Capture fishery management status through the ecosystem approach on fish resources domain in Sungai Apit sub-district, Siak district

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Abstract. Sungai Apit sub-district is located at the mouth of the Siak River which has a large and varied potential of fish resources. The waters of the Sungai Apit have long been used as fishing grounds by the community using simple technology. Even it uses simple technology, the fishing is done quite intensively. The decline in fish resources has been felt by the community in the last few years due to various factors, such as pollution and the use of destructive fishing gear. To determine the status of fish resource management in Sungai Apit sub-district, a study was carried out through an Ecosystem Approach to Fisheries Management (EAFM). The purpose of this research was to determine the status of capture fisheries resource management in the domain of fish resources in Sungai Apit sub-district, Siak district and future management policy strategies. This research was conducted in June-October 2020 in Sungai Apit sub-district, Siak district. This research used qualitative and quantitative approaches. Sampling method used was purposive sampling through depth interviews and questionnaires. The data analysis technique used flag modeling with the Multi-Criteria Analysis (MCA) approach. The results of the data analysis showed that the status of fish resource management in Sungai Apit sub-district was in a bad condition (red level), indicating that the area had undergone considerable degradation. The poor condition of fish resources was caused by several factors, including pollution and the use of destructive fishing. Management strategies that can be implemented are i) prohibiting the use of destructive fishing gear, ii) increasing the capability of the fleet (>10 GT), iii) building a Wastewater Treatment Plant (WWTP) for every industry and factory and iv) creating a fishery protected area (fish sanctuary).
Key Words: capture fisheries, ecosystem approach, Sungai Apit.

Introduction. Sungai Apit is one of the sub-districts in Siak District which has a large mangrove forest. It is estimated that the mangrove forest area in Sungai Apit sub-district is +500 ha including a secondary mangrove forest. In the last few years, the existence of mangrove forests in this sub-district has been degraded due to various human activities. Damage to mangrove forests can reduce the ecological and socio-economic role of mangroves for coastal communities. In the long term, the impacts felt are the occurrence of coastal abrasion, a decrease in fishery resources, and a decrease in the catch of fishermen and so on. In addition, this will also have an impact on the emergence of conflicts in the extraction of these resources. This is as stated by Daris et al (2019, 2020) that natural resources must be managed in a sustainable manner so that conflicts do not occur in their use. The sustainability of capture fisheries resources in the mangrove ecosystem area of Sungai Apit sub-district has an important strategic contribution and value in increasing community income, maintaining fishery production, and maintaining the germplasm of fishery resources. The correct answer to this condition is how fishery resources in Sungai Apit sub-district can be managed properly to be sustainable. Nur El Fajri et al (2020) states that there are several attributes that can improve the sustainability of fisheries resource management, including: a) carrying capacity, b) high economic dependence on swamp ecosystem, c) economic benefits of the swamp, d) local

wisdom, e) community's perception towards environment, f) swamp area management, g) monitoring, h) regulation for resource use, and i) institution for resource management.

Sungai Apit sub-district is located at the mouth of the Siak River and is a fairly productive fishing area. Fishing is still done traditionally with an average fishing fleet of <5 GT, so they are classified as small fishermen (Halim et al 2020). The dependence of the community on existing fish resources in these waters makes fishing as one of the main livelihoods for the community. However, since the last few years, there has been environmental degradation which has resulted in a decrease in fish resources in Sungai Apit sub-district. To maintain the preservation of fishery resources in this sub-district, a comprehensive management prioritizing ecological, economic, social and institutional interests are needed. One of the fisheries resource management models that can accommodate above interests is the Ecosystem Approach to Fisheries Management or EAFM.

The fisheries resource management regime in Indonesia is currently undergoing a process of transformation from conventional to ecosystem-based management. Actually, this is not something new, because since 2001, FAO has introduced EAFM (Ecosystem Approach to Fisheries Management), which in Indonesian translates as "pengelolaan perikanan berpendekatan ekosistem". EAFM does not intend to completely replace conventional management patterns, but it is more refined. The implementation mechanism for EAFM is adaptive management. In this case, the existing set of management practices are already in line with EAFM, but there are several others that need to be refined. This condition in each region varies from one region to another.

According to Garcia and Cochrane (2005), EAFM is an effort to balance socio-economic goals (economic benefits, fisherman welfare, and fair use of fish resources), while considering human interactions in aquatic ecosystems through an integrated, comprehensive and sustainable fisheries management. The most important thing that distinguishes conventional management from EAFM is placing humans as managers into the elements of the ecosystem. The purpose of this study was to determine the status of capture fisheries resource management in the domain of fish resources in Sungai Apit sub-district, Siak district, and it's future management policies.

Material and Method

Location and time of research. This research was conducted in June-October 2020 in Sungai Apit sub-district, Siak district. The research was carried out through the study of data and scientific information related to the management of capture fisheries resources in Sungai Apit sub-district, Siak district.

Sample size determination. This research used qualitative and quantitative approaches. The quantitative approach was an inductive research method in nature and emphasized on objectively measuring aspects of a phenomenon. Data on quantitative research methods were obtained by taking a number of samples considered representative of the existing population. After that, the sample group was given special treatment, usually in the form of interviews and questionnaires. The treatment results were then processed statistically and produced the results of the study in the form of numbers. Sampling method in this study used purposive sampling. Selection of respondents was conducted through purposive sampling, namely the determination of respondents deliberately by researchers with criteria or considerations. According to Sitorus (1998), qualitative data is descriptive data in the form of spoken or written words from humans or about human behavior that can be observed. In addition, qualitative data is divided into three categories, namely the results of observations, the results of speech and written materials.

Types and sources of data. Primary and secondary data was used in this study. Primary data was obtained from interviews and focus group discussions (FGD), while secondary data was obtained from library search results in the form of research results, technical reports and scientific publications. Secondary data collected were data on the condition of fish resources such as Catch Per Unit Effort (CPUE), fish size, small fish

proportion, species composition, presence of ETP species (Endangered species, Threatened species, and Protected species) and fish resources potential (SDI) collapse. Verification of the data and information obtained was carried out through interviews and holding focus group discussions with fishery resource stakeholders.

Data collection techniques. Samplings were done through primary data collection and secondary data. Primary data consisted of data on fish catches, interviews, and questionnaires. Data was collected for two months and interviews were conducted in a structured manner using a questionnaire list. Boer (2008) states that in-depth interview is conducted, while stratified sampling is carried out in several layers, through certain distinctions, for example based on the size or length class of the fish. Determination of respondents used purposive sampling method with a number of 37 respondents (Table 1). Secondary data was obtained from publications and documentation sourced from related agencies, including the Environment and Forestry Service, Animal Husbandry and Fisheries Service in Siak District, Siak District Bappeda, Fisheries and Marine Service of Riau Province, and KKP Conservation Workshop.

Table 1

Number of respondents to the EAFM questionnaire

Institute	*Number (person)*
Animal Husbandry and Fisheries Service in Siak District	4
The Chief of Sungai Apit sub-district	1
KKP Conservation Workshop	1
University	1
Fisherman	30
Total	37

Data analysis techniques. In the implementation of this research, the indicator development model used referred to the indicators prepared by the Directorate of SDI, the Directorate General of Capture Fisheries of the Ministry of Marine Affairs and Fisheries, WWF-Indonesia and the Center for Coastal and Marine Resources Studies (PKSPL-IPB) (Directorate of Fish Resources 2014). The partial indicator from the domain would then be converted into a composite indicator through the "flag modeling" technique. The flag modeling technique was carried out using the Multi Criteria Analysis (MCA) approach in which a set of criteria was built as a basis for analysis of the diversity of fisheries management areas seen from the Ecosystem Approach in Fisheries Management (EAFM) through the development of a composite index (Adrianto et al 2005). The composite index value was qualified to determine the condition of each domain, then the aggregate value of the overall composite value would determine the quality condition of fisheries management in the studied area. Indicators on the domain of fish resources used in the study can be seen in Table 2.

Tabel 2

Indicator of fish resources domain

Domain	*Indicator*	*Criteria*
Fish Resources	Standard CPUE	1=decrease>25% 2=decrease<25% 3=stable/increase
	Fish Size	1=getting smaller 2=relatively fixed, 3=getting bigger
	Small fish proportion	1=numerous (>60%) 2=many (30-60%) 3=a few (<30%)

Domain	*Indicator*	*Criteria*
	Species Composition	1=proportion of target is less (<15% of total volume) 2=proportion of target is equal to non-target (16-30% of total volume) 3=proportion of target is more (>31% of total volume)
	The Presence of ETP (Endangered species, Threatened species, and Protected species) is in line with CITES criteria	1=ETP Species with high quantity (>50% of the capture) 2=ETP Species with lower quantity (<50%) 3=No ETP Species
	Range collapse of Fish Resources	1=more difficult, due to target species, 2=relatively fixed, due to target species, 3=easier, due to target species

Each indicator in each domain would be given a weight and score. The weighting was based on the priority of issues in the domain. The scoring was conducted based on the current condition of each indicator which was compared with the ideal condition. The weighting value was carried out using a likelihood scale and a score based on a 1-3 Likert scale (Adrianto et al 2005 in Gazali et al 2017). The scoring was conducted based on the results obtained from each attribute by comparing it with reference points. This was because the reference points set minimum, medium and maximum values. Examples of scoring/consequences are shown in Table 3.

Table 3

Classification of score and flag model visualization (Adrianto et al 2011)

Value range	*Flag Model*	*Description*
1		Bad
2		Moderate
3		Good

The composite value from the weighting results and the scoring of each indicator in each domain showed the condition of each fish resource domain. The aggregate value of the entire domain could indicate the status of capture fisheries management in Sungai Apit sub-district (Table 4).

Table 4

Criteria for determining the conditions for management of the fish resource domain based on the range of composite values (Directorate of Fish Resources KKP 2014)

Value range	*Flag Model*	*Description*
100-125		Bad
126-150		Poor
151-200		Moderate
201-250		Good
251-300		Excellent

The smallest composite value of all indicators showed the magnitude of the problem in capture fisheries management, and it needed to get priority in the management efforts carried out. The determination of management steps was also carried out based on the

main issues identified by high, moderate, and low scores. The steps mentioned above were taken so that the management efforts carried out were truly focused and in accordance with the needs.

Results

Fish resource status. The types of fish found in Sungai Apit sub-district were quite diverse and some had high economic value. At least, 41 species of fish were found. Important economic fish species found were red snapper (*Lutjanus campechanus*), terubuk (*Tenualosa macrura*), kurau (*Polynemus indicus*), debuk (*Otolithes ruber*), sebelah (*Synaptura panoides*), parang (*Chirocentrus dorab*), tenggiri (*Scomberonomos commersoni*), duri (*Arius sagor*), kitang (*Mugil melinopterus*), lome (*Harpadon nehereus*), belanak (*Liza melinoptera*), biang (*Ilisha elongate*), and lepo (*Leptosynanceia asteroblepa*). Then there were several types of protected species such as *Tenualosa macrura* (Jayakusuma 2015), blangkas (*Tachypleus gigas*) (Erwyansyah et al 2018), sharks and rays.

The condition of fish resources was currently experiencing degradation due to environmental changes and fishing. The decline in capture (CPUE) in Sungai Apit sub-district can be seen in Table 5. The capture of each fishing gear used by fishermen in 2020 has decreased quite drastically, when compared with 2010 data, based on the results of the study done by Wiadnyana et al (2010). Several types of fish such as red snapper and terubuk tended to have smaller size, and the terubuk fish caught were young fish. The sustainability of capture fisheries development is not only facing the problem of overfishing and overcapacity, but several studies say that the sustainability of capture fisheries also faces various pressures, both due to climate change, pollution, resource degradation and fluctuations in commodity prices as well as disputes over national boundaries that increase vulnerability for fishermen and capture fisheries sustainability (Kusdiantoro et al 2019).

Table 5

Comparison of average capture per effort (CPUE) in 2010 and 2020

Type of Tool (Local and English name)		*The Average of CPUE (kg/day)*	
		Wiadnyana et al 2010	*2020*
Pengerih	Filtering Device	25	5
Jarring Insang	Gill Net	20	10
Gumbang	Filtering Device	20	2
Blad	Beach Barrier Trap	5	30

Due to the decline in fish resources in Sungai Apit sub-district, some fishermen were fishing further from their usual location. This was done in order to obtain more fish. However, fishing at longer distance was rarely carried out by the fishing community because the costs would be greater and the results were uncertain.

Catching activity. The use of fishing gear in Sungai Apit sub-district was less diverse. There were only 5 main types of fishing gear used, namely gill nets, splints, lift nets, filter net, and bottom longline. Among the five types, only nets were used in almost all villages in Sungai Apit sub-district. On the river estuaries or tributaries connected to the sea, several types of fishing gear used were stow nets and cast nets, which both are considered destructive. Until now, the use of destructive fishing gear is still often found, such as tuguk (stow nets), belad (seine with fad), empang (cast net) and penggaruk (dredges). These fishing methods have a low level of selectivity and are considered destructive (Sudirman 2013).

So far, fishermen still use traditional methods, which have been passed on from generation to generation, to determine fishing grounds. As a result, fishermen are unable to cope with changes in oceanographic and weather conditions that are closely related to changes in dynamically changing fishing areas. The expansion of large fishermen to

fishing areas used by small fishermen results in unhealthy competition and even conflicts between large and small fishermen often occur. In relation to fishing gear, the fishing area must be good and profitable. In this case, the fish are abundant, clustered; the area is safe, not far from the port; and fishing gear is easy to operate (Demena et al 2017, Muchlisin et al 2012).

The fishing activity in the waters of the Sungai Apit sub-district was carried out using 5 types of main fishing gears which were dominated by passive fishing gears, namely plugging and waiting fishing gear. There were permanently installed, plugging and waiting fishing gear, namely: gumbang (filtering divice); installed semi-permanently, namely blad (beach barrier traps), jaring insang (gill net), pancing rawai (bottom longline). The location of fishing in the Sungai Apit sub-district depended on the season. In January-August (southern season), fishing was mostly carried out towards the Northwest with a distance of +0-2 miles from the coast while in the west season (September-December) it was towards the Northeast with a distance of +0- 2 miles from the beach. According to Sudirman (2004), the fishing area is one of the important factors determining the success or failure of a fishing operation. Therefore, the determination of the fishing location must be done as carefully as possible by taking into account oceanographic factors and other natural signs.

Result of fish resource domain assessment. The use of indicators was reviewed based on reference values that could be used as a guide for indicator assessment using a multi-species approach. The results of the fish resource domain assessment can be seen in Table 6.

Table 6

Indicators and criteria for sustainability of fish resources

Domain	*Indicator*	*Value*	*Score*	*Total*	*Criteria*
Fish Resources	Standard CPUE	20	1	20	1 = decrease >25 %, 2 = decrease <25 %, 3 = stable/increase
	Fish size	16	1	16	1= getting smaller, 2= relatively fixed, 3= getting bigger
	Yuwana or small fish proportion	11	1	11	1 = numerous (>60%), 2 = many (30 - 60%), 3 = a few (<30%)
	Species Composition	24	1	24	1 = the target proportion is less (<15% of total volume), 2 = the target proportion is equal to non-target (16-30% of total volume), 3 = the target proportion is more (>31% of total volume)
	The presence of ETP species (*Endangered species, Threatened species, and Protected species*) based on CITES criteria	18	2	36	1= The presence of ETP species with high quantity (>50 % of capture), 2= The presence of ETP species with low quantity (<50 %), 3= No ETP species)
	Range collapse of Fish Resources	12	1	12	1 = more difficult, depends on target spesies, 2 = relatively fixed, depends on target species, 3 = easier, depends on target species
	Sub Total	100		118	

The results of the assessment showed that the status of fish resources in Sungai Apit sub-district was in bad condition with a score of 118 (red category). The score of each

indicator in the resource domain as a whole was 1 (poor), while the ETP presence indicator was 2 (moderate). This shows that if viewed from the fish resource domain, the area has undergone considerable degradation.

To evaluate from its geomorphological characteristics, the waters of the Sungai Apit sub-district are within the Siak River estuary area. As it was known that estuary functioned as a spawning ground, nursery ground and feeding ground, then it caused the fish living in this area to be mostly small (juvenile to young). Therefore, the proportion of fish capture was mostly small fish or yuwana. The trend of decreasing capture (CPUE) is caused by high environmental pressures such as pollution and fishing pressure. According to Prianto and Suryati (2010), the fish capture in estuaries is very dependent on the season, the change in seasons causes changes in waterflow. Changes in this season will also affect fish behavior, reproductive biology and migration, so that the capture in every season will change.

The decline in fish resources is thought to be caused by contamination of organic matter produced by industry, ports, oil mining, oil palm plantations, wood and domestic waste. Indications of pollution have occurred for more than 10 years, including oil spills, plastic waste and wood waste around the coast. Research conducted by Prianto et al (2010) in the estuary of the Banyuasin River shows that there has been a change in water quality due to pollution originating from human activities such as ports, plantations and industry. The values of total suspended solids, total dissolved solids, ammonia, nitrates, and phosphates are above the permissible threshold.

Management strategy. Strategies are conducted to meet management objectives. Strategic decisions should be able to facilitate the comparison of the resulting attributes and the selected reference alternatives (Gavaris 2009). Based on the domain values and fish resource indicators above, the formulation of strategies for capture fisheries management in Sungai Apit sub-district are: 1) prohibiting the use of destructive fishing gear such as tuguk (stow nets), belad (seine with fad), empang (cast net) and penggaruk (dredges), 2) increasing the capability of the fishing fleet (>10 GT), so that fishermen are able to catch fish in other waters further away (for example Malacca Strait and Natuna Waters), 3) building a wastewater treatment plant (WWTP) for every industry and factory operating around the waters to reduce the burden of water pollution, 4) creating a protected fishery area (fish sanctuary) in order to preserve fish resources.

Management strategies are applied in principle to restore the condition of fish resources to a good condition. Gokturk and Deniz (2017) in Kusdiantoro et al (2019) state that sustainable small-scale fisheries development can be done by improving fisheries management. Indonesia also experiences the same situation when future fisheries management is directly based on fisheries management areas (WPP). Basically, fisheries resource management aims to ensure how many fish that can be caught which is customized with a number of fishing efforts so that these resources can be sustainable (Muliawan 2015). The need for high-value fishery commodities such as shrimp and current technological developments has led to the exploitation in excess of resources. This can be prevented through good fisheries management. Nizar (2015) explains that business development can be done by looking at several aspects, namely technical, economic, social, financial, and management, so that the development of small-scale capture fisheries business can be realized in a sustainable manner.

Conclusions. Based on the description above, it can be concluded that the condition of the waters in Sungai Apit sub-district in terms of the fish resource domain was in bad condition (red category), indicating that the area had experienced considerable degradation. In order to conserve fish resources in the future, there are at least four management strategies that need to be implemented, namely i) prohibiting the use of destructive fishing gear, ii) increasing the capacity of the ship's fleet (>10 GT), so that fishermen are able to catch fish in waters further away, iii) building a wastewater treatment plant (WWTP) for every industry and factory operating around the waters and iv) creating a protected fishery area (fish sanctuary).

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References

Adrianto L., Matsuda Y., Sakuma Y., 2005 Assessing local sustainability of fisheries system: a participatory qualitative system approach to the case of Yoron Island, Kagoshima Prefecture, Japan. Marine Policy. Elsevier Sciences, 29:9-23.

Adrianto L., Wardiatno Y., Susanto H. A., Azizy A., Trihandoyo A., Nurcahyanto A., 2011 [Determination of Ecosystem Approach Innovators in fishery management (Ecosystem Approach to Fisheries Management)]. Lokakarya Nasional EAFM. Direktorat Sumberdaya Ikan, Ditjen Perikanan Tangkap, Kementerian Kelautan dan Perikanan, WWF Indonesia dan PKSPL– IPB: 1-33 [in Indonesian].

Boer M., 2008 [Sampling method]. Laboratory of Biomathematics and Biostatistics, Division of Fisheries Resource Management, Department of Aquatic Resources Management, FPIK, IPB University. Bogor. 80p [in Indonesian].

Daris L., Wahyuti, Yusuf M., 2019 Conflict dynamics of fishery resources utilization in Maros District, South Sulawesi Province, Indonesia. AACL Bioflux 12(3):786-791.

Daris L., Yusuf M., Ali M. S. S., Wahyuti, 2020 Priority strategies for conflict resolution of traditional fishermen and mini trawl in Maros District, South Sulawesi Province, Indonesia. AACL Bioflux 13(2):496-502.

Demena Y .E., Miswar E., Musman M., 2017 [Determination of potential fishing areas for skipjack tuna (*Katsuwonus pelamis*) using satellite imagery in South Jayapura waters, Jayapura city]. Journal of Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah, 2(1):194-199 [in Indonesian].

Directorate of Fish Resources, 2014 [Assessment of indicators for fisheries management using an ecosystem approach]. Marine and Fisheries Ministry. 205p [in Indonesian].

El Fajri N., Sukendi, Syafriadiman, Windarti, Yusuf M., 2020 Sustainability assessment of swamp ecosystem management in Sawah village, Kampar Regency, Riau. AACL Bioflux 13(5):2588-2598.

Erwyansyah, Wardiatno Y., Kurnia R., Butet N. A., 2018 Taxonomic certainty and distribution of tri-spine horseshoe 4 crab *Tachypleus tridentatus* Leach 1819 in east Balikpapan Waters. Jurnal Ilmu dan Teknologi Kelautan Tropis, Vol. 10 No. 3, Hlm. 547-559.

Gracia S. M., Cochrane K. L., 2005 Ecosystem approach to fisheries: a review of implementation guidelines. ICES Journal of Marine Sciences (62).

Gavaris S., 2009 Fisheries management planning and support for strategic and tactical decisions in an ecosystem approach context. Fisheries Research. 100:6–14

Gazali M., Edwarsyah., Shantica N., Salmah., 2017 [Tuna (*Thunnus* sp.) Fisheries management with ecosystem approach (case study of socio-economical domain at PPI Ujong Baroh West of Aceh Aceh Province]. Journal of Perikanan Tropis, 4(1):57-70 [in Indonesian].

Halim A., Wiryawan B., Loneragan N. R., Hordyke A., Sondita M. F. A., White A. T., Koeshendrajana S., Ruchimat T., Pomeroy R. S., Yuni C., 2020 [Formulating the definition of small-scale fisheries to support capture fisheries management in Indonesia]. Journal of Fisheries and Marine Research Vol. 4. No. 2 (2020):239-262.

Jayakusuma Z., 2015 [Protection of bengkalis terubuk fish geographical indications in the framework of regional trade of the Asian Economic Community]. Seminar Nasional Peluang dan Tantangan Menghadapi Masyarakat Ekonomi Asean (MEA): Perspektif Hukum dan Perlindungan Sumber Daya Laut. Prosiding. pp.327-338.

Kusdiantoro, Fahrudin A., Wisudo S. H., Juanda B., 2019 [Capture fisheries in Indonesia: portraits and challenges of sustainability]. Journal of Sosek Kelautan Perikanan, 14(2):145-162 [in Indonesian].

Muchlisin Z. A., Fadli N., Nasution A. M., Astuti R., Marzuki, Musni D., 2012 [Analysis of subsidized fuel oil (BBM) diesel for fishermen in Aceh Besar District, Aceh Province]. Depik Journal, 1(2):107-113 [in Indonesia].
Muliawan I., 2015 [Management of grouper fish resources in an integrated manner with an ecosystem approach in the waters of the Spermonde Islands, Makassar City]. Bogor: IPB University [in Indonesian].
Nizar M., 2015 [Sustainability analysis of seaweed cultivation of community direct aid pallets recipients in Muna Regency]. Program Pasca Sarjana Universitas Terbuka.
Prianto E., Suryati N. K., 2010 [Composition of types and potential of fish resources in the Musi River Estuary]. Journal of Penelitian dan Perikanan Indonesia. 16(1):1-8 [in Indonesian].
Prianto E., Husnah, Aprianti S., 2010 [Characteristics of aquatic chemical physics and the structure of the zooplankton community in the Banyuasin River Estuary, South Sumatra]. Journal of BAWAL, 3(3):149-157 [in Indonesian].
Sitorus M. T. F., 1998 [Qualitative research: an introduction]. Bogor: Kelompok Dokumentasi Ilmu-ilmu Sosial [in Indonesian].
Sudirman, 2004 [Fishing Technique]. Rineka Cipta. Jakarta. 210p [in Indonesian].
Sudirman, 2013 [To know fishing tools and methods]. PT. Rineka Cipta. 214p. [in Indonesian].
Wiadnyana N. N., Rupawan, Nurdawati S., Herlan N. M., Suryaningrat S., Abidin M., Gautama S., Bintoro A., Haidir, 2010 [Study of potential and bioecology of fish resources in the water estuary of the Siak River and along Riau Strait]. Balai Riset Perikanan Perairan Umum Puslitbang Pengelolaan Konservasi Perikanan Badan Litbang Kelautan Dan Perikanan 53p [in Indonesian].

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