-Management-211113-96dpi, (accessed on 18 February 2021).

[95] Moore, R and Reynold, 1979. Natural sex inversion in the giant perch (Lates calcarifer). Australian Journal of Marine and Freshwater Research 30: 803-813.

[96] Moore, R. 1982. Spawning and early life history of burramundi, Lates calcarifer (Bloch), in Papua New Guinea. Australian Journal of Marine and Freshwater Research 33 (4): 647-661. Available online: http://www.publish.csiro.au/paper/MF9820647.htm, (accessed on 18 February 2021).

[97] Morgan, D.; A. Rowland.; H. Gill and R. Duope. 2004. The implications of introducing a large piscivore (*Lates calcarifer)* into a regulated northern Australian river (Lake Kununurra, Western Australia), (9) 3-4: 181-193, doi: https://doi.org/10.1111/j.1440-1770.2004.00247.x

[98] Myanmmar, Ramsar, Retrieved from: https://www.ramsar.org/wetland/myanmar, (accessed on 18 February 2021).

[99] Myat Moe Aung, Gulf of Mottama Wetland more than triples in size as newest Ramsar Site, 03, Feb, 2020 Retrieved From: https://www.mmtimes.com/news/gulf-mottama-wetland-more-triples-size-newest-ramsar-site.html

[100] 20 Examples of Qualitative and Quantitative Variables, Available online: https://www.lifepersona.com/20-examples-of-qualitative-and-quantitative-variables

[101] Nelson, J. S., Fish Diversity and Fish Assemblage Structure in Seagrass Meadows at Sikao Bay, Trang Province, Thailand, (2006), Fishes of the World. 4th Edition, John Wiley & Sons, Hoboken, 601 p, Available online: https://www.scirp.org/(S(vtj3fa45qm1ean45vvffcz55))/reference/ReferencesPapers.aspx?ReferenceID=1633759, (http://as.wileyt.com/WileyCDA/WileyTitle/productCd-0471250317.html), (accessed on 18 February 2021).

[102] Nguyen Thanh Nga, Yoshiro Higano and Helmut Yabar, Analyse. 2012. Wetland Economic Value: Case Study in Xuan Thuy National Park, Viet Nam, April 2012, 1-6, Available online: https://www.researchgate.net/publication/270392831_Analysis_of_Wetland_Economic_Value_Case_Study_in_Xuan_Thuy_National_Park_Viet_Nam

[103] Our wetlands are worth saving, The Myanmar Times, 3-Oct-2019, Available online: https://www.mmtimes.com/news/our-wetlands-are-worth-saving.html, (accessed on 18 February 2021).

[104] Paolo Parenti. 2020. An annotated checklist of fishes of the family Sciaenidae, JAD 2020, 2 (1): 1-92, URL: https://jad.lu.ac.ir/article-1-49-en.html

[105] Parmesan, C and Yohe, G. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421 (6918), 37–42. doi: https://doi.org/10.1038/nature01286

[106] Peh, K. SH.; Balmford, A.; Birch, J. C.; Brown. C.; Butchart, S. H. M.; Daley, J.; Dawson, J.; Gray, G.; Hughes, F. M. R and et al. 2015. Potential impact of invasive alien species on ecosystem services provided by a tropical forested ecosystem: a case study from Montserrat. *Biol Invasions* 17: 461–475. doi: https://doi.org/10.1007/s10530-014-0743-9, Available online: https://arro.anglia.ac.uk/346857/1/Peh%20et%20al%202014%20Biol%20InvasionsPost-print%202.pdf

[107] Pethiyagoda, R. and A. C. Gill, 2012. Descriptions of two new species of sea bass (Teleostei: Latidae: *Lates*) from Myanmar and Sri Lanka. Zootaxa 3314: 1-16. (Ref. 90099), Available online: https://www.fishbase.se/summary/66563

[108] Pethiyagoda, R. and A. C. Gill, 2012. Lates uwisara, Available online: https://www.fishbase.de/summary/Lates-uwisara.html, (accessed on 18 February 2021).

[109] Peter J. Pender & Roland K. Griffin (1996) Habitat History of Barramundi *Lates calcarifer* in a North Australian River System Based on Barium and Strontium Levels in Scales, Transactions of the American Fisheries Society, 125:5, 679-689, DOI: 10.1577/1548-8659(1996)125<0679:HHOBCI>2.3.CO;2

[110] Planque, B., Lazure, P and Jegou, A.-M. 2006. Typology of hydrological structures modelled and observed over the Bay of Biscay shelf. Scientia Marina, 70 (S1): 43–50. doi: https://doi.org/10.3989/ scimar.2006.70s143

[111] Porter, M.; Stefansson, S.; Nyhammer, G.; Karlsen, Ø.; Norberg, B and Bromage N. R. 2000. Environmental influences on melatonin secretion in Atlantic cod (Gadus morhua L.) and their relevance to commercial culture. *Fish Physiology and Biochemistry* 23: 191–200. doi: https://doi.org/10.1023/A:1007816426509, Available online: https://www.researchgate.net/publication/226428815_Environmental_influences_on_melatonin_secretion_in_Atlantic_cod_Gadus_morhua_L_and_their_relevance_to_commercial_culture

[112] Pusey, B., Kennard, M and Arthington, A. 2004. Freshwater fishes of north-eastern Australia. CSIRO Publishing, Collinwood, 684 pp, doi: https://doi.org/10.1002/rra.895

[113] Rabanal, H. R. and Soesanto, V. 1982. Report of the Training course on seabass spawning and larval rearing - Songkhla, Thailand – 1 to 20, June 1982. FAO Corporate Document Repository, SCS/GEN/82/39, 120 pp. Available online: http://www.fao.org/docrep/field/003/Q8694E/Q8694E00.htm, (accessed on 18 February 2021).

[114] Rachael Hickling.; Jane K. Hill.; Richard Fox and Chris D. Thomas. 2006. The distribution of a wide range of taxonomic groups are expanding polewards 12 (3): 450-455, doi: https://doi.org/10.1111/j.1365-2486.2006.01116.x Available online: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2486.2006.01116.x

[115] Ratamess, Nicholas A.; Rosenberg, Joseph G.; Klei, Samantha; Dougherty, Brian M.; Kang, Jie; Smith, Charles R.; Ross, Ryan E and Faigenbaum, Avery D. 2015. Comparison of the Acute Metabolic Responses to Traditional Resistance, Body-Weight, and Battling Rope Exercises, Journal of Strength and Conditioning Research: January 2015, 29 (1), 47-57 doi: 10.1519/JSC.0000000000000584, Available online: https://journals.lww.com/nsca-jscr/Fulltext/2015/01000/Comparison_of_the_Acute_Metabolic_Responses_to.6.aspx

[116] Rahman, H. M. T.; Hickey, G. M and Sarker, S. K. 2015. Examining the Role of Social Capital in Community Collective Action for Sustainable Wetland Fisheries in Bangladesh. Wetlands 35, 487–499, doi: https://doi.org/10.1007/s13157-015-0635-5

[117] Ramaswamy, V.; Rao, P. S.; Rao, K. H.; Thwin Swe.; Rao, N. S and Raiker, V. 2004. Tidal influence on suspended sediment distribution and dispersal in the northern Andaman Sea and Gulf of Martaban. Marine Geology 208, 33-42, Source: OAI, doi: 10.1016/j.margeo.2004.04.019

[118] Ramsar Sites Information Service, Available online: https://rsis.ramsar.org/ris-search/myanmar?pagetab=1, (accessed on 18 February 2021).

[119] Ramsar, Myanmar, Available online: https://www.ramsar.org/wetland/myanmar, (accessed on 18 February 2021).

[120] RIS. 2020, Ramsar Information Sheet, RSIS V. 1.6., 1. Feb. 2020, RIS for Site no. 2299, Gulf of Mottama, Myanmar, Available online: https://rsis.ramsar.org/ris/2299, (accessed on 18 February 2021).

[121] Recreational Sea Bass Fishing volume 605: debated on Thursday 11 February 2016, Available online: https://hansard.parliament.uk/Commons/2016-02-11/debates/16021158000001/RecreationalSeaBassFishing, (accessed on 18 February 2021).

[122] Recreational Sea Bass Fishing, 11, Equitable life- In the house of commons, February, 2016, Available online: https://www.theyworkforyou.com/debates/?id=2016-02-11c.1818.2, (accessed on 18 February 2021).

[123] Rehage Jennifer S and Loftus W. F. 2007. Seasonal fish community variation in headwater mangrove creeks in the southeastern Everglades: an examination of their role as dry-down refuges. USGS Publications Warehouse, Bull Mar Sci 80: 625-645, Available online: https://pubs.er.usgs.gov/publication/70029769, (https://about.illinoisstate.edu/lccomte/teaching/), (accessed on 18 February 2021).

[124] Richard T. Woodward and Yong-Suhk Wui. 2001. The economic value of wetland services: a meta-analysis, Ecological Economics 37 (2): 257-270, ISSN 0921-8009, doi: https://doi.org/10.1016/S0921-8009(00)00276-7, Available online: https://www.sciencedirect.com/science/article/pii/S0921800900002767

[125] Rimmer, M. A and Russell, D. J. (1998) Survival of stocked barramundi, Lates calcarifer Bloch), in a coastal river system in far northern Queensland, Australia. Bulletin of Marine Science, 62: 325–336

[126] Robert McInnes and Tint Tun. 2020. Mid- Term Review: Gulf of Mottama Project, Report to The Swiss Confederation, April, 2020, the Federal Department of Foreign Affairs, Embassy of Switzerland in Myanmar, PR113/R1.0/F: 1-42, Available online: https://www.iucn.org/sites/dev/files/gulf_of_mottama_phase_2_mid_term_review_2020.pdf, (accessed on 18 February 2021).

[127] Robinson, R. A. J.; Bird, M. I.; Oo, Nay Win.; Hoey, T. B.; Aye, Maung Maung.; Higgitt, D. L.; X. X. Lu.; Swe, Aung.; Tun, Tin and Win, Swe Lhaing. 2007. The Irrawady River Sediment Flux to the Indian Ocean: The Original Nineteenth-Centuary Data Revisited, November 2007, The Journal of Geology 115 (6): 629-640, doi: 10.1086/521607, Available online: https://ui.adsabs.harvard.edu/abs/2007JG....115..629R/abstract

[128] Roegner GC.; Dawley EW.; Russell M.; Whiting A and Teel DJ. 2010. Juvenile salmonid use of reconnected tidal freshwater wetlands in Grays River, Lower Columbia River Basin. Trans Am Fish Soc 139: 1211-1232. doi: https://doi.org/10.1577/T09-082.1

[129] Rohan Pethiyagoda and Anthony C. Gill. 2012. Description of two new species of sea bass (Teleostei: Latidae: Lates) from Myanmar and Sri Lanka, 16, May, 2012, ISSN 1175-5326, 1-16, doi: https://doi.org/10.11646/zootaxa.3314.1.1

[130] Rue Mauverney, Fish for tomorrow? 2 February, World Wetlands Day, Daily Report of Ramsar Convention and its works, Available online: https://www.ramsar.org/sites/default/files/documents/library/wwd2007_leaflet_e.pdf, (accessed on 18 February 2021).

[131] Russell, D., and R. Garrett. 1985. Early life history of barramundi, Lates calcarifer (Bloch), in north-eastern Queensland. Australian Journal of Marine and Freshwater Research 36 (2): 191-20.

[132] Sheaves M and Johnston R. 2008. Influence of marine and freshwater connectivity on the dynamics of subtropical estuarine wetland fish metapopulations. Mar Ecol Prog Ser 357: 225-243, doi: https://doi.org/10.3354/meps07292

[133] Snelson, F.; Williams-Hooper, S and Schmid, T. 1988. Reproduction and Ecology of the Atlantic Stingray, Dasyatis sabina, in Florida Coastal Lagoons. *Copeia* 3: 729-739, doi: 10.2307/1445395, Available online: https://www.jstor.org/stable/1445395

[134] Suprenand PM.; Drexler M.; Jones DL and Ainsworth CH. 2015. Strategic assessment of fisheries independent monitoring programs in the gulf of Mexico. Plos one 10 (3): e0120929. doi: 10.1371/journal.pone.0120929, Available online: https://europepmc.org/articles/PMC4383601

[135] Stuart Butchart, Ellen Dieme-AmTing, Habiba Gitay, Steve Raaymakers and Douglas Taylor. 2005. Millennium Ecosystem Assessment (Ed). Ecosystems and human well-being: wetlands and water synthesis: a report of the Millennium Ecosystem Assessment. Washington, DC: World Resources Institute, Available online: https://www.millenniumassessment.org/documents/document.358.aspx.pdf, (accessed on 18 February 2021).

[136] Thailand Fish Photos and Information Barramundi, Asian Sea Bass, Available online: http://www.sea-ex.com/thailand/angling/barramundi.htm, (accessed on 18 February 2021).

[137] Than Htike Aung. 2019. Gulf of Mottama Management Plan, (Report), 02-Jul-2019, HELVETAS-007, Development focused: Coordination Environment Governance Protection, Natural Resource Management, 1-42, Available online: https://themimu.info/sites/themimu.info/files/assessment_file_attachments/190606_CNRMP_EnVersion_Final.pdf, (accessed on 18 February 2021).

[138] Thayer KA.; Taylor KW.; Garantziotis S.; Schurman SH.; Kissling GE.; Hunt D.; Herbert B.; Church R.; Jankowich R.; Churchwell MI and et al. 2016. Bisphenol A, bisphenol S, and 4-hydroxyphenyl 4-isoprooxyphenylsulfone (BPSIP) in urine and blood of cashiers. Environ Health Perspect 124: 437–444, doi: https://doi.org/10.1289/ehp.1409427, Available online: https://ehp.niehs.nih.gov/doi/10.1289/ehp.1409427

[139] The Fish Sites, World Wetlands Day-Fish For Tomorrow? 5, May, 2007, Available online: https://thefishsite.com/articles/world-wetlands-day-fish-for-tomorrow, (accessed on 18 February 2021).

[140] The Myanmar Time. 2020. Heartbeat of The Nation, Myanmar, September 23, Available online: https://pt.scribd.com/doc/255145272/201438767, (accessed on 18 February 2021).

[141] The Myanmar Time. 2014. Heartbeat of The Nation, Myanmar, February 10-16, Available online: https://pt.scribd.com/doc/205995668/201435716. (accessed on 18 February 2021).

[142] The Green Book (2020), Gov. UK, Available online: https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020, (accessed on 18 February 2021).

[143] Thiha, Myanmar Times, Workshop on potential for sea bass success, 9, February, 2016, Available online: https://consult-myanmar.com/2016/02/09/workshop-on-potential-for-sea-bass-success/, (accessed on 18 February 2021).

[144] Thomas, C. D. 2010. Climate, climate change and range boundaries. Diversity and Distributions 16 (3): 488–495. doi: https://doi. org/10.1111/j.1472-4642.2010.00642.x

[145] Toledo, J. D., C. L. Marte and A. R. Castillo. 1991. Spontaneous maturation and Spawning of Seabass *Lates Calcarifer* in floating net cages. *Journal of Applied Ichthoyl* 7: 217-222.

[146] Tin Tin Aye, (2004). Corralation between age, growth rate and sex reversal in sea bass *Lates calcarifer* (Bloch, 1790) based on otholith, scale microstructure and length parameters, *PhD. disseration*, University of Yangon, Yangon, Myanmar.

[147] Trebitz, A. S.; J. C. Brazner.; M. S. Pearson.; G. S. Peterson.; D. K. Tanner and D. L. Taylor. 2009. Patterns in Habitat and Fish Assemblages within Great Lakes Coastal Wetlands and Implications for Sampling Design. CANADIAN JOURNAL OF FISHERIES AND AQUATIC SCIENCES. NRC Research Press, Ottawa, Canada 66 (8): 1343-1354, 11- Aug-2009, doi: https://doi.org/10.1139/F09-090

[148] UN Fish and Agricultural Organization, 1999. FAO species identification guide for fishery purposes: the living marine resources of the western central Pacific; Volume 4 Bony fishes part 2 (Mugilidae to Carangidae). Publications Division, Food and Agriculture Organization of the United Nations, Rome

[149] UN Fish and Agricultural Organization, 2008. Barramundi (=Giant seaperch) - Lates calcarifer. FAO Fisheries and Aquaculture - Species fact sheets. Available online: http://www.fao.org/fishery/species/3068. (accessed on 18 February 2021).

[150] Vij, Shubha.; Kathireshan, P.; Gopikrishna, G.; Lau, D.; Saju, J M.; Shamsudheen, K V.; Vinayakumar, K.; Basheer, V S.; Gopalakrishnan, A and et al. 2014. Barcoding of Asian seabass across its geographic range provides evidence for its bifurcation into two distinct species. Frontiers in Marine Science Editorial Office 1 (30): 1-17, doi: 10.3389/fmars.2014.00030. Available online: https://www.researchgate.net/publication/264458676_Barcoding_of_Asian_seabass_across_its_geographic_range_provides_evidence_for_its_bifurcation_into_two_distinct_species

[151] Ward, R. D.; Holmes, B. H and Yearsley, G. K. 2008. DNA barcoding reveals a likely second species of Asian sea bass (barramundi) (Lates calcarifer). Journal of Fish Biology 72, 458–463, doi: https://doi.org/10.1111/j.1095-8649.2007.01703.x

[152] Webster, C and C. Lim. 2002. Nutrient Requirements and Feeding of Finfish for Aquaculture. Wallingford, Oxon; New York, NY: CABI Publishing, doi: 10.1079/9780851995199.0000

[153] Wetland Conservation in Myanmar, CMS/CAF/Inf.14. Available online: https://www.cms.int/sites/default/files/document/inf_04_14_Myanmar_0.pdf , (accessed on 18 February 2021).

[154] Wilmington, N.C., Up- To Date, 1902, Available online: https://docsouth.unc.edu/nc/uptodate/uptodate.html, (accessed on 18 February 2021).

[155] World Wetland Day – "Fish for tomorrow?" Available online: http://pubs.iclarm.net/resource_centre/WorldWetlandsDay_2.pdf, (accessed on 18 February 2021).

[156] Workshop Feb 3, 2016 on potential for sea bass success I. The Myanmar Times. Available online: https: www.mmtimes.com> business, (accessed on 18 February 2021).

[157] Yingthavorn, P. (1951) Notes on Pla-Kapong (Lates calcarifer Bloch) culturing in Thailand. FAO Fisheries Biology Technical Paper 20: 1–6.

[158] Yu Yu Htwe, Thida Ei and Kalayar Win Maung, ARTIFICIAL PROPAGATION OF SEABASS, LATES CALCARIFER (BLOCH, 1790) IN MYEIK ARCHIPELAGO, J. Myanmar Acad. Arts. Sci 13 (3): 341-353. Available online: http://maas.edu.mm/Research/download_details.php?id=804

[159] Biden Harris, The Biden Plan To Build A Modern, Sustainable Infrastructure And An Equitable Clean Energy Future, Available online: https://joebiden.com/clean-energy/, (accessed on 18 February 2021).

[160] Jean-François Noël and Martin O'Connor. 1998. Strong Sustainability and Critical Natural Capital, © Chapter 4 in: S. Faucheux & M. O'Connor (eds., 1998) Valuation for Sustainable Development, Edward Elgar, Cheltenham UK, 75-97. Available online: https://www.researchgate.net/publication/284078771_Strong_sustainability_and_critical_natural_capital, (accessed on 18 February 2021).

[161] Fish of Mississippi, Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, Mississippi, 39762, USA, Available online: https://www.cfr.msstate.edu/wildlife/fisheries/?a=detail&id=4&info=, (accessed on 18 January 2021).

[162] Mississippi State, Mississippi, 39762, USA, Available online: https://www.cfr.msstate.edu/wildlife/fisheries/?a=detail&id=4&info=, (accessed on 18 January 2021).