Report on the distribution of target species

Final Version of 30/06/2021

Deliverable Number D.4.1.1.

Project Acronym	SOUNDSCAPE
Project ID Number	10043643
Project Title	Soundscapes in the north Adriatic Sea and their impact on marine biological resources
Priority Axis	3
Specific Objective	3.2
Work Package Number	4
Work Package Title	Sensitivity of target species
Activity Number	4.1
Activity Title	Data collection about target species
Partner in Charge	BWI
Partners Involved	BWI, CNR
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Status	Final
Distribution	Public
Citation	Falkner R, Pokupec D, Granziol L, Frleta-Valić M, Rako-Gospić N, Vučur Blazinić T, Constaratas A, Radulović M, Cukrov Car M, Hofs J. Report on the distribution of target species. SOUNDSCAPE project, WP4, 49pp, 2021

Summary

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1.Introduction

The common bottlenose dolphin (*Tursiops truncatus*) is a cosmopolitan species that inhabits coastal and open sea areas of the moderate and tropical belt (Figure 1). Its robust body curved dorsal fin, as well as the absence of a defined body pattern with a pale ventral area and a darker upper body is characteristic of this species. Adult size ranges from 2 to 3.8m. Length and weight may vary depending on geographical positioning (Wells and Scott (2002)). In the Adriatic, bottlenose dolphins can reach approximately 3m in length and can weight up to 200 kg. The analysis of abrasion of teeth layers reveal that these species can reach up to 50 years old, however male lifespan is typically shorter than in females (40 to 45 years old) (Wells and Scott (2002)). As for the rest of marine mammals, the sound is of high importance for bottlenose dolphins. They produce "whistles" in order to communicate, and "clicks" for echolocation, helping them navigate, search for food, and detect potential dangers (Wells and Scott (2002)). This species is not only active during the day, but also at night. Diurnal activities of bottlenose dolphins involve traveling, scavenging, feeding, socializing, and resting (Wells and Scott (2002)). Duration of the particular behavior depends on various factors such as age, habitat, time of the day, or mating season (Wells and Scott (2002)). Globally, bottlenose dolphins are affected by a series of threats such as habitat loss, overfishing, bycatch, diseases caused by pollution, maritime traffic disturbances and underwater noise (Wells and Scott (2002)).

The bottlenose dolphin (*Tursiops truncatus*) is protected under the Nature Protection Act (NN 162/03) and is included in the II and IV Annex of the EU Habitats Directive. The species is listed as "endangered" (EN) in Croatia (D. Holcer (2006)). Based on aerial surveys performed in 2010 and 2013, it is estimated that there are around 5700 bottlenose dolphins (CI = 4300-7600) inhabiting the entire Adriatic area (C. M. Fortuna et al. (2018)). It is estimated that the Northern Adriatic is a significant area for bottlenose dolphins with an estimate of 2600 individuals (CI = 2200-2900), while the middle Adriatic is estimated to hold approximately 1100 individuals (CI = 800-1500) (C. M. Fortuna et al. (2018)). It is estimated that the Northern Adriatic is a significant area for bottlenose dolphins with an estimate of 2600 individuals (CI = 2200-2900), while the middle Adriatic is estimated to hold approximately 1100 individuals (CI = 800-1500) (C. M. Fortuna et al. (2018)).

Figure 1. Bottlenose dolphin (Tursiops truncatus)

Data on the status of local communities in Croatia exist only in the Kvarner area, Northern Dalmatia and in the waters of the island of Vis. However, in other areas, research has only recently been carried out occasionally and opportunistically; therefore, there is no systematic knowledge of the population and conservation status of bottlenose dolphins in the Adriatic. In the Kvarner area, more precisely in the Cres-Lošinj archipelago, the resident population of bottlenose dolphins has been studied continuously since 1987. Presently, about 200 individuals are living in this area throughout the year (Pleslić et al. (2015)), while more than 1000 individuals have been recorded in the reference database. Individual dolphins mostly form smaller groups made up of males and females, mostly for activities related to scavenging and feeding. Although food availability is reduced in the area, this allows each individual to have the same probability of finding food (Bearzi, Politi, and Sciara (1999)). Through years of research, it has been established that this resident community has a high degree of site fidelity, including males being territorial and residing in a smaller area compared to females (Rako-Gospić et al. (2017)). Rako et al. (2013) found that the dolphins in the Cres-Lošinj waters preferred different areas during peak tourist season. During the summer months, a higher rate of sightings were recorded in areas far away from the mainland,

correlating to lower levels of underwater noise. Specifically, at this time of year, the number of vessels in the archipelago had increased by 400%, which subsequently increased noise levels at sea. It can be assumed that this is the result of the animal population decline recorded from 1995-2003. Bottlenose dolphins do not have a natural predator in the Adriatic, and human activities in the form of maritime traffic and tourism are one of the main threats to this species in the Kvarner area (Nimak et al. (2007); C. M. Fortuna (2007)). Nimak et al. (2007) consider that the presence of vessels affects the behavioral budget of the bottlenose dolphins and that in the presence of the vessels, dolphins spend less time in activities related to feeding and rest, and spend more time traveling. Furthermore, negative dolphin reactions have been reported in the presence of other vessels, mainly tourists. This has prompted the Blue World Institute to further educate the local community and visitors on animal welfare standards that should be considered during human/dolphin interactions. Following these standards is voluntary but is still contributing to the positive changes in public awareness. It is essential in understanding the importance of preserving bottlenose dolphin populations in the area and across the globe. The Blue World Institute, through its activities, continuously monitors bottlenose dolphin populations in order to determine its abundance. It controls the impact of human activity on biodiversity and provides the scientific background to the competent authorities to establish protection measures within Natura2000 sites.

Three sea turtle species recorded in Croatian waters, namely the loggerhead (*Caretta caretta*), the green (*Chelonia mydas*)and the leatherback turtle (*Dermochelys coriacea*) have been legally protected in Croatia since 1995 (OG 30/94). Current protection is granted through the Law on Nature Protection (OG 70/05, 139/08) that requires implementation of conservation measures.

In addition, the loggerhead turtle is listed as Vulnerable in the Red Book of Amphibians and Reptiles of Croatia (Jelić et al. (2012)). The loggerhead turtle and the green turtle are species that are listed in both Annex II and IV of the Habitat Directive.

Croatian waters represent one of the key neritic feeding habitats for EU populations and a wintering habitat for the loggerhead sea turtle (Lazar (2009)(Figure 2). A wide and shallow continental shelf, rich benthic communities and favourable temperature regimes make the northern Adriatic Sea an important feeding habitat of the Mediterranean (Margaritoulis et al. (2003), B. Lazar et al. (2006), Casale et al. (2012)), with loggerhead population size estimated at 51,451 individuals (95% CI: 37.914-69.820)(Holcer et al. (2010)). Satellite tracking (Casale et al. (2012)) and aerial survey data (Holcer et al. (2010)) emphasized waters off the western coast of Istria Peninsula and west side of Cres-Lošinj – Dugi otok archipelago as a high-use feeding areas. High bycatch of loggerheads in bottom trawls during the winter also indicates the role of the Adriatic as a wintering habitat (Lazar and Tvrtkovic (1995), Lazar et al. (2003), Casale, Laurent, and De Metrio (2004), Casale (2010)). Trawler bycatch rates increase for about 10 folds from the western (Italian) part towards the eastern (Croatian) coast (Casale, Laurent, and De Metrio (2004)). These habitats are in waters with sea temperature >11-12°C and are located off the west coast of Cres, Lošinj and Dugi otok islands (Lazar et al. (2003), Lazar (2009)). Such distribution of wintering

habitats is result of longitudinal and latitudinal gradients of sea temperature during winter and appropriate bottom substrate for wintering turtles ((Lazar (2009)). Current goal is to improve the effectiveness of marine Natura 2000 sites for sea turtle conservation, by extending current sites over turtle hot-spot areas especially on the west side of Cres-Lošinj archipelago, around the island of Susak and improving their management.

Figure 2. Loggerhead sea turtle (Caretta caretta)

2. Methods

2.1 Research area

The Blue World Institute for Marine Research and Conservation conducted research from July to March 2021 in northern Adriatic, from the middle part of the island Cres to the Lim channel on the north, that includes two Natura 2000 sites- the Cres-Lošinj Archipelago (HR3000161) and Western Istria (HR5000032), and on the south to the northern part of Dugi otok (Figure 3).

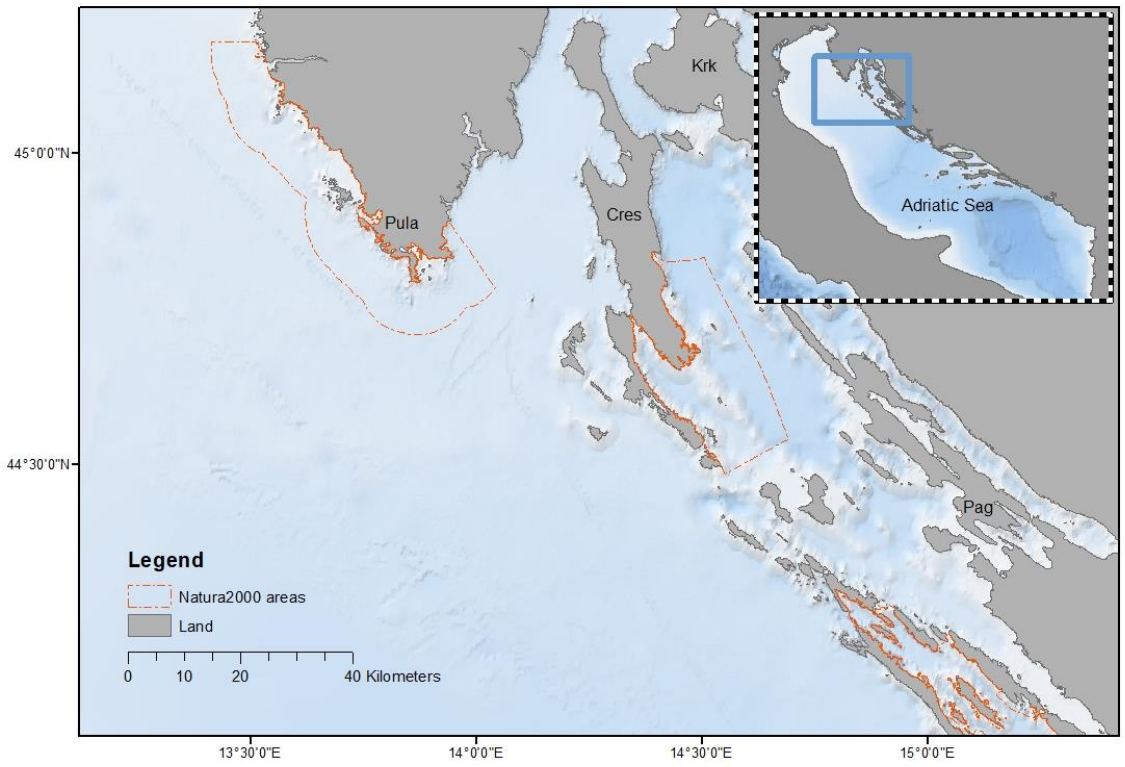

Figure 3. Study area

2.2 Data collection and analysis

2.2.1 The research effort

Distribution data were collected through dedicated boat surveys and the Blue World Institute citizen science app. Fieldwork at sea was conducted using the 6 m inflatable boat with the four-stroke engine

100hp at sea conditions less than four, according to the Beaufort scale and during good visibility. Research effort was determined *ad libitum* according to the weather conditions. The average search speed was 14 knots. At least two experienced researchers were always on board, continually inspecting the horizon in a standing position, covering the 180° range in the direction of the movement of the vessel. Information on the presence of fishing vessels within the study area and the locations of other interesting marine species had been recorded as well.

NaviLog application was used to collect the navigation data on a Samsung SM-T550 tablet, developed specifically for the needs of the Blue World Institute (Figure 4).

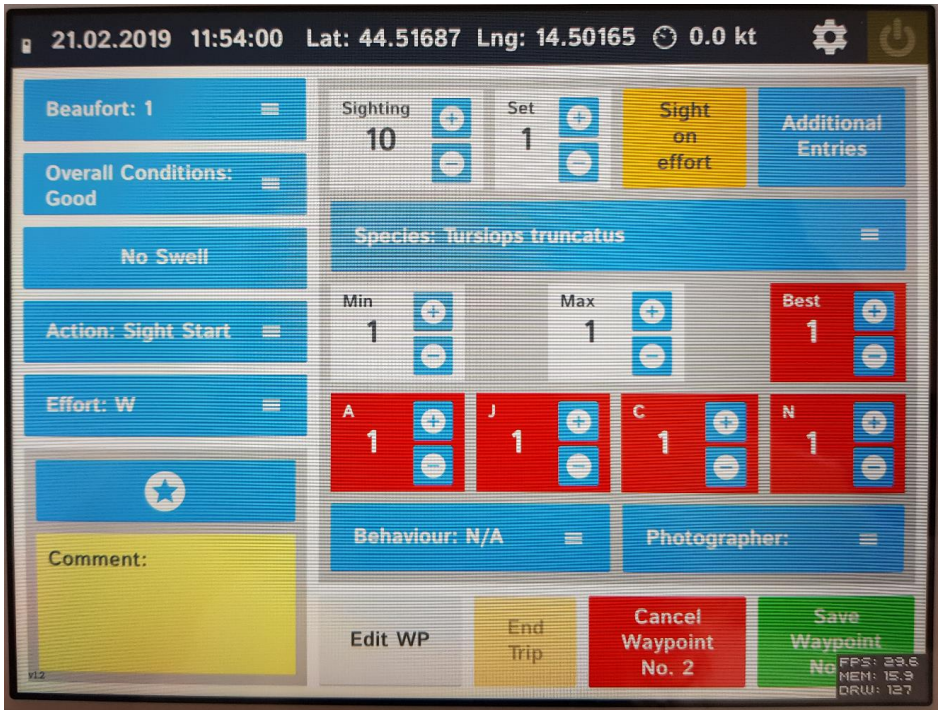

Figure 4. Android application Navilog

For the survey, an array of data were recorded: date, time, coordinates of navigation, sea state changes, the weather conditions, the current research activity, the locations of the sightings of dolphin species, group size, age categories within the group, and behaviour within the groups. All the navigation data was transferred to the navigation database using the GIS ESRI ArcMap 10.2 and RStudio to calculate the research effort and obtaining an outline of its spatial distribution (Team (2016), Bivand and Lewin-Koh

(2013), C. Brunsdon, Chen, and Brunsdon (2015), South (2011), Bivand and Rundel (2015), McDonald (2016)).

2.2.2 Encounter rate

For the purpose of this survey, data collection included date, time, navigation coordinates, sea state changes, weather conditions, current research activities, information of the research vessel tracks during sightings, number and age of individuals present in a group and behaviour. Research effort was determined *ad libitum* depending on the weather conditions at sea and trying to ensure a balanced distribution of research effort in the survey area. For this purpose, ESRI ArcMap 10.2 and R 3.3.2 computer packages (Team (2016)) were used. The encounter rate is calculated as the total number of encounters of a group of bottlenose dolphins divided by the total number of kilometres driven in the study area (ER1 = n encounters / n kilometres) (C. M.

Fortuna (2007)). A graphical chart of encounter rates in different sections of the study area was made using a polygon grid with a cell size 1x1 km, where the total number of dolphin sightings is divided by the total number of kilometres within in each grid cell (ER2) using only the cells in which the total research effort was equal to or greater than 1,414 km (corresponding to the diagonal of the cell of size 1x1 km) (Rako et al. (2013); Bearzi et al. (2005)). The land area was removed from the grid, and proportional surface area of the sea was calculated within each cell for greater accuracy of results. Subsequently, the encounter rate was recalculated as previously obtained encounter rate while divided by the share of the sea within each cell. Encounter rate analysis (ER2) was calculated using ESRI ArcMap 10.2.

2.2.3 Photo-identification

The research procedure involves photo-identification, which represents a non-invasive technique for the identification of individuals in the population. Photo-identification of the observed bottlenose dolphins is based on comparing the unique notches, scratches and scars on their dorsal fin and the side and rear of the dorsal part of the body (B. Wilson, Hammond, and Thompson (1999); Wiirsig and Jefferson (1990)) (Figure 5). The edge of the dorsal fin is often and easily damaged during the interactions between individuals and the pattern of such injuries makes every single dorsal fin unique. By systematically taking pictures of dorsal fins, the observed individuals are being identified, and photos are compiled in a reference catalogue consisting of an array of dorsal fins belonging to dolphins living in a particular area. Based on the created catalogue, the population size, social structure, relations between individuals and the rate of reproduction can be determined.

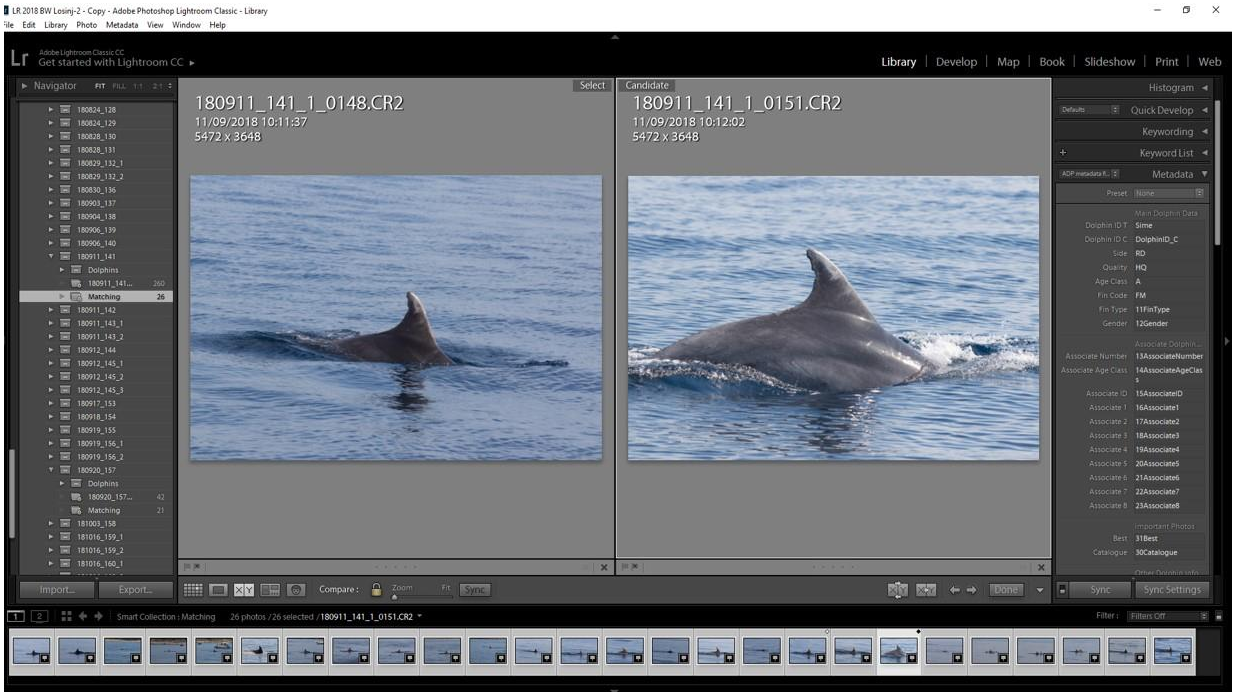

Figure 5. Photo-identification of individuals in the population

Although dorsal fins of young dolphins usually have no marks, they are individually identified by swimming in pairs with their mothers, given that they swim most of the time in their vicinity. Multi-Annual monitoring of animals with their offspring and changes of their fins allows the identification and monitoring of the calves separation from the mother. In each dolphin observation, the monitoring protocol "focal group follow" was used to trace the movement and behavioural patterns of the individual, as well as the use of photo-identification to define the focal group observed (Mann (1999)). A group is defined as all animals in apparent connection to each other, moving in the same direction and generally (though not always) behaving similarly (Shane (1990)). In case of changes in the composition and the size of the sampled group (dolphins leaving or joining the group) the sighting was divided into sets (Bearzi, Notarbartolo-DI-Sciara, and Politi (1997)). In the photo-identification analysis, each set was analysed separately to determine changes in the monitored group and its dynamics (Bearzi, Notarbartolo-DI-Sciara, and Politi (1997)). Furthermore, an evaluation of the quality of dorsal fin marks was carried out and classified into one of four categories (highly marked, fairly marked, poorly marked and unmarked).

Highly Marked (HM) - Well-worn fins with lots of nicks or notches that often change the general shape of the fin (e.g. tip of the fin missing), white coloration due to numerous scars. Positive identification possible even from poor-quality photos, extremely low chance of misidentification. (Figure 6)

Fairly Marked (FM) - Several nicks and notches of various sizes present on the fin. Positive identification possible on fair-quality and high-quality photos.

Poorly Marked (PM) - One or few small nicks on the trailing edge present, no severe scars or injuries. Positive identification possible only on high-quality photos.

Unmarked (UM) - The fin bears no marks at all, usually seen on young individuals. Positive identification made when young individual was seen in pair with identified mother throughout several occasions.

Figure 6. Example of a bottlenose dolphin with a "highly marked" dorsal fin

This categorization is necessary in order to avoid possible errors and discrepancies in the application of methods for the analysis of the size estimation of the population which is beyond the scope of this report due to the limited data. In the analysis of the size and composition of the group, the data and information on the identification of all individuals, including poorly marked and non-marked animals were used. In addition, regardless of quality, all photos were stored for their possible subsequent identification. FinFindR is an R and c++ based library for doing photo recognition on dolphins. The App provides an interface to the core library functionality, including automated image cropping, fin tracing and catalogue matching using a tripletLoss network trained using the mxnet framework (Figure 7). Photo-identification technique was applied using a Canon EOS 7D digital camera with Canon lens EF 70-200mm f / 2.8 L IS USM. During the sightings with each group of bottlenose dolphins, the goal was to make high-quality photos of the dorsal fin of every dolphin in the group from both sides. The quality of the pictures

depended on the weather conditions and/or the absence of light and on the size and composition of the group and the behaviour of the group and/or individual animals.

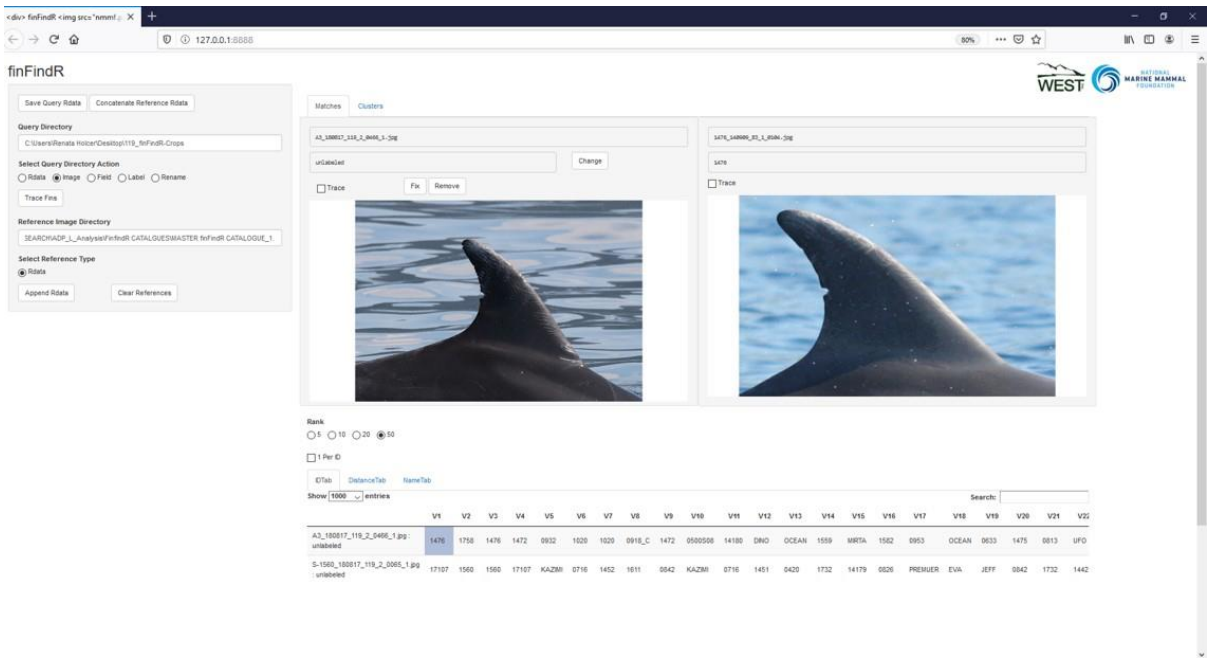

Figure 7. Photo-identification of individuals in the population using finFindR software

2.2.4 Age classes

The age of individuals present in a group was determined according to four basic categories (Table 1 and Figure 8):

Table 1: Age classes

Age class categories	Abbreviation	Definition
Adult	A	Independent individual of 2,5-3 m body length.
Juvenile	J	2/3 the length of an adult; always in the same group as its mother but not necessarily always swimming together
Calf	C	½ the length of an adult; most of the time swimming close to its mother; light colors than others
Newborn	N	1/3 the length of an adult; uncoordinatedly swimming always beside its mother; visible fetal stripes

Figure 8. Examples of the different age classes

2.2.5 Behaviour

Data on group behaviour were collected at 5-minute intervals, and the category of behaviour observed in more than half of the individuals was recorded. Behaviour category is determined by the behaviour of more than half individuals in the observed group and are defined as in Bearzi, Politi, and Sciara (1999); Lusseau et al. (2006); Wise et al. (2007) and López (2006):

Socialise (S) - Most group members in almost constant physical contact with one another; oriented towards one another; no forward movement; display of surface behaviour (jumps, leaps, rolling, tail slaps, etc.).

Social Travel (ST) – Moving steadily in one direction, while socializing intermittently; tight groups often in physical contact (leaps, rolling, etc)

Dive (D) - Pattern characterized by cycles of single long dives, lasting up to several minutes; Dives are spaced by clusters of a relative regular number of ventilations. Last of series of ventilation often a Fluke up or tail stock submergence, suggesting a vertical dive. Submergence and surfacing usually within the same area; dolphins diving often synchronous

Dive-Travel (DT) – A pattern that is consistent of both travel and dive. Dolphins keep same general direction under water as during surfacing. Usually, but not always, single long dives accompanied by a pattern of clustered ventilations. Respiration patterns can be highly variable and poorly consistent in comparison to "Dive" behaviour. Groups or sub-groups often synchronous.

Travel (T) - Consistent directional movement of dolphins, with regular surfacing typically every 10 - 60 seconds.

Active Trawler Follow (ATF) – Following wake of operating trawler, at about 150 - 300m stern. Regular single long dives for several minutes. Dives are broken up by a pattern of regular ventilations.

Passive Trawler Follow (PTF) – Consistent directional movement of dolphins, with regular surfacing typically every 10 - 60 seconds, at about 150 - 300 m stern.

Surface Feeding (SF) – Obvious feeding activities performed near the water surface (chasing of prey, belly up, leaps, jumps, etc.): prey visible near surface; sometimes birds congregating in the area.

Mill (M) - Moving in varying directions in one location, pretending to dive, but showing no surface behaviours and no apparent physical contact between individuals; usually staying close to the surface, floating, etc.

Mixed Behaviour (MB) - No clear prevalence of one of the listed behaviours; different behaviours performed inconsistently by different individuals or subgroups. It is possible to specify the combination of behavioural categories, for example: D+SF, or AFT+PFT+M, etc.

Active Purse seine Follow (APSF) - unregular diving behaviour around the purse seiner. The length of the dive varies, while the distance from the boat itself is several to 100 meters.

Fish Farm Feeding (FFF) - diving around cages where fish is farmed, the dive length varies about 1-5 min, followed by a shorter period of surfacing.

Behaviour data collected using the Navilog application was analyzed in R software (Team (2016)).

2.2.6 Trawler following

Bottlenose dolphins often swim behind bottom trawlers, feeding opportunistically. To determine the frequency of this behaviour in the study area during trawler observation, the research vessel stops at about 200 meters behind the stern of the trawler to observe the surroundings of the ship for at least five minutes. If dolphins happened to find themselves behind the trawler, photo-identification technique was applied (Figure 9). The behaviour of the group was determined to detect whether the trawler was actively or passively followed (see section Categories of behaviour). By identifying each dolphin, it is also possible to determine whether there is a specific specialization of each animal to follow bottom trawlers or if this applies as general behaviour shown by the whole population in the study area.

Figure 9. Bottlenose dolphins following a trawler

2.2.7 Sea turtles

While exploring the study area, the locations of loggerhead turtle (*Caretta caretta*) sightings were recorded using Navilog application. Also, data were collected through the BWI citizen science app (Figure 10) and the BWI website. Citizen science allows members of the public to participate in scientific activities. Blue World Institute has created the app with the purpose to expand the information available about marine species in the Adriatic and to contribute to creation of positive attitude towards nature and marine environment protection. The Adriatic Sea is recognized as an essential habitat for juvenile and adult individuals of this species, which nest on the beaches of Greece, Cyprus, and Turkey. It is estimated that individuals reside in the Adriatic, while the northern Adriatic is recognized as a critical neritic area for this species (C. M. Fortuna et al. (2018)).

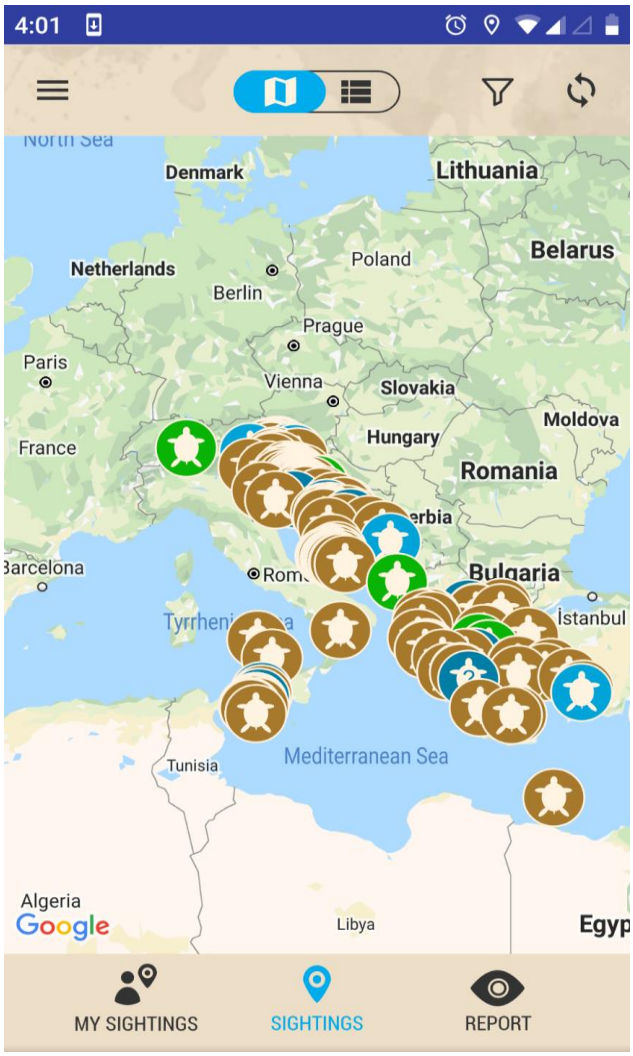

Figure 10. BWI citizen science app

3. Results

3.1 Research effort

During the period from July and March 2021 the analysis of navigation data shows that the research vessel covered the area from the middle part of the island Cres to the Lim channel in the north, that includes two Natura 2000 sites- the Cres-Lošinj Archipelago (HR3000161)and Western Istria (HR5000032), and in the south to the northern part of Dugi otok. In total, 117 field trips were conducted. Distance covered in search for dolphins was 2969.16 NM during 228.24 hours.

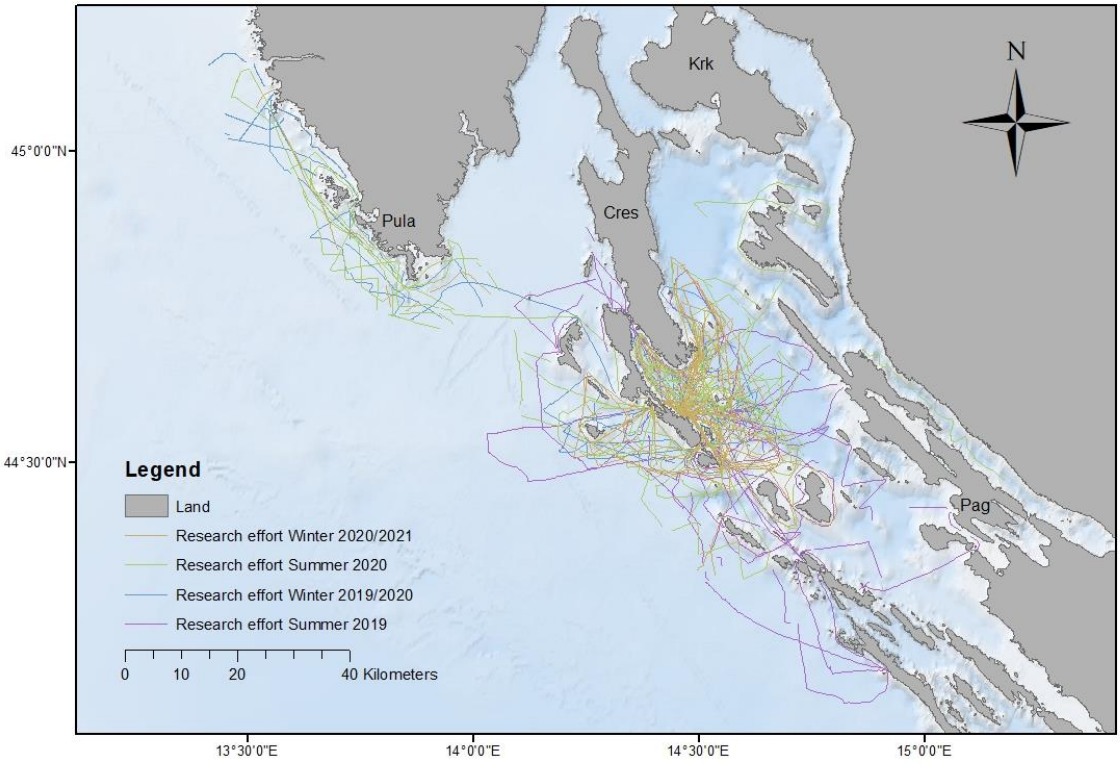

Figure 11. Research effort

3.2 Encounters

Bottlenose dolphins were encountered 184 times (Figure 12). Two different encounter rates were calculated. First method (ER1)-calculated as the ratio of the total number of sightings and total distance covered in positive search effort with a rate of 0.033. Second method (ER2)- was calculated using a polygon mesh size of 2x2 km with a mean rate of 0.027 (SD=0.054) presented in Figure 13 and Table 2.

Mean relative encounter rates (ER2) were also calculated per different seasons as shown in Table 2 and in Figure 14, 15, 16 and 17.

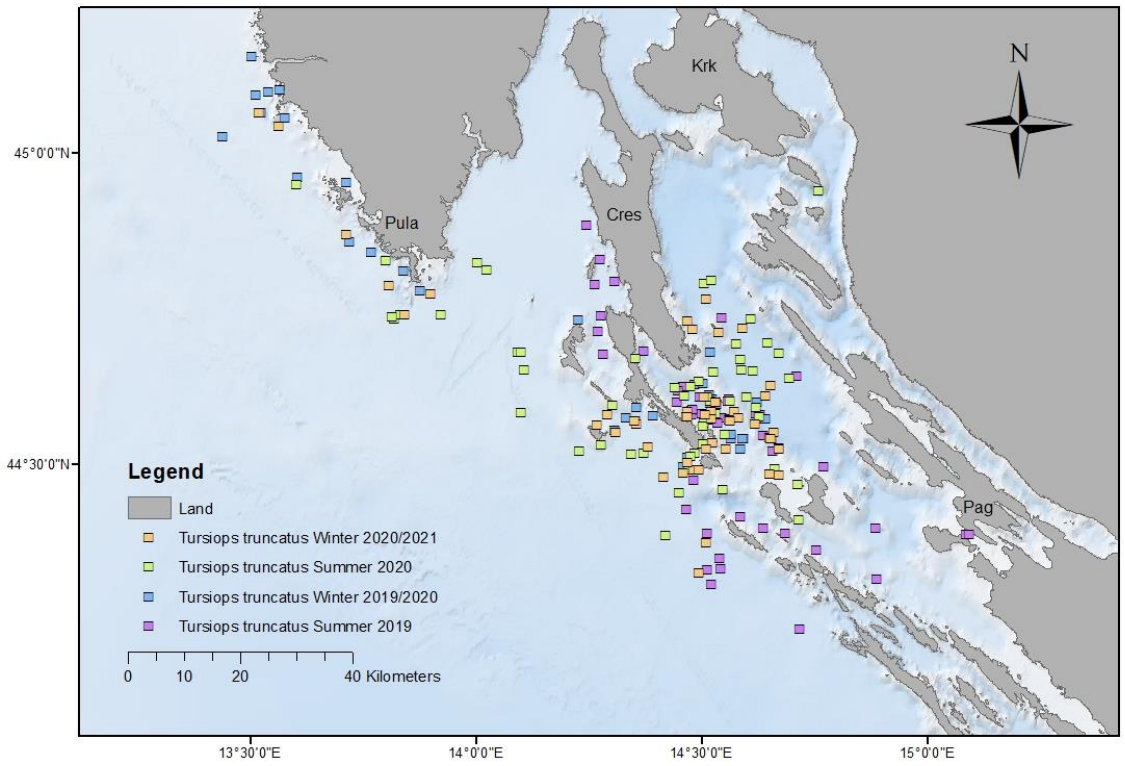

Figure 12. Bottlenose dolphin encounters

Table 2: Mean relative encounter rates of common bottlenose dolphins

	Mean relative encounter rate	Standard deviation
Total	0,02727	0,05452
Summer 2019	0,02390	0,11167
Winter 2019/2020	0,02269	0,09451
Summer 2020	0,02376	0,09009
Winter 2020/2021	0,03334	0,10769

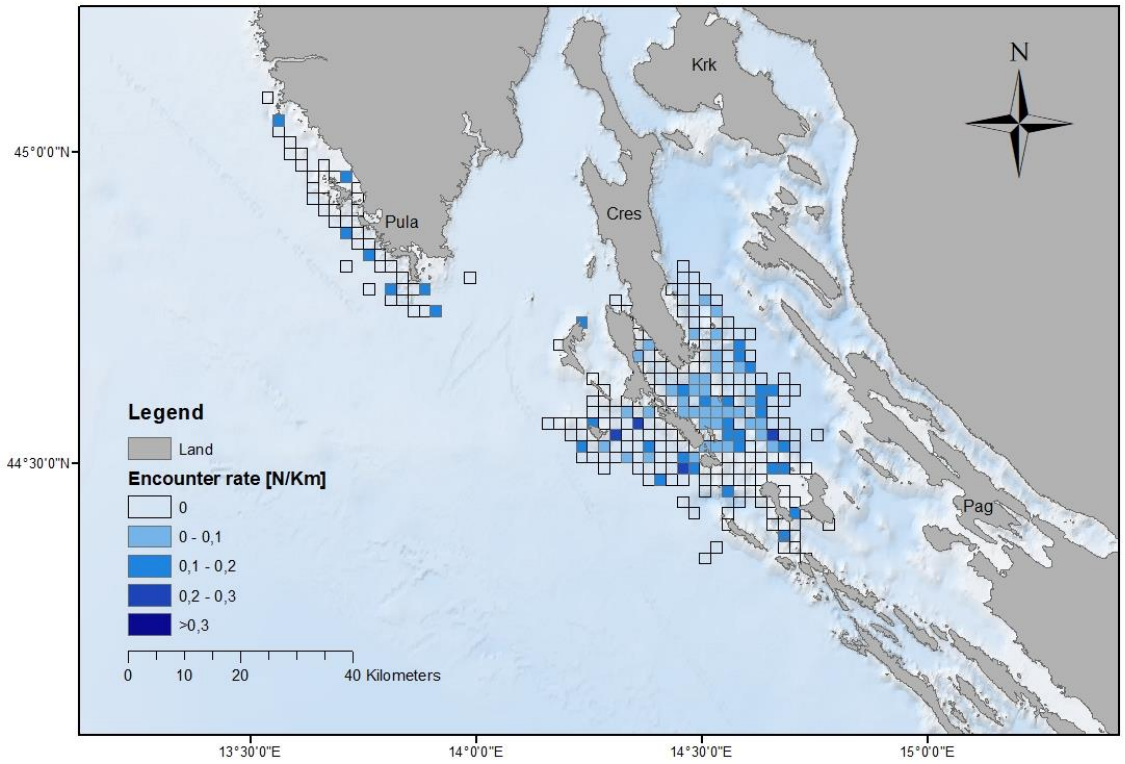

Figure 13. Encounter rate [ER2] of common bottlenose dolphins (2019-2021)

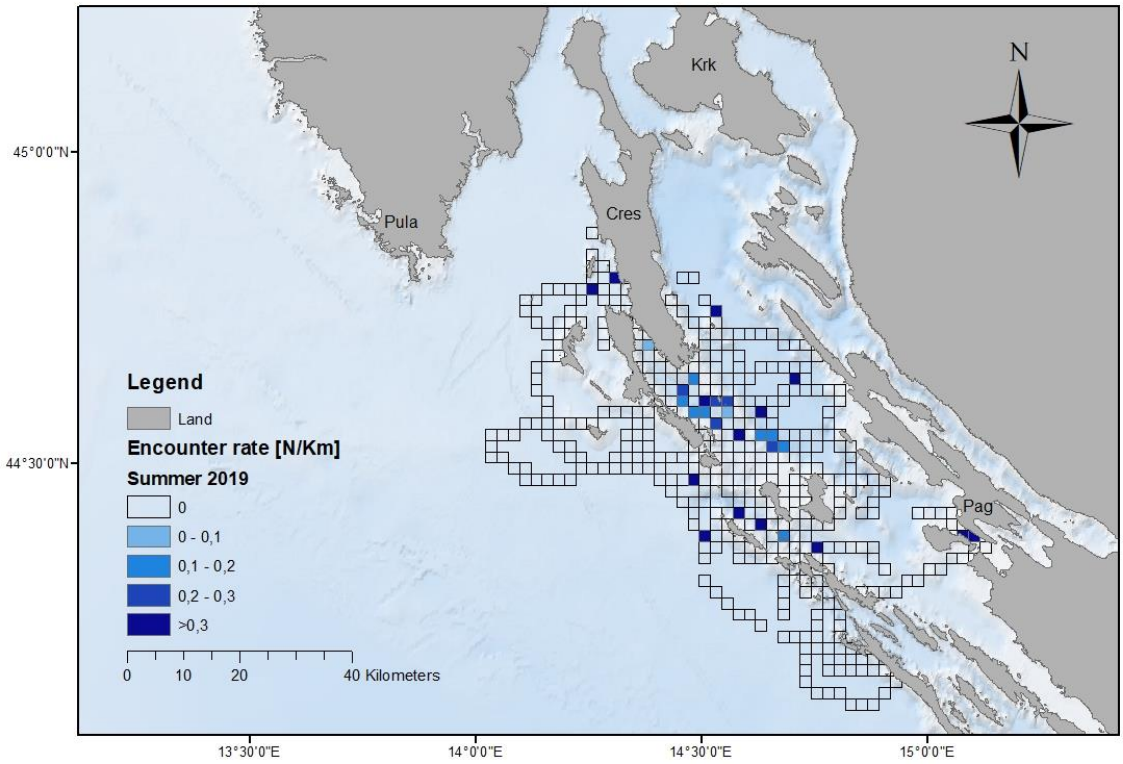

Figure 14. Encounter rate [ER2] of common bottlenose dolphins (Summer 2019)

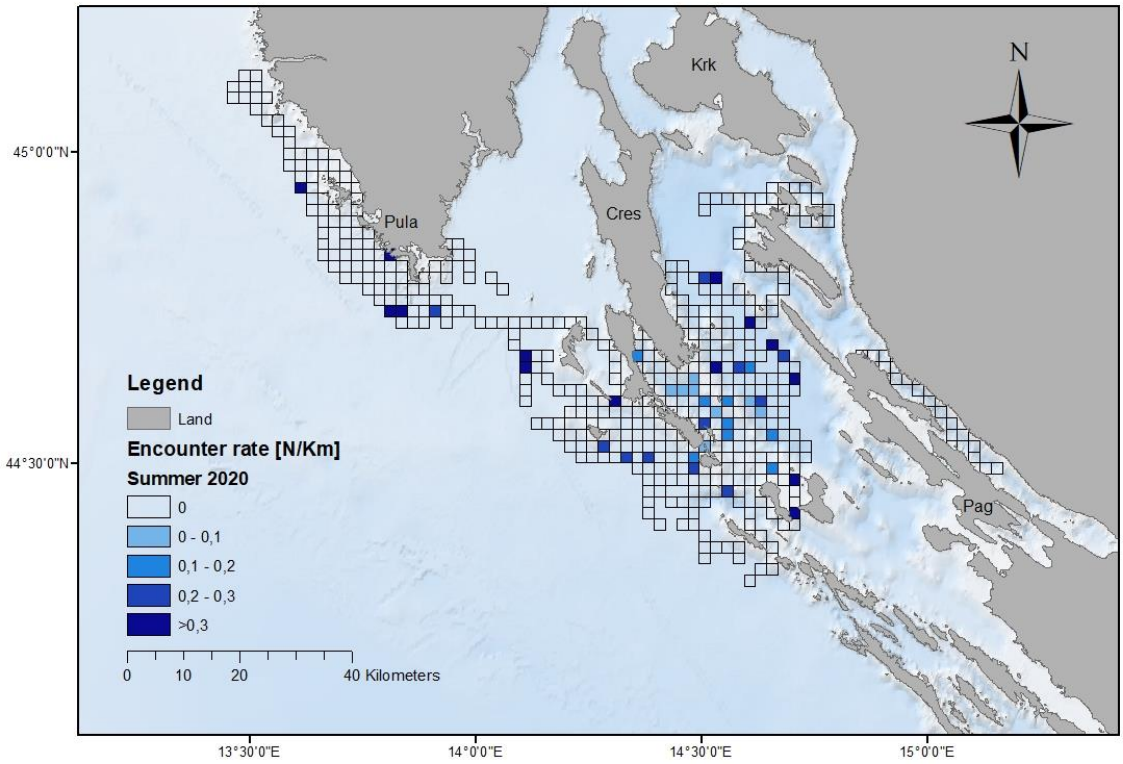

Figure 15. Encounter rate [ER2] of common bottlenose dolphins (Summer 2020)

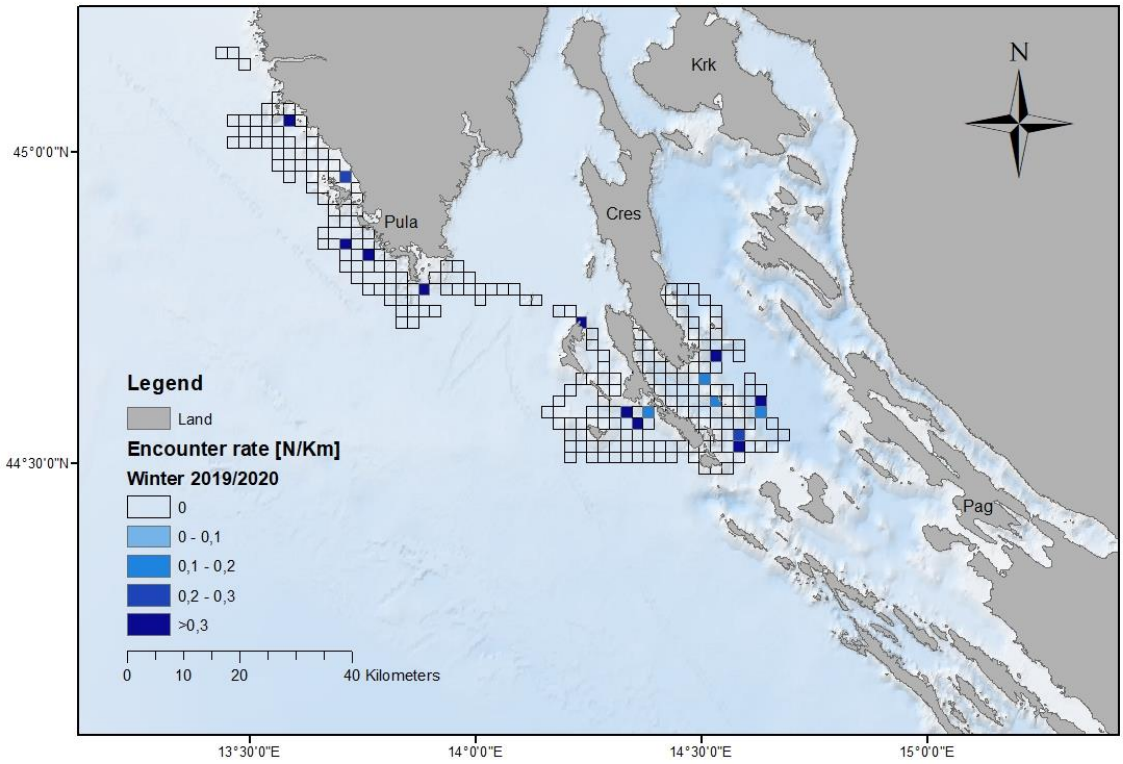

Figure 16. Encounter rate [ER2] of common bottlenose dolphins (Winter 2019/2020)

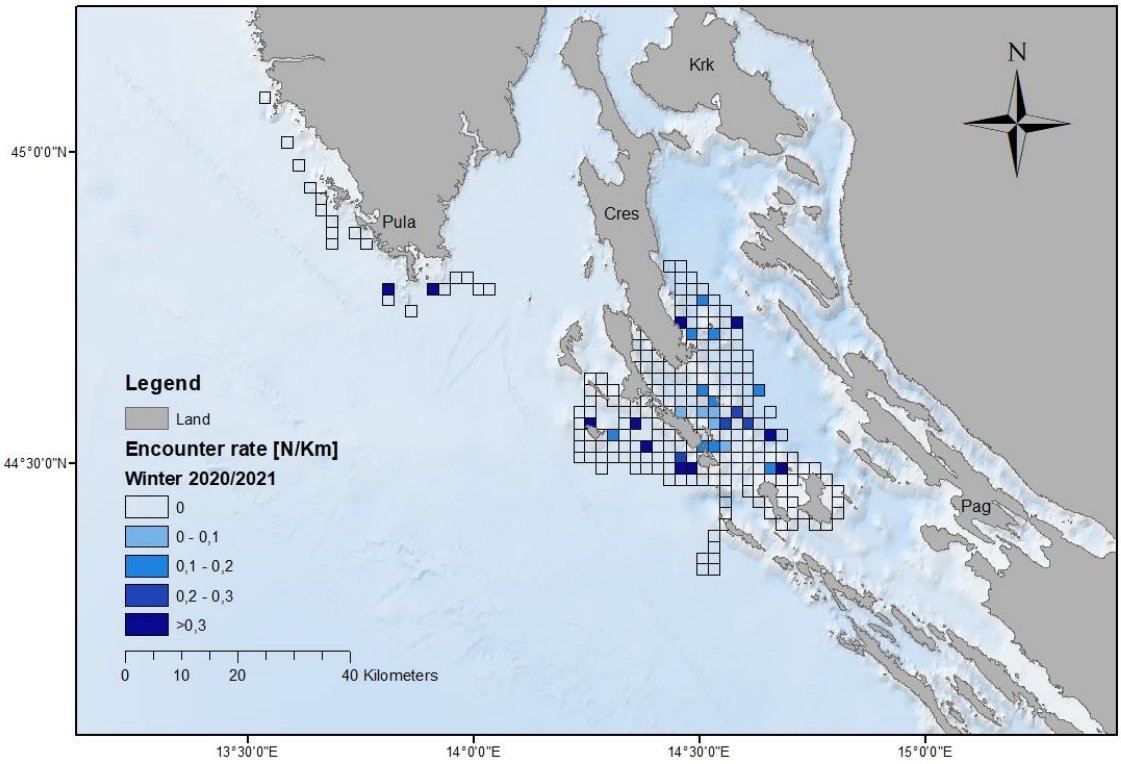

Figure 17. Encounter rate [ER2] of common bottlenose dolphins (Winter 2020/2021)

Time spent with the dolphins was 123.5 hours. Group size varied from 1 to 50 individuals, and the average group size consisted of 6 individuals.

3.3 Photo-identification

Based on data collection, a total of 775 bottlenose dolphins have been identified. Most dolphins have been encountered only once (N=427), while one individual has been encountered during the monitoring period for 17 times (Figure 18).

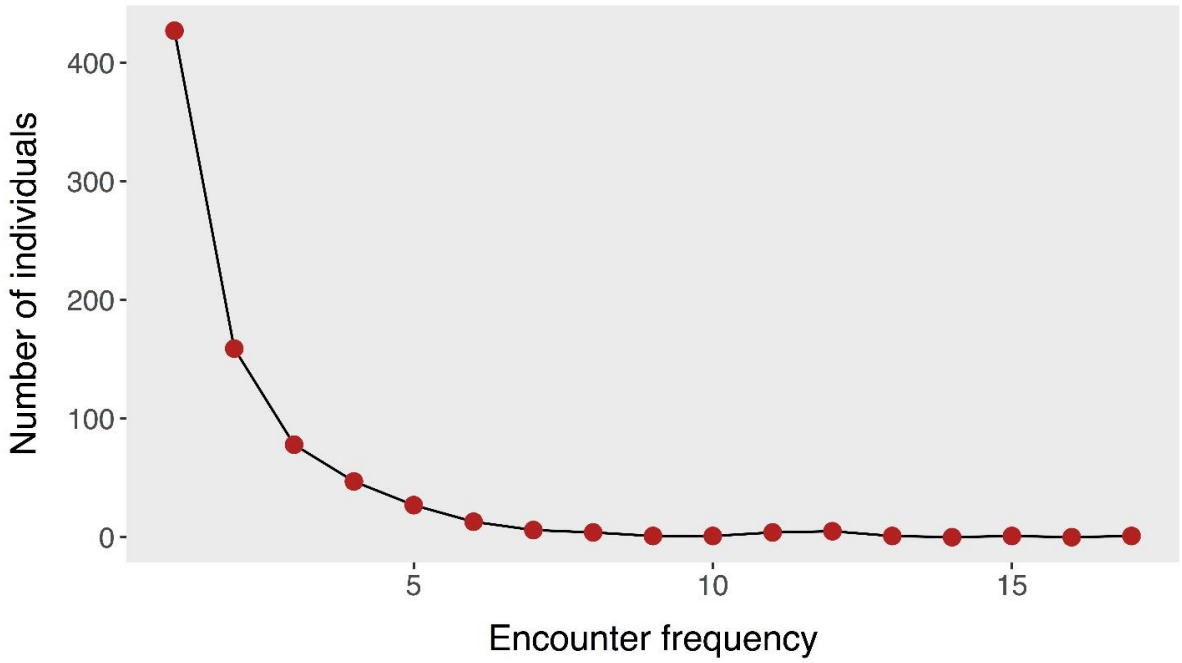

Figure 18. Frequency of occurrence of bottlenose dolphins

Analysis of age categories shows that 684 individuals were adults, 21 juveniles, 61 calves and 9 newborns (Figure 19).

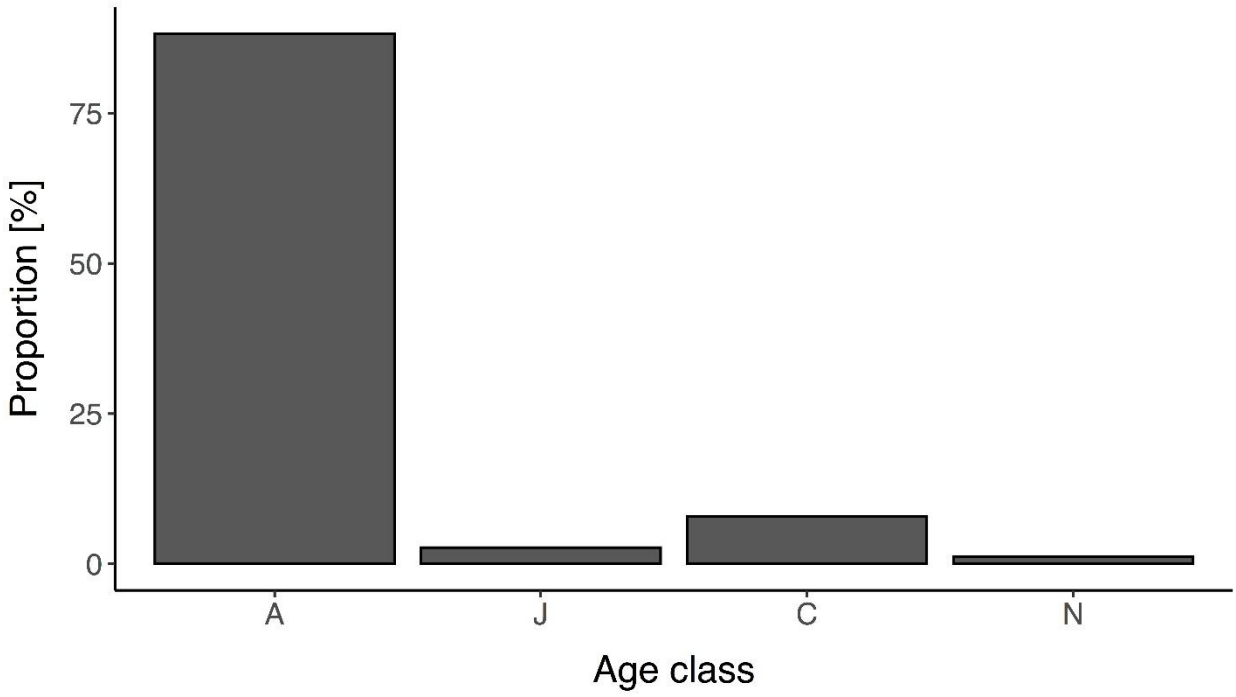

Figure 19. Age class categories observed in 2019/2020

3.4 Behaviour

When dolphins were observed, group behaviour was recorded every 5 minutes. The predominant behaviour category defined, based on the overall data collected at the beginning of each dolphin encounter, was dive–travel (DT), dive (D) active trawler follow (ATF). Partial time spent for dolphins in a specific category of behaviour is expressed in relation to the total time spent with dolphins as shown in Figure 20.

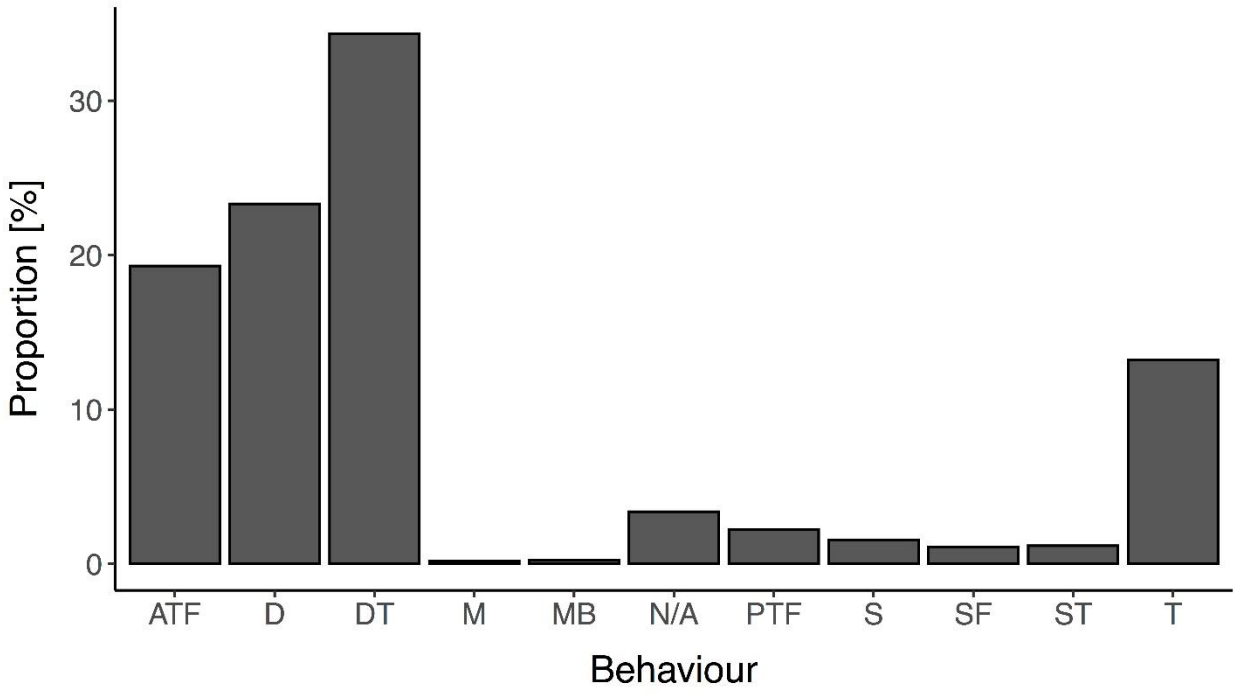

Figure 20. Proportion of activity budget

By analysing the connection of the group size with initial behaviour, it can be observed that there were no significant differences between the behaviour categories (Figure 21). Mean group size recorded at surface feeding behaviour is higher in comparison to the other recorded initial behaviours.

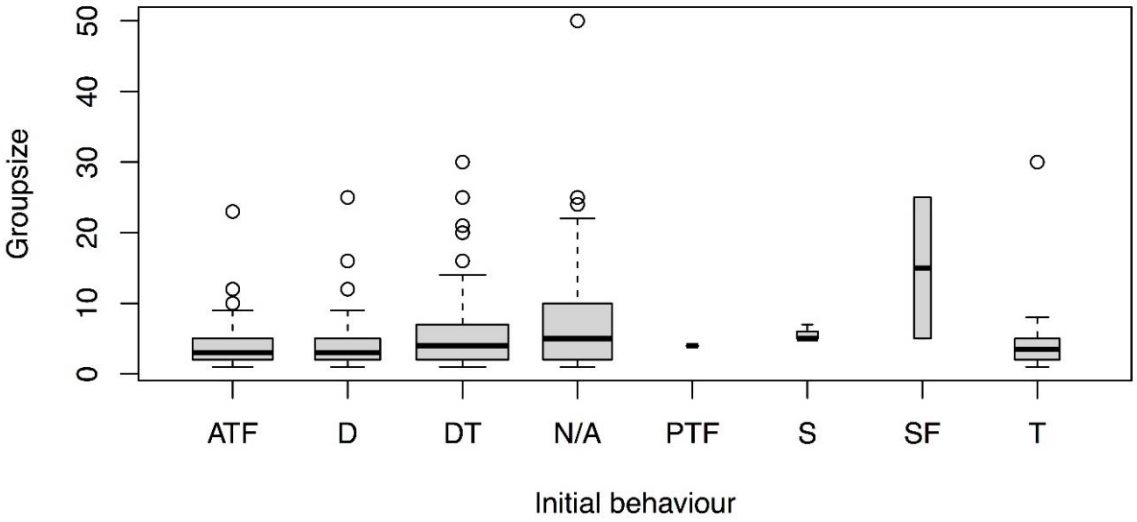

Figure 21. Group size vs. Initial behaviour

3.5 Observations behind bottom-trawlers

During the monitoring period, 69 trawling boats (Figure 22) were recorded and on 39 occasions, bottlenose dolphins were observed while feeding behind the recorded trawlers. Since the trawler following is one of the most dominant behaviour, opportunistic feeding is important for obtaining food in the study area. Mean relative encounter rate (ER2) of bottom trawlers in the period from 2019-2021 using a polygon mesh size of 2x2 km is 0.127 (SD=0.042) and shown in Figure 23 and Table 3.

Mean relative encounter rates (ER2) were also calculated per different seasons as shown in Table 3 and in Figure 24, 25, 26 and 27.

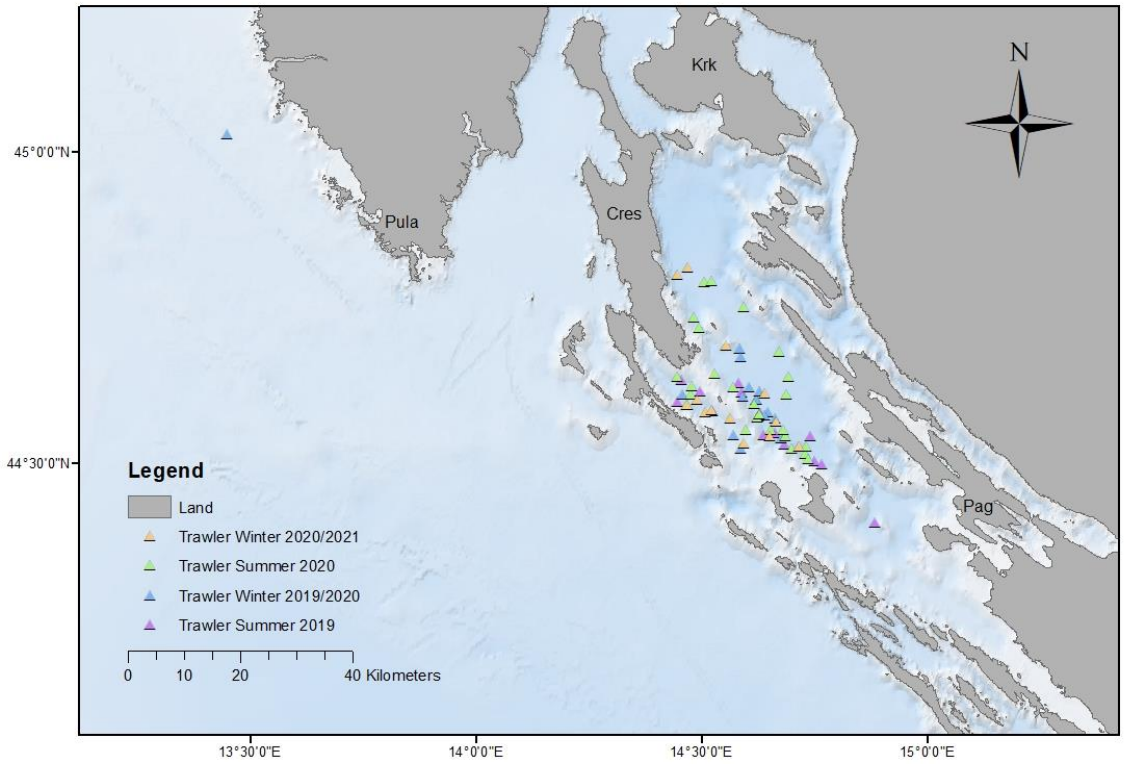

Figure 22. Observations of bottom-trawlers

Table 3: Mean relative encounter rates of bottom trawlers

	Mean relative encounter rate	Standard deviation
Total	0,01271	0,04208
Summer 2019	0,00631	0,04272
Winter 2019/2020	0,02081	0,09983
Summer 2020	0,00928	0,05678
Winter 2020/2021	0,00643	0,03627

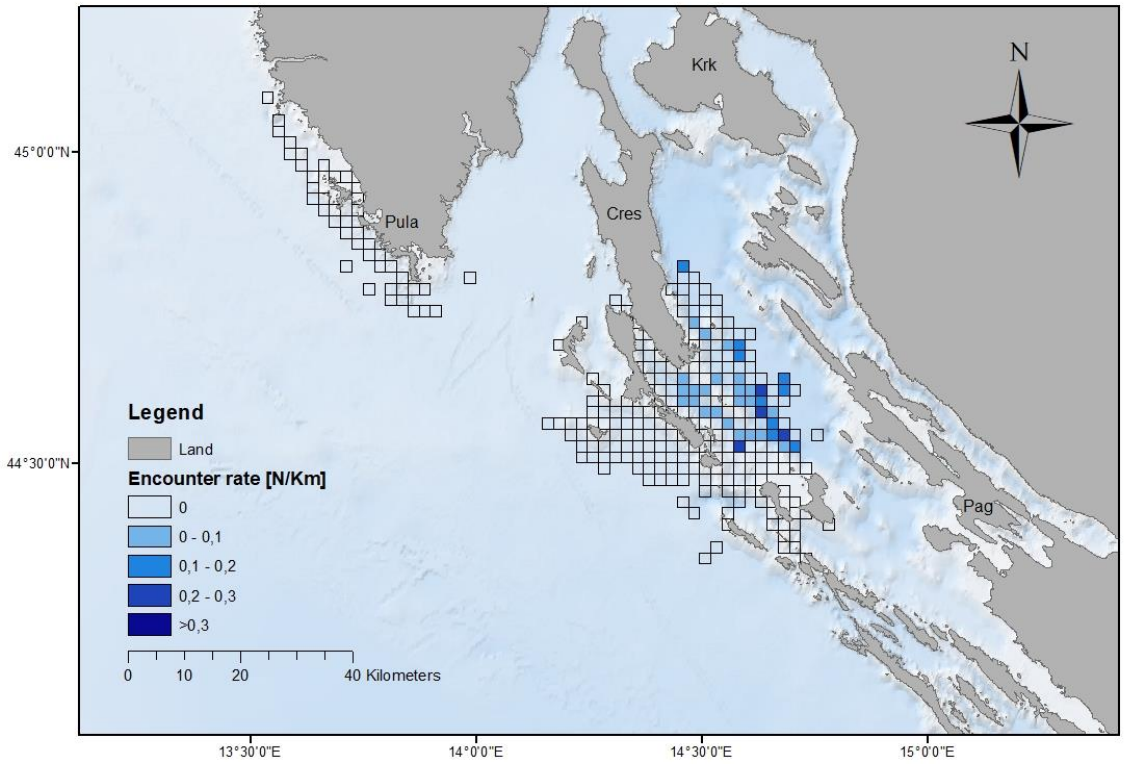

Figure 23. Encounter rate [ER2] of bottom trawlers (2019-2021)

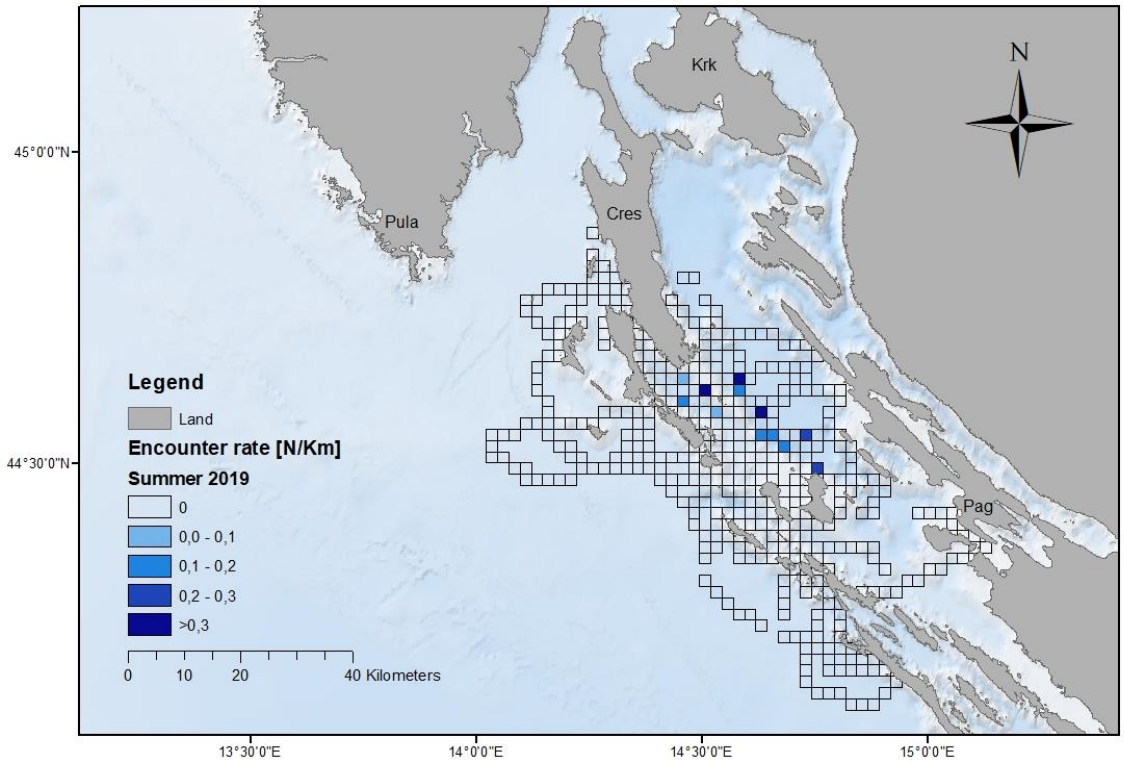

Figure 24. Encounter rate [ER2] of bottom trawlers (Summer 2019)

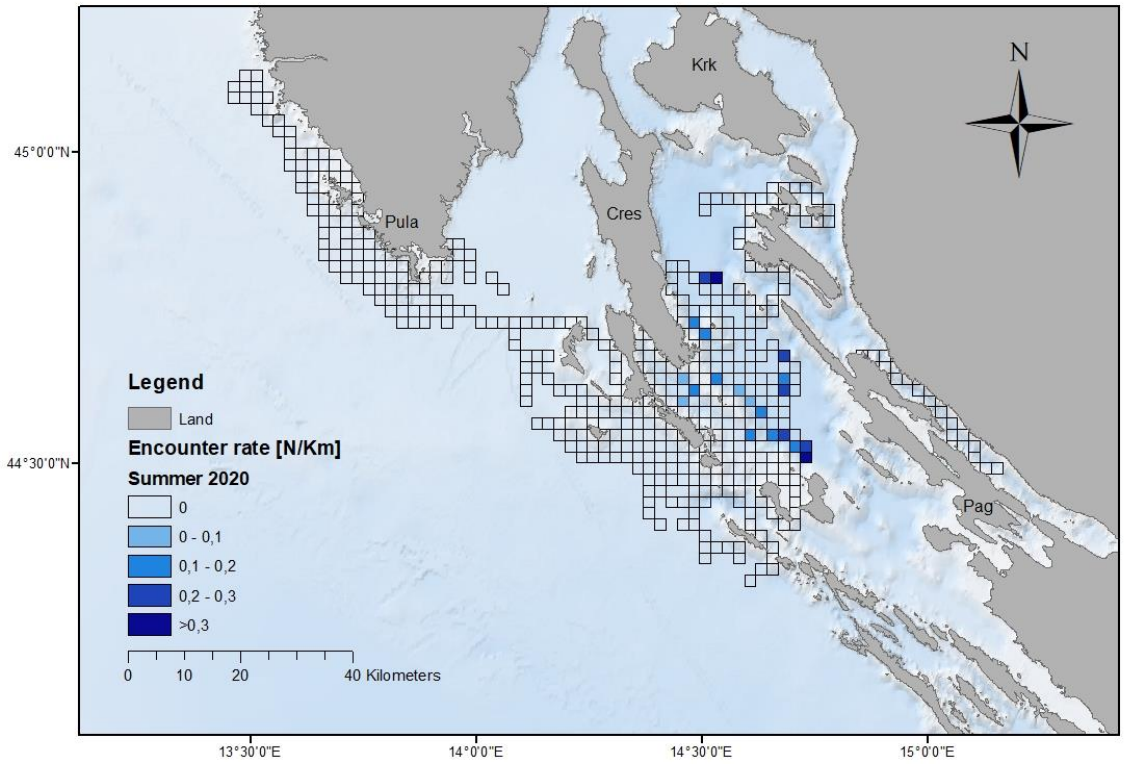

Figure 25. Encounter rate [ER2] of bottom trawlers (Summer 2020)

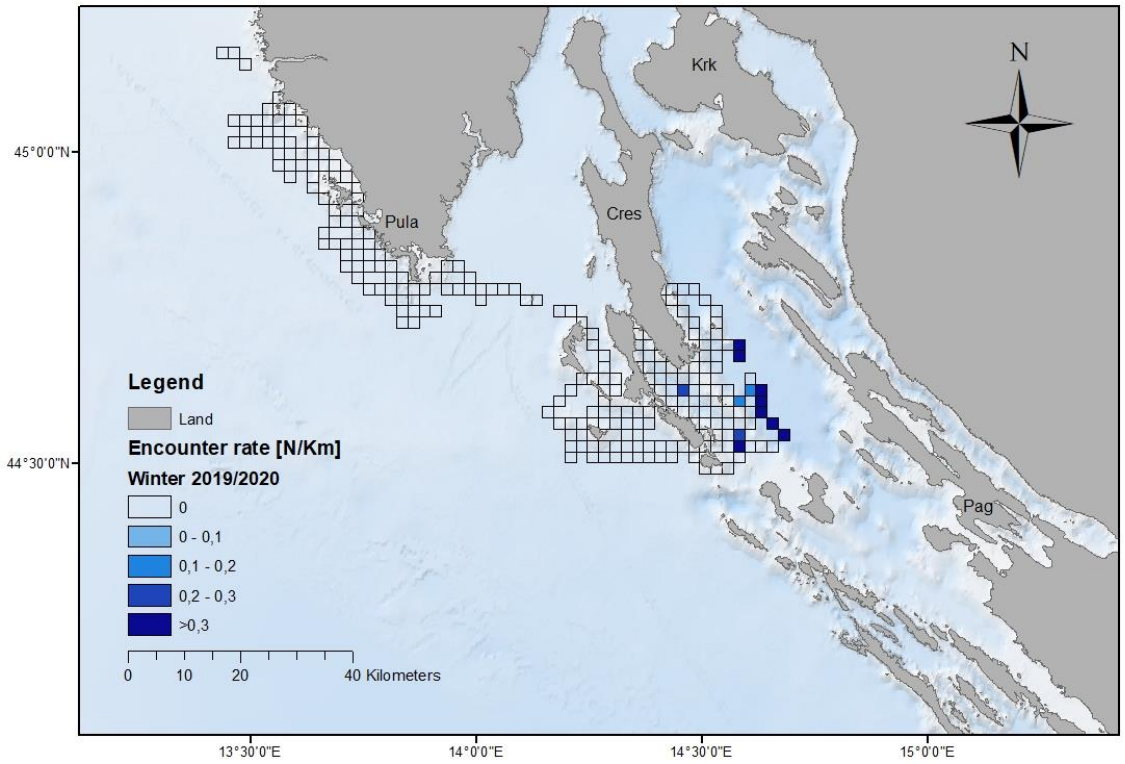

Figure 26. Encounter rate [ER2] of bottom trawlers (Winter 2019/2020)

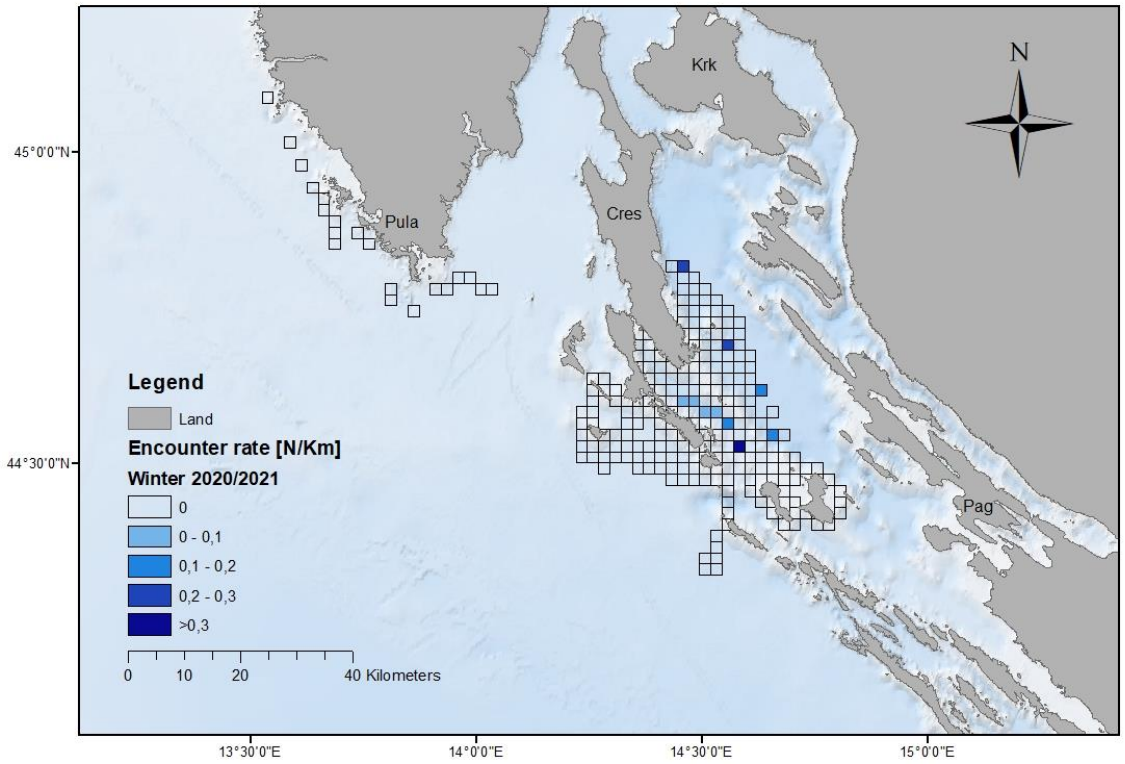

Figure 27. Encounter rate [ER2] of bottom trawlers (Winter 2020/2021)

3.6 Sea turtles

During the boat based survey, using the Navilog application, 74 loggerhead sea turtles were recorded. Sightings locations can be found on Figure 28. The locations of loggerhead sea turtle sightings were also collected through the BWI citizen science app. Through the citizen science app 10 alive individuals were reported within the research area.

Encounter rate of loggerhead sea turtle, using a polygon mesh size of 2x2 km, is shown on Figure 29.

Mean relative encounter rates (ER2) were also calculated per different seasons as shown in Table 4 and in Figure 30, 31, 32 and 33.

Most of the individuals were observed along the western side of the island of Lošinj, near the islands of Susak and Dugi otok.

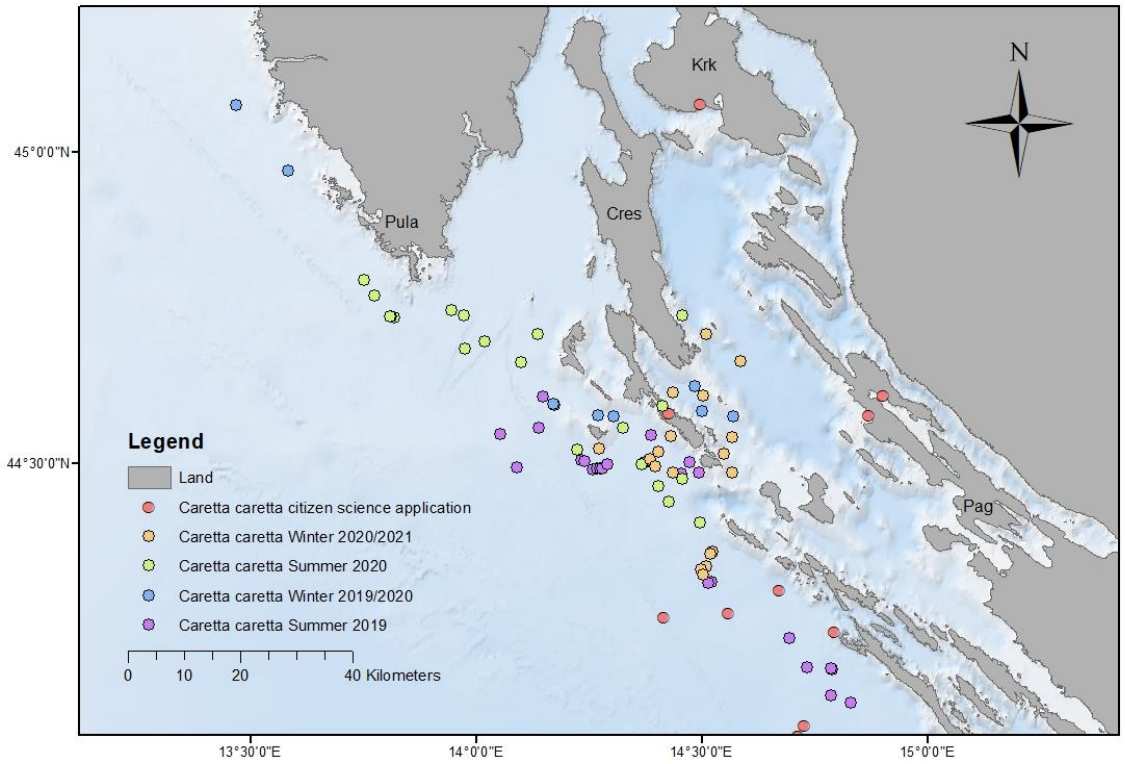

Figure 28. Encounter of loggerhead sea turtles through boat survey and citizen science app entrances

Table 4: Mean relative encounter rates of loggerhead sea turtles

	Mean relative encounter rate	Standard deviation
Total	0,01122	0,04332
Summer 2019	0,01896	0,10093
Winter 2019/2020	0,01443	0,09730
Summer 2020	0,01015	0,06311
Winter 2020/2021	0,02270	0,15020

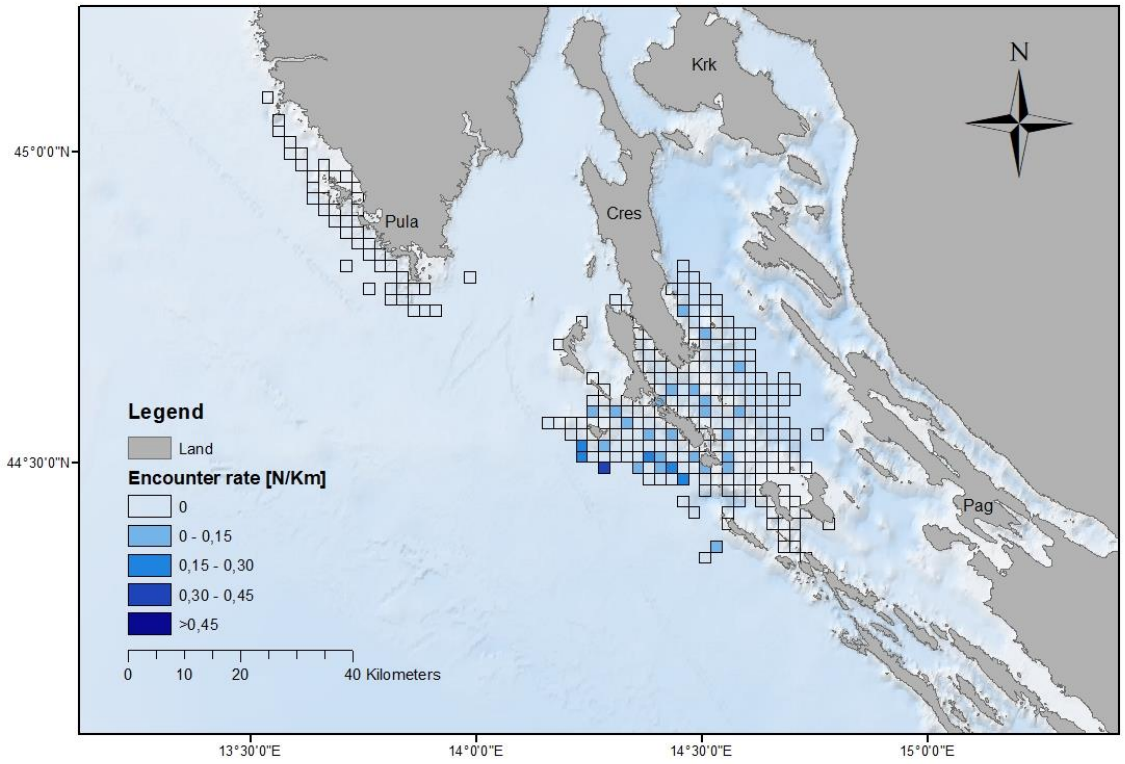

Figure 29. Encounter rate [ER2] of loggerhead sea turtles (2019-2021)

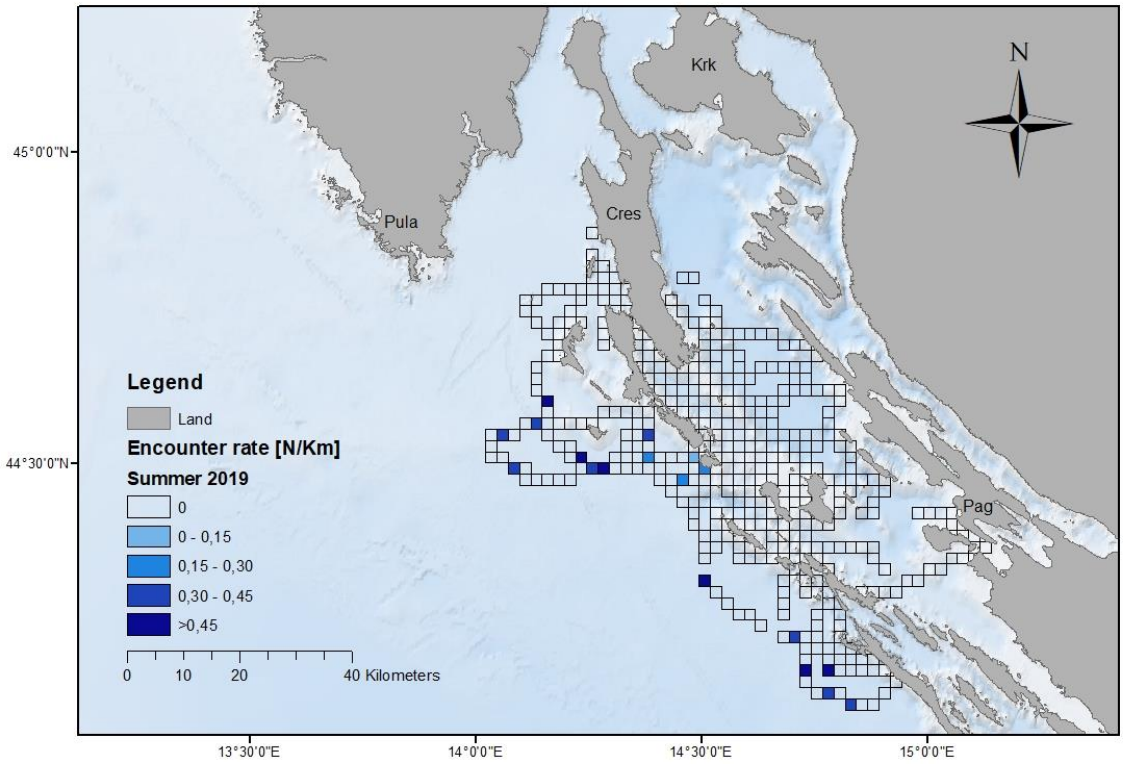

Figure 30. Encounter rate [ER2] of loggerhead sea turtles (Summer 2019)

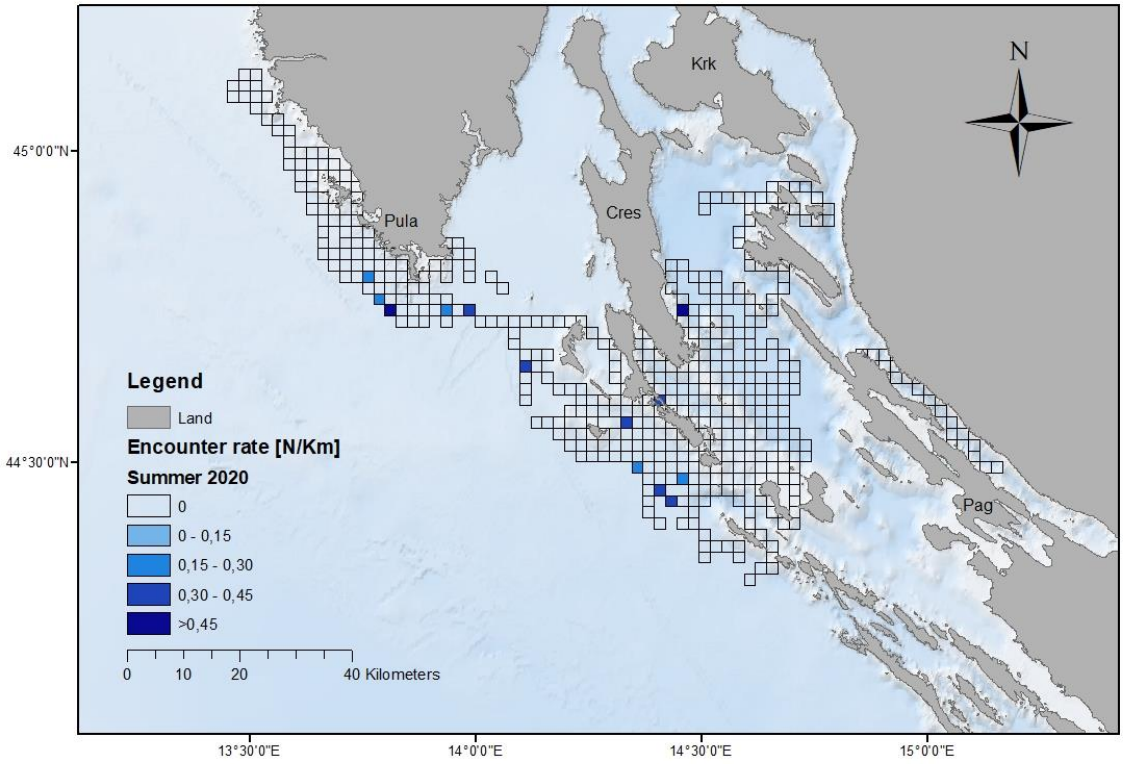

Figure 31. Encounter rate [ER2] of loggerhead sea turtles (Summer 2020)

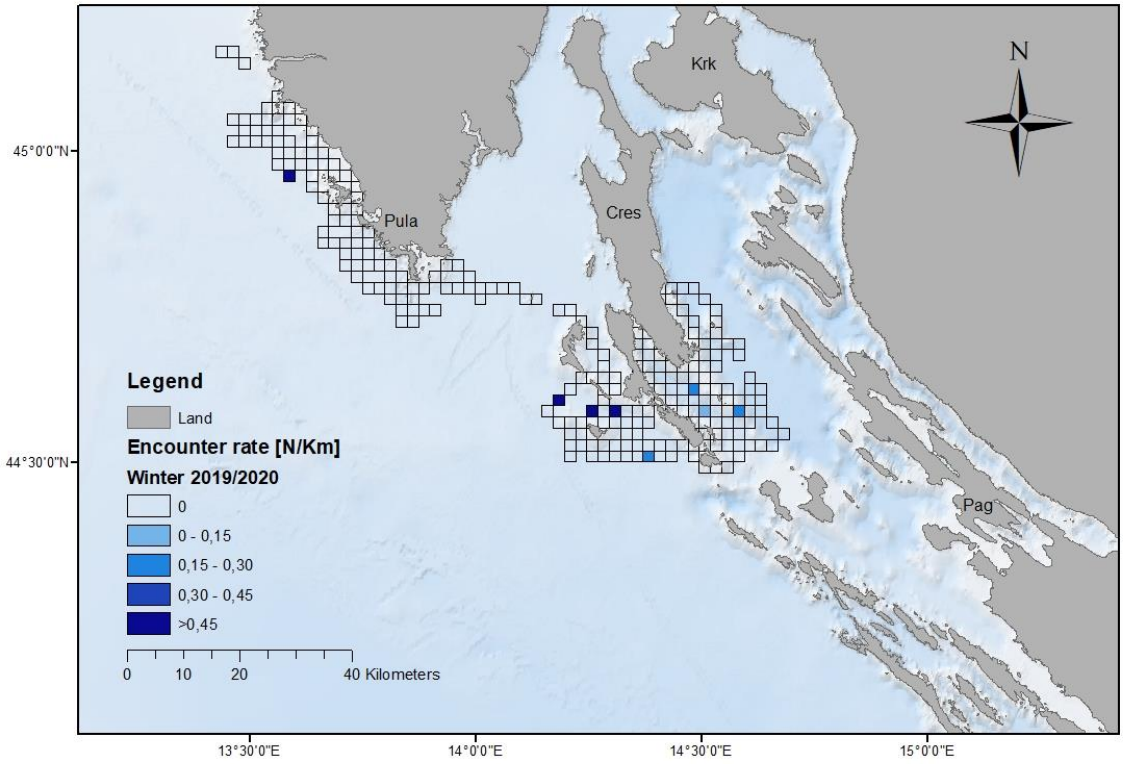

Figure 32. Encounter rate [ER2] of loggerhead sea turtles (Winter 2019/2020)

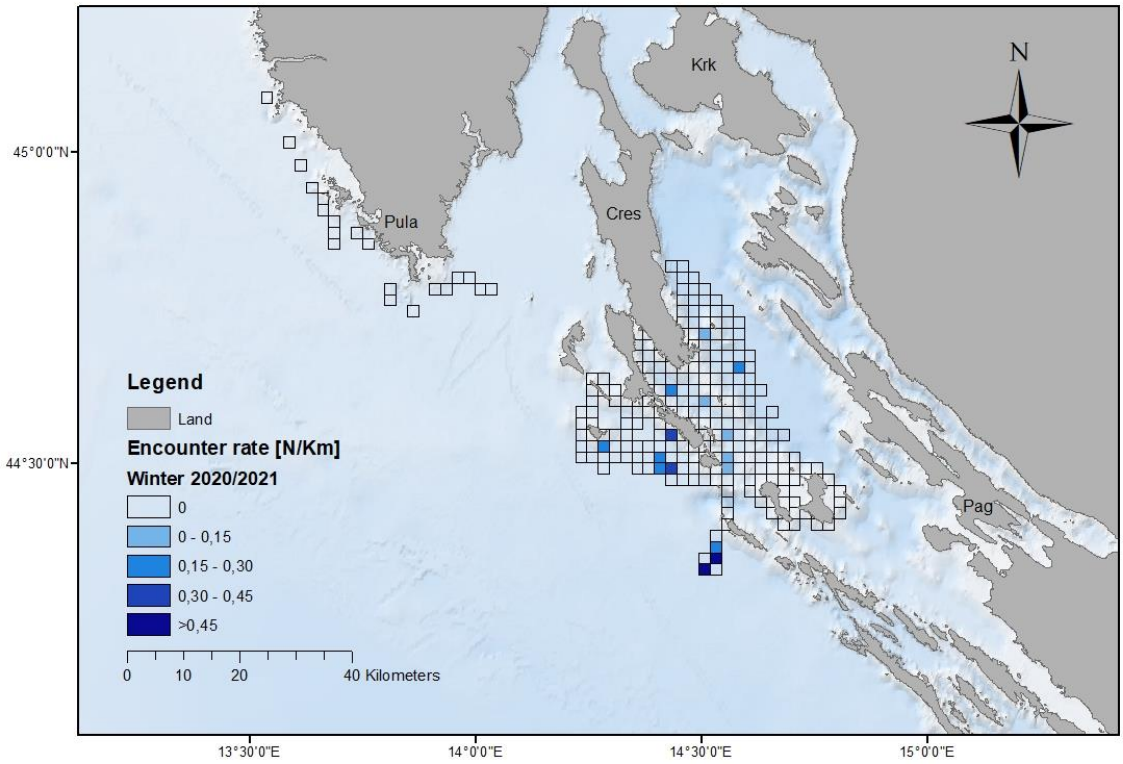

Figure 33. Encounter rate [ER2] of loggerhead sea turtles (Winter 2020/2021)

5. Conclusion

During the period from July to March 2021, 117 fieldtrips were conducted; over 2969 NM was passed in positive effort, and more than 228 hours were spent in search for dolphins. 184 dolphin groups were observed, and their photographs were collected. Total time spent with dolphins was 123.5 hours. The encounter rate (ER2) of dolphins was calculated and the results obtained corresponded to the upper limit of the range of observation rates recorded during recent years (0.008-0.024) (C. M. Fortuna (2007); Rako et al. (2013)). The average size of the group was 6 individuals, which is within the range recorded in previous years in this area (Pleslić et al. (2015)), and according to the description of this species, typically, the number of individuals in the groups ranges from 2-15 individuals (Wells and Scott (2002)). Overall 775 individuals were identified in preliminary photo analysis. Bottlenose dolphins in the Cres-Lošinj waters show habitat fidelity and a relatively low rate of emigration (C. M. Fortuna (2007); Genov et al. (2008); Pleslić et al. (2015); Gaspari et al. (2015); Rako-Gospić et al. (2017). Given regular observations of females with calves, the results of the monitoring presented here and a comparison with the results of previous Blue World Institute research indicate that the Cres-Lošinj (HR0000161) Natura 2000 site is of great significance for bottlenose dolphins, especially for sensitive groups composed of mothers with newborns.

During 2019/2021, the most common initial behaviour was dive-traveling (DT), diving (D) and active trawler following (ATF). The most significant anthropogenic factors affecting the conservation status of the local bottlenose populations are fisheries and tourism. Regarding fisheries, dolphins often feed behind the fishing trawlers. During inspections of the trawlers, dolphins were encountered in 56 percent of the time. This feeding strategy makes it easier for dolphins to catch their prey, but also points to the deficiency of prey. Interactions with tourist vessels are numerous, but deliberate harassment has not been observed during the monitoring. Nonetheless, a negative impact on the dolphin community is possible since, even without intentional disturbance, cumulative negative effects of boat engine noise and vessel presence occur. Pleslić et al. (2018) showed that the home ranges of individuals were positively correlated to association strength between them, and that four out of six Sites of Community Importance currently in place within the Croatian Adriatic Sea lie within the home ranges of three local dolphin communities. The Cres -Lošinj SCI (HR3000161) lies completely within the home range of the local community, whereas the Western Istria SCI (HR5000032) is currently data deficient.

During the boat based survey, using the Navilog application, 74 loggerhead turtles were recorded. Through the BWI citizen science app 10 alive individual were reported in the research area in this period. Most of the individuals were observed along the western side of the island of Lošinj, near the islands of Susak and Dugi otok. This region hosts critical marine habitats for the loggerhead sea turtle (*Caretta caretta*) belonging to the Ionian–Adriatic management sub-unit. The results show that this species resides in Cres-Lošinj archipelago on a year-round basis. These waters host summer foraging as well as over-wintering habitats shared by juvenile and adult loggerheads, mostly belonging to the Greek nesting stock. High levels of loggerhead's by-catch incidents in trawls are reported by local fishermen (10-100

turtles/trawl/year), particularly in the winter months. Mediterranean loggerhead population is classified as endangered, and listed under Appendix 2 of the Bern and Barcelona Conventions (Margaritoulis et al. (2003), B. Lazar et al. (2006), Casale et al. (2012)).

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