Potential carrying capacity of marine ecotourism in Sub-region III of Seribu Islands Marine National Park

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Abstract. The carrying capacity analysis needs to be approved to control the impacts caused by marine tourism activities. Before the management related to limiting the number of tourists is carried out, an analysis of the carrying capacity potential is accepted to determine the maximum number of tourists who can conduct marine ecotourism. This paper aimed to analyze the potential carrying capacity and allocation of marine tourism tourists in sub-region III, the Taman Nasional Laut Kepulauan Seribu (TNLKpS – Seribu Islands Marine National Park). The research method used is tourism suitability analysis, carrying capacity analysis and Geographic Information System (GIS) analysis. Marine ecotourism in sub-region III TNLKpS is divided into two activities based on the distribution of coral reef resources used; snorkeling and diving. The area of coral reefs for snorkeling activities is 1,008,433.24 m², while the area of coral reefs for diving activities is 2,766,593.80 m² scattered in the waters of sub-region III TNLKpS. The potential carrying capacity for snorkeling and diving tourism activities is 3,752 and 9,814 people/day, respectively. This paper concludes that marine ecotourism in sub-region III TNLKpS can still be developed by applying the carrying capacity principle and setting spot tourism allocation per trip per day.

Keywords: carrying capacity; marine ecotourism; Seribu Islands Marine National Park

1. Introduction

Economically, tourism activities provide a very significant contribution to the economy, including the local economy. Tourism is one of the economic sectors whose growth is fast enough even for the world, including the largest and fastest-growing. UNWTO (United Nations World Tourism Organization) [1] noted that tourism’s economic value is equivalent to 7% of the total export value of goods and services worldwide. This value continues to increase from 2014 by 5%, 2015 to 6%, and lastly in 2016 to 7%.

As a case, most of the natural tourism in the Seribu Islands is a type of mass tourism characteristic. First, the tourism system is a package, with the number of tourists in groups of 2-5 people or 5-8 people. Second, sightseeing, where the nature of mass tourism is usually not too focused on certain natural resources. Third, on a large scale, using low prices to bring in as many tourists as possible. One of the coastal resources heavily affected by tourism activities is coral reefs. In some tourist spots, there was damage to coral reefs, such as fractures on the surface of branching and table corals, abrasions and...
lesions on the surface of massive and submassive coral colonies, and the form of growth that tended to be vertically shorter in certain coral colonies.

Natural resources, including coral reef ecosystems, can tolerate incoming disturbances. As long as the disturbance does not exceed the coral reef ecosystem's carrying capacity, coral reefs can continue to exist. However, suppose the incoming disturbance exceeds the limit and has a large impact or beyond the coral reef ecosystem's ability to accept the disturbance. In that case, the coral reef ecosystem will experience degradation. In extreme conditions where the disturbance that enters is very large and continuous, it can destroy the coral reef ecosystem.

Tourism management, in this case, marine tourism, must emphasize the concept of ecotourism, namely a management concept that prioritizes sustainability and utilizes the natural and cultural resources of the community. According to Yulianda [2], the concept of ecotourism management is not only oriented towards sustainability but more than that, namely maintaining the value of natural and human resources. The concept of ecotourism is closely related to determining the carrying capacity of the area.

The carrying capacity concept limits visitors' number to the onset of degradation as a direct threat to the resource's survival [3]. Even though conservation area designation is often to protect the resource, in other cases, protected areas may be developed for ecotourism [4]. This paper aims to identify the suitability and estimate the area's carrying capacity for marine tourism activities in the Seribu Islands National Park, especially in the Seksi Pengelolaan Taman Nasional (SPTN - National Park Management Section) III the Taman National Laut Kepulauan Seribu (TNLKpS – Seribu Islands Marine National Park) area.

2. Methodology

2.1. Case study
The TNLKpS is one of the nature conservation areas in Indonesia, which is located north of Jakarta. Administratively, the TNLKpS area is located in the North Seribu Islands District, Seribu Islands Administrative District, Daerah Khusus Ibukota (DKI – the Special Capital Region) Jakarta. This area includes three villages, namely Pulau Panggang Village, Kelurahan Pulau Kelapa and Kelurahan Pulau Harapan. This area extends over an area of 107,489 ha (SK. Minister of Forestry No. 6310/Kpts-II/2002) and is geographically located at 5° 24' - 5° 45' South Latitude and 106° 25' - 106° 40' East Longitude. The Seribu Islands Marine National Park management is carried out by the Seribu Islands National Park Agency (SK. Dirjen Forest Protection and Nature Conservation No. 6186/Kpts-II/2002 dated 10 June 2002 concerning the Organizational Structure of the National Park Hall).

The TNLKpS area is divided into four zones: the Core Zone, Protection Zone, Tourism Use Zone, and Settlement Zone. The tourism use zone is a zone developed to accommodate marine tourism activities. SPTN III is the area with the closest distance to the mainland to visit, especially local tourists. The short distance and low cost are the main reasons tourists visit the SPTN III area of the Thousand Islands National Park [5]. Some of the islands that are the main destinations are Pramuka Island, Panggang Island and Semak Daun Island.

2.2. Data collection
The data are categorized into two parts, namely primary data and secondary data. Primary data collection was carried out in 13 locations, where each site was sampled for each area of the distribution of existing coral reefs with a total sampling of 39 points (table 1). The survey and field data collection were conducted in August-September 2017. In addition to ecological data, the water environment conditions were also measured, namely water visibility, current velocity, and depth. The biophysical data collection method refers to English et al. [6]. Secondary data includes spatial data. Spatial data was obtained from OpenStreetMap (www.openstreetmap.org) and Landsat Satellite Imagery in 2017. Field data and satellite imagery interpretation data were employed to observe the distribution, quality and suitability of
resources. Furthermore, the overlay method was conducted to identify a suitable area for tourism and carrying capacity using the Geographic Information System (GIS).

### Table 1. Location of data collection in the study area.

| No. | Island                  | Location             |
|-----|-------------------------|----------------------|
| 1   | Pramuka Island          |                      |
| 2   | Pramuka                 |                      |
|     | 1) North Pramuka        |                      |
|     | 2) South Pramuka        |                      |
|     | 3) East Pramuka         |                      |
|     | 4) West Pramuka         |                      |
| 2   | Panggang Island         |                      |
|     | 5) North Panggang       |                      |
|     | 6) West Panggang        |                      |
|     | 7) South Panggang       |                      |
|     | 8) East Panggang        |                      |
| 3   | APL (Area Perlindungan Laut or Marine Protected Area) |                     |
|     | 9) West APL             |                      |
|     | 10) East APL            |                      |
|     | 11) North APL           |                      |
| 4   | Karang Lebar            |                      |
|     | 12) North Karang Lebar  |                      |
|     | 13) South Karang Lebar  |                      |
|     | 14) West Karang Lebar   |                      |
|     | 15) East Karang Lebar   |                      |
| 5   | Semak Daun              |                      |
|     | 16) North Semak Daun    |                      |
|     | 17) South Semak Daun    |                      |
|     | 18) West Semak Daun     |                      |
|     | 19) East Semak Daun     |                      |
| 6   | Balik Layar             |                      |
|     | 20) North Balik Layar   |                      |
|     | 21) South Balik Layar   |                      |
|     | 22) West Balik Layar    |                      |
|     | 23) East Balik Layar    |                      |
| 7   | Karang Bongkok Island   |                      |
|     | 24) South Karang Bongkok|                      |
|     | 25) West Karang Bongkok |                      |
|     | 26) South West Karang Bongkok |          |
|     | 27) East Karang Bongkok |                      |
| 8   | Gosong Pandan           |                      |
|     | 28) South Gosong Pandan |                      |
| 9   | Kotok Besar Island      |                      |
|     | 29) West Kotok Besar    |                      |
|     | 30) North Kotok Besar   |                      |
|     | 31) South Kotok Besar   |                      |
| 10  | Kotok Kecil Island      |                      |
|     | 32) North West Kotok Kecil |                  |
|     | 33) North East Kotok Kecil |             |
| 11  | Karang Halima           |                      |
|     | 34) East Karang Halima  |                      |
| 12  | Karang Congkak          |                      |
|     | 35) North Karang Congkak|                      |
|     | 36) South Karang Congkak|                      |
| 13  | Karya Island            |                      |
|     | 37) North Karya         |                      |
|     | 38) East Karya          |                      |
|     | 39) West Karya          |                      |

2.3. Marine tourism suitability index

The tourist suitability index (IKW) is an index of determining an area is considered appropriate or not used as a tourist area by looking at the parameters in an area compared to the parameter values that correspond to the tourist area. IKW is derived from the following formula [2]:

\[
IKW = \sum_{i=1}^{n} (B_i \times S_i)
\]
where, IKW is tourism suitability index, B, is the weight of parameter, and S, is the score of parameter condition. IKW is divided into four categories, namely very suitable (S1) with a value of $2.5 \leq IKW < 3$, fairly appropriate (S2) with a value of $2.0 \leq IKW < 2.5$, conditional (S3) with a value of $1 \leq IKW < 2.0$, and incompatible (N) with a value of $< 1$.

The main marine tourism in TNLKpS, especially in the SPTN III area, is diving and snorkeling tours. The suitability of marine tourism in the diving tourism category (table 2) considers six parameters, namely water transparency, coral community cover, life form types, coral fish species, coral reef depth current velocity, while for snorkeling tourism (table 3), there are wide flat reef parameters [2].

### Table 2. Value of tourism suitability index (IKW) for marine tourism diving.

| No. | Parameters                      | Weight | Category | Score | Category | Score | Category | Score | Category | Score |
|-----|---------------------------------|--------|----------|-------|----------|-------|----------|-------|----------|-------|
| 1.  | Water visibility (%)            | 0.150  | S1       | >80   | 3        | 50 - 80| 2        | 20 - < 50| 1      | < 20   | 0     |
| 2.  | Cover of coral reef (%)         | 0.375  | S2       | >75   | 3        | > 50-75| 2        | 25-50 | 1       | < 25   | 0     |
| 3.  | Kind of life form               | 0.135  | S2       | >12   | 3        | < 7 - 12| 2        | 4 - 7  | 1       | < 4    | 0     |
| 4.  | Kind of reef fish               | 0.120  | S3       | >100  | 3        | 50 - 100| 2        | 20 - < 50| 1      | < 20   | 0     |
| 5.  | Current velocity (cm/dt)        | 0.070  | S3       | 0-15  | 3        | >15 - 30| 2        | >30 - 50| 1      | > 50   | 0     |
| 6.  | Depth of coral reef (m)         | 0.150  | S3       | 6-15  | 3        | > 15 - 20| 2        | > 20 - 30| 1      | > 30   | 0     |

Source: Yulianda [2]

Note: S1 = Very suitable, S2 = Fairly appropriate, S3 = Conditional, and N = Incompatible, with a value of $< 1$.

### Table 3. Value of tourism suitability index (IKW) for marine tourism snorkeling.

| No. | Parameters                      | Weight | Category | Score | Category | Score | Category | Score | Category | Score |
|-----|---------------------------------|--------|----------|-------|----------|-------|----------|-------|----------|-------|
| 1.  | Water visibility (%)            | 0.100  | S1       | 100   | 3        | 80 - <100| 2        | 20 - < 50| 1      | < 20   | 0     |
| 2.  | Cover of coral reef (%)         | 0.375  | S2       | >75   | 3        | > 50-75| 2        | 25-50 | 1       | < 25   | 0     |
| 3.  | Kind of life form               | 0.145  | S3       | >12   | 3        | < 7 - 12| 2        | 4 - 7  | 1       | < 4    | 0     |
| 4.  | Kind of reef fish               | 0.140  | S3       | >50   | 3        | 30 - 50 | 2        | < 10   | 1       | < 10   | 0     |
| 5.  | Current velocity (cm/dt)        | 0.075  | S3       | 0-15  | 3        | >15 - 30| 2        | >30 - 50| 1      | > 50   | 0     |
| 6.  | Depth of coral reef (m)         | 0.100  | S3       | 1-3   | 3        | > 3 - 6 | 2        | > 6 - 10| 1      | > 10   | 0     |
| 7.  | Width of coral reef spread (m)  | 0.075  | S3       | >500  | 3        | >100-500| 2        | 20 - 100| 1      | < 20   | 0     |

Source: Yulianda [2]

Note: S1 = Very suitable, S2 = Fairly appropriate, S3 = Conditional, and N = Incompatible, with a value of $< 1$.

### 2.4. Carrying capacity

The carrying capacity analysis for marine tourism is calculated using the regional carrying capacity (DDK) concept. DDK is the maximum number of visitors who can physically be accommodated in one provided area at a particular time without disturbing nature and humans. DDK is determined using the following equation [2]:

$$DDK = K \times \frac{L_p}{L_t} \times \frac{W_t}{W_p}$$

where, DDK is the carrying capacity of the tourist area (person/day), K is the ecological potential of visitors per unit area, Lp is the area of the area or the length of the area that can be utilized, Lp is the
area unit for the tourism category, Lt is the time provided by the area for tourist activities in one day, and Wp is the time spent by visitors for each tourist activity.

| Island              | Location         | Status             | Width of coral reef area (m²) |
|---------------------|------------------|--------------------|-------------------------------|
| Pramuka Island      | North Pramuka    | Fairly Appropriate | 22,694.78                     |
|                     | West Daya Pramuka| Fairly Appropriate | 26,170.56                     |
|                     | East Pramuka     | Fairly Appropriate | 14,498.15                     |
|                     | West Laut Pramuka| Fairly Appropriate | 6,450.03                      |
| Panggang Island     | North Panggang   | Fairly Appropriate | 5,001.69                      |
|                     | West Panggang    | Very Suitable      | 43,162.36                     |
|                     | South Panggang   | Very Suitable      | 7,699.36                      |
|                     | East Panggang    | Fairly Appropriate | 14,498.15                     |
| APL (Area Perlindungan Laut or Marine Protected Area) | West APL | Fairly Appropriate | 21,290.28                     |
|                     | East APL         | Fairly Appropriate | 8,232.24                      |
|                     | North APL        | Fairly Appropriate | 5,057.82                      |
| Karang Lebar        | North Karang Lebar| Fairly Appropriate | 101,222.51                    |
|                     | South Karang Lebar| Fairly Appropriate | 10,173.93                     |
|                     | West Karang Lebar| Very Suitable      | 20,078.08                     |
|                     | East Karang Lebar| Very Suitable      | 30,468.00                     |
| Semak Daun          | North Semak Daun | Fairly Appropriate | 13,077.55                     |
|                     | South Semak Daun | Very Suitable      | 30,089.44                     |
|                     | West Semak Daun  | Fairly Appropriate | 18,904.11                     |
|                     | East Semak Daun  | Conditional -      | -                             |
| Balik Layar         | North Balik Layar| Fairly Appropriate | 4,507.18                      |
|                     | South Balik Layar| Fairly Appropriate | 6,850.41                      |
|                     | West Balik Layar | Very Suitable      | 8,099.33                      |
| Karang Bongkok Island | South Karang Bongkok | Very Suitable | 65,077.56                     |
|                     | West Karang Bongkok| Fairly Appropriate | 24,601.03                     |
|                     | South West Karang Bongkok | Fairly Appropriate | 90,087.29                     |
|                     | East Karang Bongkok| Fairly Appropriate | 70,556.76                     |
| Gosong Pandan       | South Gosong Pandan| Fairly Appropriate | 30,789.36                     |
| Kotok Besar Island  | West Kotok Besar | Very Suitable      | 24,743.01                     |
|                     | North Kotok Besar| Very Suitable      | 20,650.56                     |
|                     | South Kotok Besar| Very Suitable      | 17,800.81                     |
| Kotok Kecil Island  | North West Kotok Kecil | Fairly Appropriate | 11,436.99                     |
|                     | North East Kotok Kecil | Very Suitable | 6,772.00                      |
| Karang Halima       | East Karang Halima| Fairly Appropriate | 3,071.00                      |
| Karang Congkak      | North Karang Congkak | Fairly Appropriate | 51,025.32                     |
|                     | South Karang Congkak | Fairly Appropriate | 70,434.30                     |
| Karya Island        | North Karya      | Conditional -      | -                             |
|                     | East Karya       | Fairly Appropriate | 17,020.45                     |
|                     | West Karya       | Conditional -      | -                             |
| Total               |                  |                    | 1,008,433.24                  |

3. Result and discussion

3.1. Marine tourism potential
The tourism suitability analysis considers several environmental parameters used as a reference for weight and score assessments. Each parameter's weight and score will determine whether a tourist location falls into the very suitable, appropriate, conditional, or unsuitable category. Environmental parameters used as a reference for weighting or scoring assessments are attributes that often determine
a person's satisfaction value in traveling. Each type of tour has different attributes depending on the type of tour.

Especially for snorkeling tourism, the parameters used as a reference in weighting and score are water transparency, percentage of hard coral cover, number of lifeform species, number of reef fish species, depth, current and width of coral reefs. Meanwhile, environmental parameters for diving tourism are water transparency, percentage of hard coral cover, number of lifeform species, number of reef fish species, depth, and currents. The potential snorkeling and diving resources for marine tourism's suitability varied from conditional to very suitable (table 4 and 5). The tourism area is generally in the fairly appropriate category for both snorkeling and diving.

Eleven coral reef locations have a very suitable category, and 25 most of the coral reef locations are still in the appropriate criteria for snorkeling tourism (figure 1). However, the three marine tourism locations were included in the conditional category; generally, the three locations had a low coral cover percentage value.

![Figure 1. Suitability map for snorkeling tourism at SPTN III TNLKpS.](image-url)
Table 5. Suitability status of coral reefs for diving in the SPTN III Kepulauan Seribu area.

| Island                        | Location          | Status                | Width of coral reef area (m²) |
|-------------------------------|-------------------|-----------------------|--------------------------------|
| Pramuka Island                | North Pramuka     | Fairly Appropriate    | 41,356.47                      |
|                               | South Pramuka     | Fairly Appropriate    | 66,036.64                      |
|                               | East Pramuka      | Fairly Appropriate    | 41,956.20                      |
|                               | West Pramuka      | Fairly Appropriate    | 16,628.13                      |
| Panggang Island               | North Panggang    | Fairly Appropriate    | 13,916.09                      |
|                               | West Panggang     | Fairly Appropriate    | 97,252.33                      |
|                               | South Panggang    | Fairly Appropriate    | 44,730.67                      |
|                               | East Panggang     | Fairly Appropriate    | 41,956.20                      |
| APL (Area Perlindungan Laut or Marine Protected Area) | West APL          | Fairly Appropriate    | 25,494.21                      |
|                               | East APL          | Fairly Appropriate    | 26,696.98                      |
|                               | North APL         | Fairly Appropriate    | 50,142.79                      |
| Karang Lebar                  | North Karang Lebar| Fairly Appropriate    | 212,623.93                     |
|                               | South Karang Lebar| Fairly Appropriate    | 50,147.13                      |
|                               | West Karang Lebar | Fairly Appropriate    | 73,011.55                      |
|                               | East Karang Lebar | Fairly Appropriate    | 74,533.81                      |
| Semak Daun                    | North Semak Daun  | Fairly Appropriate    | 75,855.26                      |
|                               | South Semak Daun  | Very Suitable         | 111,573.06                     |
|                               | West Semak Daun   | Fairly Appropriate    | 49,630.45                      |
|                               | East Semak Daun   | Fairly Appropriate    | 81,648.95                      |
| Balik Layar                   | North Balik Layar | Fairly Appropriate    | 8,992.82                       |
|                               | South Balik Layar | Fairly Appropriate    | 21,016.11                      |
|                               | West Balik Layar  | Conditional           | -                              |
|                               | East Balik Layar  | Fairly Appropriate    | 13,811.58                      |
| Karang Bongkok Island         | South Karang Bongkok| Fairly Appropriate    | 116,036.34                     |
|                               | West Karang Bongkok| Conditional           | -                              |
|                               | South West Karang Bongkok| Fairly Appropriate    | 292,146.83                     |
|                               | East Karang Bongkok| Fairly Appropriate    | 168,565.45                     |
| Gosong Pandan                 | South Gosong Pandan| Fairly Appropriate    | 142,910.64                     |
| Kotok Besar Island            | West Kotok Besar  | Fairly Appropriate    | 24,726.93                      |
|                               | North Kotok Besar | Fairly Appropriate    | 52,977.19                      |
|                               | South Kotok Besar | Fairly Appropriate    | 65,201.50                      |
| Kotok Kecil Island            | North West Kotok Kecil| Fairly Appropriate    | 29,532.55                      |
|                               | North East Kotok Kecil| Fairly Appropriate    | 18,396.11                      |
| Karang Halima                 | East Karang Halima| Fairly Appropriate    | 16,729.00                      |
| Karang Congkak                | North Karang Congkak| Fairly Appropriate    | 176,902.38                     |
|                               | South Karang Congkak| Conditional           | -                              |
| Karya Island                  | North Karya       | Fairly Appropriate    | 114,789.37                     |
|                               | East Karya        | Conditional           | -                              |
|                               | West Karya        | Conditional           | -                              |
| Total                         |                   |                       | 2,766,593.80                   |
One coral reef location is in a very suitable category. Most coral reef locations are still in the appropriate criteria for snorkeling tourism (figure 2). Five coral reef locations belong to the conditional category for diving. Several factors that make the conformity status into the conditional category are the low percentage of coral cover at the observation location and the low level of fish diversity.

![Figure 2. Suitability map for diving tourism at SPTN III TNLKpS.](image)

3.2. Carrying capacity
The total distribution area of coral reefs suitable for snorkeling and diving tourism in SPTN III TNLKpS is 1,008,443.24 m² and 2,766,593.80 m², respectively (table 6 and figure 3). The assumption used is for snorkeling; the required area of coral reefs is 500 m²/person, while diving tourism is 2,000 m²/two person. The concept of ecotourism, which is determined by gainful attention to carrying capacity, is instrumental in influencing the development of ecotourism activities. Carrying capacity system is a way as effective public conservation systems in order to keep sustainable resources [7].

Table 5 shows that the total carrying capacity of the SPTN III TNLKpS coral reef ecosystem is 3,752 and 9,814 people/day for snorkeling and diving, respectively. This total capacity assumes that snorkeling is two trips or trips a day because the time provided by the tourist attraction is only six hours. One
snorkeling trip takes three hours (activities and trips to the object location), so the maximum trip that can be done in a day is only two trips. Therefore, the number of people on one trip that can be accommodated is 2,057 (3,752 people divided by two trips travel).

Table 6. Supporting capacity for snorkeling and diving tours at SPTN III TNLKpS.

| Name of island        | Location               | Carrying capacity (person) |
|-----------------------|------------------------|-----------------------------|
|                       |                        | Snorkeling | Diving  |
| Pramuka Island        | North Pramuka          | 90         | 165     |
|                       | West Daya Pramuka      | 104        | 264     |
|                       | East Pramuka           | 57         | 167     |
|                       | North West Pramuka     | 25         | 66      |
| Panggang Island       | North Panggang         | 20         | 55      |
|                       | West Panggang          | 172        | 389     |
|                       | South Panggang         | 30         | 178     |
|                       | East Panggang          | 57         | 167     |
| APL (Area Perlindungan| West APL               | 85         | 101     |
| Laut or Marine Protected| East APL              | 32         | 106     |
|                       | North APL              | 20         | 200     |
| Karang Lebar          | North Karang Lebar     | 404        | 850     |
|                       | South Karang Lebar     | 40         | 200     |
|                       | West Karang Lebar      | 80         | 292     |
|                       | East Karang Lebar      | 181        | 298     |
| Semak Daun            | North Semak Daun       | 52         | 303     |
|                       | South Semak Daun       | 120        | 446     |
|                       | West Semak Daun        | 75         | 198     |
|                       | East Semak Daun        | -          | 326     |
| Balik Layar           | North Balik Layar      | 18         | 35      |
|                       | South Balik Layar      | 27         | 84      |
|                       | West Balik Layar       | 32         | -       |
|                       | East Balik Layar       | 20         | 55      |
| Karang Bongkok Island | South Karang Bongkok   | 260        | 464     |
|                       | West Karang Bongkok    | 98         | -       |
|                       | South West Karang Bongkok | 360   | 1168    |
|                       | East Karang Bongkok    | 282        | 674     |
| Gosong Pandan         | South Gosong Pandan    | 123        | 571     |
| Kotok Besar Island    | West Kotok Besar       | 98         | 98      |
|                       | North Kotok Besar      | 82         | 211     |
|                       | South Kotok Besar      | 71         | 260     |
| Kotok Kecil Island    | North West Kotok Kecil | 45         | 118     |
|                       | North East Kotok Kecil | 27         | 73      |
| Karang Halima         | East Karang Halima     | 12         | 66      |
| Karang Congkak        | North Karang Congkak   | 204        | 707     |
|                       | South Karang Congkak   | 281        | -       |
| Karya Island           | North Karya            | -          | 459     |
|                       | East Karya             | 68         | -       |
|                       | West Karya             | -          |         |
| Total                 |                        | 3,752      | 9,814   |
| Estimated carrying capacity per trip |              | 1,876      | 2,453   |

The assumption for diving is four trips a day because, in diving tours, the time spent is only two hours and the time that can be used in a day is eight hours so that in one diving trip, the number of people that can be accommodated is 2,762 people (9,814 people divided by four trip times).
4. Conclusion
In general, most of the coral reef ecosystem locations in the SPTN III TNLKpS area are still in the appropriate category for snorkeling and diving activities. The locations that are not suitable are three locations for snorkeling tours and five locations for diving tours. The total carrying capacity for snorkeling tours is 3,472 people/day assuming two trips a day, while for diving tours, it is 9,214 people/day assuming four trips a day. Most of the factors that cause this location to be categorized as conditional are low coral cover, so it is necessary to rehabilitate coral reefs. Therefore, implementing the carrying capacity-based ecotourism concept needs to be done as a form of sustainable management of marine tourism activities in the TNLKpS.

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