Validation of the paired sets from the comparative fishing experiments conducted between CCGS Teleost and CCGS Capt. Jacques Cartier in the southern Gulf of St. Lawrence, September 2021 and 2022

Daniel Ricard, David Fishman, Nicolas Rolland, François-Étienne Sylvain, François Turcotte and Pablo Vergara

Science Branch
Gulf Region
Fisheries and Oceans Canada
Moncton, New Brunswick, E1C 5K4, Canada

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VALIDATION OF THE PAIRED SETS FROM THE COMPARATIVE FISHING EXPERIMENTS CONDUCTED BETWEEN CCGS TELEOST AND CCGS CAPT. JACQUES CARTIER IN THE SOUTHERN GULF OF ST. LAWRENCE, SEPTEMBER 2021 AND 2022

by

Daniel Ricard, David Fishman, Nicolas Rolland, François-Étienne Sylvain, François Turcotte and Pablo Vergara

Science Branch
Gulf Region
Fisheries and Oceans Canada
Moncton, New Brunswick, E1C 5K4, Canada

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Ricard, D., Fishman, D., Rolland, N., Sylvain, F.-É., Turcotte, F. and Vergara, P. 2023. Validation of the paired sets from the comparative fishing experiments conducted between CCGS Teleost and CCGS Capt. Jacques Cartier in the southern Gulf of St. Lawrence, September 2021 and 2022. Can. Tech. Rep. Fish. Aquat. Sci. 3547: v + 274 p.

Comparative fishing experiments took place in the southern Gulf of St. Lawrence between *CCGS Capt. Jacques Cartier* and *CCGS Teleost* in September 2021 and 2022. The main objective of these experiments was to estimate the catchability differences between the two survey platforms in order to maintain continuity in time-series derived from the annual September survey in the southern Gulf of St. Lawrence. A total of 183 stations were fished by both platforms, 130 in 2021 and 53 in 2022. The paired sets were subsequently examined to identify those deemed valid to be included in analyses of fishing efficiencies of the two platforms. The following technical report presents a summary of this comparative fishing experiment, focusing on identifying the 179 paired sets that were considered valid, alongside their spatial coverage and species composition. This document also provides guidelines to help develop and conduct similar comparative fishing experiments.

RÉSUMÉ

Ricard, D., Fishman, D., Rolland, N., Sylvain, F.-É., Turcotte, F. and Vergara, P. 2023. Validation of the paired sets from the comparative fishing experiments conducted between CCGS Teleost and CCGS Capt. Jacques Cartier in the southern Gulf of St. Lawrence, September 2021 and 2022. Can. Tech. Rep. Fish. Aquat. Sci. 3547: v + 274 p.

Des expériences de pêche comparatives ont eu lieu dans le sud du golfe du Saint-Laurent entre le *NGCC Capt. Jacques Cartier* et le *NGCC Teleost* en septembre 2021 et 2022. L'objectif principal de ces expériences était d'estimer les différences de capturabilité entre les deux platesformes d'échantillonnage afin de maintenir la continuité des séries temporelles dérivées du relevé annuel de septembre dans le sud du golfe du Saint-Laurent. Au total, 183 stations ont été échantillonnées par les deux platesformes, 130 en 2021 et 53 en 2022. Parmi celles-ci, les traits appariés ont été examinés afin d'identifier ceux jugés valides pour être inclus dans les analyses de l'efficacité de pêche des deux platesformes. Ce rapport technique présente un résumé de ces expériences de pêche comparatives, en se concentrant sur l'identification des 179 traits jumelés qui ont été considérés comme valides, ainsi que leur couverture spatiale et leur composition en espèces. Ce document fournit également des lignes directrices pour aider à développer et à mener des expériences de pêche comparative similaires.

1 Introduction

Every September since 1971, Fisheries and Oceans Canada (DFO) has conducted a bottom trawl survey in the southern Gulf of St. Lawrence. The primary purpose of this survey is to gather data to evaluate the abundance, size and distribution of marine fish and invertebrates taxa in Northwest Atlantic Fisheries Organization (NAFO) Division 4T (Hurlbut and Clay 1990). This monitoring program provides a unique and uninterrupted time series of information on all fish and invertebrate taxa that can be captured by the bottom trawl used during the survey. The data from this survey are an important source of information for stock assessments of commercially important species, and also provide an unmatched source of information about marine biodiversity in the southern Gulf. For the majority of marine taxa in this area, this survey provides the longest fisheries-independent source of information on their abundance and distribution, and how these have changed over time.

The southern Gulf September survey was originally carried out by the fishing trawler *E.E. Prince* from 1971 to 1985 using a Yankee-36 trawl. The *Lady Hammond*, a chartered fisheries research vessel, was then used from 1985 to 1991, Canadian Coast Guard Ship (CCGS) *Alfred Needler* from 1992 to 2005 (with the exception of 2003 when *CCGS Wilfred Templeman* was used) and *CCGS Teleost* from 2004 to 2021, all using a Western IIA trawl (WIIA) (Figure 1). In order to maintain the continuity of the time series, comparative fishing experiments were conducted when new vessels were introduced, and conversion factors that estimate the fishing efficiency of different vessels, gears, and diurnal periods were estimated for a limited number of the taxa captured (Nielsen 1994; Benoît et al. 2003; Benoît and Swain 2003; Benoît 2006).

In late 2019, *CCGS Capt. Jacques Cartier*, a new Offshore Fisheries Science Vessel (OFSV), was introduced to the Canadian Coast Guard (CCG) fleet and was used in the southern Gulf for the first time during the September 2021 survey. The vessel is equipped with a Northeast Fisheries Science Center Ecosystem Survey Trawl (NEST) as its primary fishing gear. To maintain the continuity of the southern Gulf of the St. Lawrence time series given the most recent change of vessels and fishing gears, comparative fishing experiments were conducted in 2021 and 2022 between the two survey platforms; *Teleost* fishing for 30 minutes at 3.5 knots using a Western IIA trawl and *Capt. Jacques Cartier* fishing for 20 minutes at 3.0 knots using a NEST trawl.

This document summarizes the data collected in the southern Gulf of St. Lawrence during the September 2021 and 2022 comparative fishing surveys between both platforms. The information contained herein is not meant to be a thorough analysis of comparative sets, but rather to provide an overview of the number of paired sets done, to document their spatial coverage and individual set details, and to also visualize how the catches from both vessels compare for a selected number of taxa. Moreover, this document aims to provide some guidelines for conducting future comparative surveys.

2 Methods

2.1 Comparative fishing experiment

In 2021, *Teleost* was used as our "primary vessel" while this role was fulfilled by *Capt. Jacques Cartier* in 2022. This designation was used mostly to identify the leading vessel on which a full science crew was onboard and on which the regular/full survey protocol was conducted. The sampling protocols used on the primary vessel followed those described in Hurlbut and Clay (1990). The "secondary vessel" was identified as the one fishing next to the primary vessel, and on which a reduced science crew followed a reduced sampling protocol to focus mainly on the variables required for the estimation of conversion factors; mainly length frequencies, although in some cases additional parameters such as specimen weight and sex were also collected. The comparative fishing experiments were conducted in the area covered annually during the southern Gulf of St. Lawrence September survey (strata 401 to 403, 415 to 429 and 431 to 439, Figure 2).

2.1.1 Vessel-specific protocols

Both vessels used different fishing protocols in order to suit the requirements of the different fishing gear. Fishing set numbers were assigned according to chronological order, albeit independently on each vessel.

Teleost used the Western IIA trawl (WIIA), which is the type of trawl that has been used in the southern Gulf survey since 1985. Tows were conducted for 30 minutes at a speed of 3.5 knots, therefore covering 1.75 nautical miles over ground. Tows of less than 20 minutes duration were not considered as valid sets. Following the survey protocols, the duration of tows was measured according to the time elapsed between locking the trawl winches and hauling back the trawl.

Capt. Jacques Cartier was equipped with the Northeast Fisheries Science Center Ecosystem Survey Trawl (NEST), a small mesh trawl with a cod end liner, which ensures the capture of various sizes of specimens from a variety of taxa. In 2021, the NEST trawl was set up using a two-piece headline which was the configuration used by DFO Maritimes Region at that time. However, DFO Maritimes Region modified the NEST trawl in 2022 to use a configuration with a one-piece headline. In order not to bias our dataset, we decided to keep using the two-piece headline configuration in 2022. This configuration will be kept for further surveys in the southern Gulf of St Lawrence, and will be identified as the "Gulf configuration". Tows were conducted for a duration of 20 minutes at a speed of 3 knots, with an expected tow distance of 1.0 nautical miles. Tow duration could be shortened if rough bottom was encountered, but tows of less than 16 minutes duration were not considered valid sets. In contrast to the protocol on *Teleost*, the duration of tows was measured between the moment the net reached the bottom and the moment it was lifted off bottom (based on trawl positioning data given by the trawl mensuration sensors).

2.1.2 Comparative protocol

Paired sets were conducted at pre-determined fishing stations. Prior to fishing, both vessels communicated the planned station coordinates and, after careful review of the bottom condition using onboard OLEX chart system, they agreed on the compass heading where the fishing track was to take place. Paired sets were conducted with the two vessels being less than 0.5 nautical miles of each other. The fishing tracks were parallel to each other when possible. Exception to this occurred in areas where the depth difference between the vessels was too large if they fished parallel to each other. In such case, both vessels followed a singular track, front to back, and maintained a distance of approximately 1.5 nautical miles for safety reasons and to ensure they would not fish the same ground. Care was always taken to minimize the difference in water depths between each vessel's fishing track. In exceptional circumstances when no suitable fishing bottom could be found within 1.75 nautical miles of the planned station location, the search radius was extended to 3.5 nautical miles of the planned station location.

The two vessels maintained a side-by-side configuration during fishing. To remove any potential effects of vessel position on catches, it is important that the relative position of the comparative vessel is not fixed to one side. While randomizing the relative position is optimal, it was difficult to achieve due to practical constraints relating to communication within and between vessels. Instead, the simpler and more practical method of alternating sides between sets was used. In the few cases where fishing side-by-side was not possible, the same approach using a front-to-back configuration was used instead. Whether relative position was determined by random selection or by alternation, we expect to see similar frequencies of "port" vs. "starboard" comparative fishing sets.

The configuration, dimensions and location of the trawls when underwater were monitored and recorded throughout the tow using an electronic trawl mensuration system (Scanmar). The fishing officer used this information to ensure that the trawl was behaving as expected in terms of door spread, trawl net sinking rate, trawl net opening width and height, and other relevant measures provided by the Scanmar system.

While at sea, tows were considered invalid if:

- they crossed strata boundaries;
- crab traps were caught or engaged in the trawl;
- there was significant gear failure (winches not working, doors crossed, etc.);
- there was extensive damage to the trawl net (tears), or other reasons that would prevent the trawl from fishing normally;
- the tow had to be aborted before the minimum tow duration.

In the event of an invalid set on only one of the two vessels, and when practical, the station was fished again by either 1) the vessel that had an invalid set or 2) by both vessels. If the vessel that has an invalid set was ready to fish again within the same day/night period, i.e., 0700-1900 (day) or 1900-0700 (night), then only that vessel would repeat the set. If the trawl repairs pushed the timing of fishing into a different day/night period, the set would be repeated by both vessels.

2.2 Data extraction

Data extraction was conducted directly from the mission-level information collected by, and available from, the bespoke DFO “Another data entry system” (Andes) on each vessel. JavaScript Object Notation (JSON) text files corresponding to the “Comparative Report” in Andes were generated for the 2021 and 2022 surveys on *Teleost* and *Capt. Jacques Cartier*, for a total of four data files.

The JSON files were used to present the following:

Geographic location: For each fishing stations, details for each paired sets

Set level: Taxa composition for each pair of sets

All sets: comparison of total catch in kilograms per tow and of total number of taxa per tow

Taxon level: *Capt. Jacques Cartier* catch versus *Teleost* catch for selected taxa and comparison of cumulative length frequencies

Before any analyses were conducted with these datasets, rocks and organic debris, as well as some unsorted organic materials, were removed from the data (Andes species codes above 9000). Because the detailed sampling of shrimp species was not yet available, shrimp species were grouped together and identified as “shrimps unsorted”.

2.3 Data analyses

2.3.1 Fixing errors associated with Cartier set number 18

A catch processing error occurred onboard *Capt. Jacques Cartier* in 2022. This was identified by the observation that there was no catch associated with set number 18 at station 034. We carefully reviewed the timestamp of data entered into Andes, as well as the relative abundance of the main taxa in the subsequent sets on the Cartier. Our observations lead us to two conclusions:

1. There was compelling evidence to support the fact that set 18 was mistakenly entered into set 19, and that this offset continued until set 23.
2. A deck operation error on the Cartier occurred and the contents of set 25 were accidentally put in the hopper that was already containing the catches from "real" set 23. Consequently, the catch data recorded as coming from set 25 on *Capt. Jacques Cartier* correspond to sets 10 and 11 on *Teleost*. These paired sets occurred at stations 054 and 053 of stratum 422. Note that set 24 on *Capt. Jacques Cartier* was a hydrographic station only, so no fishing data was collected for that set.

To correct these catch processing errors, the following steps were taken post-survey:

1. To address the offset in the sets, the catches from sets 19-23 on *Capt. Jacques Cartier* were shifted back by one (e.g. the catch recorded as set 19 became the catch for set 18, etc.).

2. To address the fact that sets 23 and 25 were combined on *Capt. Jacques Cartier*, the catches of corresponding sets on *Teleost* (sets 10 and 11) were also combined for the purpose of the comparative data analysis only. However, in the underlying Oracle production database, sets 10 and 11 from *Teleost* were kept separate while the combined set 23 and 25 from *Capt. Jacques Cartier* were both flagged as invalid sets, thus ensuring that they will be excluded from any future analyses of the survey data.

We do not recommend combining sets unless it can be ascertained that the sets were conducted in similar environments and sampled similar species assemblages. In the case described above, the affected stations were luckily from the same stratum / depth profile and contained similar species assemblages. It was ultimately decided that the cost of losing a paired tow outweighed any drawbacks from combining the two sets.

2.3.2 Geographic and temporal distance between paired tows

To ensure that the differences between the catch from both vessels result from vessel-specific or gear-specific differences, and not from ecosystem spatial heterogeneity, it was paramount to ensure that the distance between both vessels, when fishing, was reduced to a minimum, and to carefully record such distance. In this report, we document the minimum and maximum distance between the two vessels, when fishing, for each of the comparative tows. To calculate these distances, the tracks from both vessels were both divided in 100 points distributed evenly along the fishing tracks. Then, the minimum and maximum distances between the points along the track of *Capt. Jacques Cartier* and the track of *Teleost* were computed.

Additionally, to ensure that differences between the catch of both vessels were not the result of short-term temporal variations in ecological community structure, it was essential to ensure that the time elapsed between the start of the tows from each vessel was reduced to a minimum. The amount of time between the "onset of fishing" was calculated as the number of minutes between the beginning of the fishing events on each vessel.

The location of each vessel with respect to each other was determined by 1) projecting the start and end locations from each vessel in UTM coordinates, 2) make all coordinates relative to the starting coordinates of the Teleost and compute the track heading θ, 3) rotating all coordinates by an angle $-\theta$ using a rotation matrix ($R = \begin{bmatrix} cos(-\theta) & -sin(-\theta) \\ sin(-\theta) & cos(-\theta) \end{bmatrix}$), and 4) determining whether the x value of the rotated midpoint of the Cartier track was positive or negative. By setting the value of θ based on the heading of the Teleost track ($\theta = 2\pi(heading/360)$), a positive value means that the Cartier was on the starboard side and the Teleost was on the port side, and a negative value means that the Cartier was on the port side and the Teleost was on the starboard side (see Figure 3 for an example).

2.3.3 Taxa composition

The taxon-level catch weights from a pair of trawl sets can be used to compare taxa composition between the primary and secondary platforms. For each pair of tows, the effort-corrected catch weight for each taxon t and vessel v ($v \in (1, 2)$, where 1 is *Teleost* and 2 is *Capt. Jacques Cartier*) can be summed over taxa and vessel, and the proportion of each taxon that is captured by each vessel can be calculated.

Since both vessels have a different target distance towed, a shared target distance d^{target} of 1.0 nautical mile was used to normalised the catch of both vessels and make them comparable. The recorded tow distances for each vessel, d_v, are used to calculate the effort-corrected catch weight (C^*_{tv}) for each taxon and vessel:

$$C^*_{tv} = C_{tv} \left(d^{target} / d_v \right) \tag{1}$$

For each available pair of tows, the proportional catch weight by taxon and vessel, p_{tv}, can be calculated as:

$$p_{tv} = C^*_{tv} / \sum_{t=1}^{T_v} \sum_{v=1}^{2} C^*_{tv} \tag{2}$$

where T_v is the number of taxa caught in vessel v. We then identify the top 10 taxa T^{keep} of those that account for 99% of the effort-corrected combined catch by weight (i.e. $\sum_{t=1}^{T^{keep}} \sum_{v=1}^{2} p_{sv} \geq 0.99$), and report p_{tv} values for them.

2.3.4 Comparison of fishing efficiency for selected taxa

For a subset of taxa, the effort-corrected catch weight on each platform is shown in a bivariate plot. The cumulative length frequency distributions from each platform are computed for the available pairs of tows. These visualisations are meant to provide a cursory look at the differences in the fishing efficiency of the two platforms. Please see Benoît and Yin ((in prep)) for more details about the analyses of these comparative fishing experiments and the estimation of conversion factors for selected species.

2.3.5 Criteria used to determine the validity of paired trawl sets

Paired fishing sets are not considered valid comparative tows if the answer is “yes” to any of the following questions:

- Time difference
    1. Does the time difference between the onset of fishing on each vessel exceed 12 hours?
    2. For those exceeding 60 minutes, are the two tows in different diurnal time period (day or night)?

- Distance between vessels
    1. Does the maximum distance between the two vessel tracks exceed 1.75 nautical miles?
- Depth difference
    1. For shallow strata (less than 92m, Figure 2), does the depth difference between the two vessels exceed 5 meters?
    2. For strata with steep bathymetry (more than 92m, Figure 2), does the depth difference between the two vessels exceed 20 meters?

3 Results

3.1 Sampled stations

Over the course of two years of comparative surveys, a total of 282 unique stations were visited by one or both vessels. From these, a total of 183 fishing stations were sampled by both vessels and 179 pairs of comparative sets were considered as valid, i.e. within the selection criteria (defined above) that considered the distance between each vessel, the fishing depth, the interval of time at which each vessel started their fishing activities, and the overall taxa composition of the resulting catch.

The number of tows, and the different types of sets (e.g. hydrography or fishing, null or valid) for each vessel and for each year of the comparative mission are detailed in Table 1. The location of all the comparative fishing sets are provided on Figure 4, while the details of each sets are provided in Table 2 for both 2021 and 2022. Three pairs of comparative sets were deemed invalid in 2021 because the time difference threshold was exceeded. One pair of comparative sets was deemed invalid in 2022 because of a trawl deck error on *Capt. Jacques Cartier*.

For the 183 pairs of comparative sets, the minimum and maximum distance between each comparative fishing sets had mean values of 0.45 nautical miles (median value of 0.46 nautical miles, range of 0 to 1.42 nautical miles, two bottow panels of Figure 5) and 0.53 nautical miles (median value of 0.52 nautical miles, range of 0.08 to 1.62 nautical miles), respectively. Very small distances between the two tracks occurred when the vessels fished one behind the other (e.g. station 174 in 2021, Figure 99). The mean difference in depth recorded by both vessels was 3.5 meters (median value of 1.9), with a range of 0 to 32 meters (second from top panel of Figure 5). The largest depth differences occurred in strata with steep bathymetry (e.g. stations 172 and 173 in 2021). Excluding the first three paired sets that took place days apart (paired sets numbers 1, 2 and 3, Table 2), both vessels' fishing activities commenced within an average interval of 11 minutes (median of 7 minutes, range of 1 to 142 minutes, top panel of Figure 5). From the 183 total paired sets, the Cartier was on the port side of the Teleost for 87 sets and on the starboard side for 96 sets.

The distance derived from the GPS start and end points of each tow is reported in Table 2. In addition, the distances that were manually entered (i.e, those recorded by the navigation officer) are provided in the same table, whenever available. The former is the preferred distance

measurement while the latter was recorded as a vestige of the historical paper-based protocol. The manual distance was not captured consistently over the two years: in 2021 it was recorded on both vessels, whereas in 2022, it was only recorded on *Capt. Jacques Cartier*.

Several reasons explain why the number of originally planned tows differs from the number of tows that were actually executed during the comparative mission (Table 2):

- Significant mechanical problems occurred on *Capt. Jacques Cartier* both in 2021 and 2022, which led the vessel to be non-operational for several days at the start of the surveys.
- Sheltering from hurricanes Ida (2021) and Fiona (2022) required the temporary suspension of fishing operations and navigation outside the fishing area.
- Staffing issues on *Capt. Jacques Cartier* caused the vessel to be operational only during 12 hours per day (first leg of 2021 survey) and delayed the boarding of the science staff (2022).
- Other reasons such as a Search and Rescue (SAR) call in 2021, in addition to multiple trips ashore to accommodate CCG personnel (2022), explain the difference between the number of planned and executed tows.

3.2 Total catch weight and total number of taxa

Overall, the fishing efficiency of the NEST trawl was found to be greater than that of the WIIA trawl (Figure 6), and is mostly explained by the smaller foot gear on the NEST which greatly improves the amount of flat fish being captured. However, a historical modification of the lower belly of the WIIA, which increased the frequency of its contact with the bottom substrate and therefore the collection of a large variety of small invertebrates and fish (Bill MacEachern, DFO pers. comm.), is reflected by the higher total number of taxa caught being higher with the WIIA compare to the NEST trawl (Figure 7).

3.3 Tow-level taxa composition

For each paired set, the taxa composition from the Cartier and the Teleost were compared in order to identify any potential bias in the catch that could prevent the use of each paired set to compute the conversion factors. The relative abundances (p_{sv} in Equation 2.3.3) of the most abundant taxa for each set were displayed in stacked barplots (bottom panels of Figures 8 to 190). Overall, the results show that the taxa composition of the corresponding catch from both vessels was similar and no major and consistent vessel-specific bias was observed for the taxa sampled.

3.4 Taxon-level comparisons

For each taxon caught by either vessel a minimum of five times over all comparative sets, a figure showing the set-level catch from each vessel (referred to as the “fishing efficiency”) is presented along with the cumulative length frequency distribution obtained by both vessels (Figures 191 to 242). For the most part, results show corresponding patterns for the fishing efficiency and cumulative length frequencies between both fishing platforms - for instance see the patterns for Atlantic cod (*Gadus morhua*, Figure 191), Greenland Halibut (*Reinhardtius hippoglossoides*, Figure 196), Yellowtail flounder (*Limanda ferruginea*, Figure 199), Winter flounder (*Pseudopleuronectes americanus*, Figure 200), American lobster (*Homarus americanus*, Figure 242), and others.

4 Discussion

4.1 Achievements

As part of the National Comparative Trawl Workshop that was conducted in late 2017 (Thiess et al. 2018), it was recognized that a minimum of 200 paired sets were necessary in order to ensure sufficient data to estimate the conversion factors for the most frequent taxa encountered in the southern Gulf of St. Lawrence. Although the comparative fishing experiments conducted between *Teleost* and *Capt. Jacques Cartier* in 2020 and 2021 did not reach the minimum number of 200 paired sets, the 178 sets identified as valid should provide enough data for estimating conversion factors for key species that are or were until recently commercially exploited in NAFO Division 4T.

The tows conducted in 2022 aimed to sample strata that were missed in 2021 to ensure that comparative tows were done in all strata of the survey area. In addition to achieving a satisfactory geographic coverage of comparative tows, we were also able to achieve a minimum annual survey coverage for year 2022, by judiciously fishing both vessels separately during the 2-week campaign.

4.2 Recommendations for effectively conducting comparative fishing experiments

Based on our two years of experience conducting comparative fishing experiments, and following discussions with the CCG crews from both vessels, we defined a set of recommendations for the successful conduct of future comparative fishing missions. Most of these recommendations are seemingly self-evident, but given their importance in obtaining a successful mission outcome, it is worth stating them here.

It is expected that both fishing vessels are fully operational for science activities as comparative fishing experiments are not meant to also include gear trial and crew training. A high level of operational experience is required to conduct comparative fishing as it involves navigation where vessels are in close proximity and weather conditions may exacerbate the difficulties associated with trying to fish along tow tracks that are parallel and within 0.5 nautical miles of each other.

We suggest that the following events occur before the start of the comparative mission:

- The Coast Guard crew from both vessels should be invited to a meeting where sampling procedures are discussed. The ship's commanding officer, chief navigation officer and fishing officer should be present at this briefing. Important points to be introduced and discussed during the meeting are:
    1. The importance of conducting comparative missions with specific examples of taxon-specific catch bias according to the different vessels or fishing gears used.
    2. The specific goals of the mission and the fishing objectives (e.g. expectations about the number of comparative sets that can be conducted, planned route to follow, ...).
    3. The differences between the fishing protocols of the two platforms (e.g. duration and speed of the tows, what sampling takes place in the wet lab when a vessel is either the primary or the secondary platform, which vessel is in charge of the hydrography component of the survey, ...).
    4. The information to be communicated between the wheelhouses before and after each tow (see below for more details).
    5. The meal schedule for both vessels. Meal schedules should be identical for both sampling platforms to optimize the number of hours that both crews are simultaneously available to conduct comparative fishing activities each day.
    6. The roles and expectations of primary and secondary vessels. For instance, it should be clarified that the vessel conducting hydrographic measurements and/or using the detailed catch sampling protocol is expected to take more time than the other vessel where these activities do not take place. After completing a tow, the secondary vessel should head out to the next sampling station, start the search for trawlable bottom, and formulate a strategy for fishing that includes a start location and a heading along which a standard tow can be conducted. The final decision on the heading to follow while fishing should ultimately be taken by the primary vessel after its arrival to the station.
- All critical scientific and navigation equipment should be checked prior to departure. Scientific equipment include all equipments related to fishing gear, scientific IT network components, laboratory scales (making sure they are not setup with the automatic tare functionality), monitors used for data entry in the wet lab (make sure the touch screen functionality is working correctly), proper operation of all hydraulic systems, offal chute, water availability, and many others. Attention should be given to the initial configuration of the scientific acoustic system and its operational status should be regularly monitored. Vessel / CCG equipment such as ultrasonic antifouling systems and any auxiliary sounders should be turned off before the mission is underway.

During the mission, the following guidelines should be followed:

- On the way to the first station, both vessels should conduct at least one "test" fishing station, where the communication between wheelhouses is tested and the objective is for both vessels to "shoot" their gear at an agreed-upon location, to conduct a standard fishing set within 0.5 nm of each other, to recover their respective trawls, and agree on the next station that will be visisted.

- It is imperative that the fishing gear configuration remains identical for the whole duration of a comparative fishing experiment. Changes in gear configuration could affect trawl fishing efficiency and would negatively impact on the comparability of the catch data.
- In the event of a major fishing gear failure on one vessel, where the other vessel would sit idle while waiting for trawl repairs to be done, the other vessel should continue its fishing activities. In such cases, the other vessel will have to use the full survey protocol when processing the catch from the station fished. Under a sampling design where stations are within a few hours of each other, this strategy can greatly improve the regular survey coverage achieved during the limited time when both vessels are available.
- The simultaneous storage of catches from different sets (i.e.using more than one hopper at a time) should only be done in exceptional circumstances, as it quickly leads to confusion for both the scientific and Coast Guard crews. This is especially true when several sets have to be processed on a tight schedule. There should be clear communication between the bridge and the wet lab to ensure that the processing of the most recent catch is well underway before starting fishing operations at the next station. This information should also be shared between both vessels conducting the comparative mission to coordinate the timing of comparative fishing operations.
- For each fishing set, make sure to record into which hopper (e.g., port vs. starboard) the catch was emptied.
- In case of discrepancy between both vessels concerning the bathymetric profile detected at a station (slope, flat bottom versus the presence of boulders or edges), the vessels should rely on the information coming from the platform with the most recently updated OLEX system to make the final decision on the suitability of the bottom to be successfully trawled.
- *Communication is key* during comparative missions. Science crew on each vessel should have access to VHF radios so that real-time interactions between the chief scientists can occur. Before each tow, the following information should be clearly communicated between the Coast Guard officers of both vessels:
    1. The position of each vessel (port or starboard of each other) for the upcoming tow
    2. The heading to follow and the coordinates of the starting point for each vessel
    3. The time and distance required to deploy the trawl gear for each vessel
    4. The timing of the tow start time (e.g. to make sure that all scientific and Coast Guard staff are ready on both vessels to conduct the tow and process the catch and to keep the use of both hoppers to a minimum)
- After each tow, the following should be discussed and agreed upon:
    1. The activities that still need to be conducted at the station (e.g. hydrographic sampling, the deployment of zooplankton sampling equipment, or if one of the vessels needs to re-do the tow because of a null set)
    2. The station number and exact coordinates of the next fishing station
    3. Approximate amount of time required to reach the next station and which vessel will get there first based on current activities on each vessel

During the comparative fishing experiments of 2021 and 2022, we developed reporting functionality in Andes to regularly compare the catch data obtained on each vessel. There was great benefit in having the ability to keep track of the number of stations visited and to compare the catch from each vessel as the comparative surveys were progressing.

After the comparative fishing experiments have been conducted, each pair of tows should be scrutinised using detailed criteria such as those described in section 2.3.5 to establish their validity. To ensure that comparative fishing experiments are well documented and that the data they collected can be analysed in the future, we recommend that a report similar to this one be produced upon completion of the planned activities.

5 Acknowledgments

The authors wish to thank all DFO and Coast Guard personnel that participated in the southern Gulf of St. Lawrence comparative fishing experiments in 2021 and 2022. Jordan Ouellette-Plante and Katherine Skanes provided valuable reviews of an earlier draft of this document and we thank them for their constructive input and helping us improve the quality of this report.

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7 Tables

Table 1. Details of the number of sets conducted by each vessel during the comparative fishing experiments conducted in the southern Gulf of St. Lawrence in 2021 and 2022. The planned number of tows was determined based on the achieved number of tows in previous years.

Year	Vessel	Role	Tows planned	Stations visited	Gear testing	Hydro only	Fishing sets	Null sets	Valid sets	Comp. sets	Invalid comp. sets	Valid comp. sets
2021	Teleost	Primary	172	186	1	0	185	19	166	130	3	127
	Cartier	Secondary	172	163	3	18	142	7	135			
2022	Teleost	Secondary	95	83	0	0	83	6	77	53	1	52
	Cartier	Primary	195	85	0	2	83	8	75			

Table 2. Paired sets conducted during the 2021 and 2022 southern Gulf comparative fishing experiments between *CCGS Teleost* and *CCGS Capt. Jacques Cartier*. Each paired set is identified by its sequential number (which contains a hyperlink to its corresponding figure), year, stratum and station number. For each vessel, the set number, its date and time when fishing started and distance towed are reported. All times are in Atlantic Daylight Time (ADT). The main distance towed reported is the GPS-derived value, in nautical miles, and the manually entered value is presented in parentheses. For each paired set, the time difference between when fishing started, the depth difference, and the minimum and maximum distances between vessels are also presented. The validity of each paired sets is identified in the last column of the table. The sets are ordered chronologically based on the date and time when fishing started on *CCGS Teleost*.

Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time (ADT)	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
1	2021	415	013	11	2021-08-29 23:35:44	1.77 (1.77)	19	2021-09-04 21:03:13	0.95 (1.00)	8,488	2.2	0.007	0.866	invalid[1]
2	2021	415	015	13	2021-08-30 07:46:53	1.81 (1.75)	17	2021-09-04 13:15:41	0.91 (0.91)	7,529	25.4	0.449	0.627	invalid[1]
3	2021	415	016	14	2021-08-30 10:19:00	1.80 (1.70)	18	2021-09-04 18:00:15	1.06 (1.04)	7,662	11.3	0.559	0.615	invalid[1]
4	2021	425	091	22	2021-08-31 14:14:29	1.65 (1.64)	2	2021-08-31 14:17:48	0.94 (1.15)	4	16.0	0.504	0.530	valid
5	2021	426	322	26	2021-09-01 04:56:17	1.18 (1.2)	5	2021-08-31 23:58:50	1.08 (1.06)	298	8.3	0.192	0.660	valid
6	2021	427	104	30	2021-09-01 14:39:58	1.75 (1.75)	9	2021-09-01 14:55:08	1.05 (1.05)	16	9.6	0.414	0.525	valid
7	2021	427	326	32	2021-09-01 23:27:31	1.16 (1.18)	11	2021-09-01 23:41:36	1.05 (1.00)	15	0.5	0.368	0.443	valid

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[1] time difference threshold exceeded

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
8	2021	423	059	37	2021-09-02 13:07:41	1.78 (1.74)	15	2021-09-02 13:27:36	1.18 (1.17)	20	0.2	0.375	0.413	valid
9	2021	427	100	38	2021-09-02 16:01:44	1.44 (1.42)	16	2021-09-02 16:12:15	1.00 (1.01)	11	0.3	0.491	0.553	valid
10	2021	416	024	39	2021-09-05 12:02:45	1.68 (1.7)	25	2021-09-05 12:23:50	1.06 (1.01)	22	4.1	0.044	0.139	valid
11	2021	416	023	40	2021-09-05 14:36:31	1.75 (1.74)	26	2021-09-05 14:39:13	1.02 (1.00)	3	2.8	0.394	0.442	valid
12	2021	416	026	41	2021-09-05 17:31:28	1.47 (1.47)	27	2021-09-05 17:43:30	0.99 (0.98)	13	0.2	0.357	0.416	valid
13	2021	420	039	48	2021-09-06 12:58:55	1.44 (1.44)	32	2021-09-06 12:34:09	1.08 (1.07)	25	0.6	0.046	0.525	valid
14	2021	418	197	49	2021-09-06 16:04:52	1.77 (1.77)	33	2021-09-06 16:13:18	1.06 (1.12)	9	8.4	0.443	0.643	valid
15	2021	419	295	51	2021-09-07 00:03:48	1.17 (1.21)	34	2021-09-06 22:41:12	1.02 (1.03)	83	6.2	0.545	1.106	valid
16	2021	419	038	53	2021-09-08 17:44:35	1.79 (1.75)	38	2021-09-08 17:50:52	1.02 (0.95)	7	4.0	0.640	0.644	valid
17	2021	419	296	54	2021-09-08 19:30:11	1.82 (1.65)	39	2021-09-08 19:36:29	1.03 (1.00)	7	1.9	0.512	0.548	valid
18	2021	417	030	56	2021-09-09 09:27:29	1.85 (1.69)	40	2021-09-09 09:29:31	1.03 (1.00)	3	6.0	0.409	0.432	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
19	2021	416	191	57	2021-09-09 15:04:27	1.79 (1.74)	41	2021-09-09 15:12:23	1.03 (0.98)	8	5.8	0.448	0.513	valid
20	2021	424	079	58	2021-09-09 19:40:03	1.74 (1.73)	42	2021-09-09 19:46:15	1.06 (1.1)	7	2.8	0.497	0.506	valid
21	2021	424	080	59	2021-09-09 22:58:03	1.71 (1.74)	43	2021-09-09 23:00:42	0.98 (1.01)	3	3.2	0.587	0.632	valid
22	2021	424	081	60	2021-09-10 01:31:28	1.83 (1.8)	44	2021-09-10 01:41:25	1.08 (1.10)	10	1.1	0.521	0.598	valid
23	2021	426	095	61	2021-09-10 04:32:55	1.79 (1.79)	45	2021-09-10 04:40:33	1.02 (1.07)	8	1.7	0.527	0.548	valid
24	2021	426	096	63	2021-09-10 10:49:08	1.77 (1.74)	47	2021-09-10 10:54:15	1.03 (1.03)	6	0.0	0.014	0.714	valid
25	2021	423	069	65	2021-09-10 16:02:55	1.82 (1.80)	49	2021-09-10 16:11:31	1.05 (1.01)	9	3.0	0.488	0.555	valid
26	2021	424	083	66	2021-09-10 19:04:39	1.74 (1.75)	50	2021-09-10 19:09:26	1.03 (1.05)	5	0.0	0.513	0.577	valid
27	2021	424	082	67	2021-09-10 20:53:14	1.75 (1.75)	51	2021-09-10 20:58:40	1.07 (1.10)	6	3.5	0.440	0.507	valid
28	2021	424	085	69	2021-09-11 03:50:11	1.80 (1.80)	53	2021-09-11 03:57:56	1.09 (1.10)	8	2.3	0.460	0.552	valid
29	2021	424	086	70	2021-09-11 06:29:42	1.69 (1.65)	54	2021-09-11 06:34:44	1.07 (1.03)	6	2.5	0.563	0.815	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
30	2021	424	087	71	2021-09-11 09:13:18	1.67 (1.70)	55	2021-09-11 09:23:17	1.05 (1.03)	10	2.5	0.468	0.500	valid
31	2021	422	050	73	2021-09-11 12:53:01	1.79 (1.75)	56	2021-09-11 12:03:59	1.04 (1.00)	50	4.9	0.002	0.083	valid
32	2021	422	051	75	2021-09-11 20:50:34	1.77 (1.80)	58	2021-09-11 20:55:46	1.08 (1.05)	6	1.0	0.651	0.668	valid
33	2021	422	053	77	2021-09-12 01:28:48	1.83 (1.80)	60	2021-09-12 01:34:55	1.03 (1.05)	7	1.0	0.440	0.489	valid
34	2021	420	040	78	2021-09-12 03:56:11	1.8 (1.83)	61	2021-09-12 04:02:05	1.06 (1.05)	6	0.8	0.452	0.471	valid
35	2021	420	041	79	2021-09-12 09:39:39	1.77 (1.70)	62	2021-09-12 09:37:51	1.05 (1.00)	2	1.5	0.575	0.648	valid
36	2021	420	042	80	2021-09-12 13:03:44	1.82 (1.80)	63	2021-09-12 13:16:37	0.86 (0.88)	13	0.2	0.085	0.103	valid
37	2021	420	043	81	2021-09-12 15:57:05	1.82 (1.80)	64	2021-09-12 16:00:00	1.08 (0.98)	3	3.4	0.756	0.762	valid
38	2021	420	044	82	2021-09-12 18:07:16	1.81 (1.80)	65	2021-09-12 18:13:08	1.02 (1.06)	6	0.8	0.447	0.487	valid
39	2021	420	300	83	2021-09-12 20:46:29	1.77 (1.60)	66	2021-09-12 20:46:40	1.05 (1.07)	1	1.0	0.560	0.581	valid
40	2021	422	058	84	2021-09-13 00:48:37	1.84 (1.80)	67	2021-09-13 00:55:24	1.09 (1.04)	7	0.9	0.658	0.672	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
41	2021	422	057	85	2021-09-13 03:23:46	1.84 (1.80)	68	2021-09-13 03:27:41	1.00 (1.08)	4	0.1	0.753	0.782	valid
42	2021	421	046	86	2021-09-13 08:02:41	1.77 (1.65)	69	2021-09-13 08:03:40	1.05 (1.02)	1	0.5	0.488	0.527	valid
43	2021	421	207	87	2021-09-13 14:56:19	1.80 (1.80)	70	2021-09-13 15:02:41	0.84 (0.74)	7	1.2	0.825	0.834	valid
44	2021	422	056	88	2021-09-13 19:31:48	1.77 (1.60)	71	2021-09-13 19:31:40	1.05 (1.02)	1	1.2	0.532	0.534	valid
45	2021	422	054	89	2021-09-13 22:08:30	1.75 (1.60)	72	2021-09-13 22:14:06	1.05 (1.08)	6	2.5	0.509	0.539	valid
46	2021	422	055	91	2021-09-14 04:58:58	1.33 (1.30)	74	2021-09-14 05:13:42	1.04 (1.03)	15	3.1	0.604	0.677	valid
47	2021	423	078	93	2021-09-14 09:08:55	1.77 (1.70)	75	2021-09-14 07:49:11	1.07 (1.03)	80	0.0	0.441	0.895	valid
48	2021	423	076	95	2021-09-14 13:20:05	1.57 (1.60)	76	2021-09-14 12:03:36	0.92 (0.80)	77	4.2	1.422	1.621	valid
49	2021	423	070	98	2021-09-14 23:09:37	1.79 (1.80)	78	2021-09-14 23:12:58	0.91 (1.06)	4	1.2	0.488	0.511	valid
50	2021	428	107	101	2021-09-15 07:54:22	1.75 (1.70)	79	2021-09-15 08:06:38	0.91 (0.92)	13	1.0	0.379	0.463	valid
51	2021	428	108	102	2021-09-15 10:45:15	1.77 (1.80)	80	2021-09-15 10:53:10	1.02 (1.02)	8	0.0	0.756	0.812	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
52	2021	423	063	103	2021-09-15 14:27:39	1.83 (1.80)	81	2021-09-15 14:34:42	1.04 (1.01)	8	0.0	0.431	0.511	valid
53	2021	423	067	104	2021-09-15 17:36:33	1.77 (1.70)	82	2021-09-15 17:39:59	1.07 (1.07)	4	1.0	0.582	0.601	valid
54	2021	423	074	107	2021-09-16 02:32:46	1.81 (1.80)	84	2021-09-16 02:38:27	1.05 (1.07)	6	1.4	0.748	0.796	valid
55	2021	423	075	108	2021-09-16 05:15:30	1.82 (1.80)	85	2021-09-16 05:23:40	1.10 (1.08)	9	3.0	0.545	0.549	valid
56	2021	429	117	109	2021-09-16 09:50:54	1.81 (1.70)	86	2021-09-16 09:57:23	1.07 (1.00)	7	1.5	0.605	0.631	valid
57	2021	401	001	110	2021-09-16 15:24:38	1.80 (1.80)	87	2021-09-16 15:31:35	1.05 (1.00)	7	0.5	0.493	0.577	valid
58	2021	429	118	111	2021-09-16 17:51:59	1.79 (1.70)	88	2021-09-16 17:56:57	0.96 (1.01)	5	1.5	0.545	0.546	valid
59	2021	429	114	112	2021-09-16 21:15:35	1.77 (1.70)	89	2021-09-16 21:21:29	1.09 (1.04)	6	2.0	0.514	0.556	valid
60	2021	429	113	113	2021-09-17 01:05:34	1.83 (1.80)	90	2021-09-17 01:20:33	1.04 (1.05)	15	1.4	0.186	0.248	valid
61	2021	429	111	114	2021-09-17 05:40:01	1.78 (1.80)	92	2021-09-17 07:05:46	1.02 (1.04)	86	0.5	0.464	0.484	valid
62	2021	429	112	115	2021-09-17 09:23:42	1.81 (1.70)	93	2021-09-17 09:31:50	1.02 (1.02)	9	2.0	0.479	0.484	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
63	2021	429	115	116	2021-09-17 13:04:42	1.70 (1.70)	94	2021-09-17 13:08:46	1.02 (1.00)	5	0.8	0.388	0.428	valid
64	2021	401	002	117	2021-09-17 17:00:11	1.80 (1.70)	95	2021-09-17 17:05:40	1.04 (1.01)	6	0.3	0.483	0.500	valid
65	2021	431	128	118	2021-09-17 21:10:39	1.79 (1.70)	96	2021-09-17 21:15:03	1.02 (1.05)	5	1.5	0.556	0.567	valid
66	2021	431	126	119	2021-09-18 01:00:01	1.84 (1.80)	97	2021-09-18 01:06:12	1.03 (1.04)	7	1.7	0.441	0.482	valid
67	2021	431	121	120	2021-09-18 09:39:11	1.74 (1.70)	98	2021-09-18 09:46:34	0.87 (0.81)	8	2.0	0.151	0.210	valid
68	2021	431	124	121	2021-09-18 12:55:45	1.58 (1.65)	99	2021-09-18 12:59:37	0.83 (0.80)	4	1.7	0.395	0.416	valid
69	2021	431	241	122	2021-09-18 15:49:38	1.79 (1.80)	100	2021-09-18 15:59:20	1.06 (1.00)	10	0.6	0.278	0.311	valid
70	2021	435	352	123	2021-09-18 21:26:03	1.75 (1.60)	101	2021-09-18 21:08:08	1.14 (1.08)	18	0.2	0.462	0.523	valid
71	2021	435	152	124	2021-09-19 00:13:18	1.28 (1.30)	102	2021-09-19 00:19:46	1.04 (1.03)	7	2.4	0.513	0.587	valid
72	2021	435	153	125	2021-09-19 02:59:34	1.82 (1.80)	103	2021-09-19 03:04:38	1.06 (1.05)	6	1.8	0.523	0.550	valid
73	2021	434	143	126	2021-09-19 05:02:54	1.84 (1.80)	104	2021-09-19 05:09:50	1.04 (1.06)	7	0.3	0.454	0.487	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
74	2021	431	119	127	2021-09-19 09:16:06	1.76 (1.70)	105	2021-09-19 09:18:19	1.04 (1.03)	3	6.5	0.430	0.442	valid
75	2021	431	120	128	2021-09-19 11:52:05	1.82 (1.80)	106	2021-09-19 12:00:15	1.03 (1.00)	9	5.9	0.537	0.580	valid
76	2021	434	146	129	2021-09-19 14:09:57	1.79 (1.80)	107	2021-09-19 14:18:57	0.98 (1.00)	9	0.4	0.484	0.532	valid
77	2021	434	145	131	2021-09-19 20:06:03	1.65 (1.60)	109	2021-09-19 20:02:30	1.05 (1.02)	4	2.5	0.488	0.585	valid
78	2021	434	142	132	2021-09-19 23:46:41	1.80 (1.70)	110	2021-09-19 23:59:06	1.06 (1.07)	13	2.0	0.508	0.627	valid
79	2021	434	141	133	2021-09-20 02:51:31	1.84 (1.80)	111	2021-09-20 02:57:54	1.05 (1.08)	7	0.5	0.614	0.627	valid
80	2021	436	160	134	2021-09-20 05:01:21	1.36 (1.30)	112	2021-09-20 05:11:56	1.07 (1.06)	11	0.2	0.511	0.611	valid
81	2021	435	151	135	2021-09-20 08:07:42	1.77 (1.70)	113	2021-09-20 08:23:45	1.10 (1.08)	17	1.0	0.464	0.976	valid
82	2021	435	150	136	2021-09-20 10:50:34	1.82 (1.75)	114	2021-09-20 10:51:55	1.06 (1.06)	2	0.6	0.666	0.720	valid
83	2021	436	156	137	2021-09-20 14:25:19	1.83 (1.80)	115	2021-09-20 14:34:10	1.09 (1.08)	9	2.7	0.416	0.434	valid
84	2021	436	259	138	2021-09-20 17:40:43	1.80 (1.70)	116	2021-09-20 17:44:00	1.01 (1.06)	4	0.5	0.441	0.518	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
85	2021	438	361	140	2021-09-20 22:06:27	1.79 (1.70)	118	2021-09-20 22:13:38	1.06 (1.07)	8	4.0	0.488	0.558	valid
86	2021	439	172	141	2021-09-21 00:43:16	1.86 (1.80)	119	2021-09-21 00:57:43	1.11 (1.11)	15	32.0	0.542	0.639	valid
87	2021	438	169	142	2021-09-21 04:11:53	1.86 (1.80)	120	2021-09-21 04:32:55	1.07 (1.06)	22	12.7	0.101	0.126	valid
88	2021	439	173	143	2021-09-21 07:20:54	1.78 (1.70)	121	2021-09-21 07:25:10	1.03 (1.00)	5	26.5	0.560	0.580	valid
89	2021	436	155	144	2021-09-21 10:37:09	1.79 (1.70)	122	2021-09-21 10:44:35	0.90 (1.04)	8	0.5	0.398	0.462	valid
90	2021	438	170	145	2021-09-21 12:53:40	1.87 (1.90)	123	2021-09-21 13:02:44	1.14 (1.03)	10	4.5	0.488	0.497	valid
91	2021	436	161	146	2021-09-21 15:13:09	1.86 (1.80)	124	2021-09-21 15:20:43	1.09 (1.07)	8	3.2	0.575	0.580	valid
92	2021	439	174	147	2021-09-21 18:47:53	1.78 (1.70)	125	2021-09-21 19:20:08	1.09 (1.08)	33	6.5	0.066	0.240	valid
93	2021	438	171	148	2021-09-21 21:40:26	1.77 (1.70)	126	2021-09-21 21:46:23	1.06 (1.08)	6	13.0	0.456	0.506	valid
94	2021	439	176	149	2021-09-22 00:50:57	1.83 (1.80)	127	2021-09-22 01:04:25	1.08 (1.08)	14	30.0	0.629	0.683	valid
95	2021	439	175	150	2021-09-22 04:15:00	1.82 (1.80)	128	2021-09-22 04:26:55	1.06 (1.05)	12	9.0	0.446	0.576	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
96	2021	437	162	151	2021-09-22 07:42:46	1.78 (1.70)	129	2021-09-22 07:55:11	1.08 (1.07)	13	3.5	0.500	0.507	valid
97	2021	437	165	152	2021-09-22 10:27:11	1.82 (1.80)	130	2021-09-22 10:29:12	1.07 (1.05)	3	1.5	0.508	0.553	valid
98	2021	437	164	153	2021-09-22 13:36:19	1.88 (1.80)	131	2021-09-22 13:53:20	1.06 (1.06)	18	10.5	0.238	0.257	valid
99	2021	436	157	154	2021-09-22 16:14:30	1.84 (1.80)	132	2021-09-22 16:22:49	1.09 (1.05)	9	1.5	0.476	0.480	valid
100	2021	436	158	155	2021-09-22 18:34:38	1.78 (1.70)	133	2021-09-22 18:41:15	1.08 (1.06)	7	4.0	0.493	0.522	valid
101	2021	436	261	156	2021-09-22 20:58:50	1.79 (1.70)	134	2021-09-22 21:05:51	1.05 (1.06)	8	1.5	0.507	0.531	valid
102	2021	437	360	157	2021-09-22 23:52:39	1.83 (1.80)	135	2021-09-23 00:00:47	1.05 (1.06)	9	7.8	0.594	0.635	valid
103	2021	437	166	158	2021-09-23 01:57:39	1.83 (1.80)	136	2021-09-23 02:06:26	1.06 (1.06)	9	1.2	0.443	0.473	valid
104	2021	434	253	159	2021-09-23 04:38:23	1.82 (1.80)	137	2021-09-23 04:45:35	1.05 (1.06)	8	3.3	0.624	0.681	valid
105	2021	437	167	160	2021-09-23 07:58:42	1.81 (1.70)	138	2021-09-23 08:19:37	1.07 (1.02)	21	1.0	0.244	0.416	valid
106	2021	434	148	161	2021-09-23 12:01:27	1.86 (1.80)	139	2021-09-23 12:08:03	1.06 (1.05)	7	0.2	0.473	0.512	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
107	2021	434	149	162	2021-09-23 14:21:36	1.71 (1.70)	140	2021-09-23 14:30:30	1.04 (1.02)	9	3.5	0.488	0.492	valid
108	2021	434	147	163	2021-09-23 16:05:45	1.81 (1.80)	141	2021-09-23 16:11:59	1.04 (1.03)	7	1.7	0.423	0.528	valid
109	2021	401	273	164	2021-09-24 00:13:12	1.63 (1.58)	142	2021-09-24 00:26:29	0.84 (0.83)	14	0.4	0.011	0.160	valid
110	2021	431	244	165	2021-09-24 03:22:32	1.82 (1.80)	143	2021-09-24 03:36:17	1.04 (1.05)	14	1.8	0.227	0.228	valid
111	2021	433	135	166	2021-09-24 08:01:43	1.85 (1.70)	144	2021-09-24 08:08:35	1.08 (1.04)	7	0.5	0.482	0.515	valid
112	2021	433	134	167	2021-09-24 10:14:35	1.77 (1.70)	145	2021-09-24 10:18:44	1.08 (1.05)	5	0.5	0.542	0.608	valid
113	2021	433	133	168	2021-09-24 12:34:21	1.87 (1.80)	146	2021-09-24 12:41:45	1.05 (1.03)	8	1.6	0.543	0.564	valid
114	2021	403	011	169	2021-09-24 15:19:22	1.84 (1.80)	147	2021-09-24 15:27:36	1.03 (1.05)	9	0.5	0.491	0.504	valid
115	2021	403	010	170	2021-09-24 19:31:09	1.85 (1.70)	148	2021-09-24 19:35:32	1.01 (1.01)	5	0.5	0.494	0.508	valid
116	2021	403	008	172	2021-09-25 01:41:49	1.85 (1.80)	149	2021-09-24 23:20:09	1.06 (1.02)	142	0.9	0.412	0.532	valid
117	2021	433	132	173	2021-09-25 06:40:36	1.77 (1.70)	150	2021-09-25 06:43:56	1.10 (1.08)	4	1.8	0.439	0.481	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
118	2021	433	136	174	2021-09-25 09:43:33	1.78 (1.70)	151	2021-09-25 09:52:46	1.06 (1.03)	10	4.0	0.536	0.776	valid
119	2021	433	138	175	2021-09-25 12:38:31	1.8 (1.79)	152	2021-09-25 12:46:05	0.93 (0.98)	8	0.8	0.366	0.397	valid
120	2021	433	137	176	2021-09-25 15:11:35	1.83 (1.83)	153	2021-09-25 15:17:45	1.05 (1.05)	7	1.8	0.550	0.576	valid
121	2021	433	139	177	2021-09-25 17:48:45	1.76 (1.70)	154	2021-09-25 17:56:02	1.07 (1.05)	8	1.0	0.517	0.593	valid
122	2021	433	140	178	2021-09-25 20:07:16	1.77 (1.70)	155	2021-09-25 20:10:26	1.02 (1.04)	4	0.5	0.560	0.566	valid
123	2021	432	131	179	2021-09-25 22:37:43	1.79 (1.70)	156	2021-09-25 22:41:42	1.05 (1.05)	4	2.5	0.536	0.590	valid
124	2021	432	130	180	2021-09-26 01:59:01	1.67 (1.63)	157	2021-09-26 02:16:31	1.04 (1.04)	18	6.3	0.297	0.455	valid
125	2021	432	246	181	2021-09-26 06:17:22	1.80 (1.70)	158	2021-09-26 06:22:23	1.09 (1.08)	6	2.3	0.503	0.527	valid
126	2021	402	007	182	2021-09-26 10:00:20	1.79 (1.70)	159	2021-09-26 10:05:43	1.01 (1.06)	6	1.0	0.411	0.434	valid
127	2021	402	004	183	2021-09-26 14:04:21	1.74 (1.64)	160	2021-09-26 14:06:52	1.05 (1.06)	3	0.6	0.377	0.423	valid
128	2021	402	006	184	2021-09-26 17:49:10	1.77 (1.70)	161	2021-09-26 17:52:06	1.04 (1.09)	3	0.5	0.436	0.470	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
129	2021	402	181	185	2021-09-26 19:51:57	1.84 (1.70)	162	2021-09-26 19:55:27	1.04 (1.09)	4	2.0	0.505	0.517	valid
130	2021	432	340	186	2021-09-26 22:23:10	1.79 (1.70)	163	2021-09-26 22:28:12	1.04 (1.04)	6	1.0	0.500	0.528	valid
131	2022	419	219	1	2022-09-17 18:30:36	1.77 (—)	14	2022-09-17 18:29:40	1.01 (1.01)	1	0.2	0.333	0.391	valid
132	2022	419	039	2	2022-09-17 21:32:33	1.81 (—)	15	2022-09-17 21:34:20	0.99 (0.99)	2	1.9	0.497	0.513	valid
133	2022	419	037	3	2022-09-18 00:02:09	1.89 (—)	16	2022-09-18 00:05:22	1.01 (1.01)	4	4.0	0.401	0.412	valid
134	2022	418	035	4	2022-09-18 04:07:54	1.76 (—)	17	2022-09-18 04:12:06	1.00 (1.00)	5	0.1	0.435	0.446	valid
135	2022	418	034	5	2022-09-18 06:33:41	1.90 (—)	18	2022-09-18 06:37:08	1.01 (1.01)	4	0.4	0.524	0.525	valid
136	2022	417	031	6	2022-09-18 09:33:00	1.77 (—)	19	2022-09-18 09:35:03	1.00 (1.01)	3	3.2	0.408	0.496	valid
137	2022	420	046	7	2022-09-18 11:27:32	1.63 (—)	20	2022-09-18 11:27:17	0.99 (1.00)	1	0.2	0.471	0.805	valid
138	2022	420	041	8	2022-09-18 14:35:52	1.81 (—)	21	2022-09-18 14:36:31	1.00 (1.00)	1	1.1	0.435	0.443	valid
139	2022	420	316	9	2022-09-18 17:30:12	1.80 (—)	22	2022-09-18 17:33:13	1.01 (1.00)	4	0.6	0.449	0.463	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
140	2022	422	054	10	2022-09-18 19:53:53	1.74 (—)	23	2022-09-18 19:50:54	0.93 (0.93)	3	1.6	0.484	0.637	invalid[2]
141	2022	422	053	11	2022-09-19 01:50:37	1.76 (—)	25	2022-09-19 01:53:02	0.97 (0.97)	3	3.7	0.609	0.657	valid[3]
142	2022	422	052	12	2022-09-19 05:07:54	1.29 (—)	26	2022-09-19 05:10:24	1.00 (1.00)	3	3.8	0.499	0.520	valid
143	2022	417	308	13	2022-09-19 08:58:05	1.76 (—)	27	2022-09-19 09:02:17	1.00 (1.01)	5	0.3	0.443	0.461	valid
144	2022	417	033	14	2022-09-19 12:39:02	1.84 (—)	28	2022-09-19 12:50:28	0.99 (0.99)	12	1.6	0.308	0.338	valid
145	2022	416	025	15	2022-09-19 15:42:22	1.76 (—)	29	2022-09-19 15:45:37	0.99 (0.99)	4	1.8	0.423	0.429	valid
146	2022	416	029	16	2022-09-19 19:11:06	1.76 (—)	30	2022-09-19 19:12:40	1.02 (1.02)	2	6.0	0.362	0.375	valid
147	2022	415	014	17	2022-09-19 22:43:48	1.62 (—)	31	2022-09-19 22:46:24	0.98 (0.98)	3	8.0	0.247	0.316	valid
148	2022	415	012	18	2022-09-20 02:07:27	1.74 (—)	32	2022-09-20 02:07:31	1.00 (1.00)	1	22.2	0.356	0.491	valid
149	2022	415	013	19	2022-09-20 06:57:10	1.75 (—)	33	2022-09-20 07:05:55	0.96 (0.96)	9	2.8	0.433	0.511	valid

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[2]deck error on Cartier, no catch recorded for this set
[3]if Cartier is compared to Teleost sets 10 and 11 combined

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
150	2022	425	101	27	2022-09-21 13:18:18	1.80 (—)	35	2022-09-21 13:21:10	0.96 (0.96)	3	4.3	0.422	0.559	valid
151	2022	426	338	28	2022-09-21 16:35:40	1.40 (—)	36	2022-09-21 16:35:23	0.97 (0.97)	1	5.6	0.458	0.468	valid
152	2022	425	102	29	2022-09-21 19:20:26	1.79 (—)	37	2022-09-21 19:22:50	0.93 (0.93)	3	1.9	0.290	0.408	valid
153	2022	427	114	30	2022-09-21 22:46:42	1.27 (—)	38	2022-09-21 22:46:02	0.97 (0.97)	1	2.4	0.327	0.389	valid
154	2022	426	109	32	2022-09-22 02:37:01	1.77 (—)	39	2022-09-22 01:39:39	1.00 (1.00)	58	5.6	0.233	0.369	valid
155	2022	428	121	33	2022-09-22 08:28:02	1.78 (—)	40	2022-09-22 08:32:19	1.02 (1.01)	5	1.7	0.543	0.570	valid
156	2022	428	122	34	2022-09-22 10:07:08	1.75 (—)	41	2022-09-22 10:05:44	1.03 (1.03)	2	1.0	0.470	0.485	valid
157	2022	428	120	36	2022-09-22 16:07:10	1.84 (—)	42	2022-09-22 16:09:15	0.99 (0.99)	3	0.2	0.345	0.368	valid
158	2022	427	117	37	2022-09-22 17:54:22	1.39 (—)	43	2022-09-22 17:57:05	0.99 (0.99)	3	0.1	0.461	0.478	valid
159	2022	425	106	38	2022-09-22 20:47:50	1.81 (—)	44	2022-09-22 20:52:49	0.98 (0.98)	5	11.5	0.285	0.313	valid
160	2022	426	110	39	2022-09-22 23:34:49	1.77 (—)	45	2022-09-22 23:35:06	0.99 (0.99)	1	4.7	0.370	0.423	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
161	2022	427	116	40	2022-09-23 01:59:15	1.73 (—)	46	2022-09-23 02:10:24	1.00 (1.01)	12	3.8	0.672	0.822	valid
162	2022	425	103	42	2022-09-23 09:36:20	1.75 (—)	48	2022-09-23 09:39:46	0.97 (0.98)	4	5.1	0.467	0.504	valid
163	2022	418	310	43	2022-09-25 16:31:26	1.79 (—)	49	2022-09-25 16:42:47	1.01 (1.00)	12	7.6	0.419	0.488	valid
164	2022	418	215	45	2022-09-25 20:43:09	1.81 (—)	50	2022-09-25 19:38:25	0.99 (1.00)	65	2.3	0.455	0.509	valid
165	2022	417	306	46	2022-09-26 01:40:21	1.46 (—)	51	2022-09-26 01:36:28	0.99 (0.99)	4	2.0	0.320	0.339	valid
166	2022	435	169	55	2022-09-27 07:22:45	1.72 (—)	59	2022-09-27 07:26:01	1.02 (1.02)	4	2.7	0.446	0.449	valid
167	2022	435	167	56	2022-09-27 10:23:34	1.78 (—)	60	2022-09-27 10:29:03	1.00 (1.01)	6	2.9	0.295	0.433	valid
168	2022	435	166	58	2022-09-27 15:14:12	1.77 (—)	61	2022-09-27 13:26:30	0.92 (0.97)	108	4.5	0.060	0.111	valid
169	2022	438	185	60	2022-09-27 21:22:26	1.78 (—)	63	2022-09-27 21:21:48	1.00 (1.00)	1	4.6	0.408	0.446	valid
170	2022	439	190	61	2022-09-27 23:36:20	1.78 (—)	64	2022-09-27 23:42:50	0.97 (0.97)	7	4.2	0.261	1.202	valid
171	2022	438	186	62	2022-09-28 03:38:43	1.78 (—)	65	2022-09-28 03:48:38	1.01 (1.00)	10	4.6	0.457	0.532	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
172	2022	438	187	64	2022-09-28 07:53:32	1.76 (—)	66	2022-09-28 07:55:47	1.00 (1.00)	3	5.6	0.450	0.472	valid
173	2022	439	192	65	2022-09-28 10:12:06	1.76 (—)	67	2022-09-28 10:20:53	1.02 (1.04)	9	7.8	0.527	0.578	valid
174	2022	439	288	66	2022-09-28 12:57:34	1.77 (—)	68	2022-09-28 12:56:59	0.98 (0.98)	1	1.4	0.328	0.635	valid
175	2022	437	179	67	2022-09-28 15:22:50	1.61 (—)	69	2022-09-28 15:22:26	0.97 (0.97)	1	8.8	0.506	0.527	valid
176	2022	437	180	69	2022-09-28 19:41:48	1.74 (—)	71	2022-09-28 19:39:34	0.99 (0.99)	3	3.7	0.348	0.435	valid
177	2022	437	181	70	2022-09-28 22:47:05	1.78 (—)	72	2022-09-28 22:47:32	0.98 (0.98)	1	0.3	0.437	0.458	valid
178	2022	402	005	78	2022-09-30 01:56:11	1.71 (—)	80	2022-09-30 02:14:08	0.99 (1.00)	18	4.7	0.403	0.462	valid
179	2022	402	292	79	2022-09-30 04:29:59	1.78 (—)	81	2022-09-30 04:26:54	1.04 (1.04)	4	4.8	0.469	0.491	valid
180	2022	432	143	80	2022-09-30 08:03:43	1.79 (—)	82	2022-09-30 08:01:15	1.01 (1.01)	3	3.2	0.471	0.620	valid
181	2022	402	006	81	2022-09-30 11:47:16	1.37 (—)	83	2022-09-30 11:48:22	0.97 (0.97)	2	5.9	0.458	0.622	valid
182	2022	432	358	82	2022-09-30 15:04:21	1.78 (—)	84	2022-09-30 15:06:51	0.99 (0.99)	3	9.1	0.324	0.422	valid

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Paired set num.	Year	Strat.	Station num.	Teleost Set num.	Teleost Date and time	Teleost Dist. (nm)	Cartier Set num.	Cartier Date and time (ADT)	Cartier Dist. (nm)	Time diff. (min)	Depth diff. (m)	Min. dist. (nm)	Max. dist. (nm)	Validity
183	2022	433	155	83	2022-09-30 18:23:17	1.83 (—)	85	2022-09-30 18:26:22	1.00 (1.00)	4	3.6	0.239	0.357	valid

8 Figures

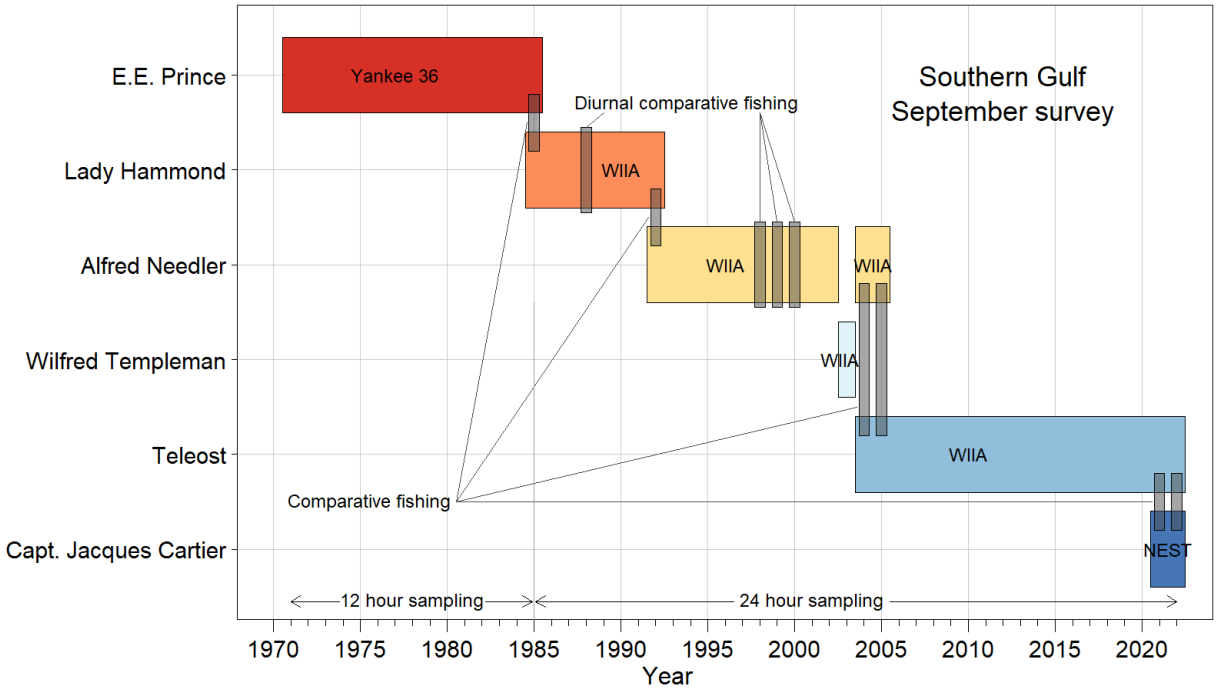

Figure 1. Timeline of survey platforms used in the Gulf Region September survey. The x axis denotes the timespan of the survey. The y axis identifies the vessel on which survey sets were conducted. The type of fishing gear deployed is overlaid on the rectangles representing the time window when each vessel was used (WIIA is the Western IIA trawl, NEST is the Northeast Fisheries Science Center Ecosystem Survey Trawl). Comparative fishing experiments are identified by gray polygons overlapping the survey platforms under comparison.

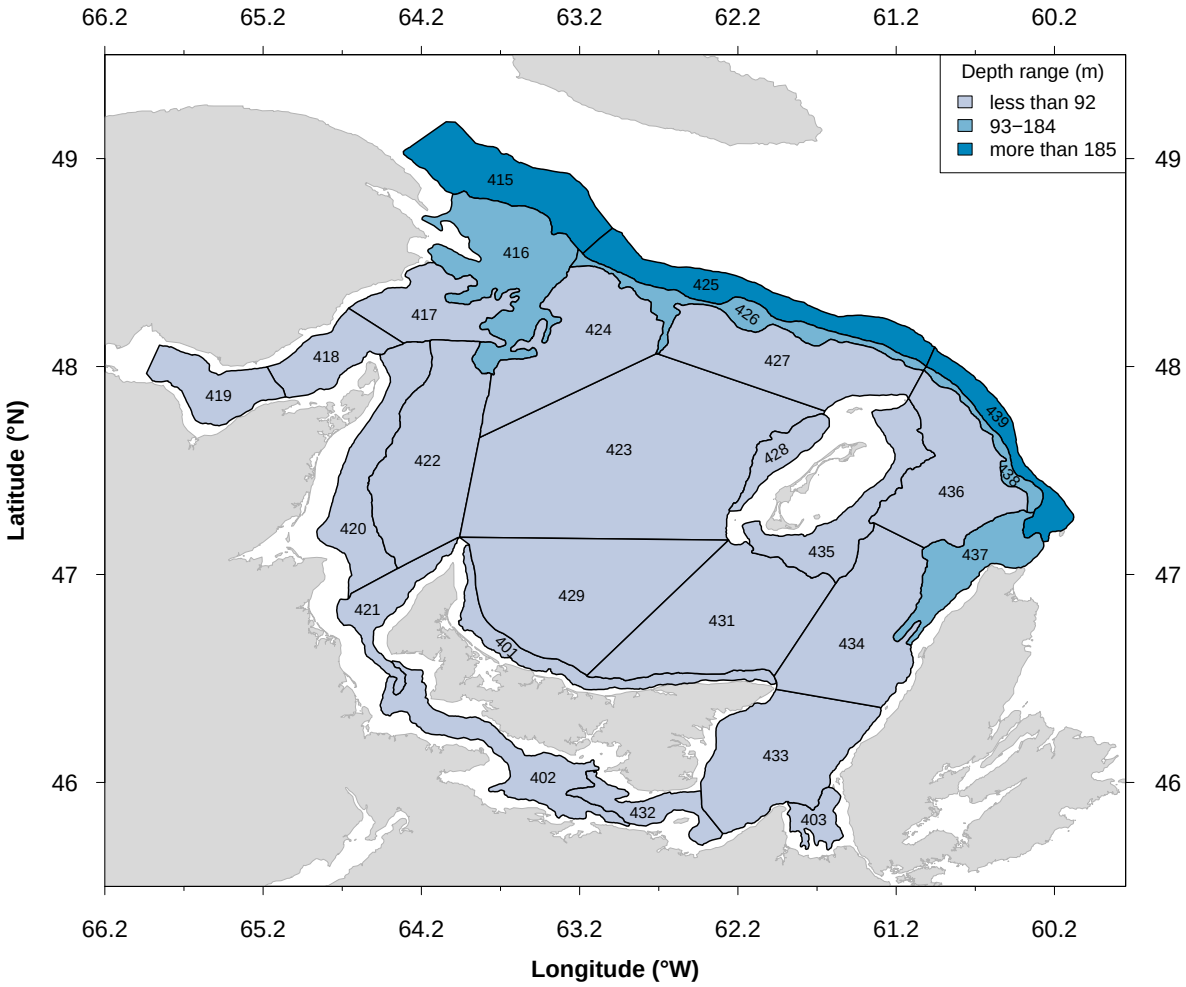

Figure 2. Stratification scheme used in the Fisheries and Oceans Gulf Region September survey. Strata are colour-coded based on the depth range that they cover.

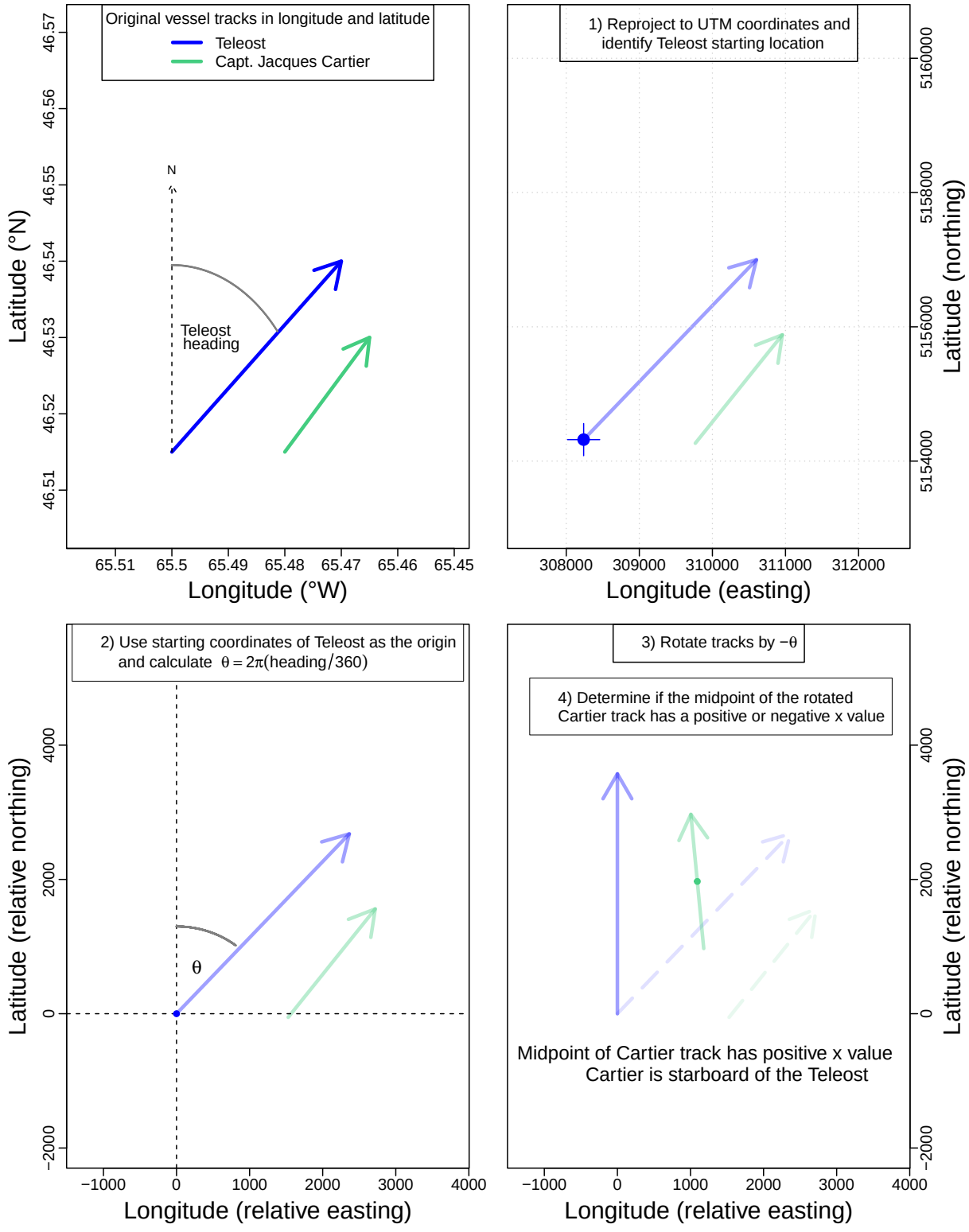

Figure 3. Graphical depiction of the methodology used to determine the position of the secondary vessel with respect to the primary vessel.

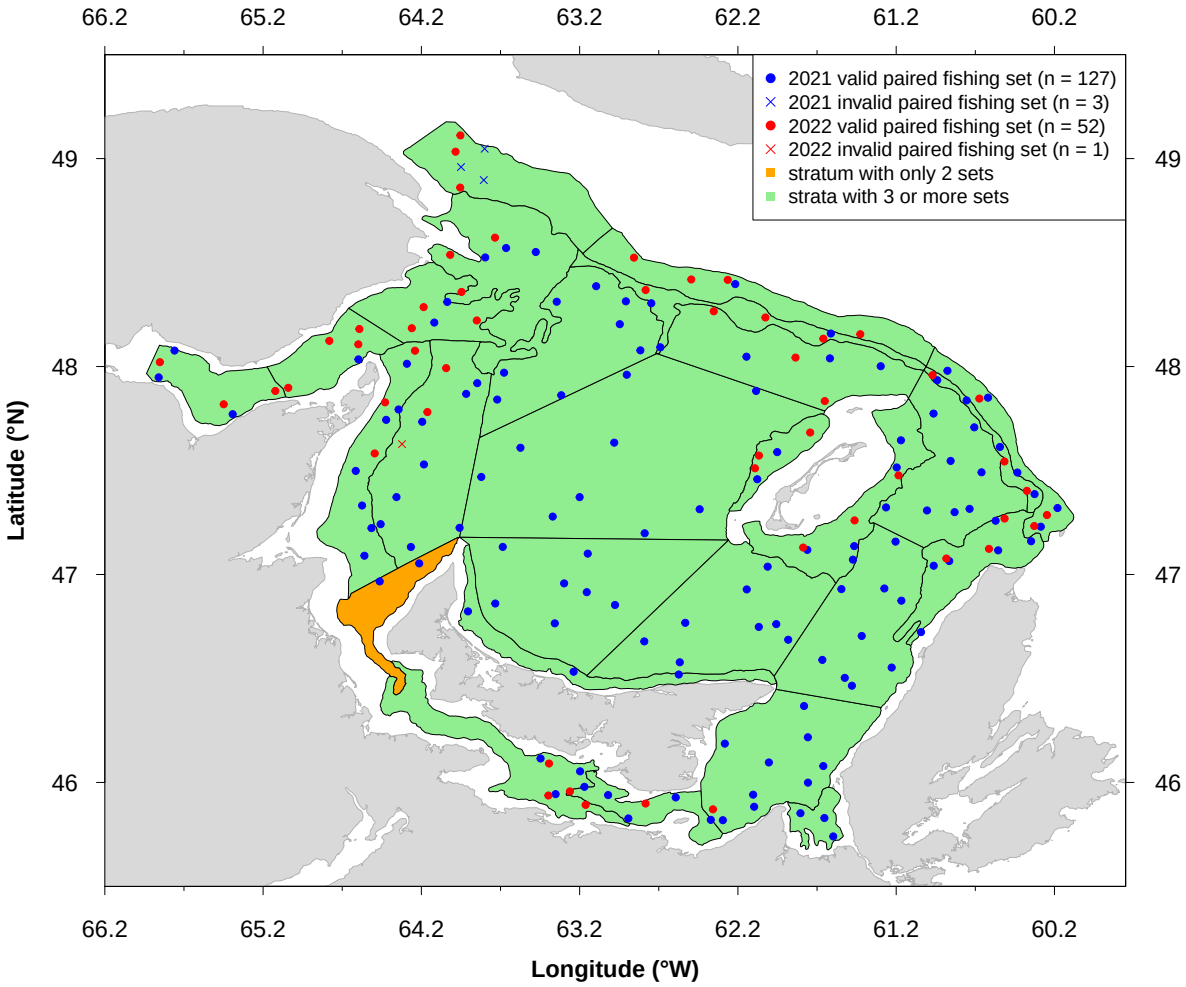

Figure 4. Location of paired sets conducted during the 2021 and 2022 comparative fishing experiments in the southern Gulf of St. Lawrence. Valid and invalid sets are presented for each year. Each stratum in the survey area is colour-coded based on whether it was sampled by 3 or more paired sets.

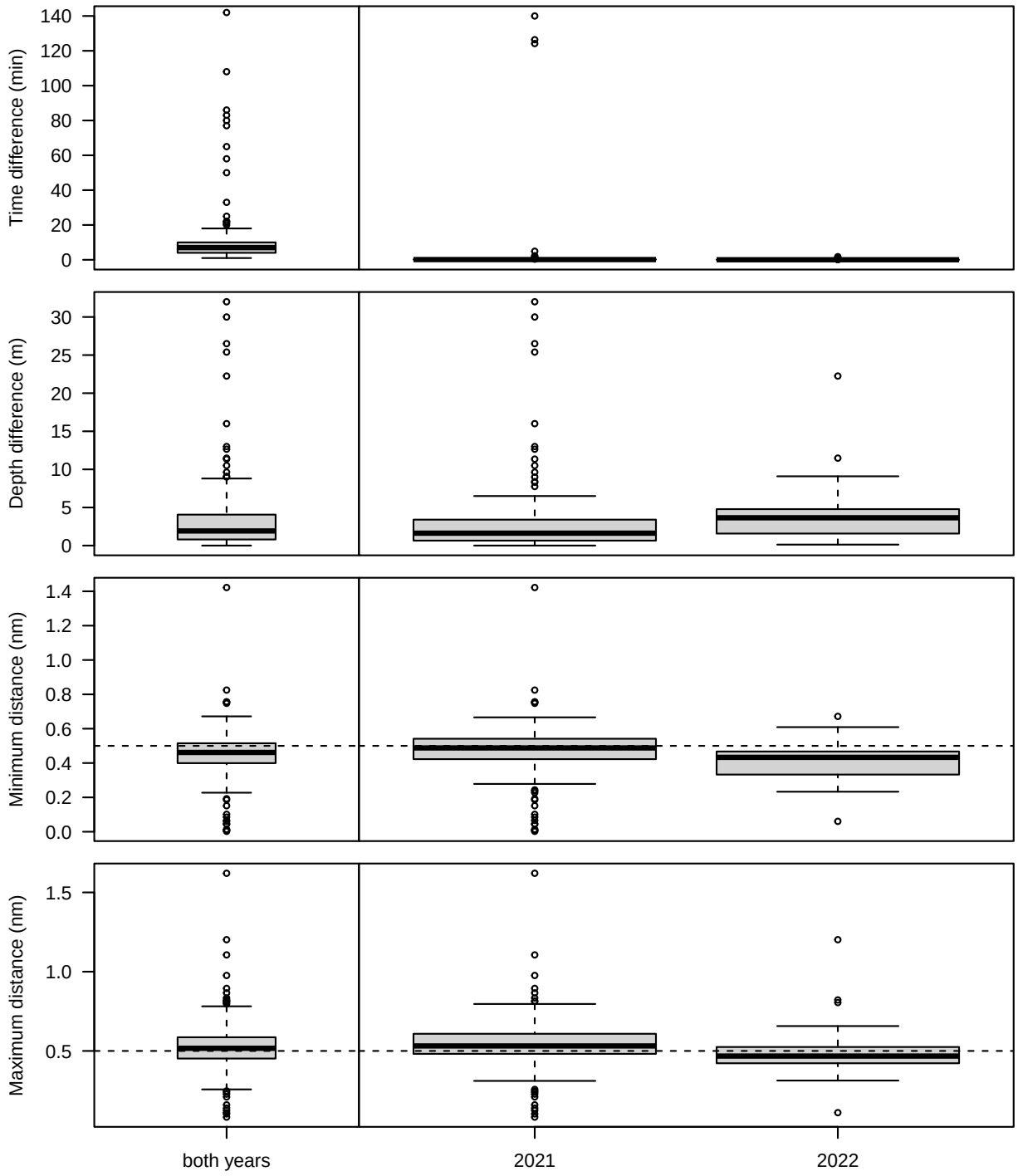

Figure 5. Boxplots showing the amount of time in minutes between the onset of fishing between vessels (top panel), the difference in depth in meters between vessels (second from top panel) and the minimum and maximum distances between vessels in nautical miles (third from top panel and bottom panel, respectively). Both years where comparative fishing took place are presented together in the left column, and separately in the right column. The y axis range of the top panel is truncated and does not show the three paired sets that took place days apart in 2021 (paired sets numbers 1, 2 and 3).

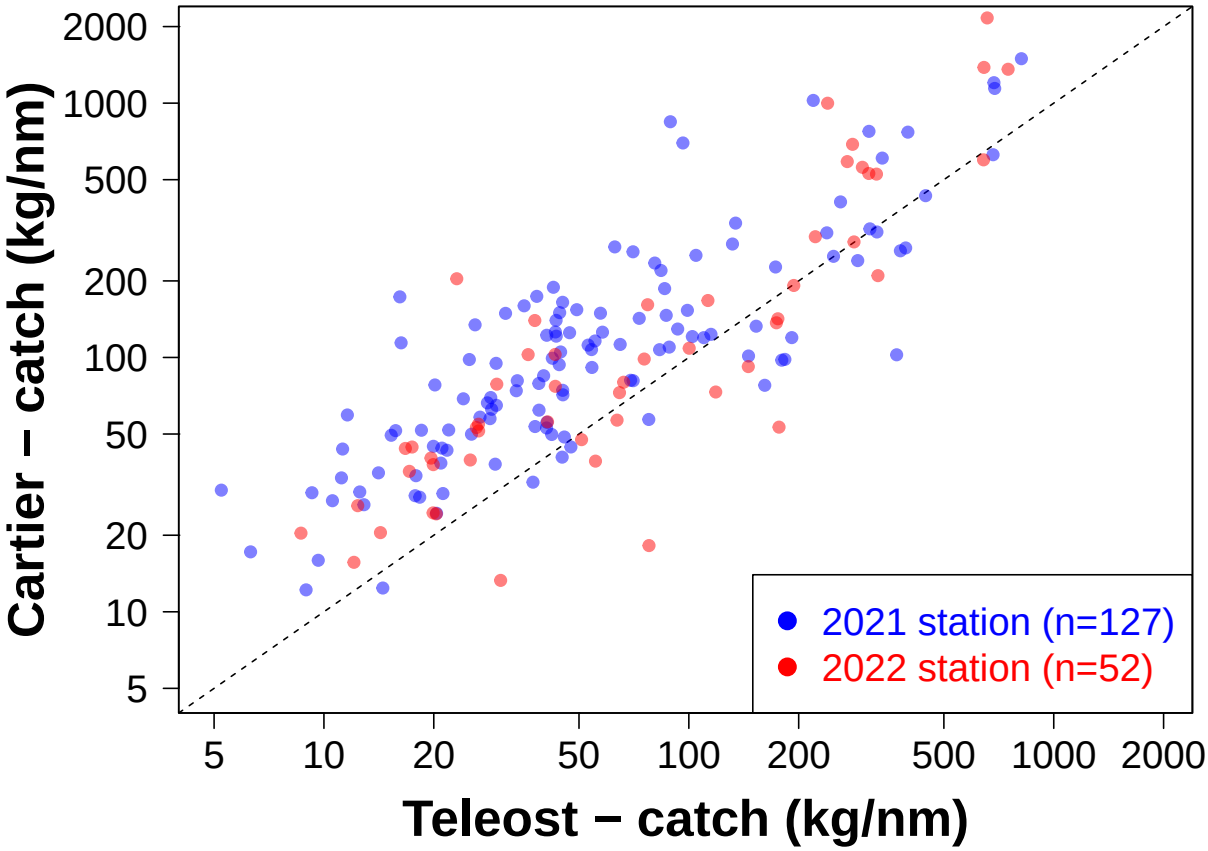

Figure 6. Total catch weight per tow by each vessel used in the 2021 and 2022 comparative fishing experiments in the southern Gulf of St. Lawrence. The observations from 2021 and 2022 are represented by different colours. The catch for *CCGS Capt. Jacques Cartier* at paired set number 141 (*CCGS Capt. Jacques Cartier* set number 25 at station number 053 in 2021) is paired with the combined data from *CCGS Teleost* sets number 10 and 11.

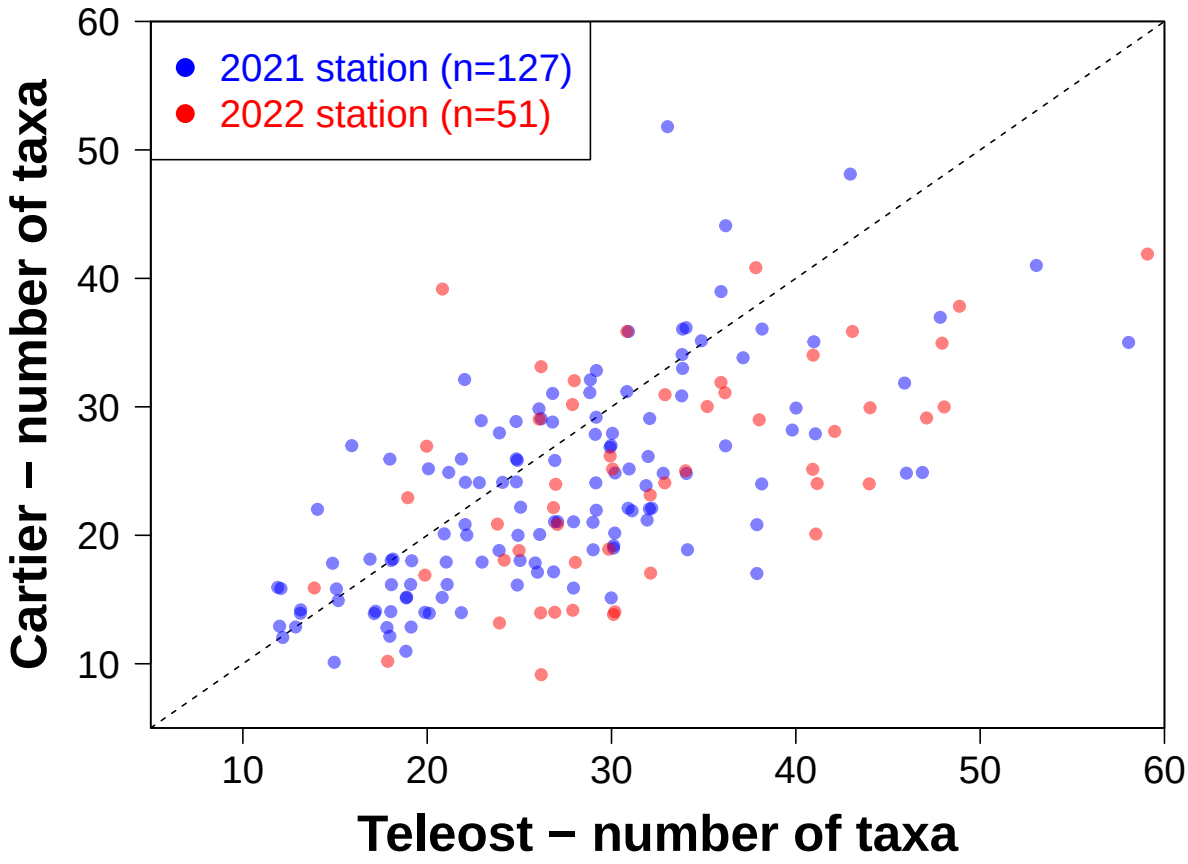

Figure 7. Number of taxa per tow by each vessel used in the 2021 and 2022 comparative fishing experiments in the southern Gulf of St. Lawrence. The observations from 2021 and 2022 are represented by different colours. The number of taxa at paired set numbers 140 and 141 are not included in this figure.

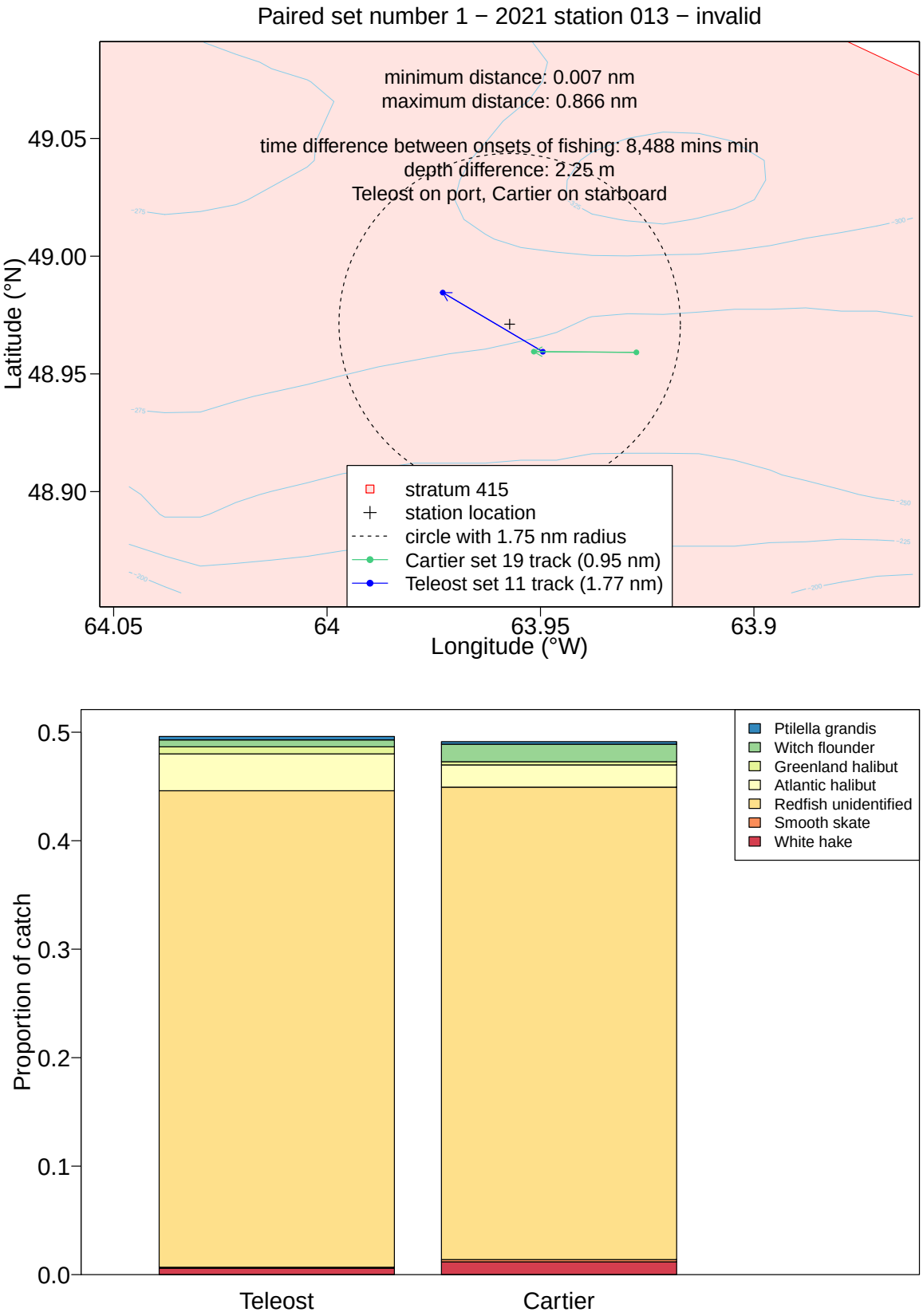

Figure 8. Tow tracks and major species composition for station 013 in 2021.

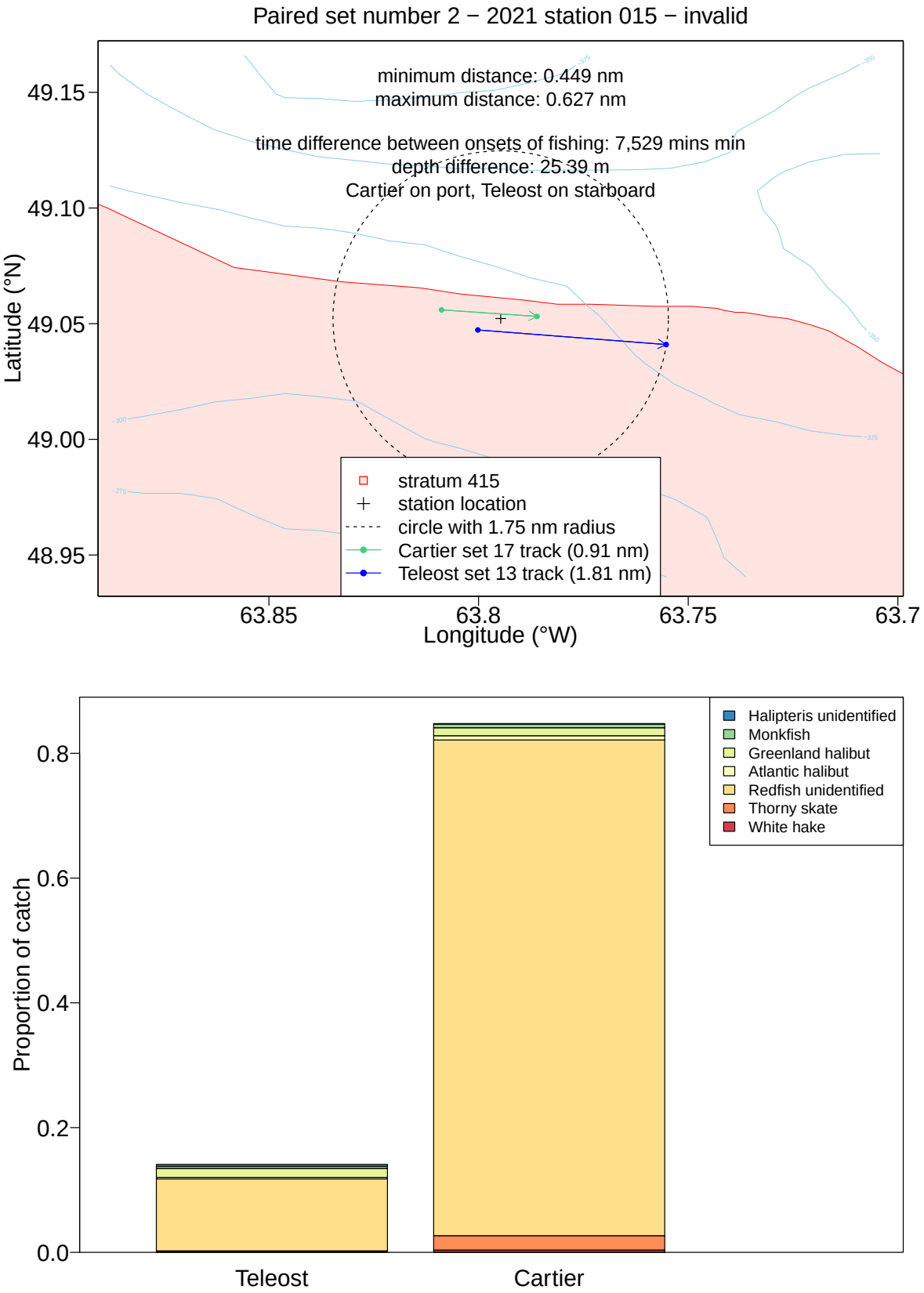

Figure 9. Tow tracks and major species composition for station 015 in 2021.

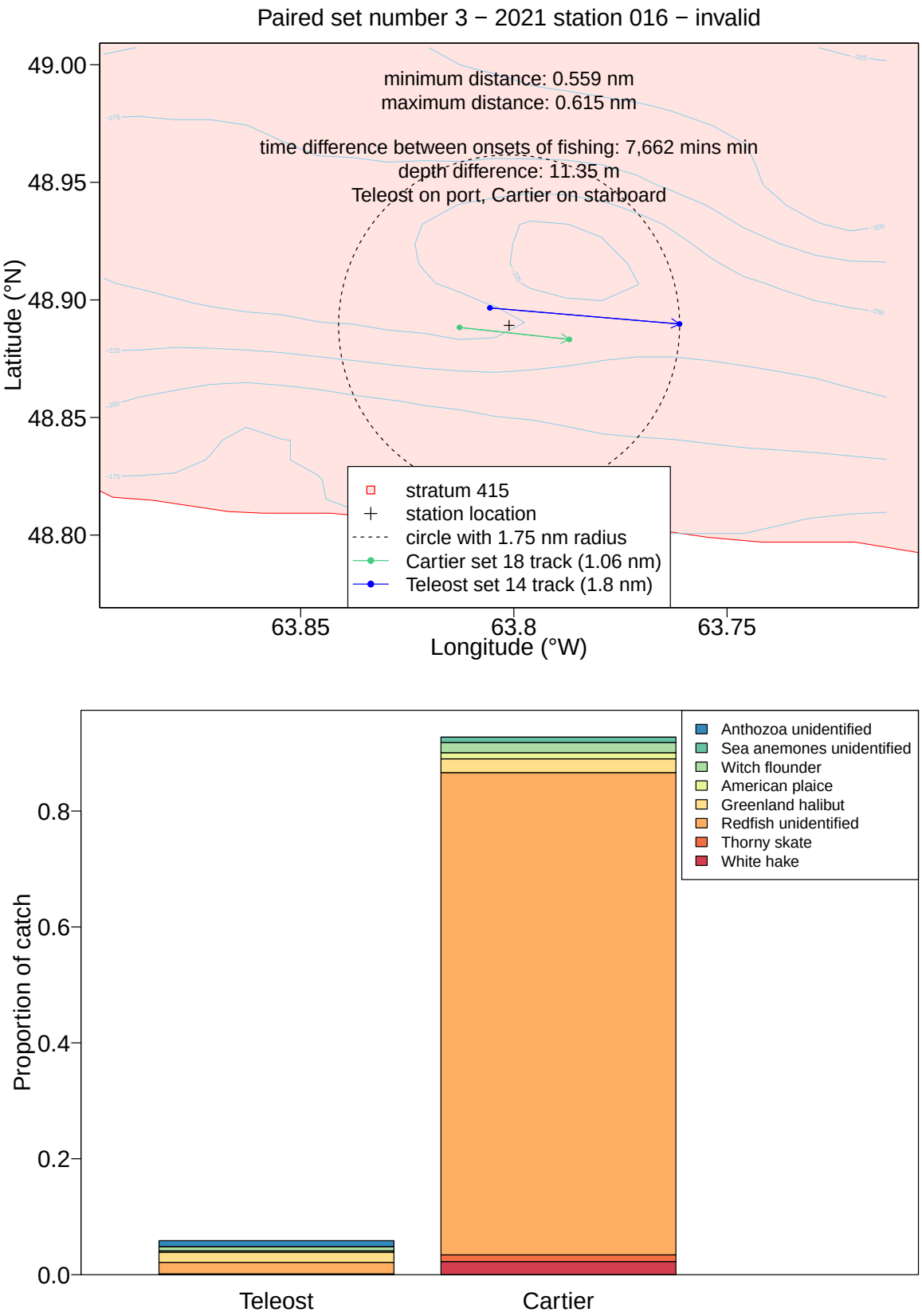

Figure 10. Tow tracks and major species composition for station 016 in 2021.

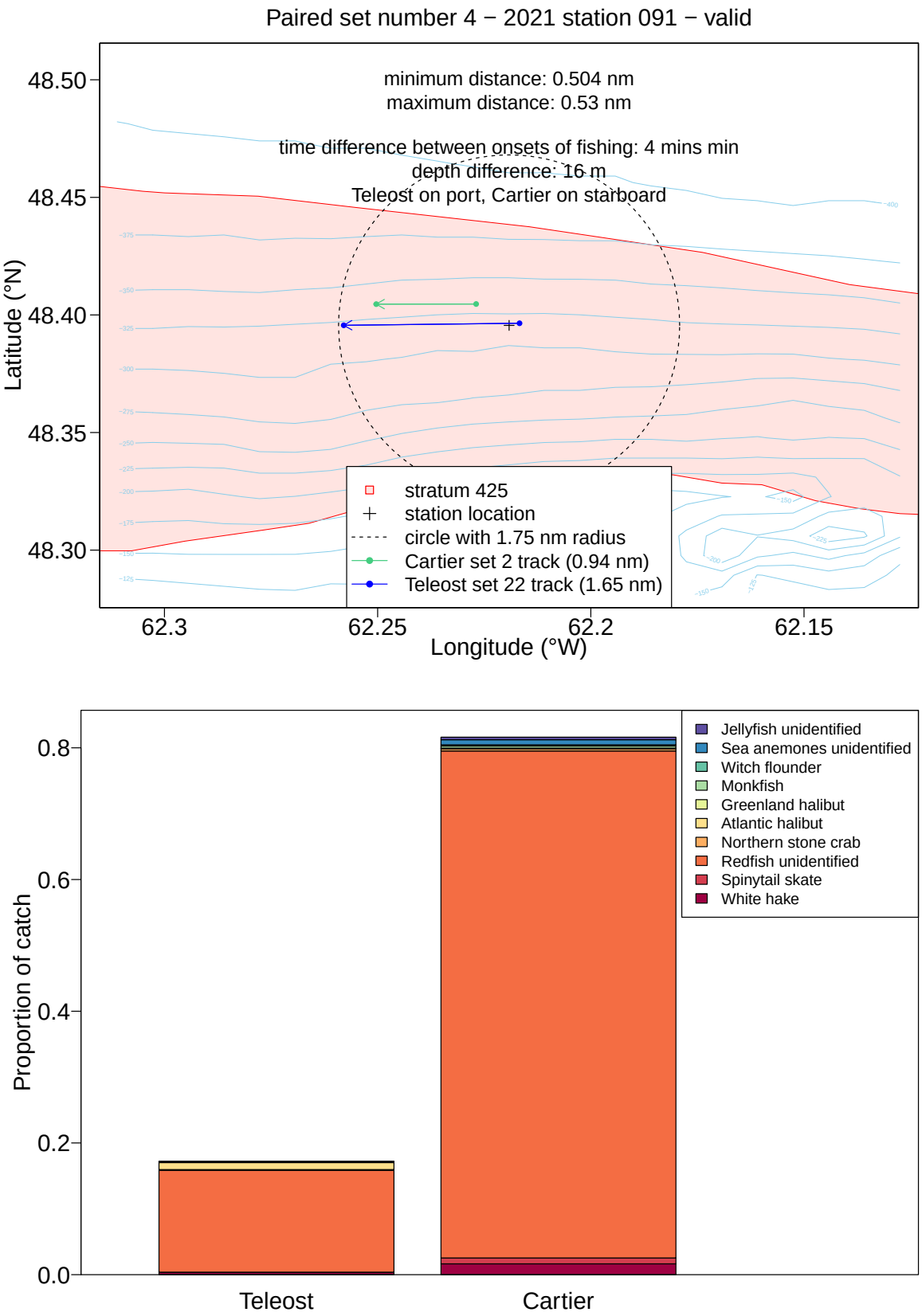

Figure 11. Tow tracks and major species composition for station 091 in 2021.

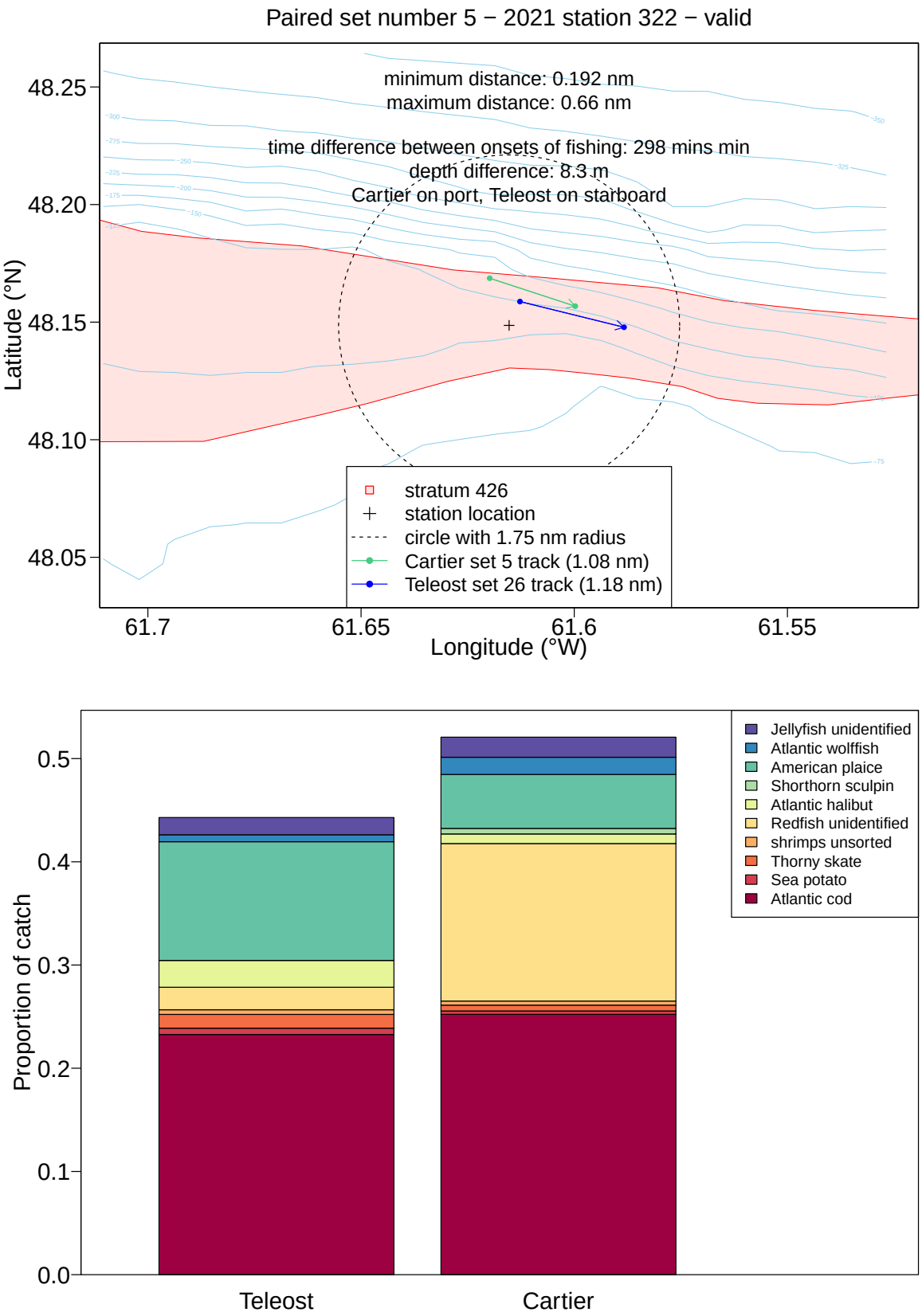

Figure 12. Tow tracks and major species composition for station 322 in 2021.

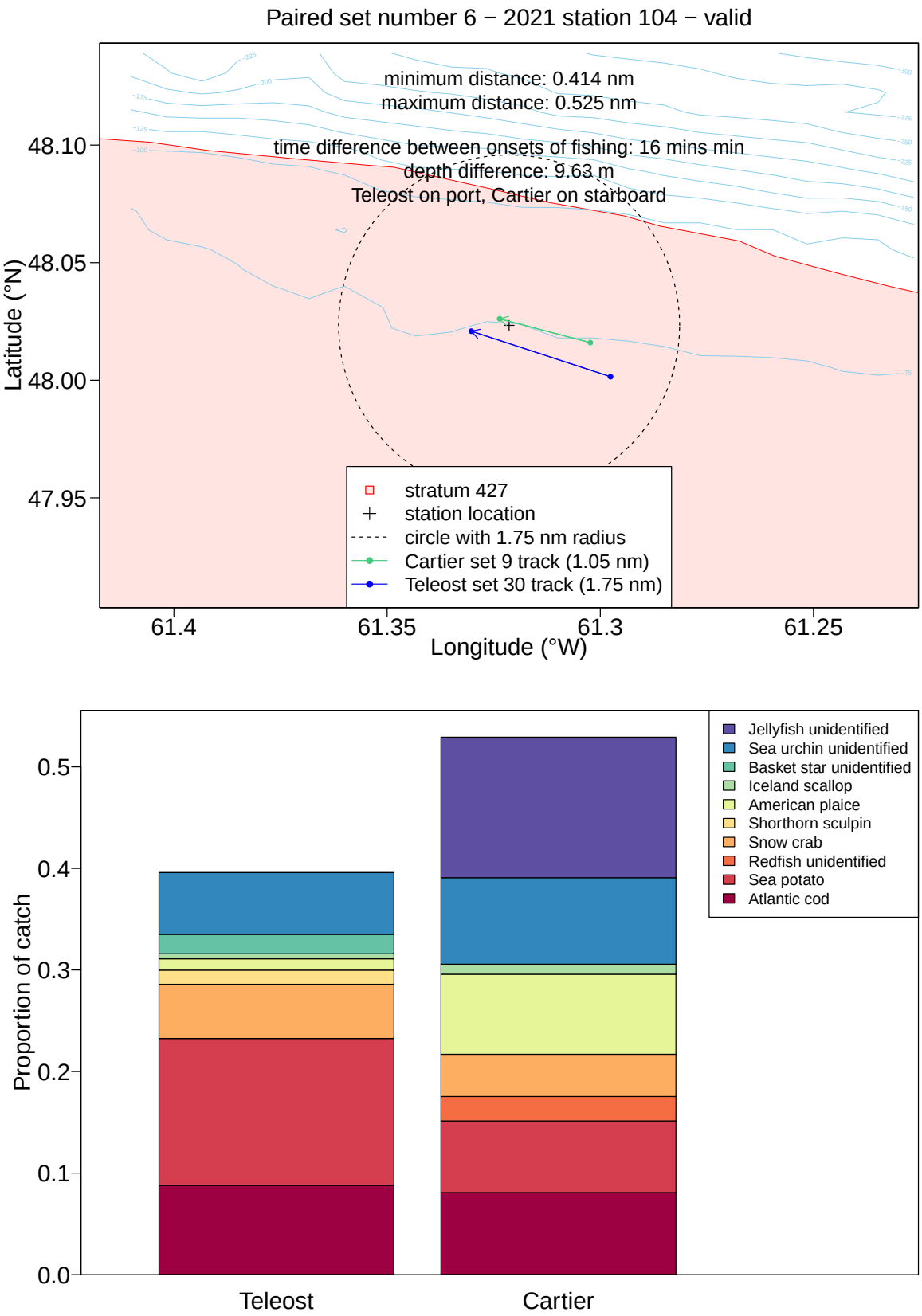

Figure 13. Tow tracks and major species composition for station 104 in 2021.

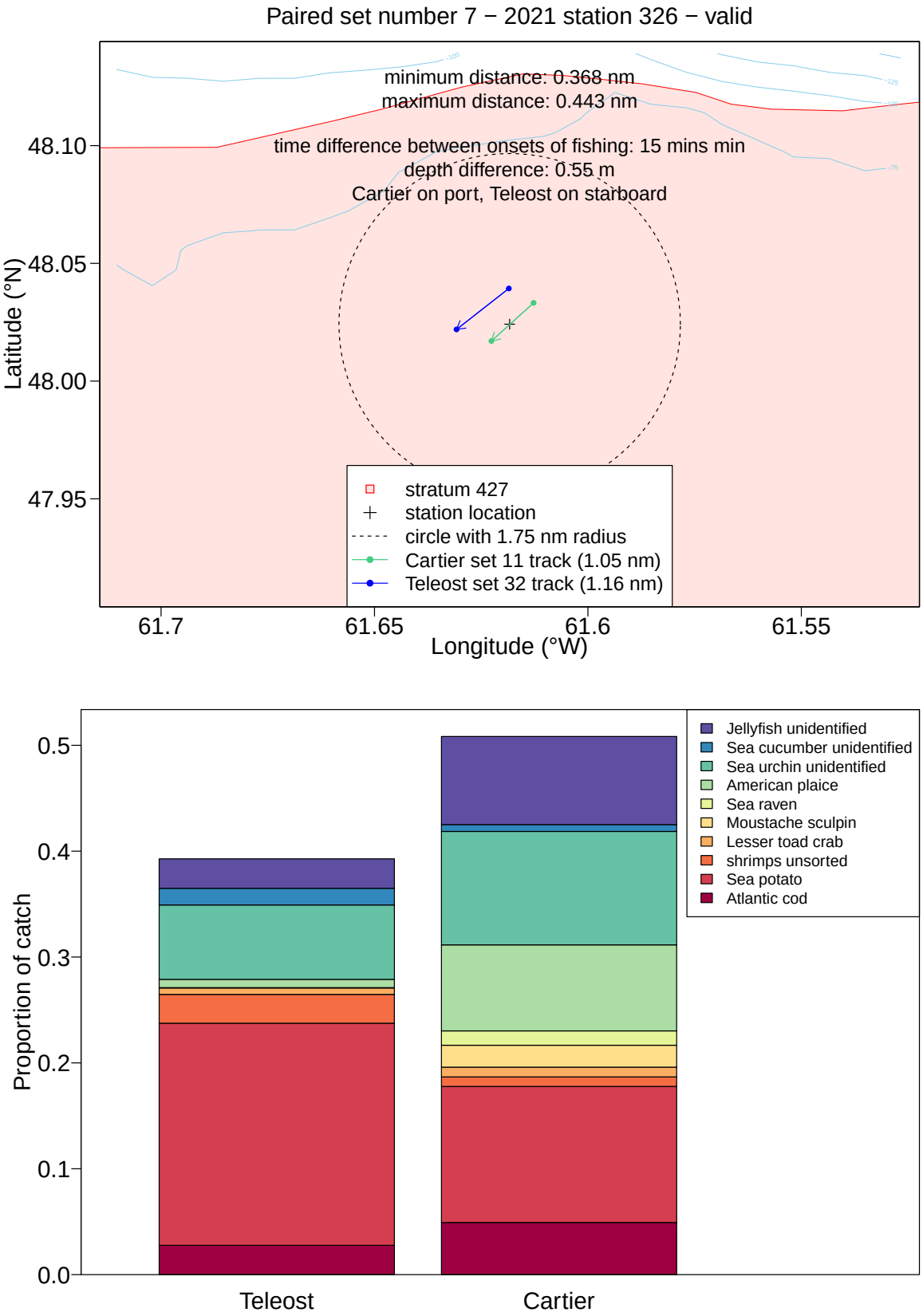

Figure 14. Tow tracks and major species composition for station 326 in 2021.

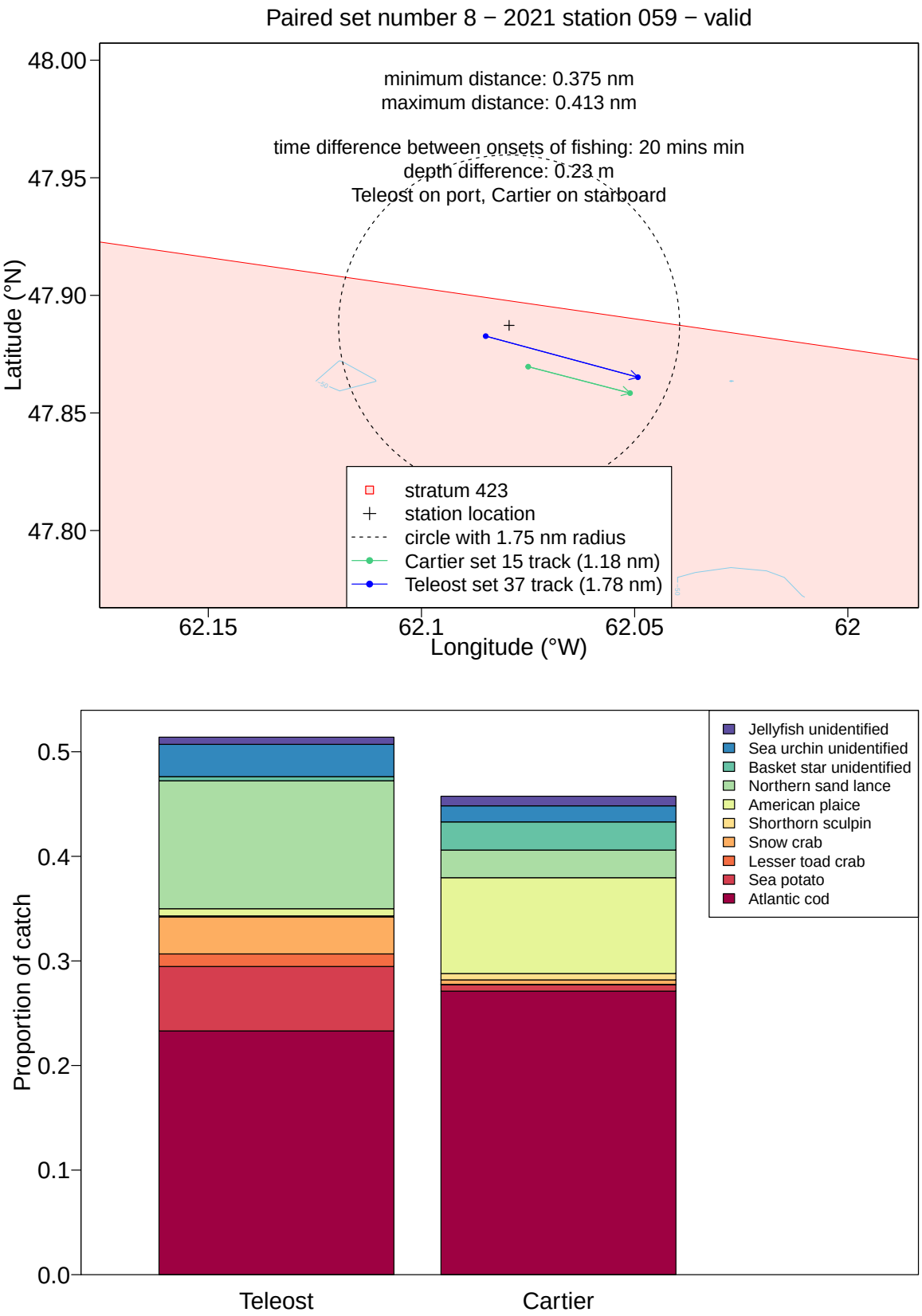

Figure 15. Tow tracks and major species composition for station 059 in 2021.

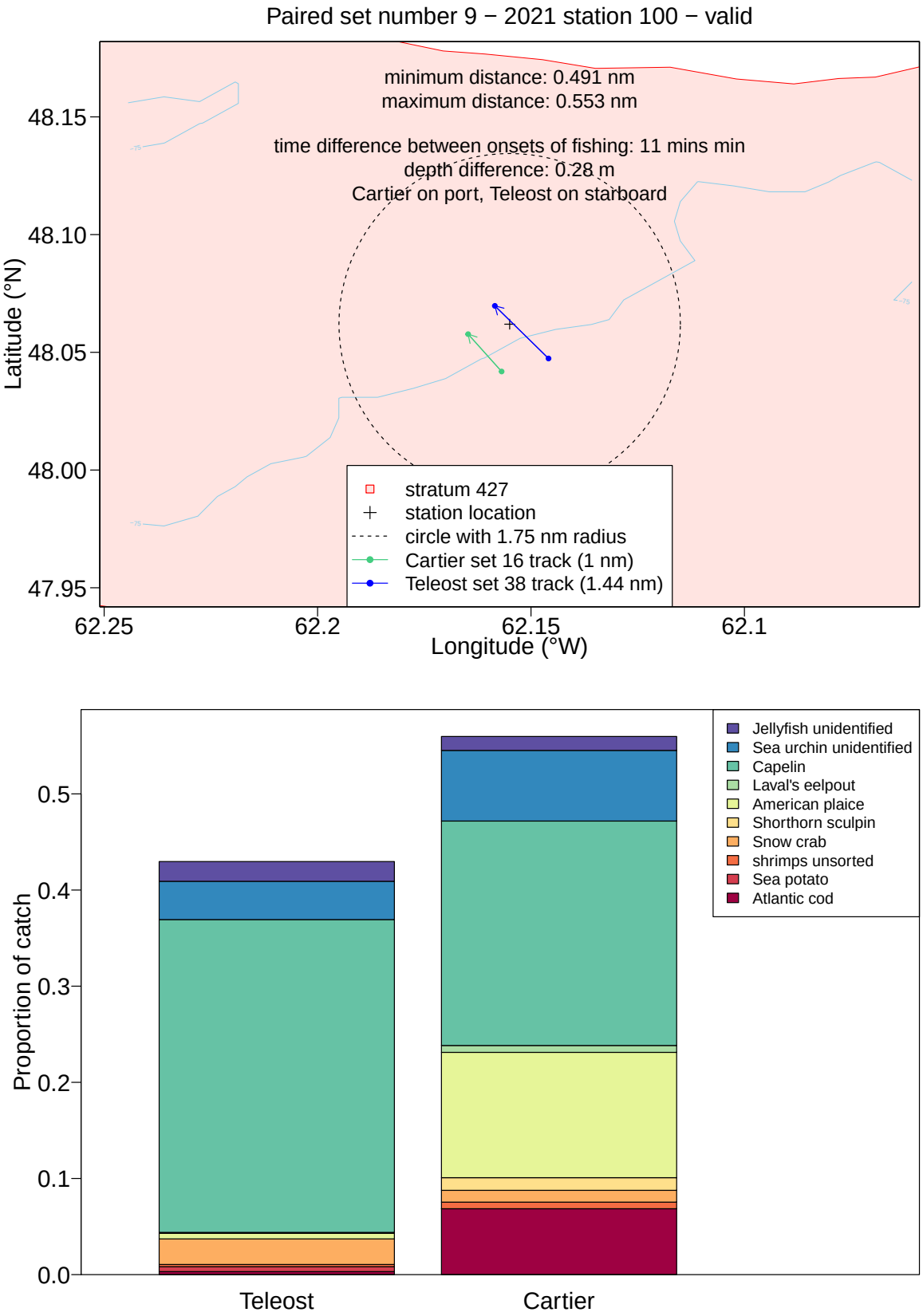

Figure 16. Tow tracks and major species composition for station 100 in 2021.

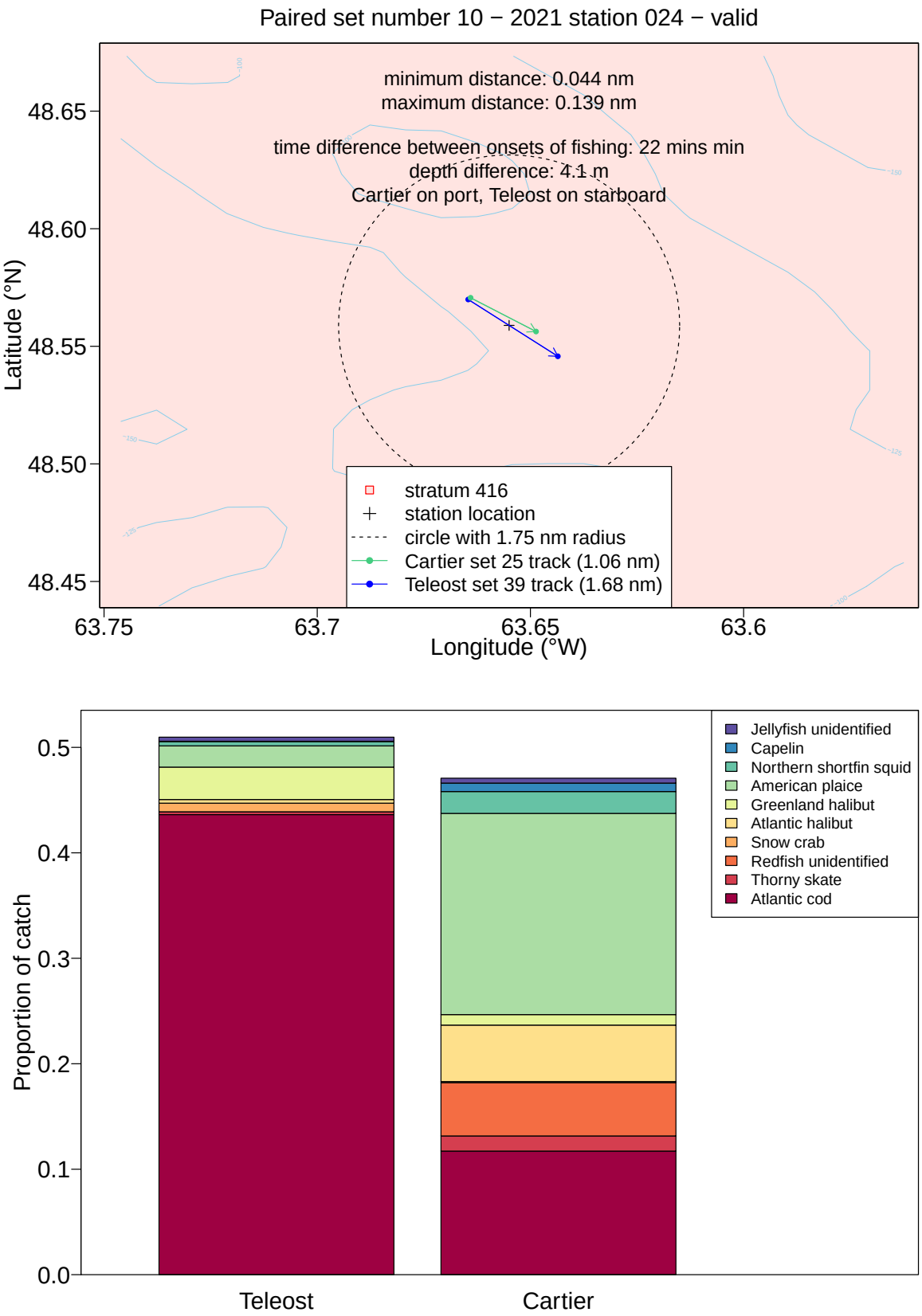

Figure 17. Tow tracks and major species composition for station 024 in 2021.

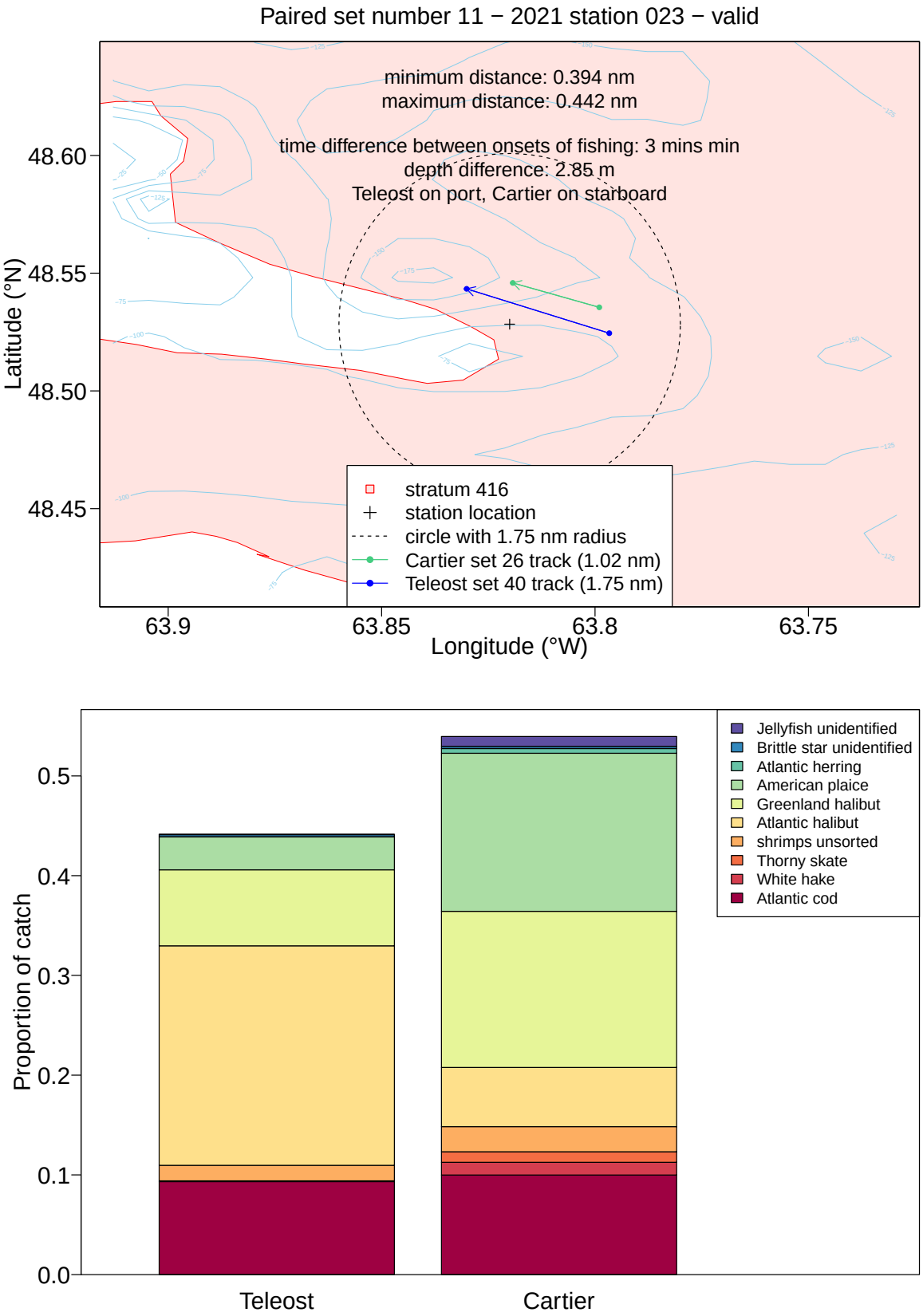

Figure 18. Tow tracks and major species composition for station 023 in 2021.

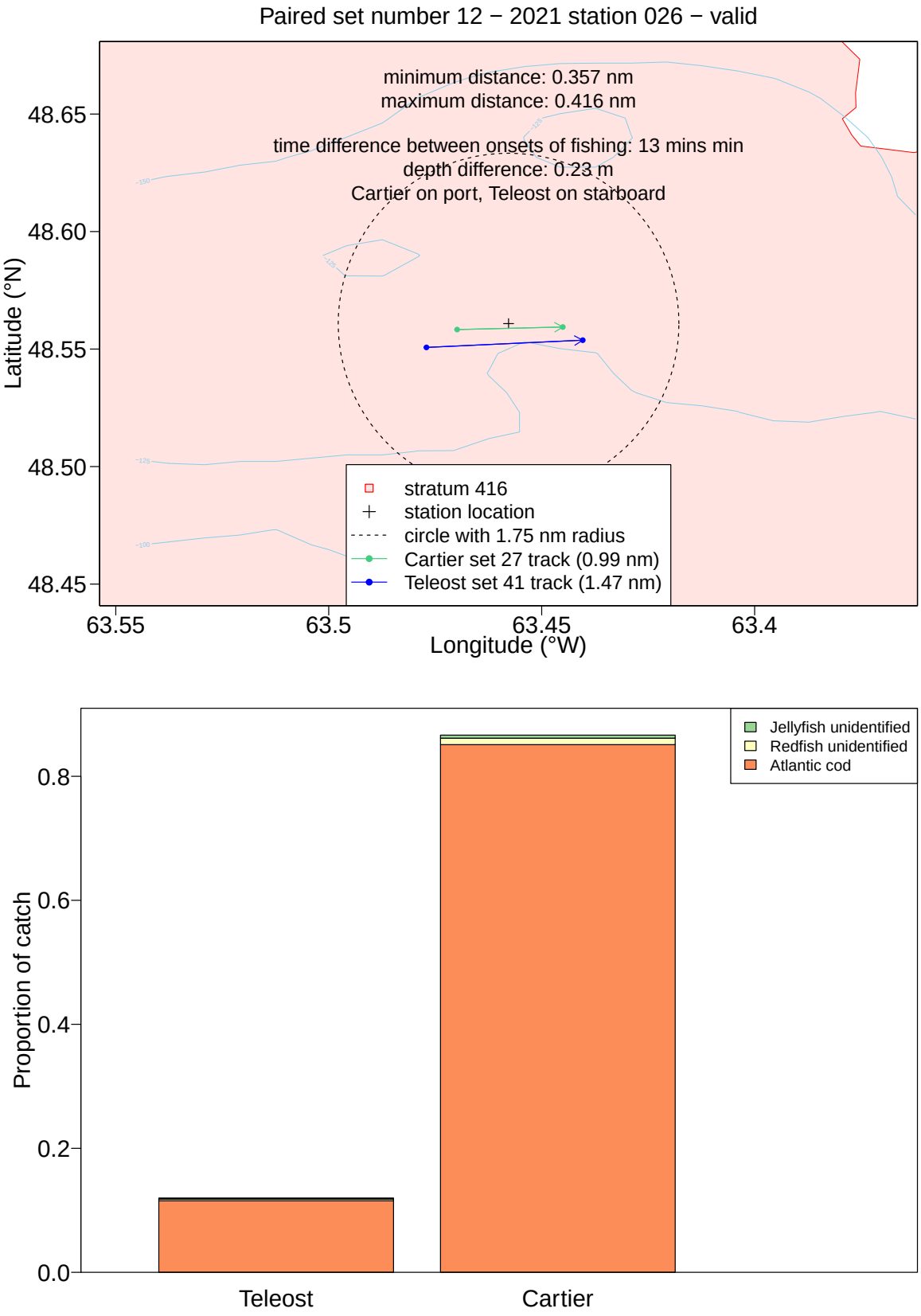

Figure 19. Tow tracks and major species composition for station 026 in 2021.

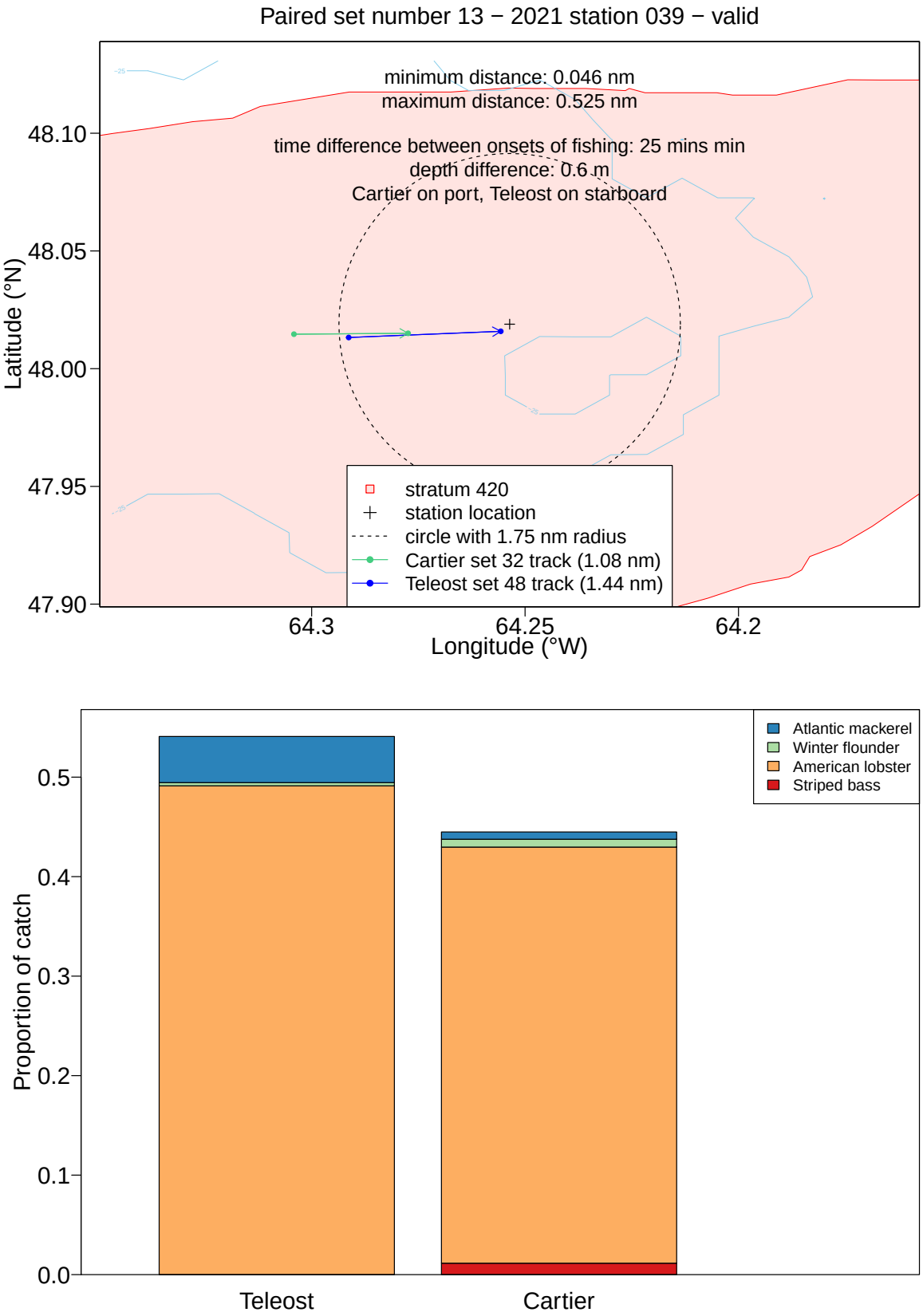

Figure 20. Tow tracks and major species composition for station 039 in 2021.

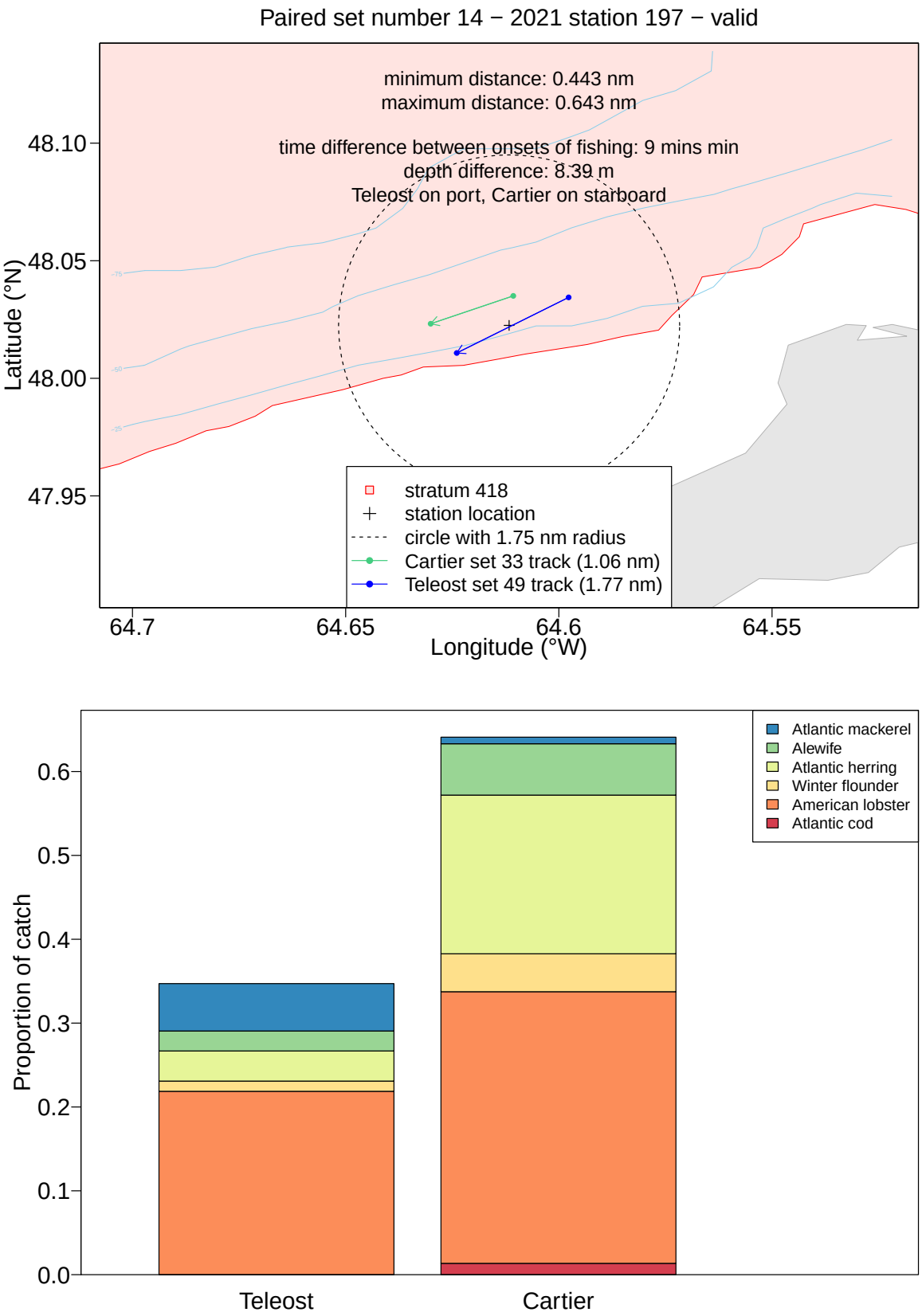

Figure 21. Tow tracks and major species composition for station 197 in 2021.

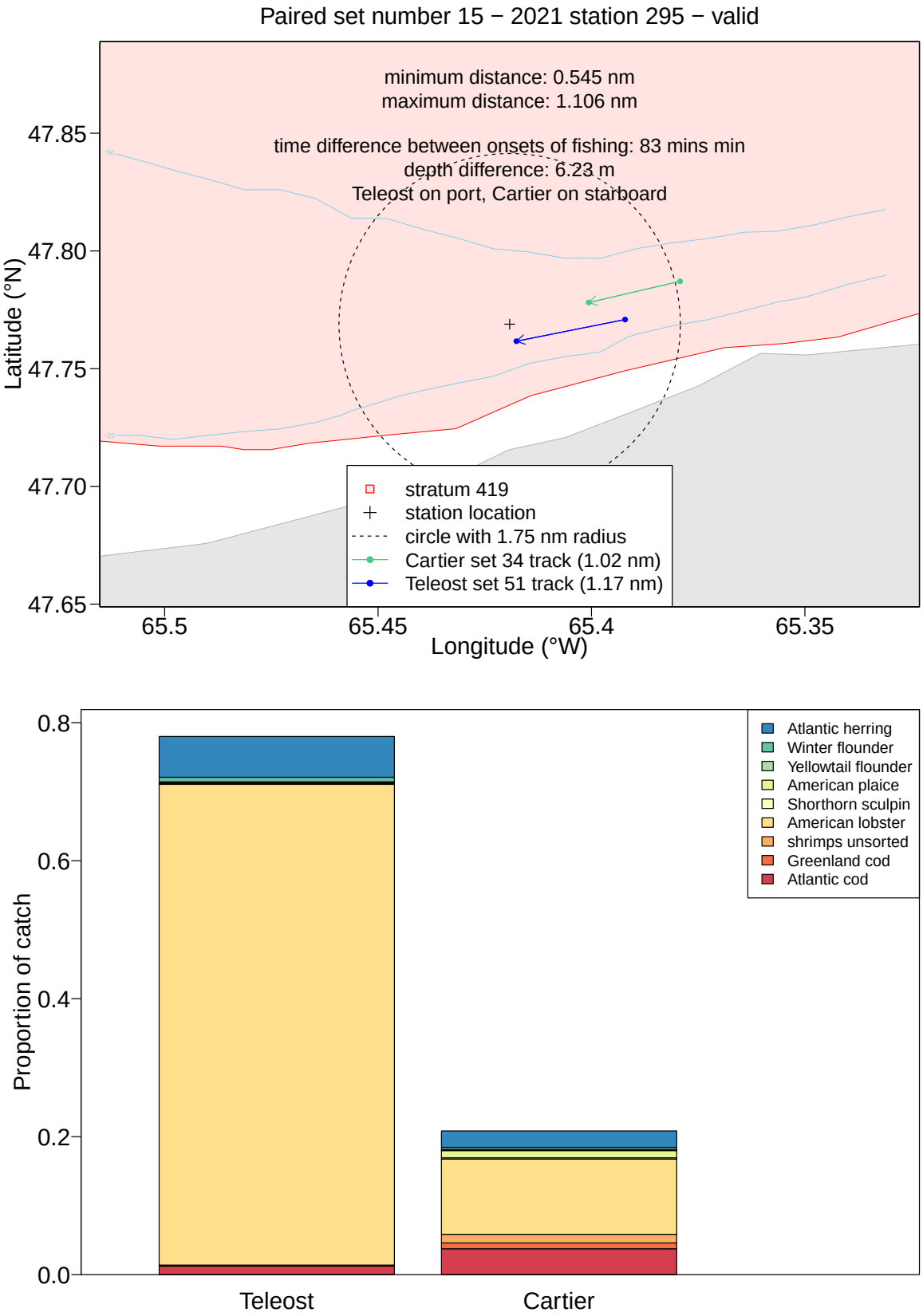

Figure 22. Tow tracks and major species composition for station 295 in 2021.

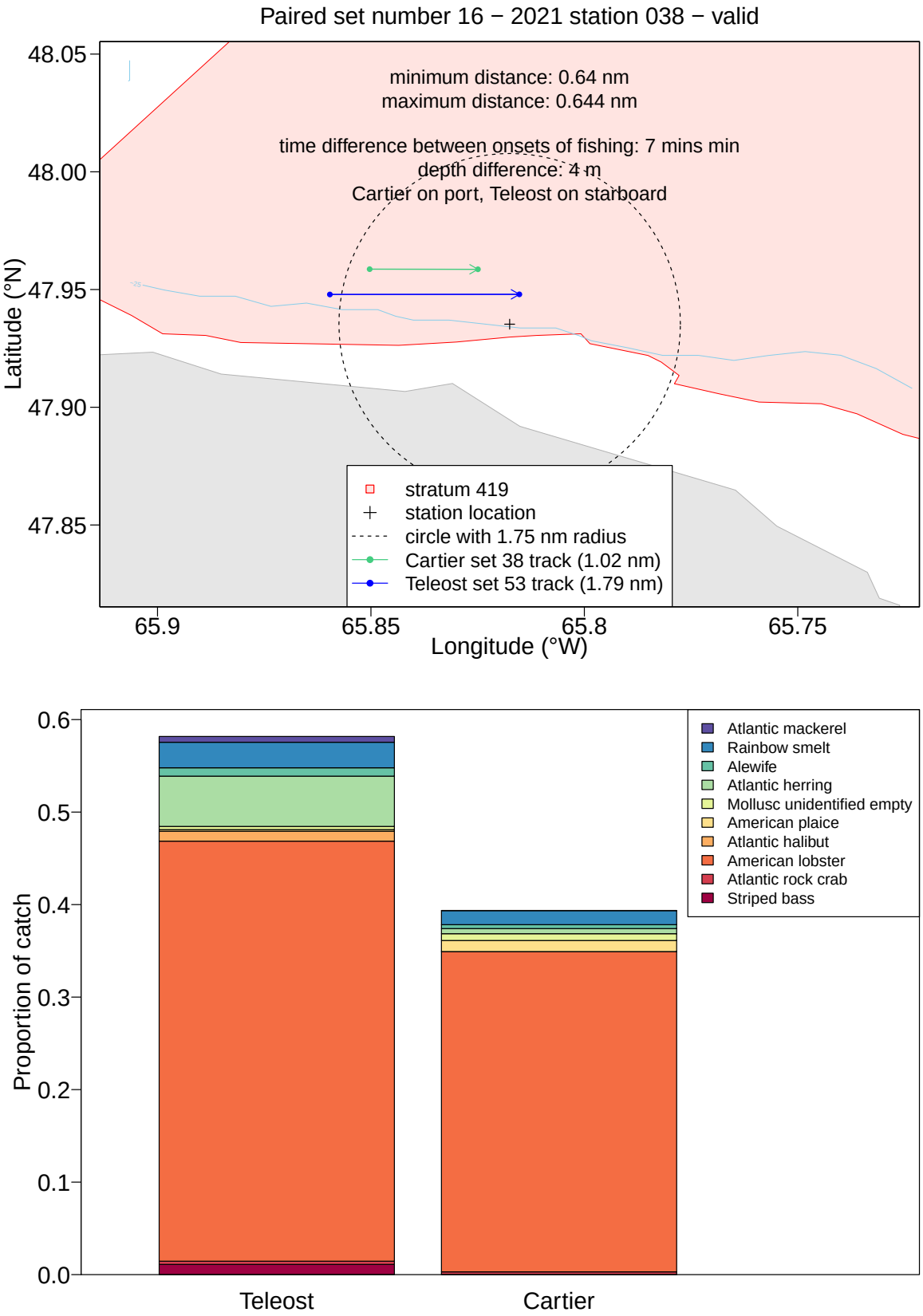

Figure 23. Tow tracks and major species composition for station 038 in 2021.

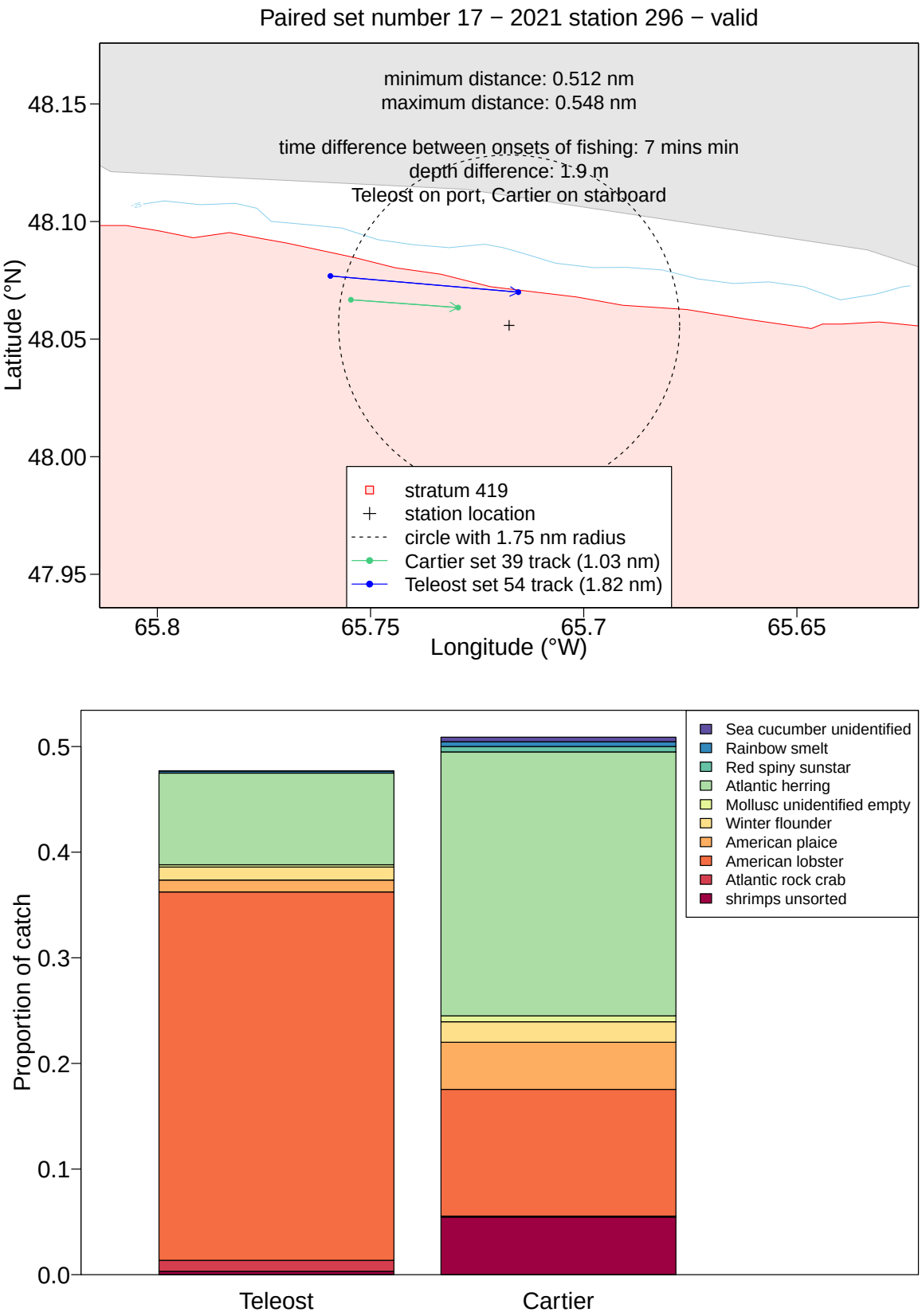

Figure 24. Tow tracks and major species composition for station 296 in 2021.

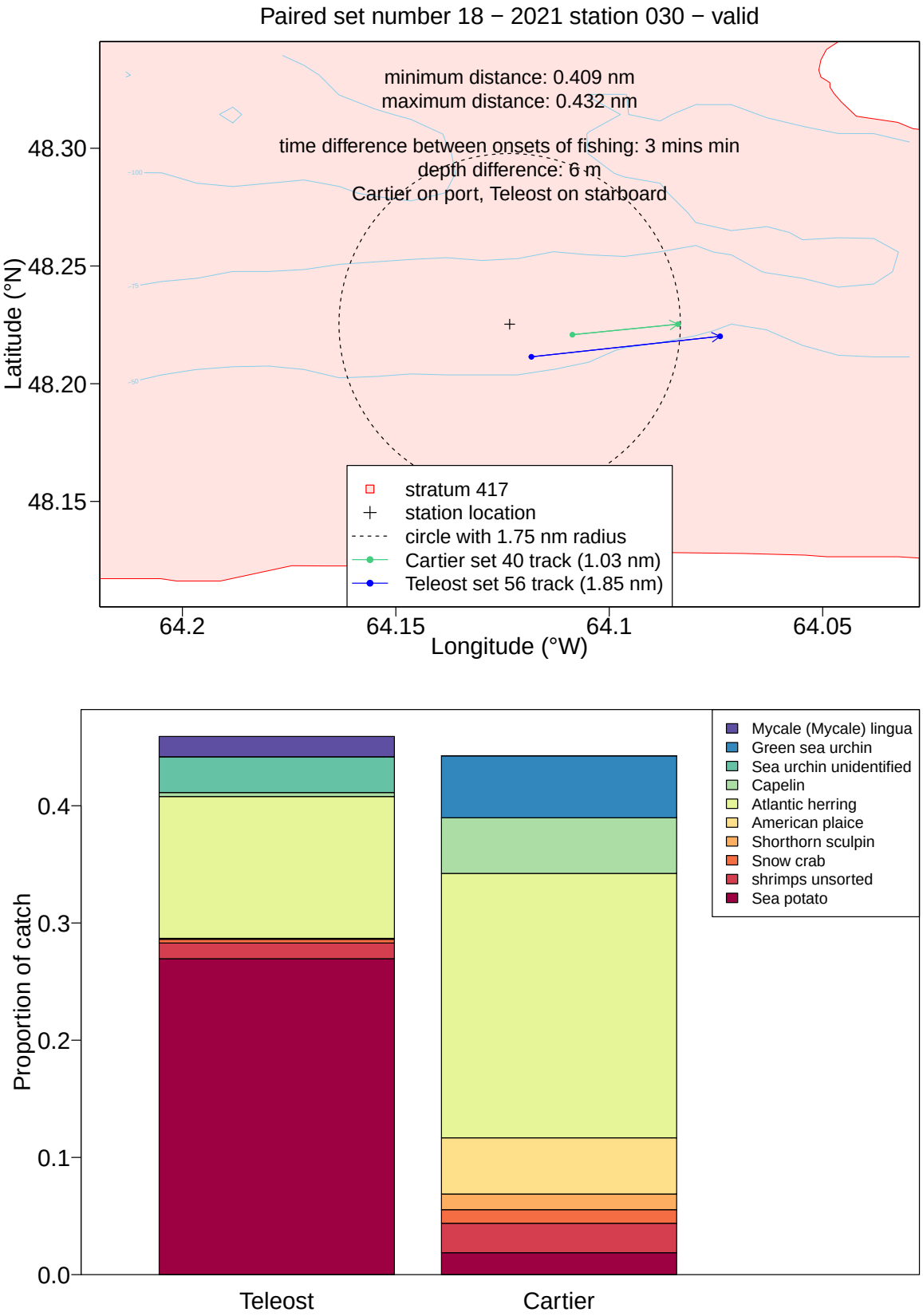

Figure 25. Tow tracks and major species composition for station 030 in 2021.

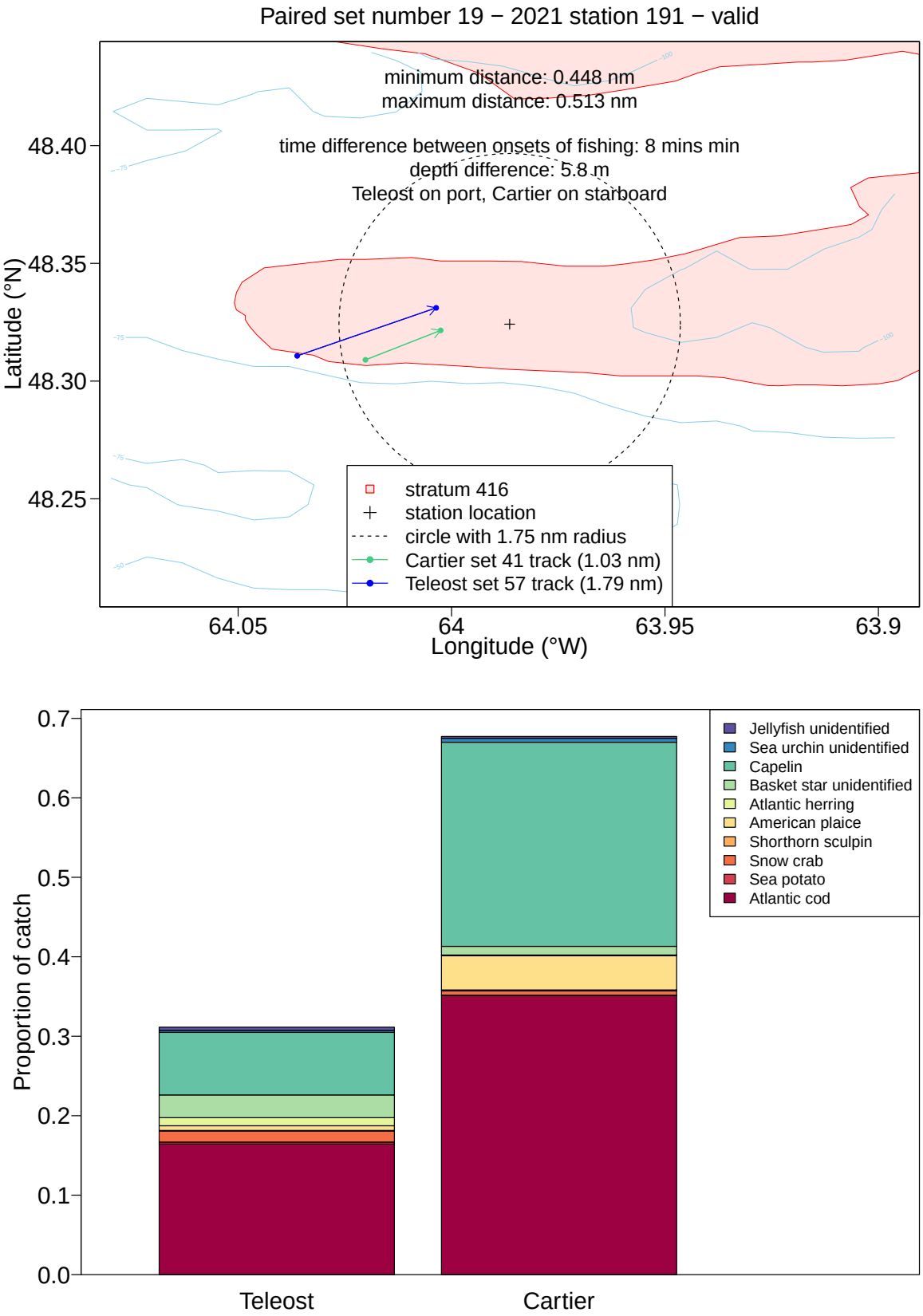

Figure 26. Tow tracks and major species composition for station 191 in 2021.

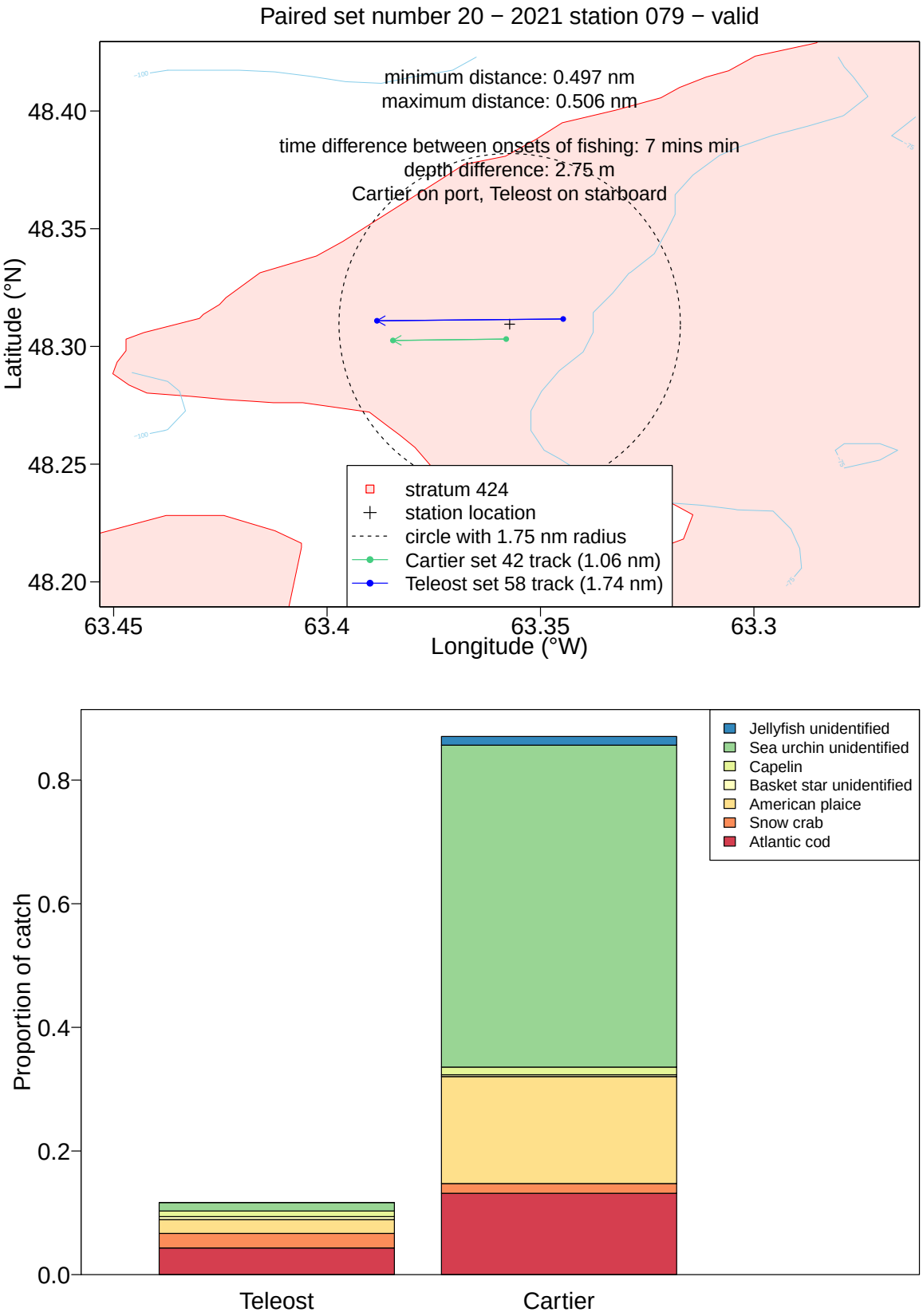

Figure 27. Tow tracks and major species composition for station 079 in 2021.

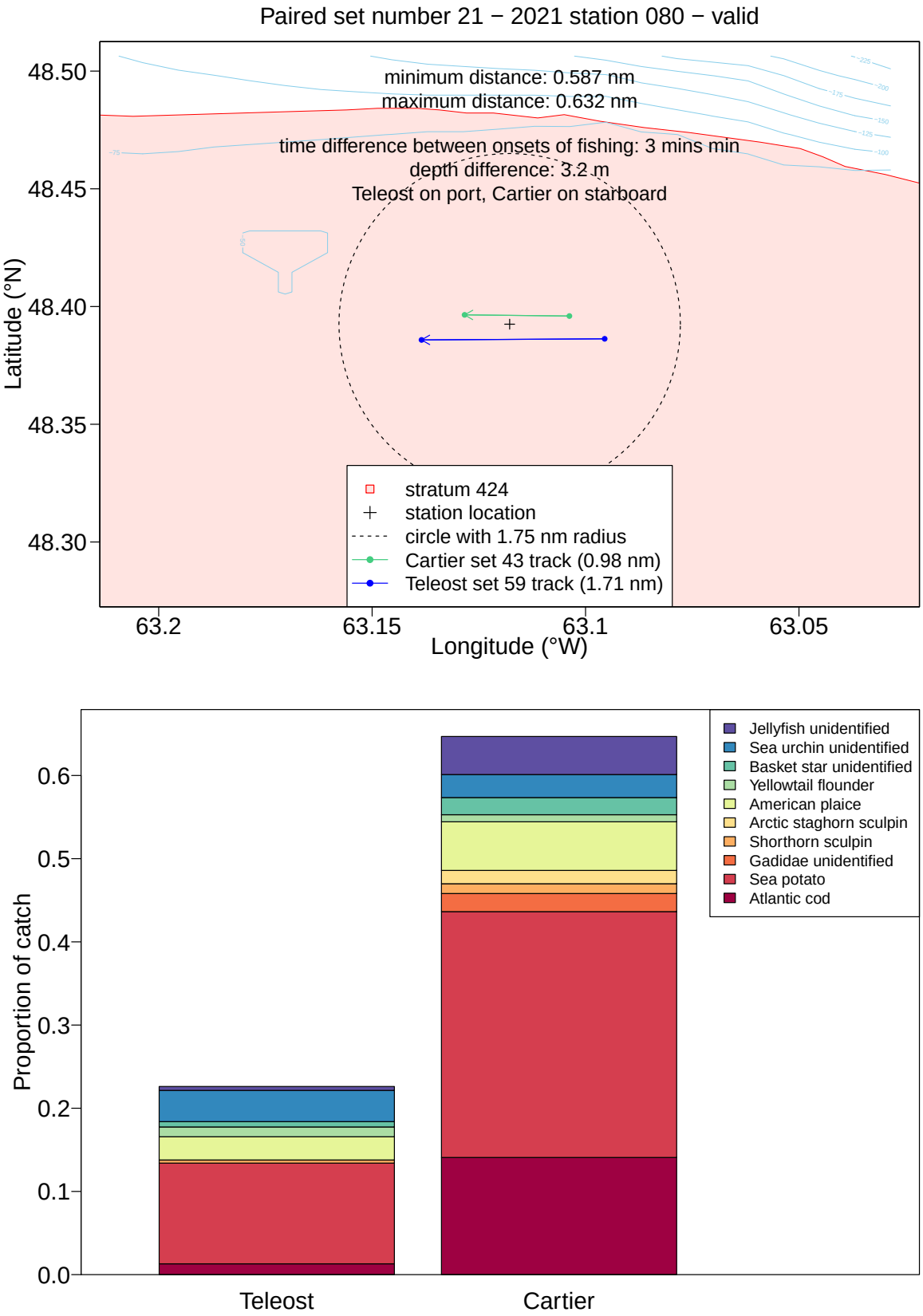

Figure 28. Tow tracks and major species composition for station 080 in 2021.

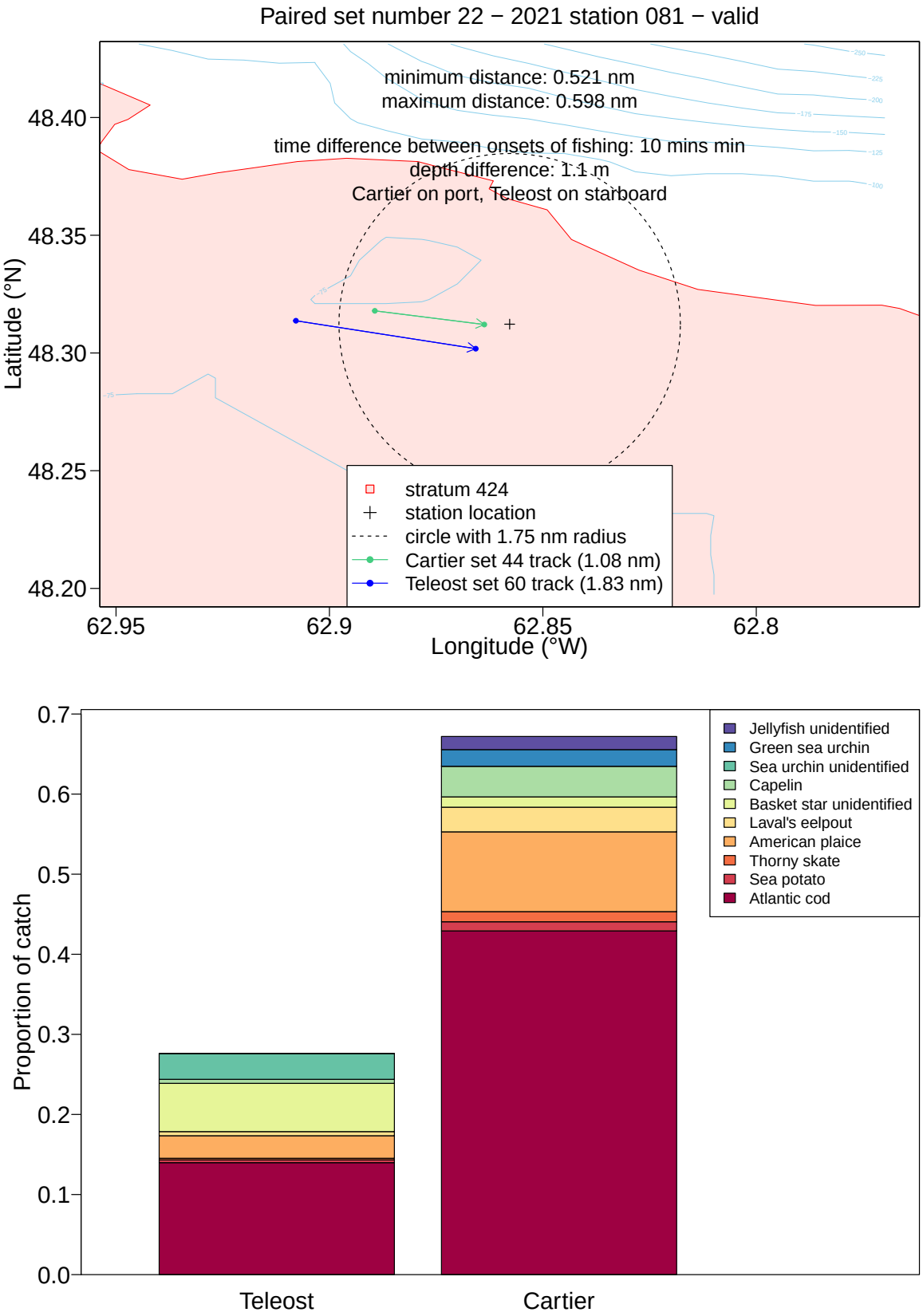

Figure 29. Tow tracks and major species composition for station 081 in 2021.

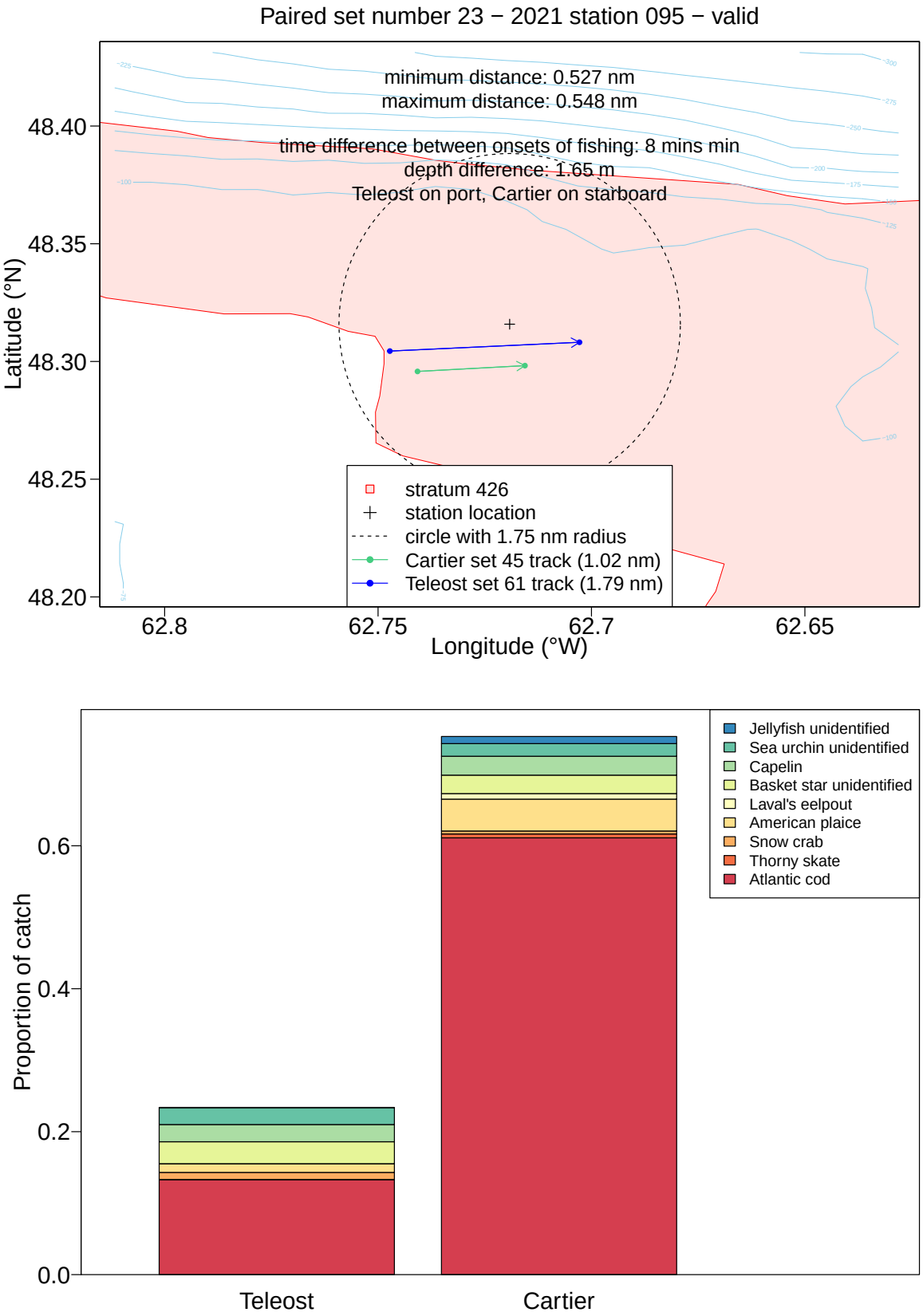

Figure 30. Tow tracks and major species composition for station 095 in 2021.

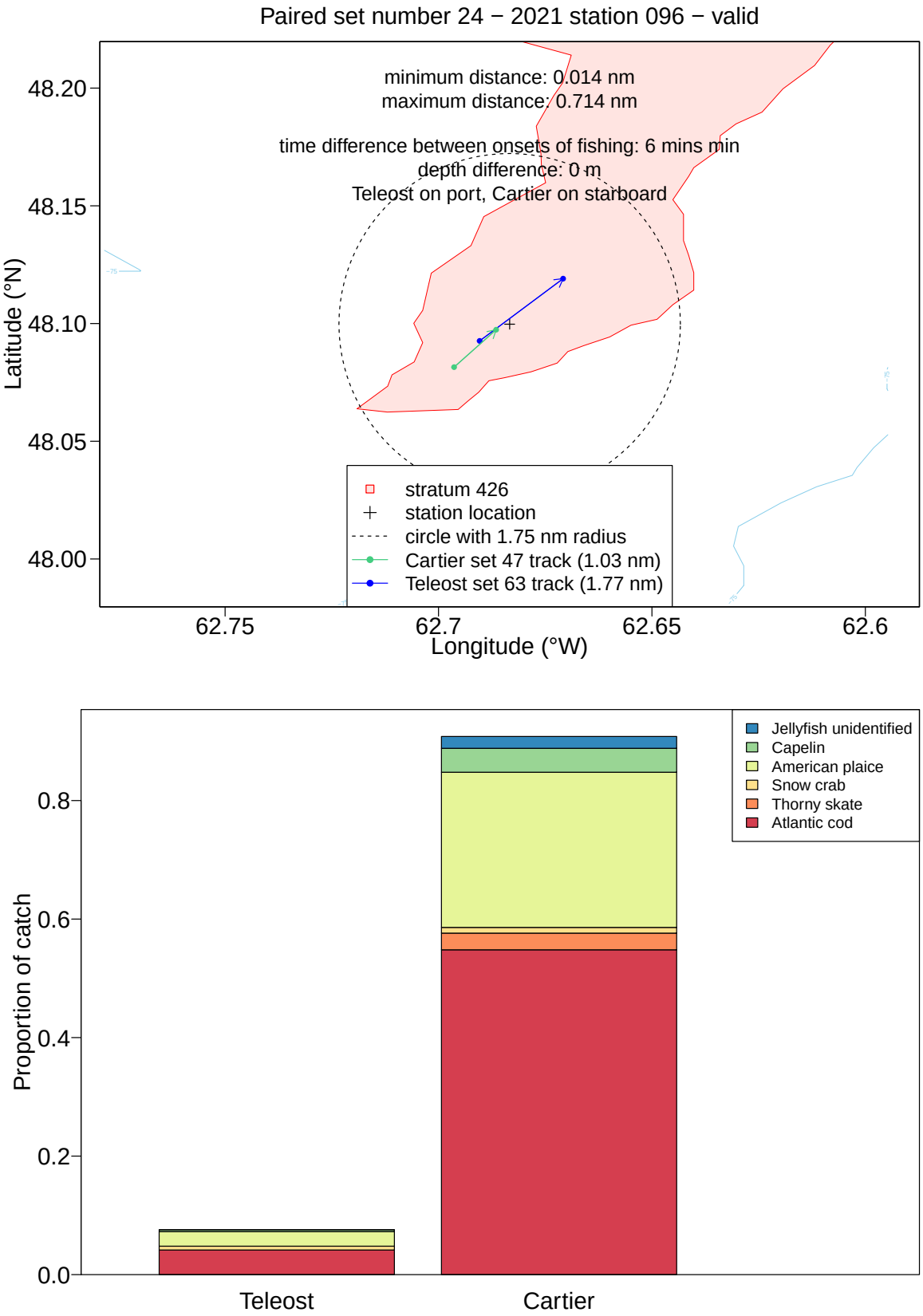

Figure 31. Tow tracks and major species composition for station 096 in 2021.

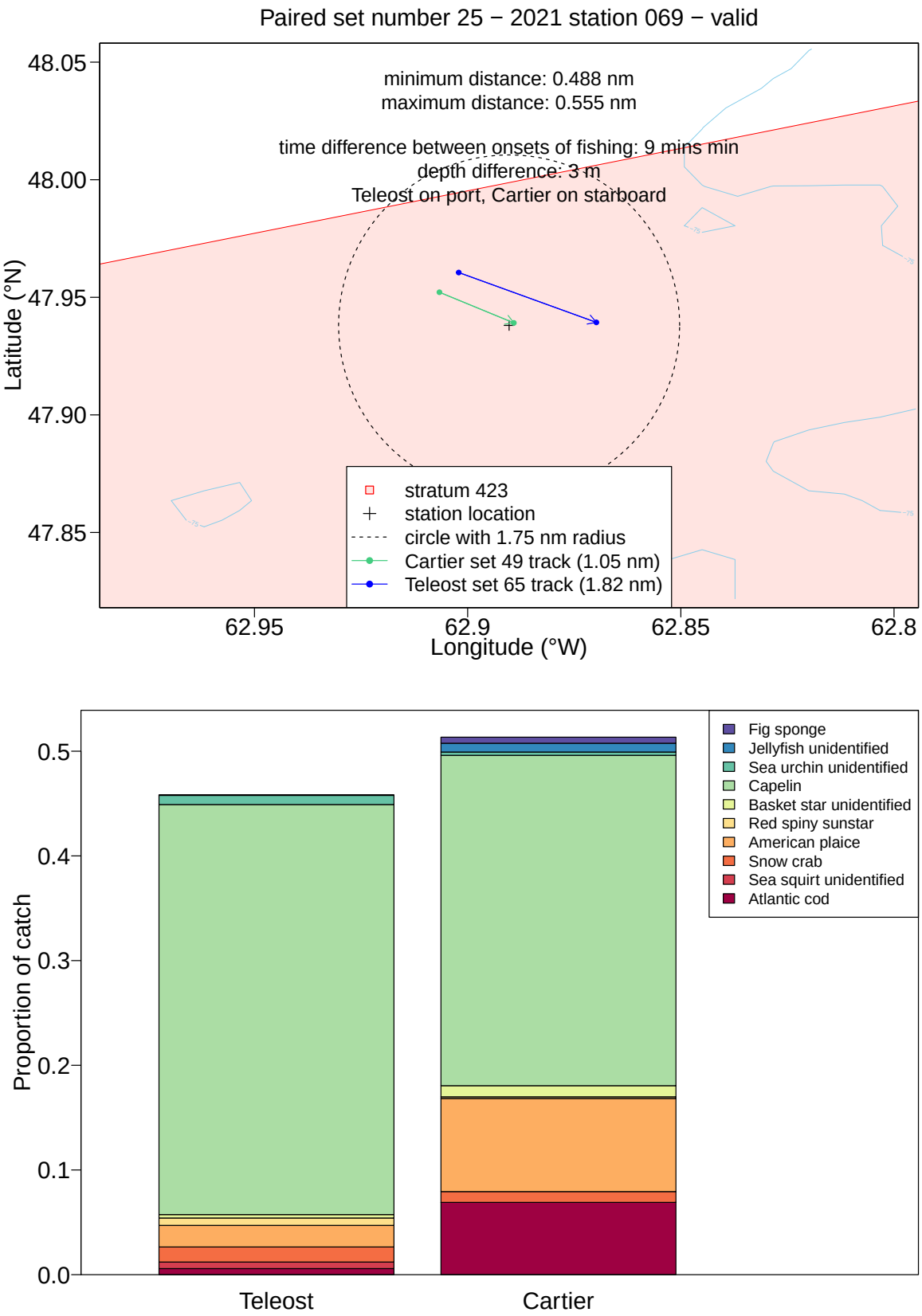

Figure 32. Tow tracks and major species composition for station 069 in 2021.

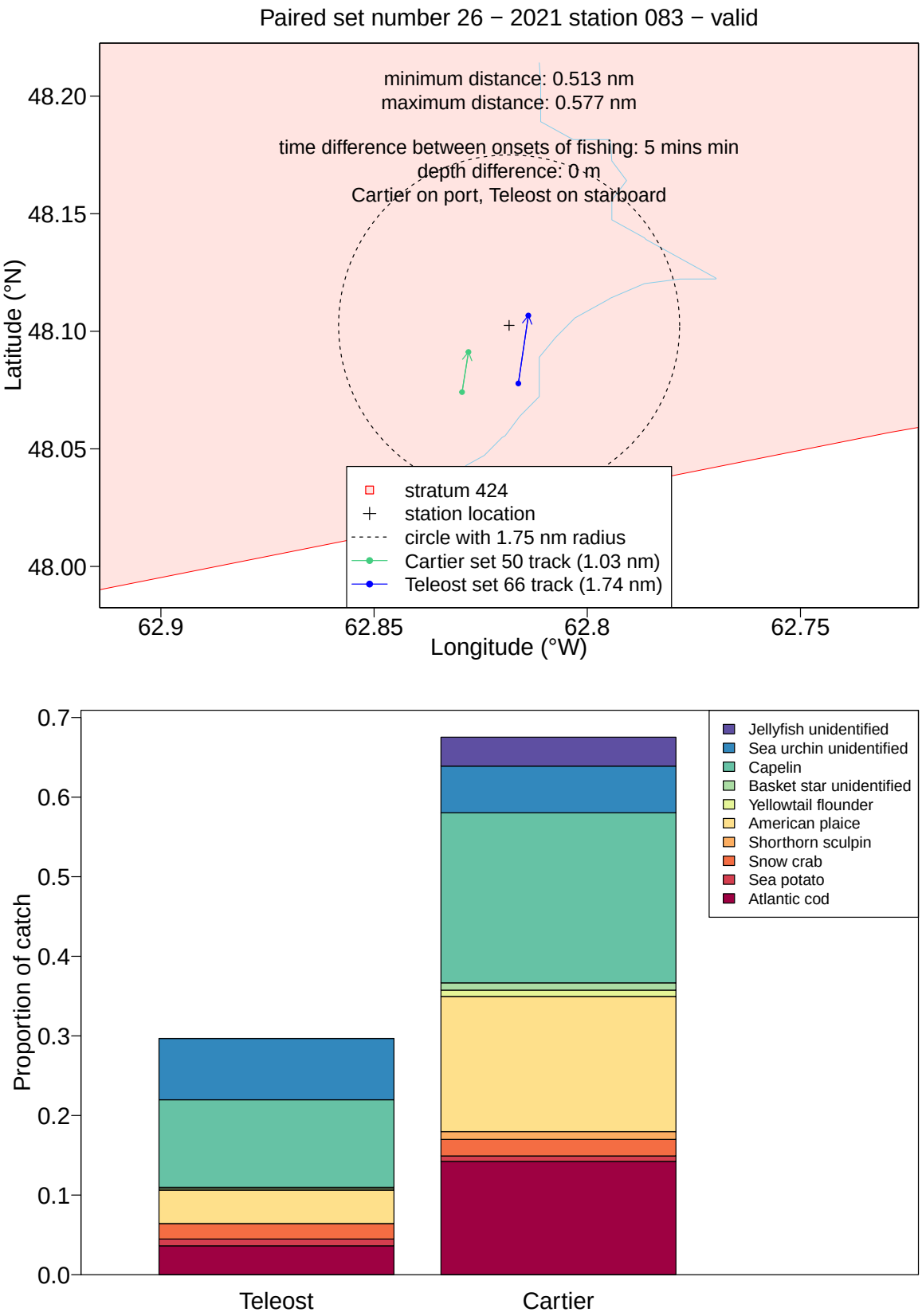

Figure 33. Tow tracks and major species composition for station 083 in 2021.

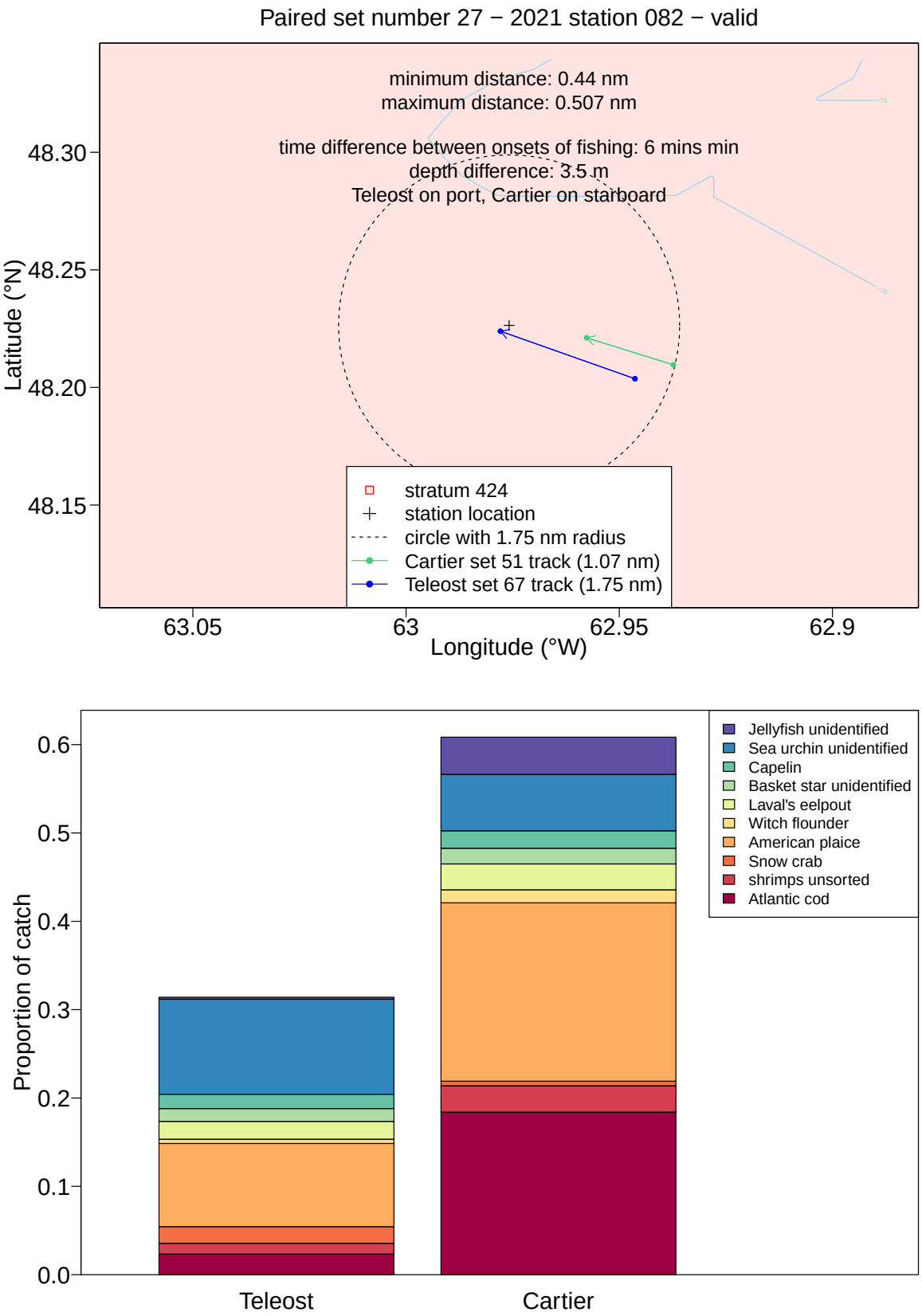

Figure 34. Tow tracks and major species composition for station 082 in 2021.

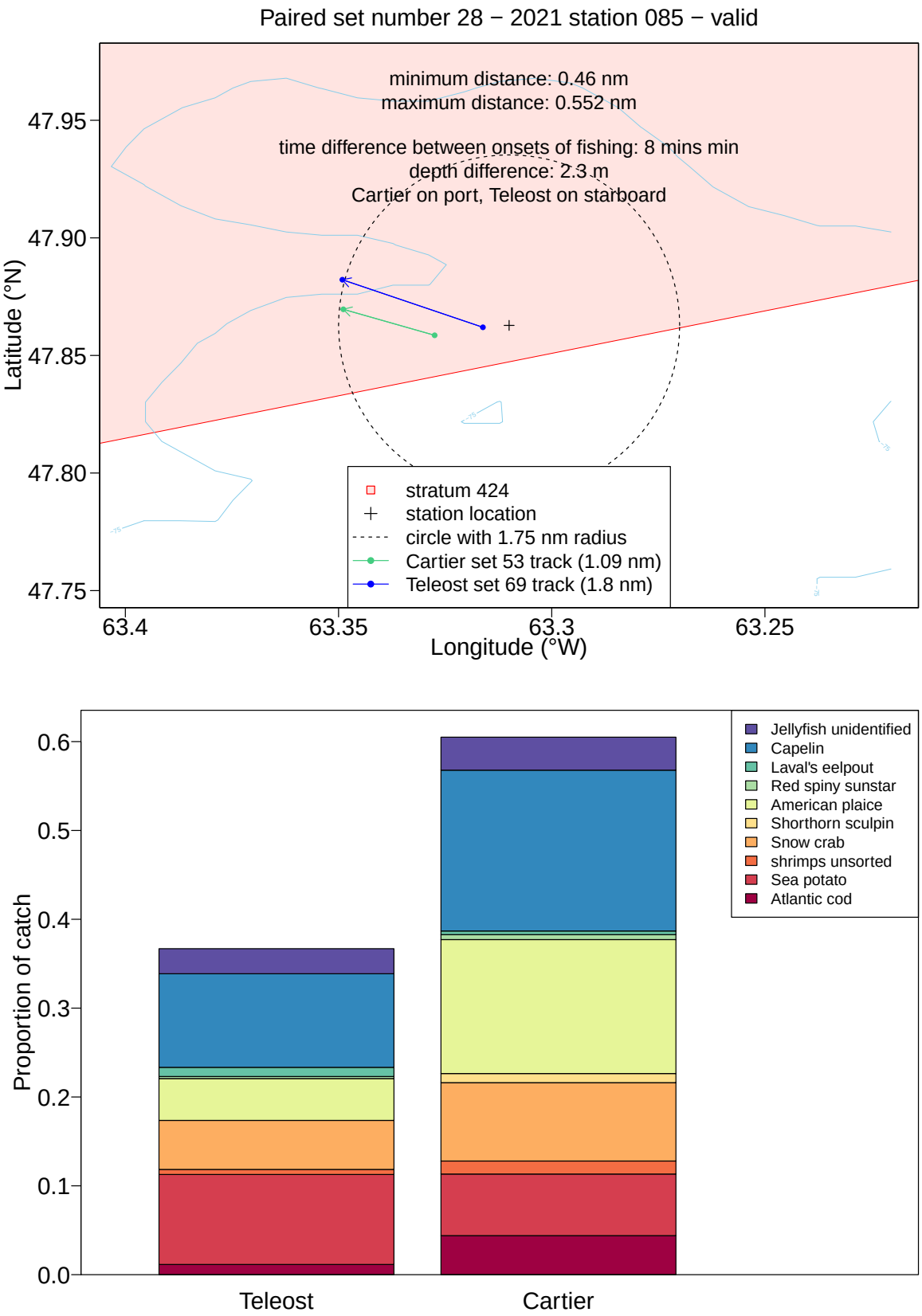

Figure 35. Tow tracks and major species composition for station 085 in 2021.

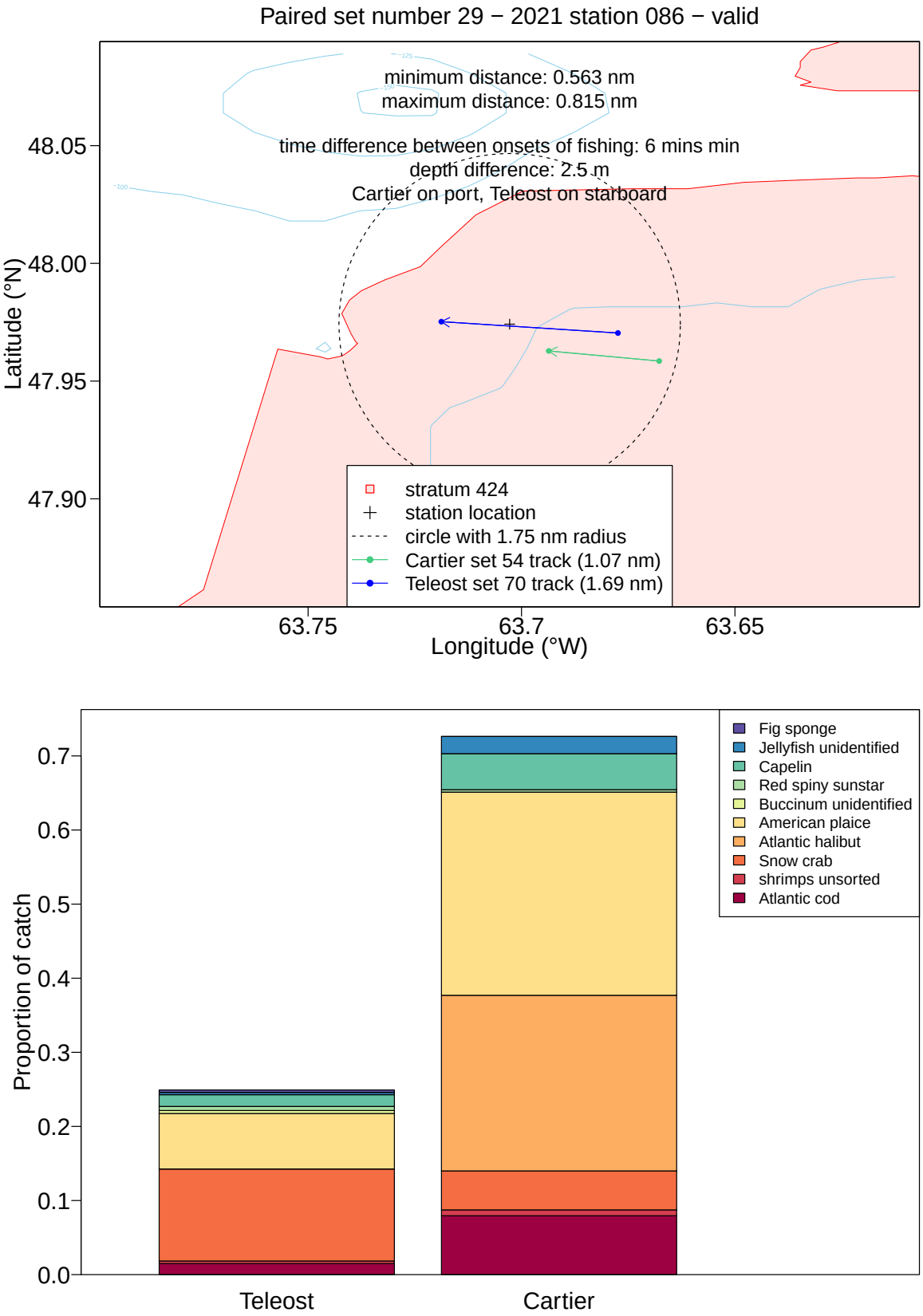

Figure 36. Tow tracks and major species composition for station 086 in 2021.

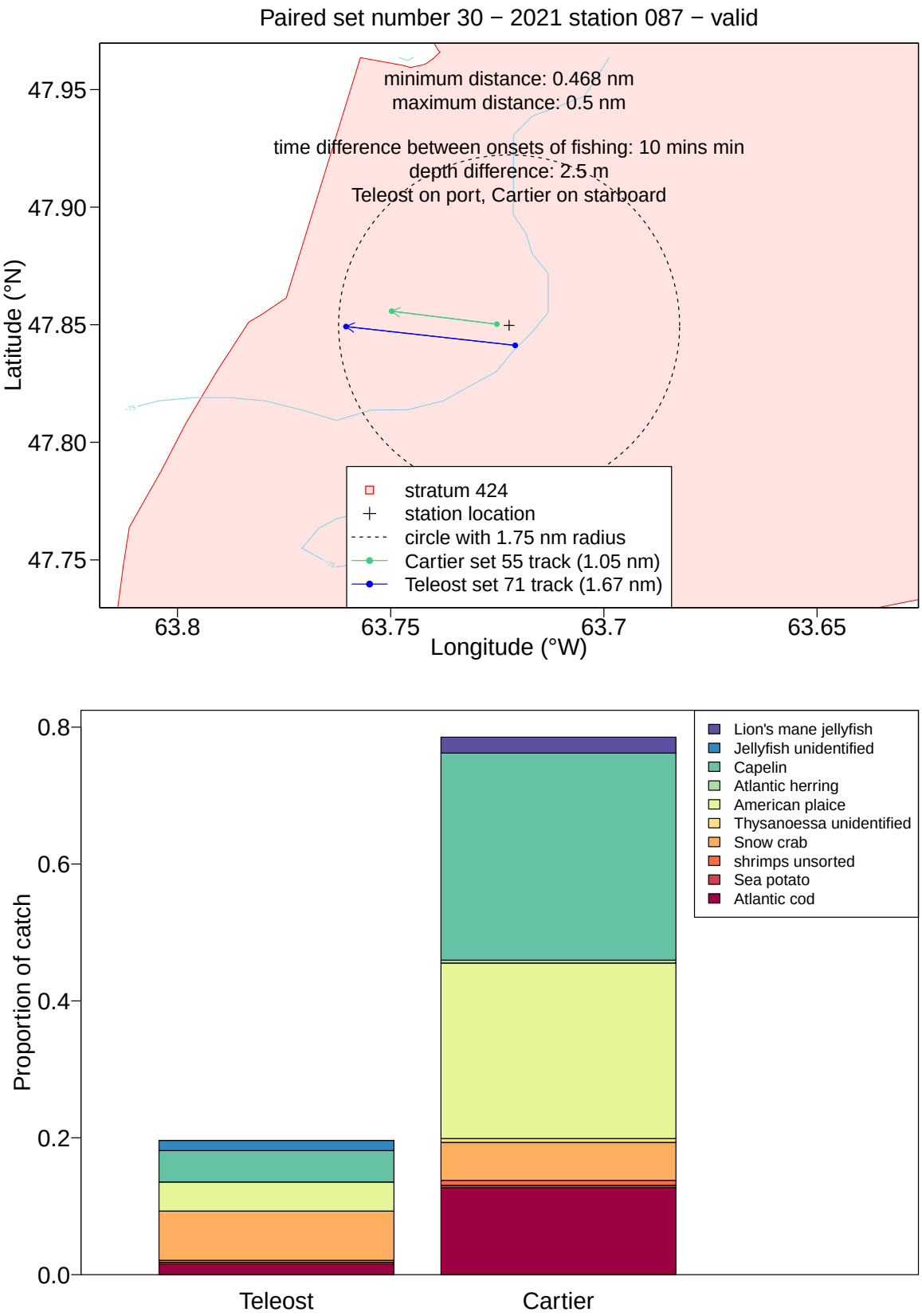

Figure 37. Tow tracks and major species composition for station 087 in 2021.

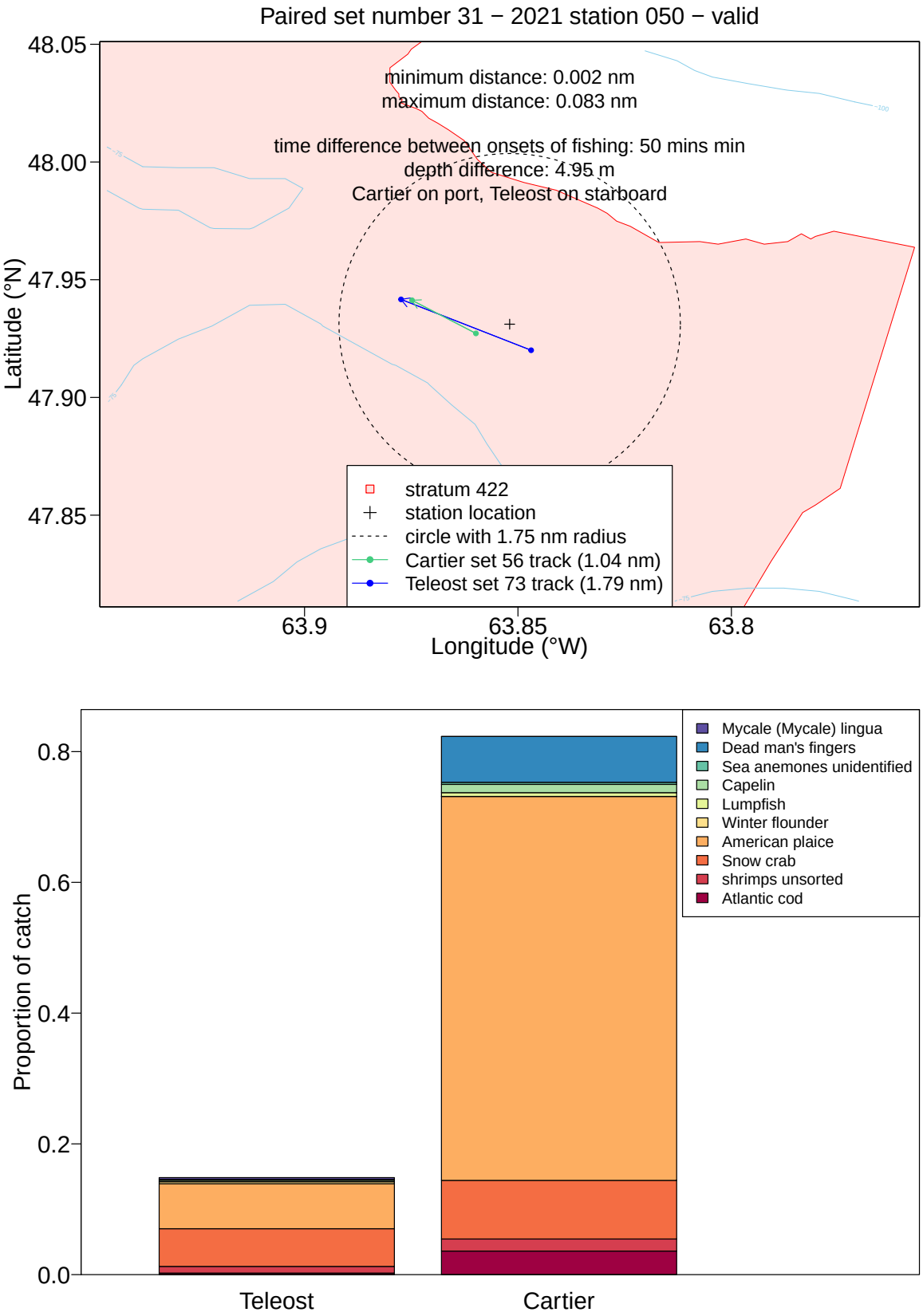

Figure 38. Tow tracks and major species composition for station 050 in 2021.

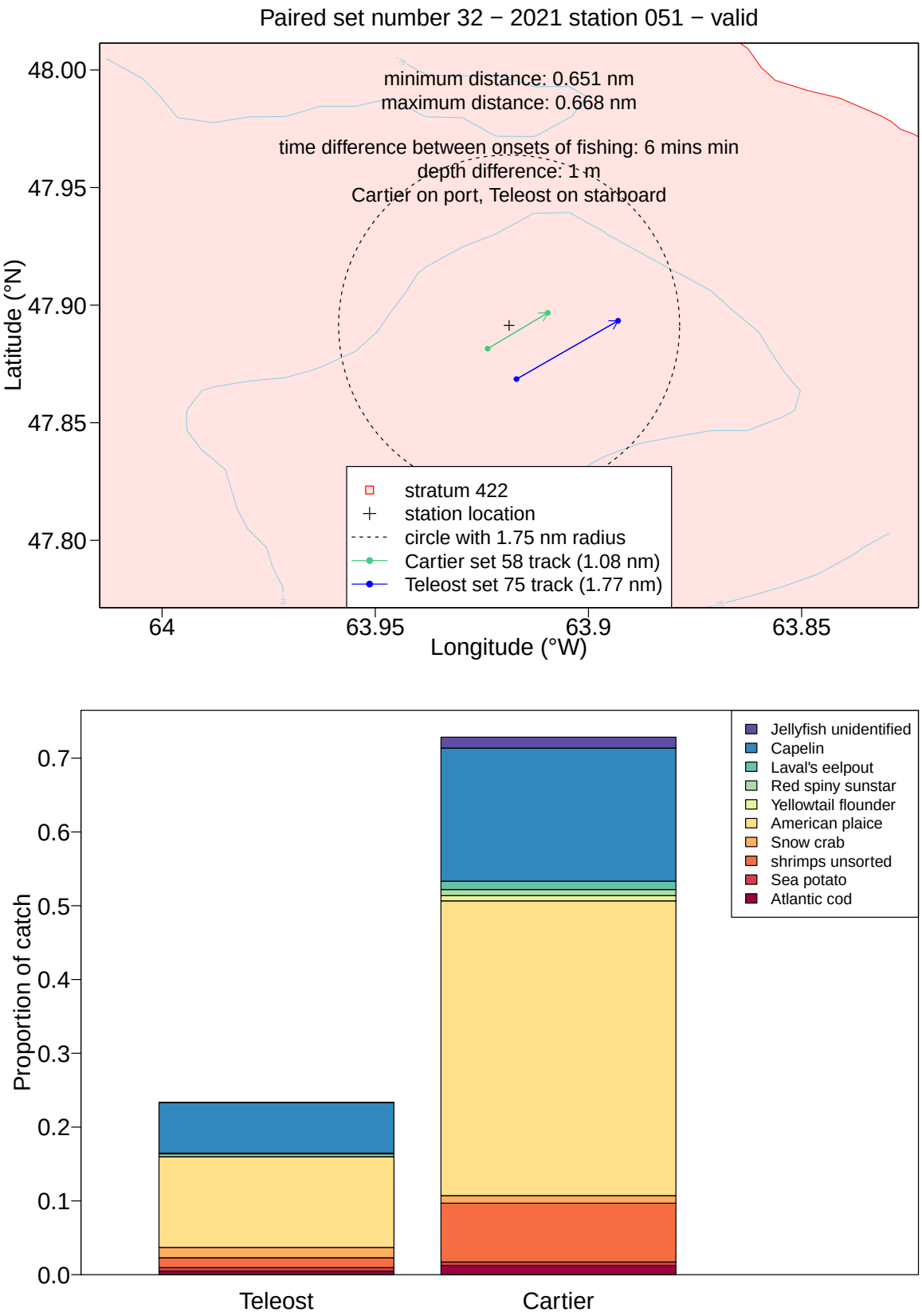

Figure 39. Tow tracks and major species composition for station 051 in 2021.

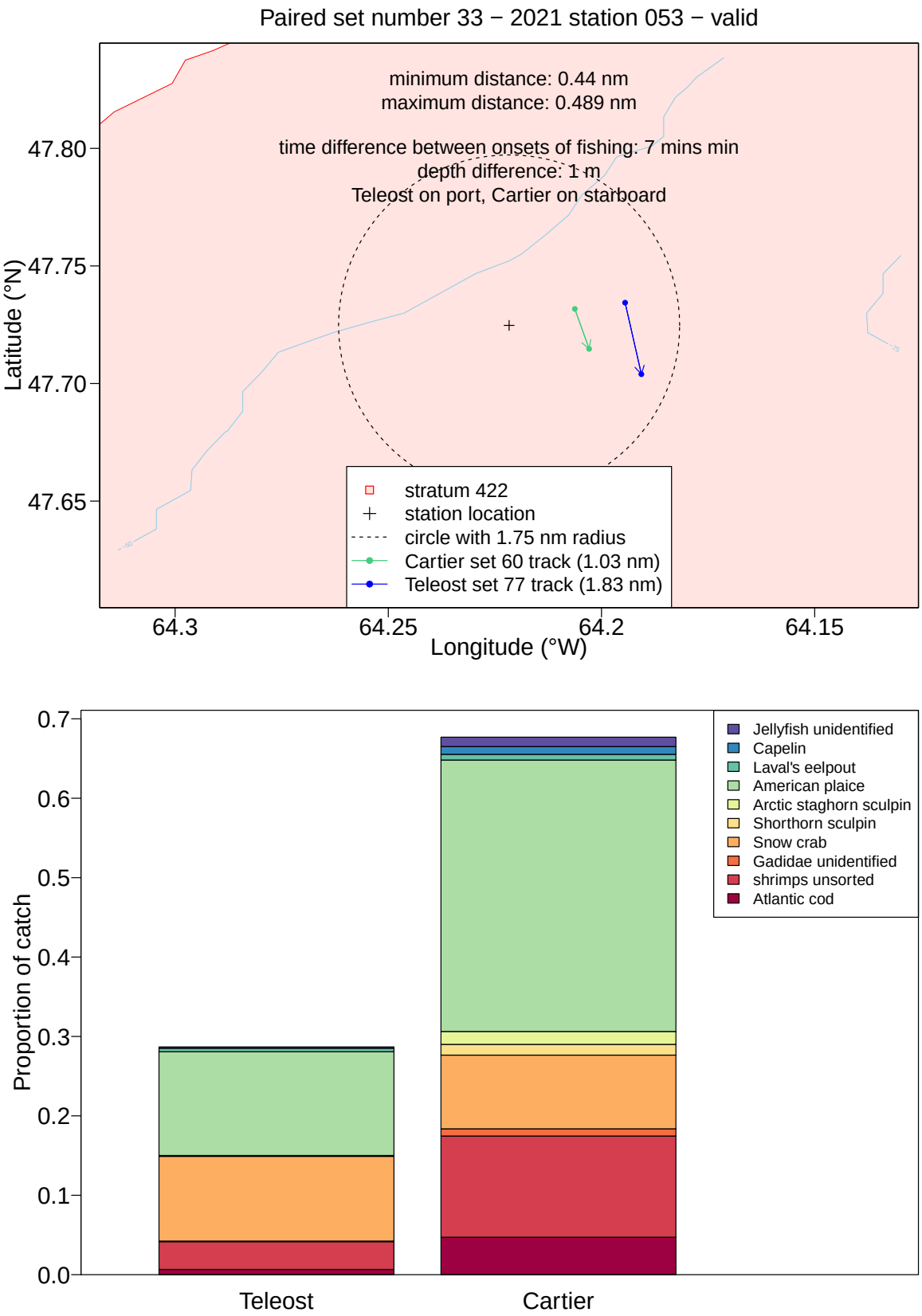

Figure 40. Tow tracks and major species composition for station 053 in 2021.

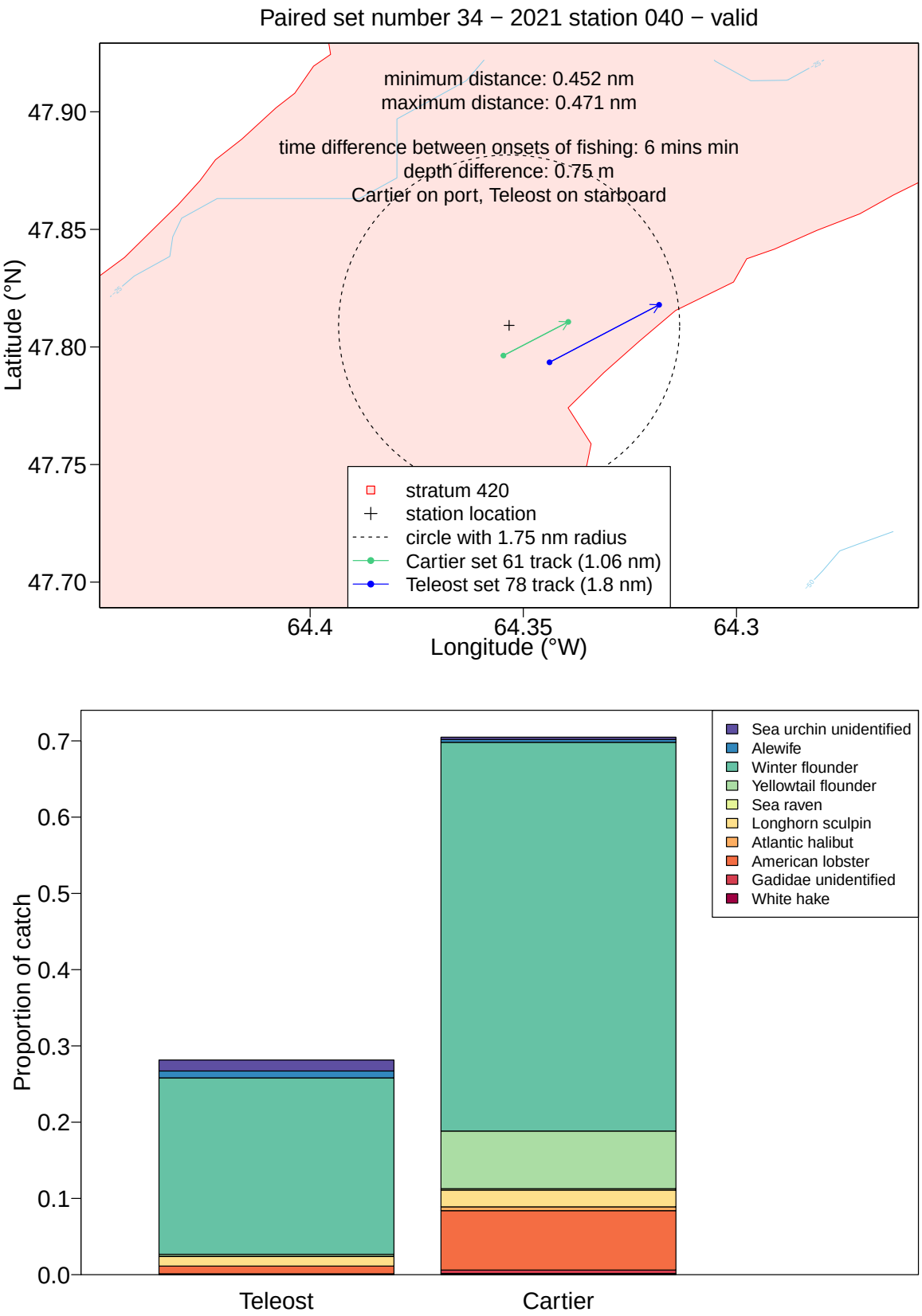

Figure 41. Tow tracks and major species composition for station 040 in 2021.

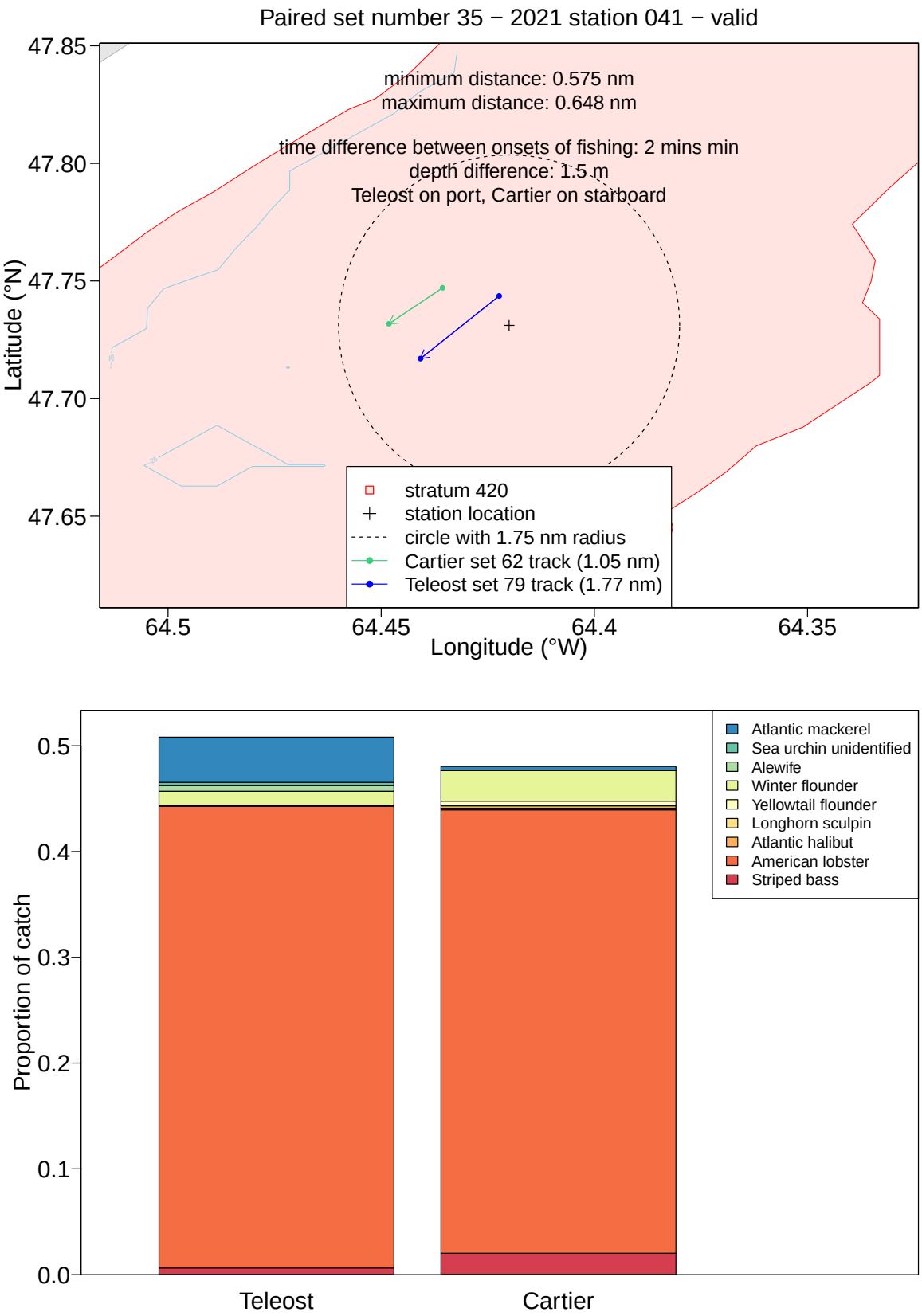

Figure 42. Tow tracks and major species composition for station 041 in 2021.

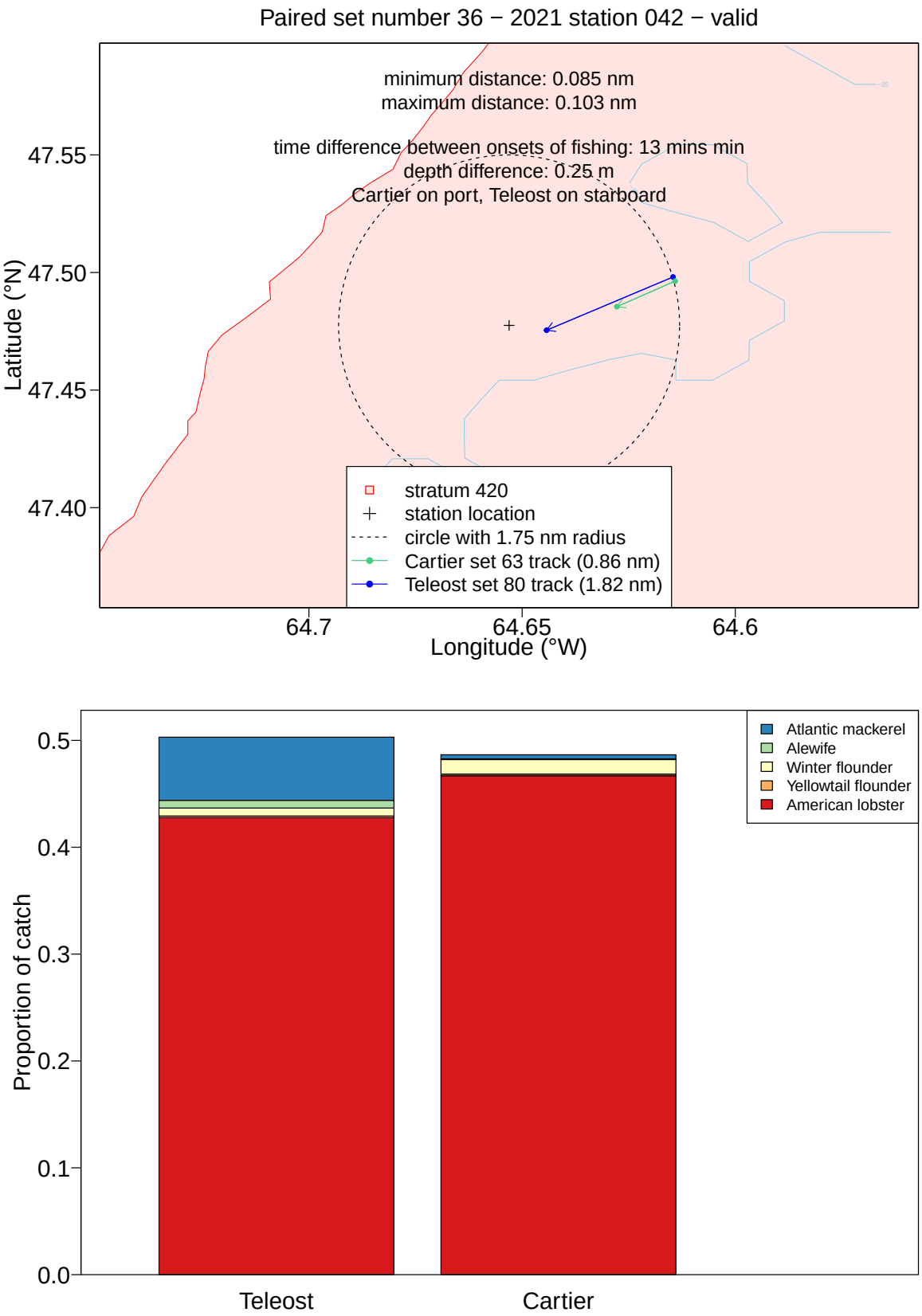

Figure 43. Tow tracks and major species composition for station 042 in 2021.

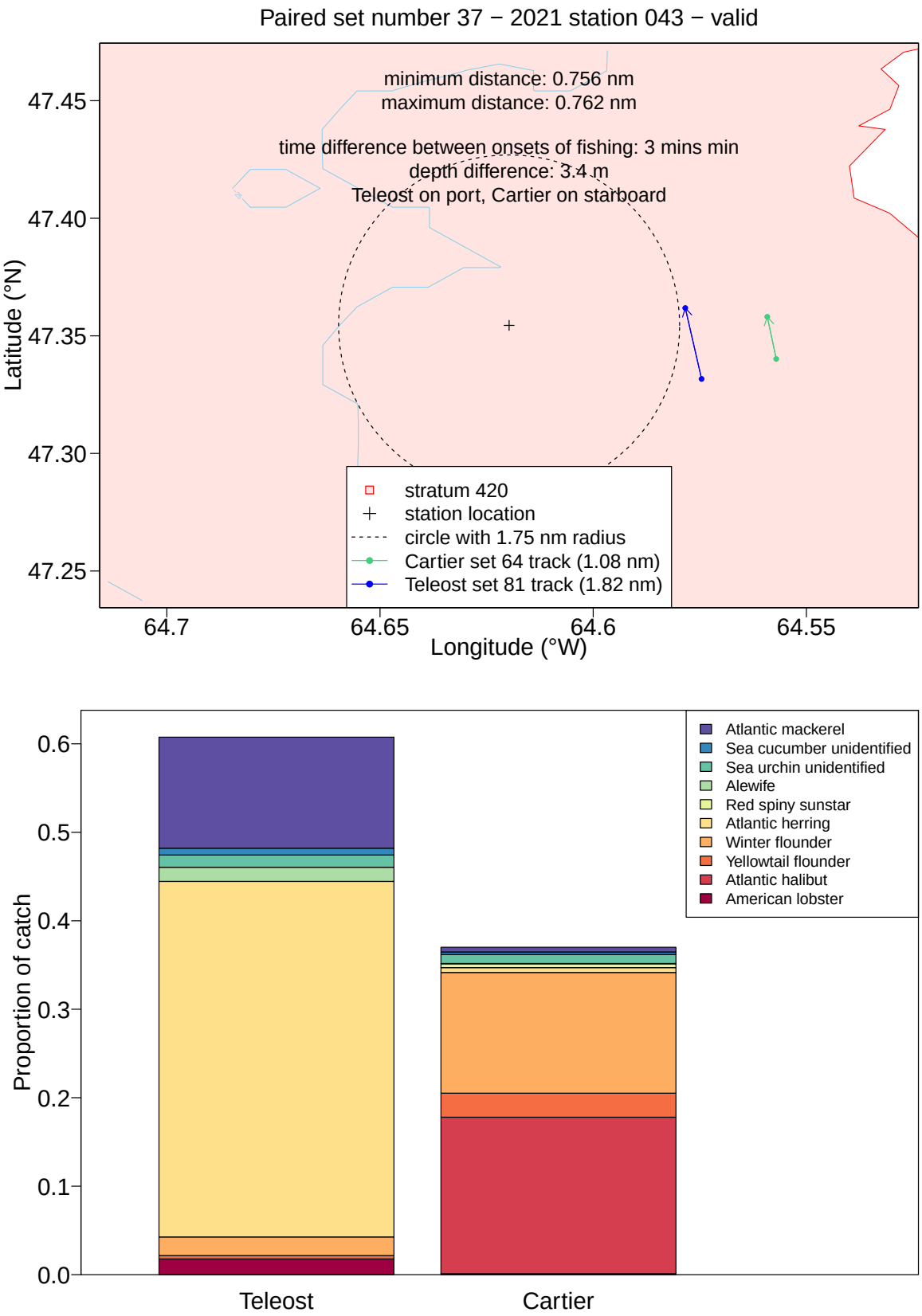

Figure 44. Tow tracks and major species composition for station 043 in 2021.

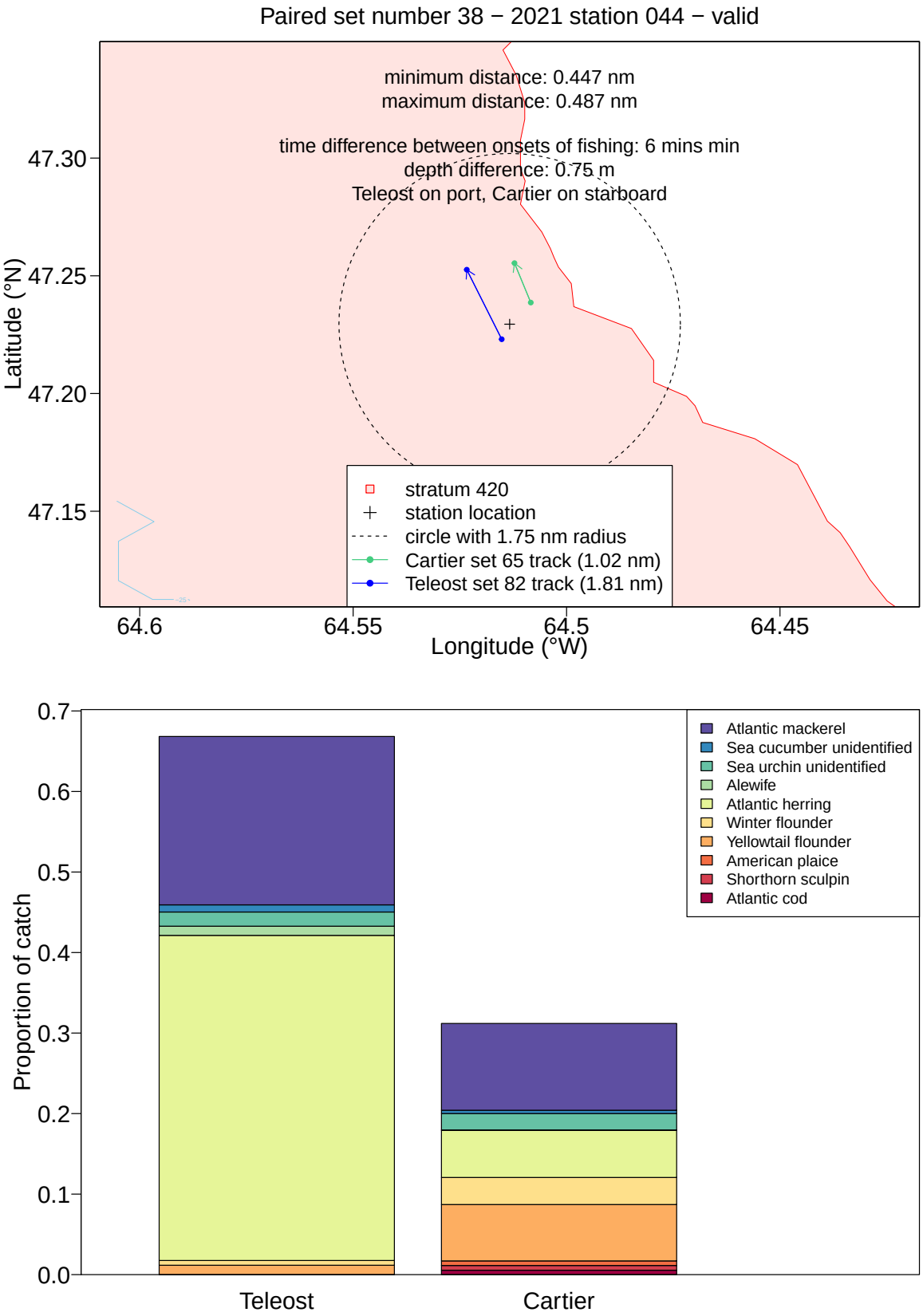

Figure 45. Tow tracks and major species composition for station 044 in 2021.

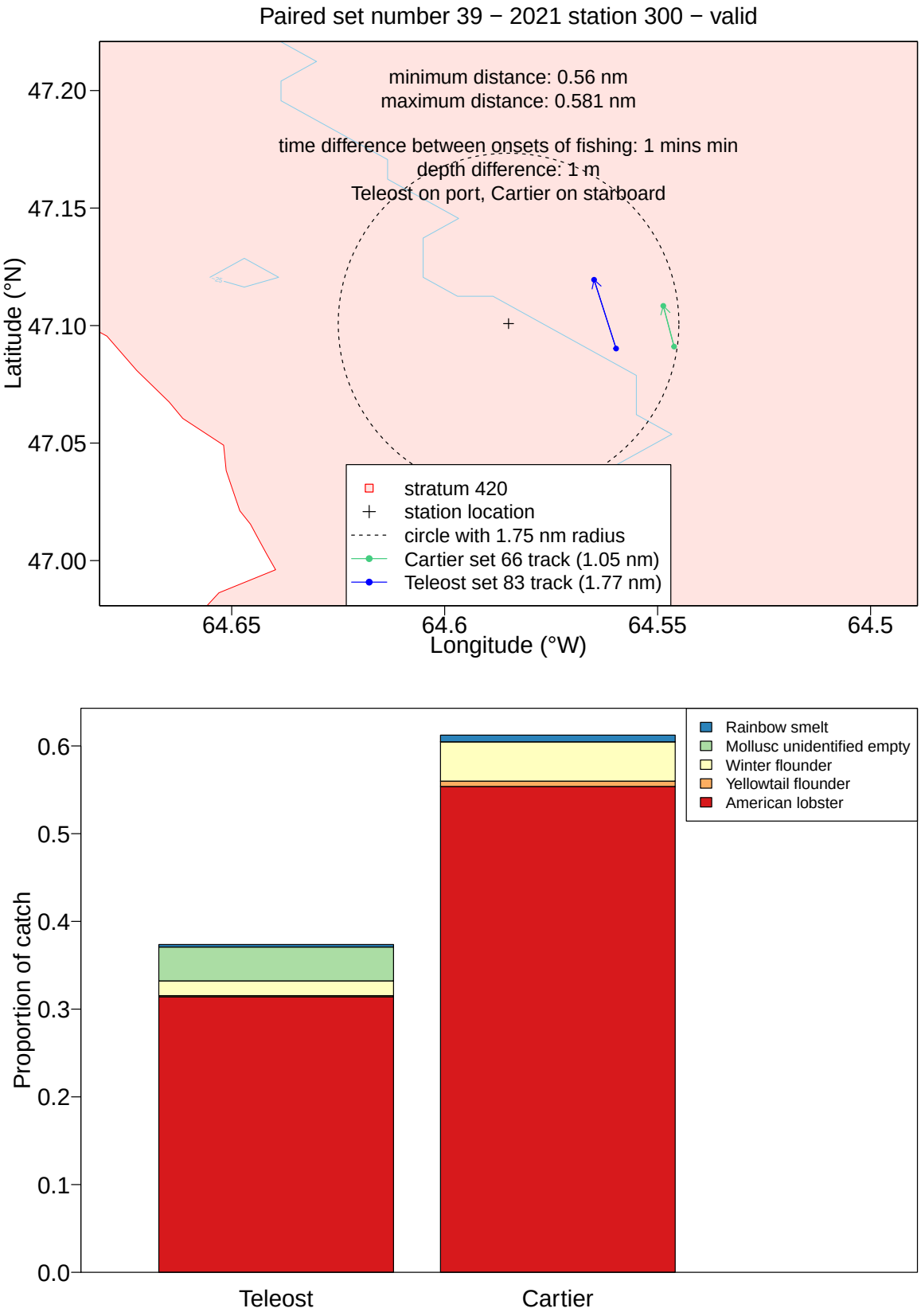

Figure 46. Tow tracks and major species composition for station 300 in 2021.

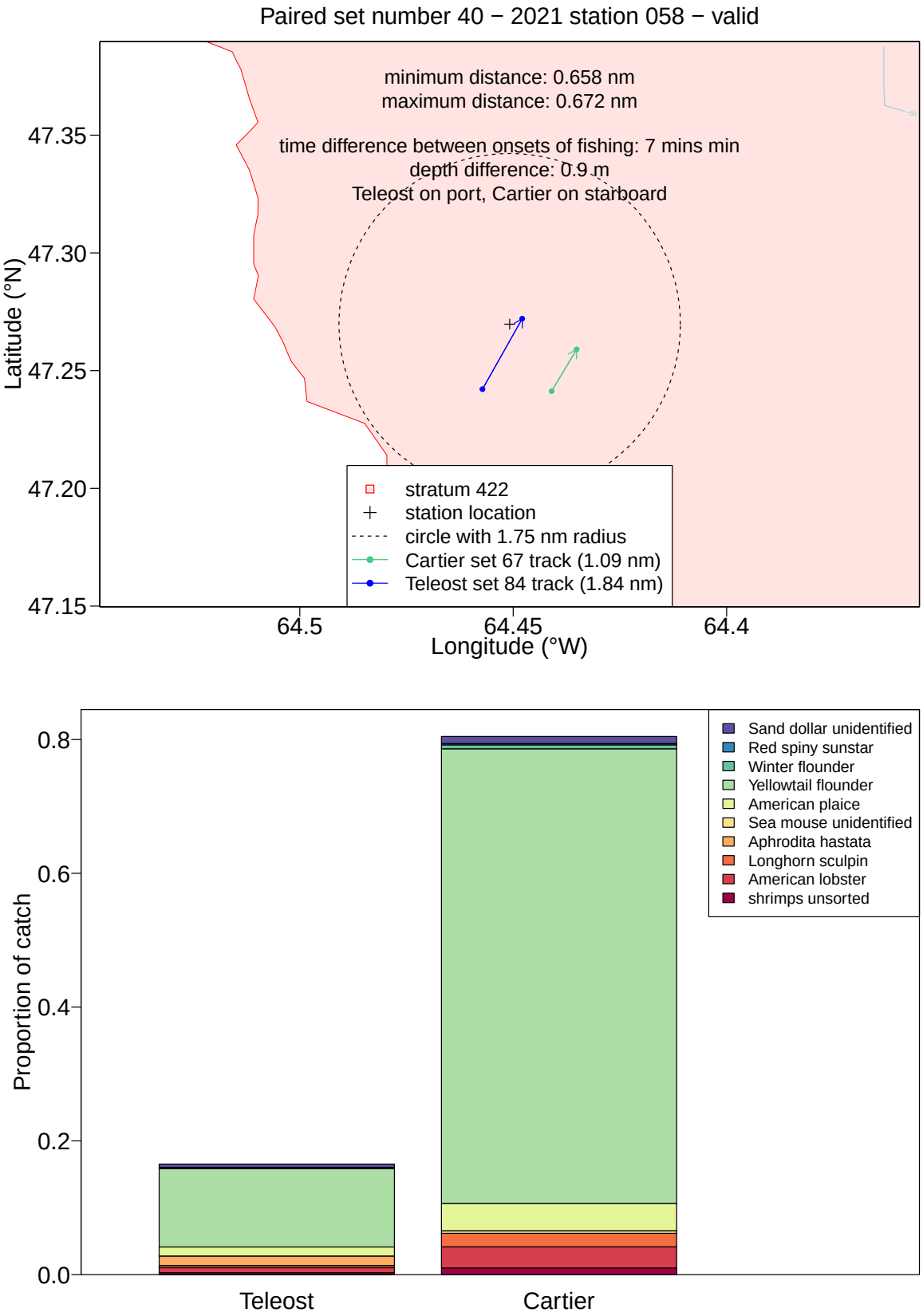

Figure 47. Tow tracks and major species composition for station 058 in 2021.

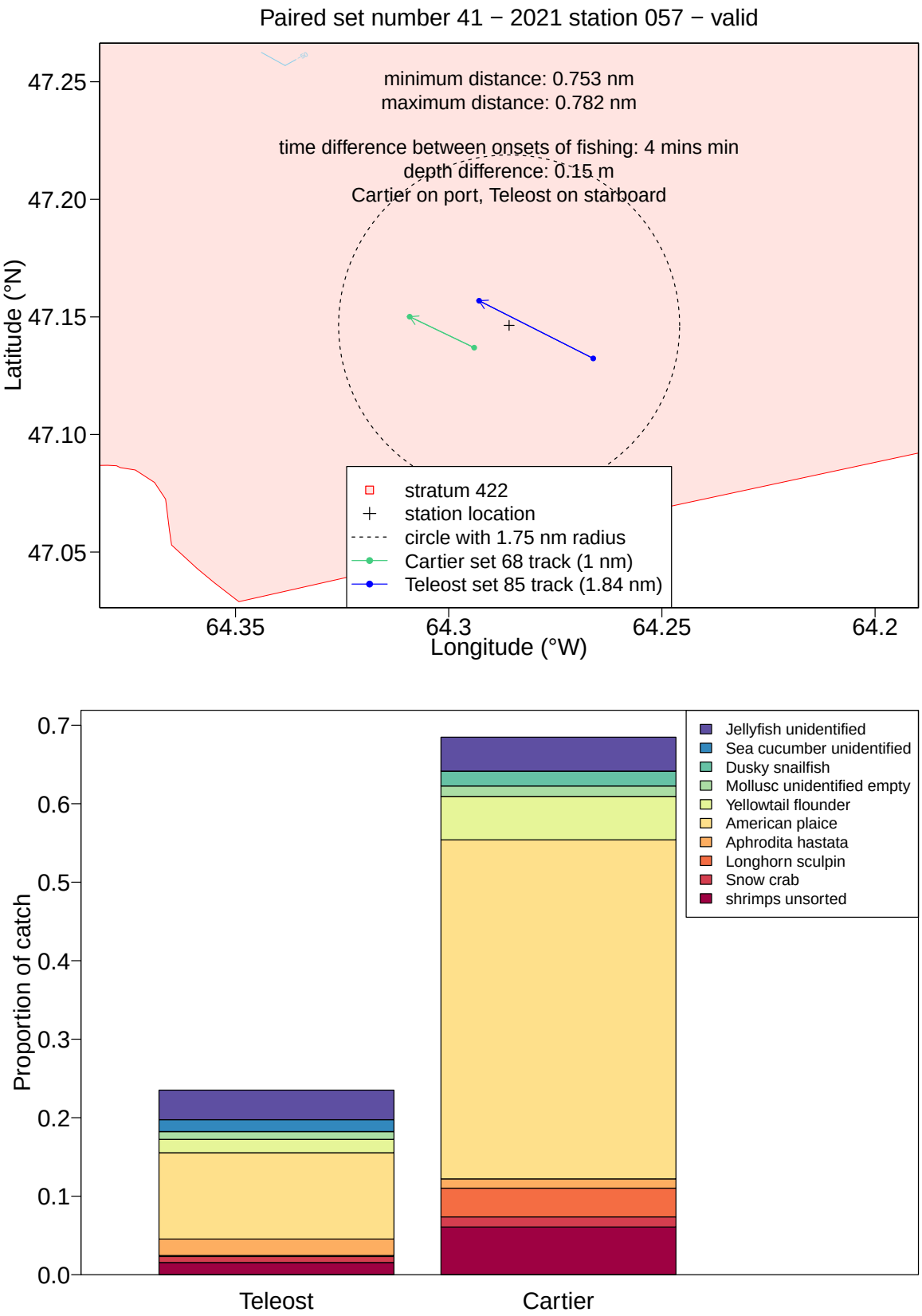

Figure 48. Tow tracks and major species composition for station 057 in 2021.

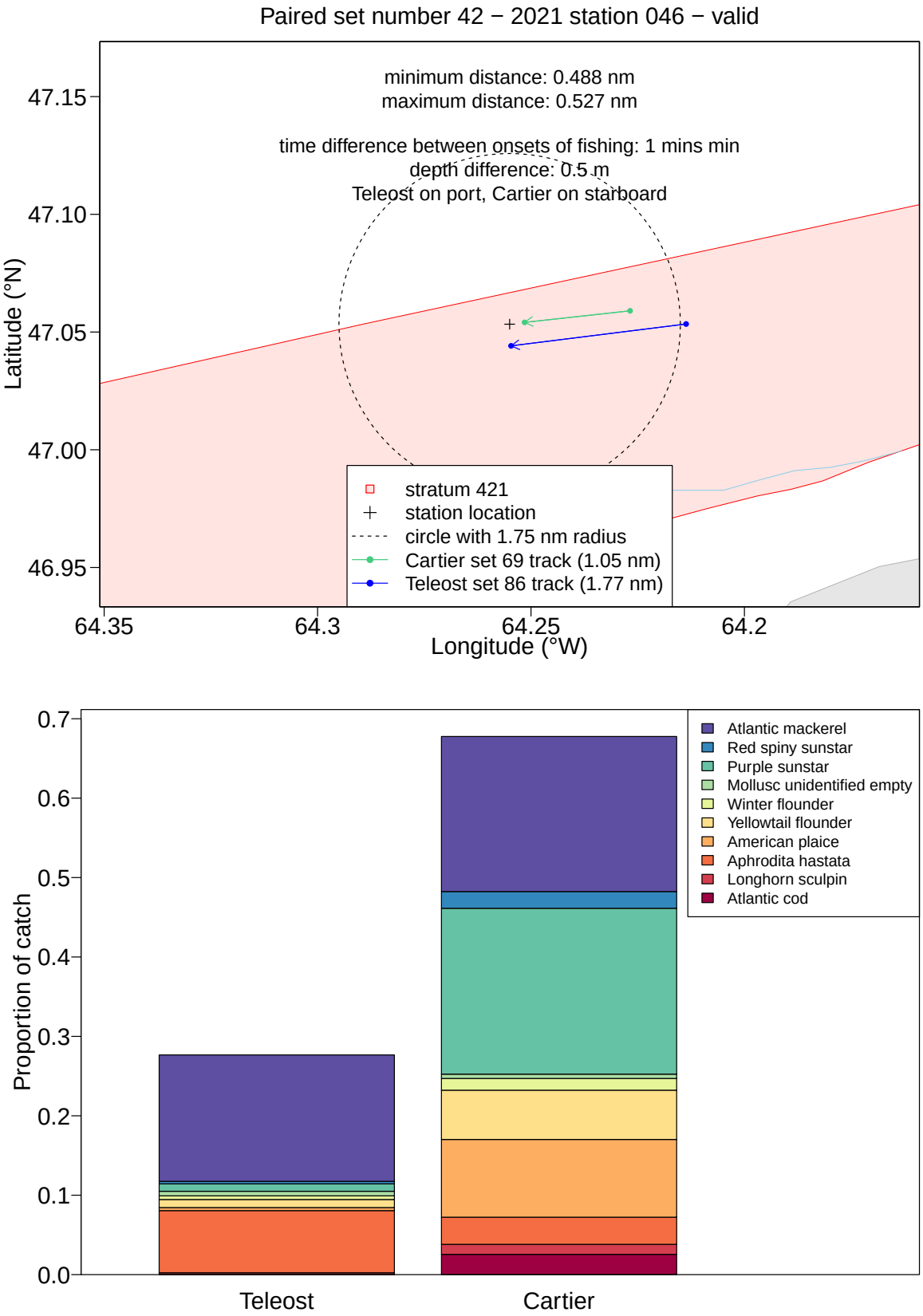

Figure 49. Tow tracks and major species composition for station 046 in 2021.

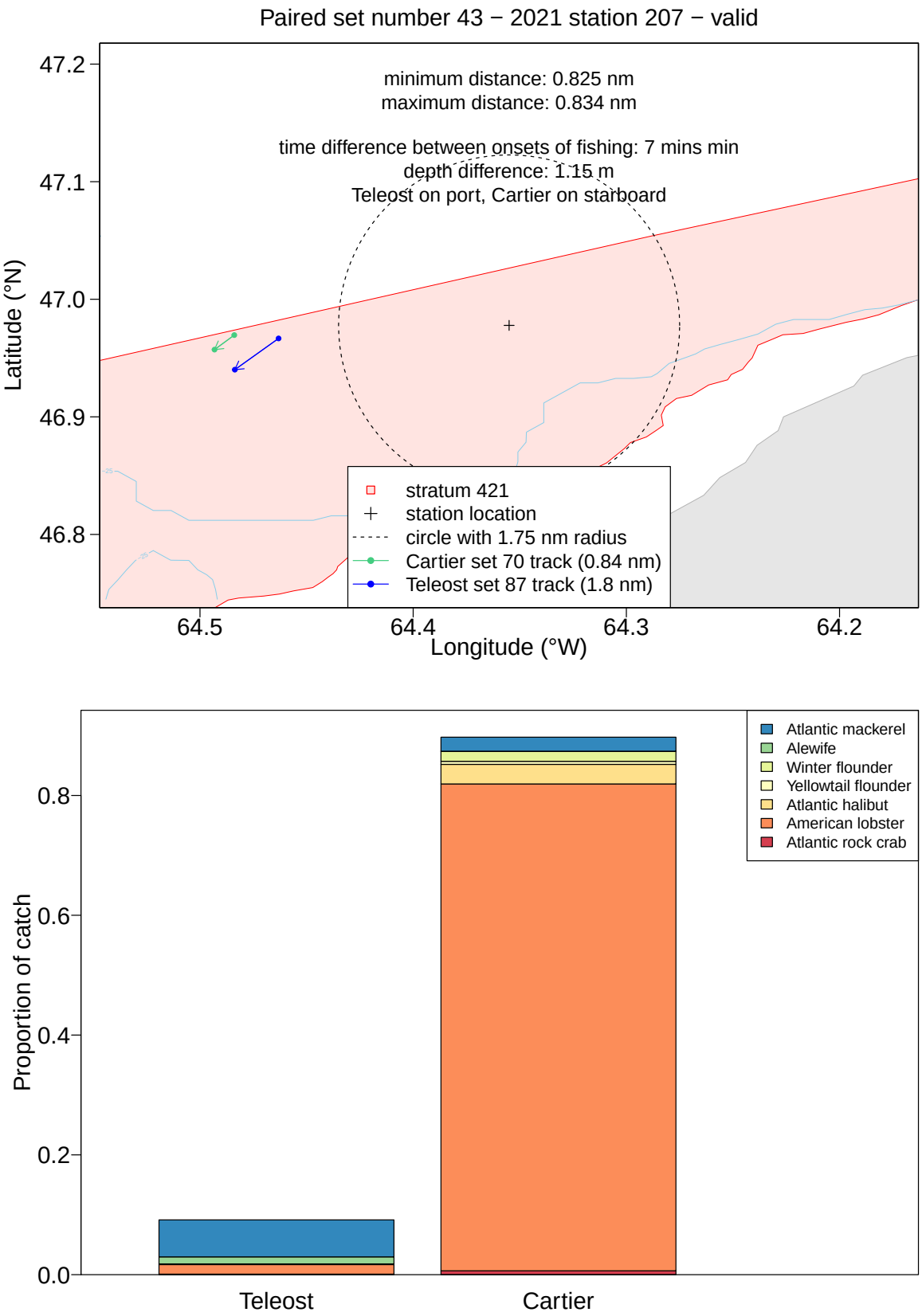

Figure 50. Tow tracks and major species composition for station 207 in 2021.

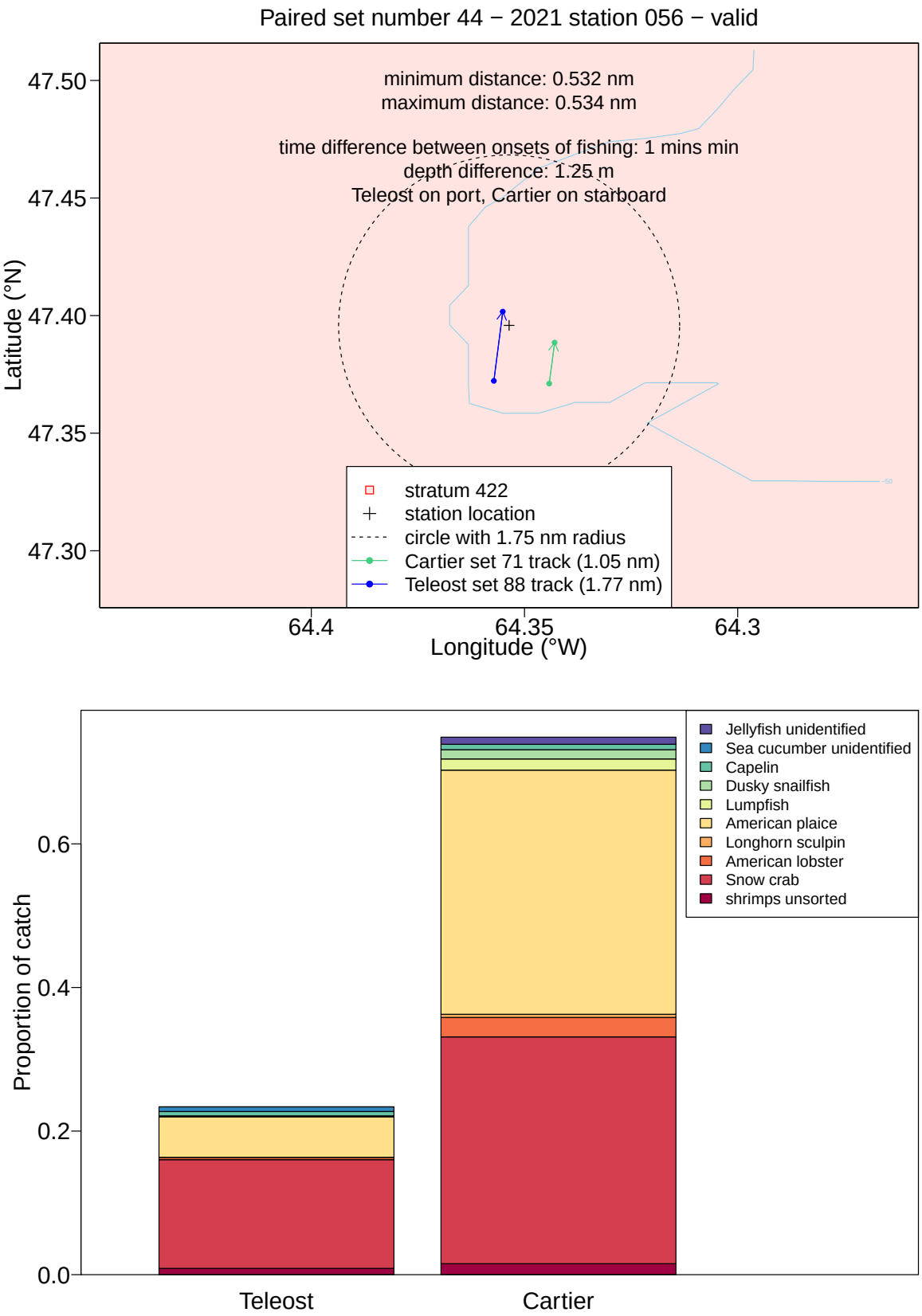

Figure 51. Tow tracks and major species composition for station 056 in 2021.

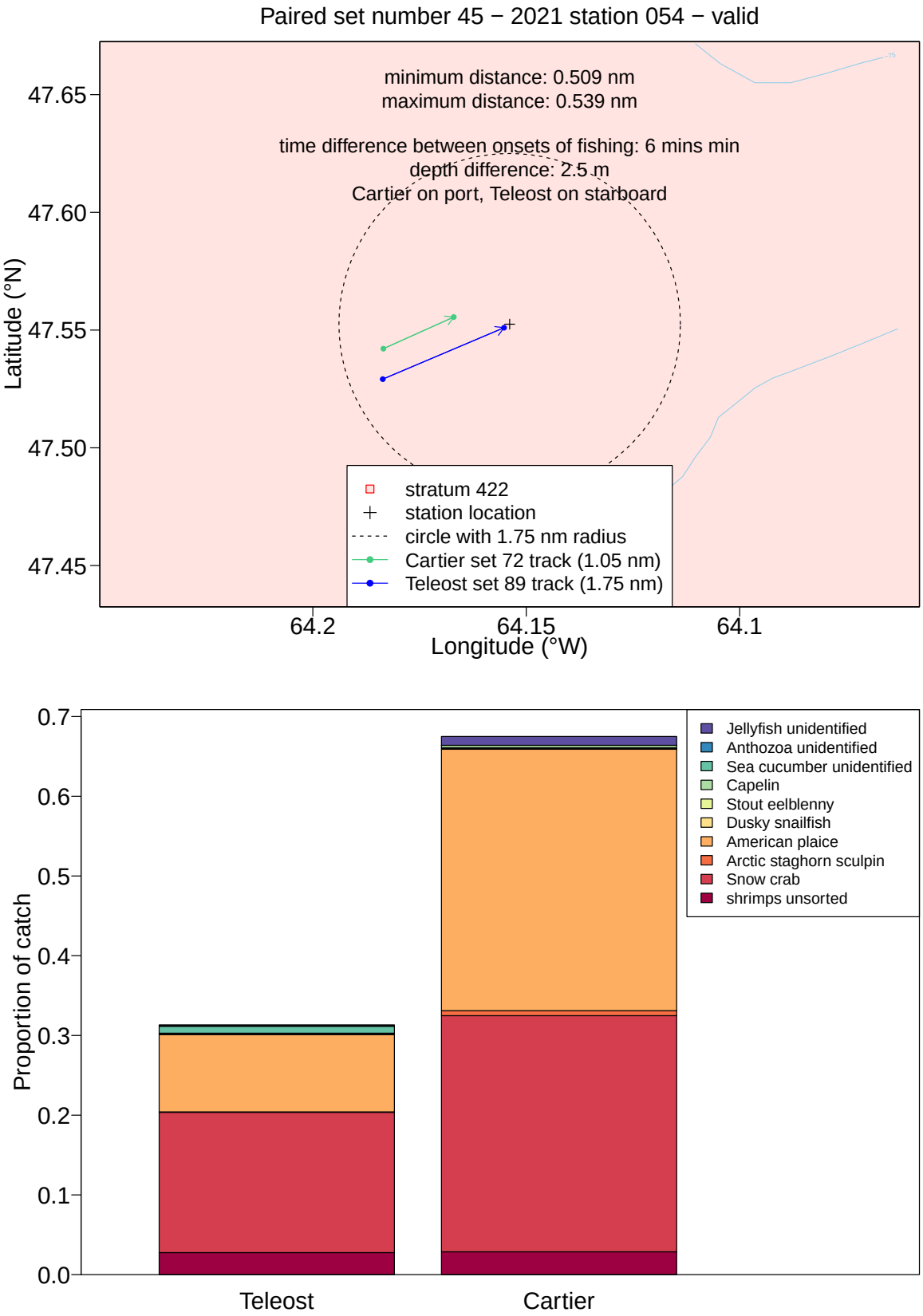

Figure 52. Tow tracks and major species composition for station 054 in 2021.

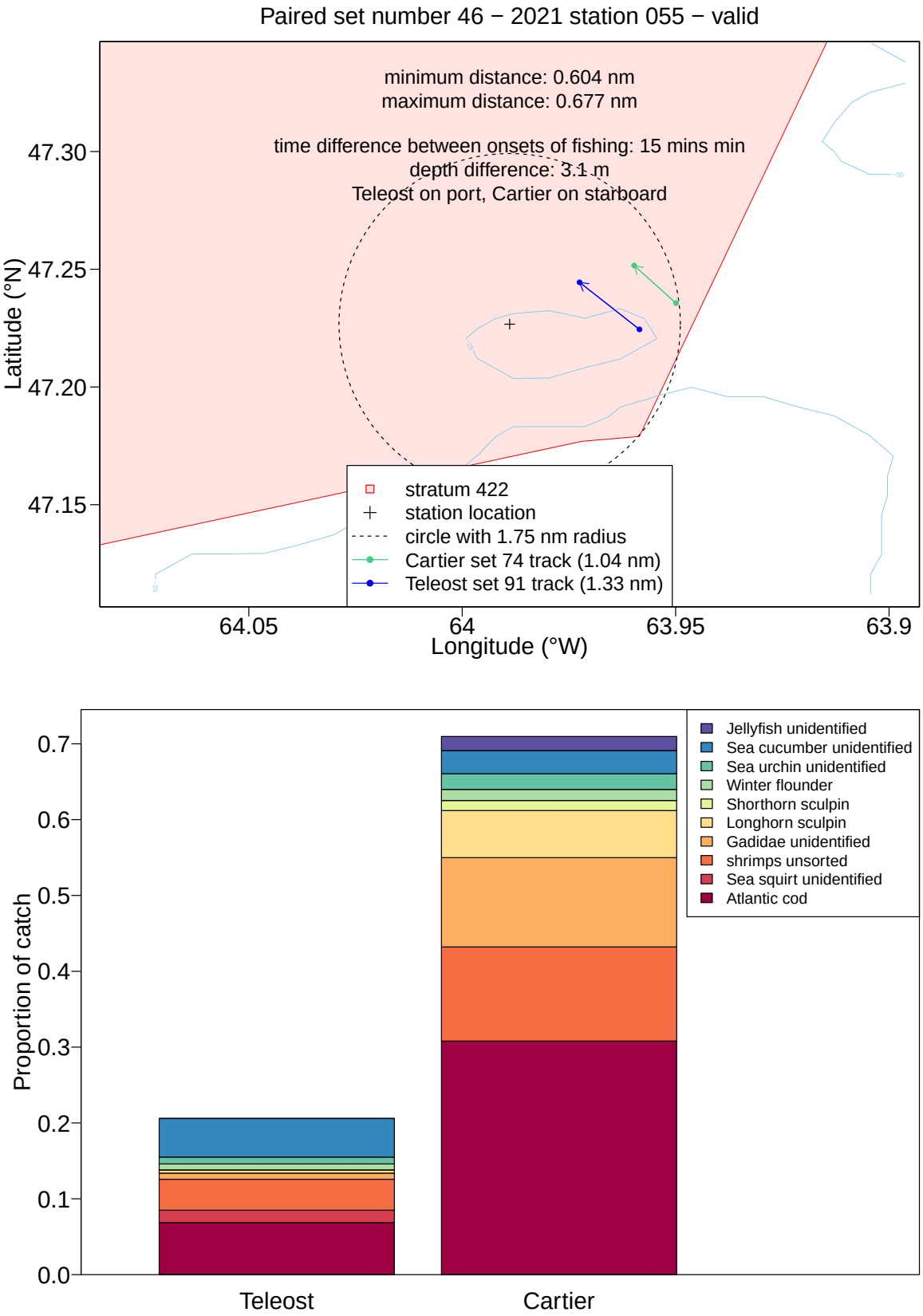

Figure 53. Tow tracks and major species composition for station 055 in 2021.

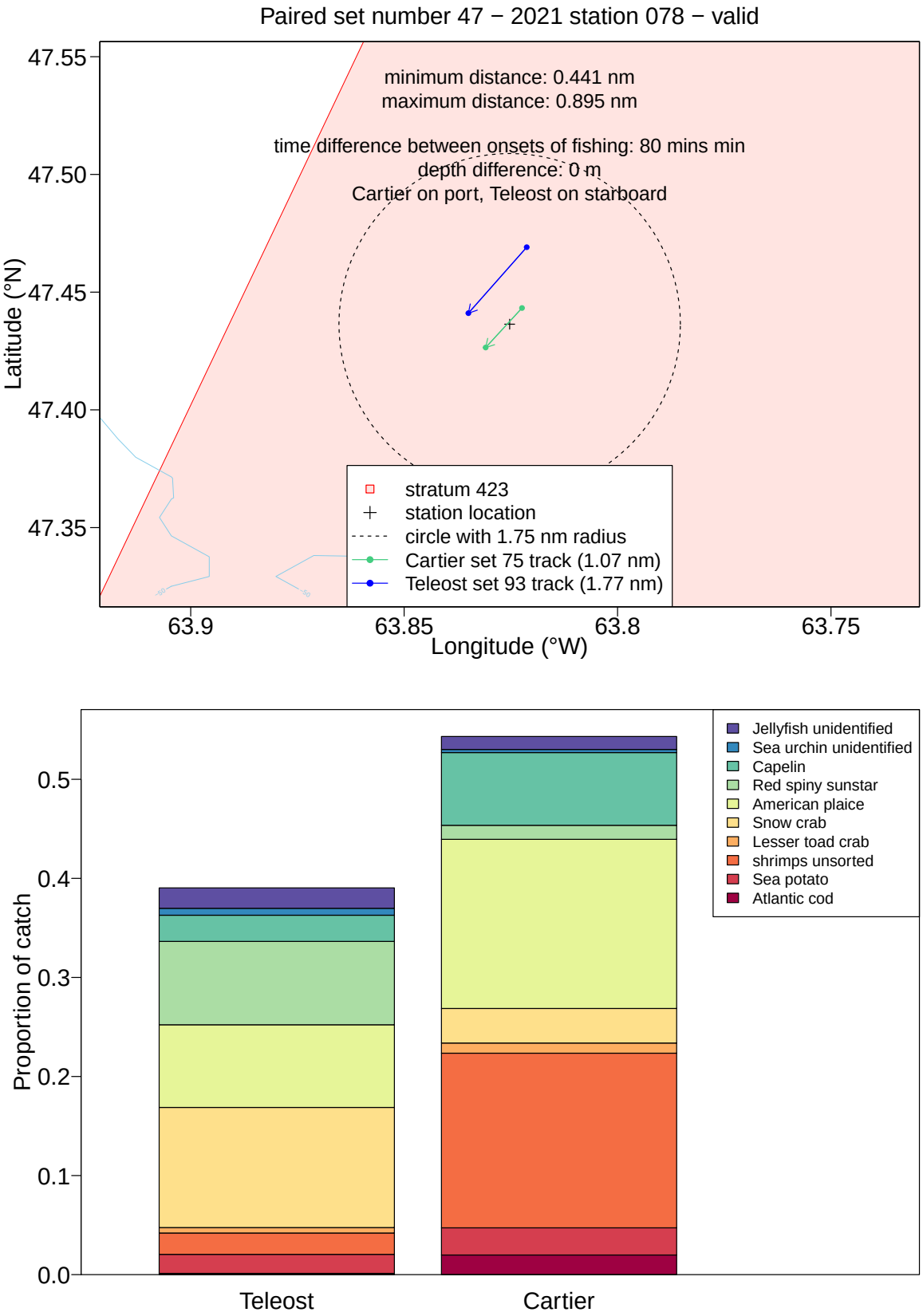

Figure 54. Tow tracks and major species composition for station 078 in 2021.

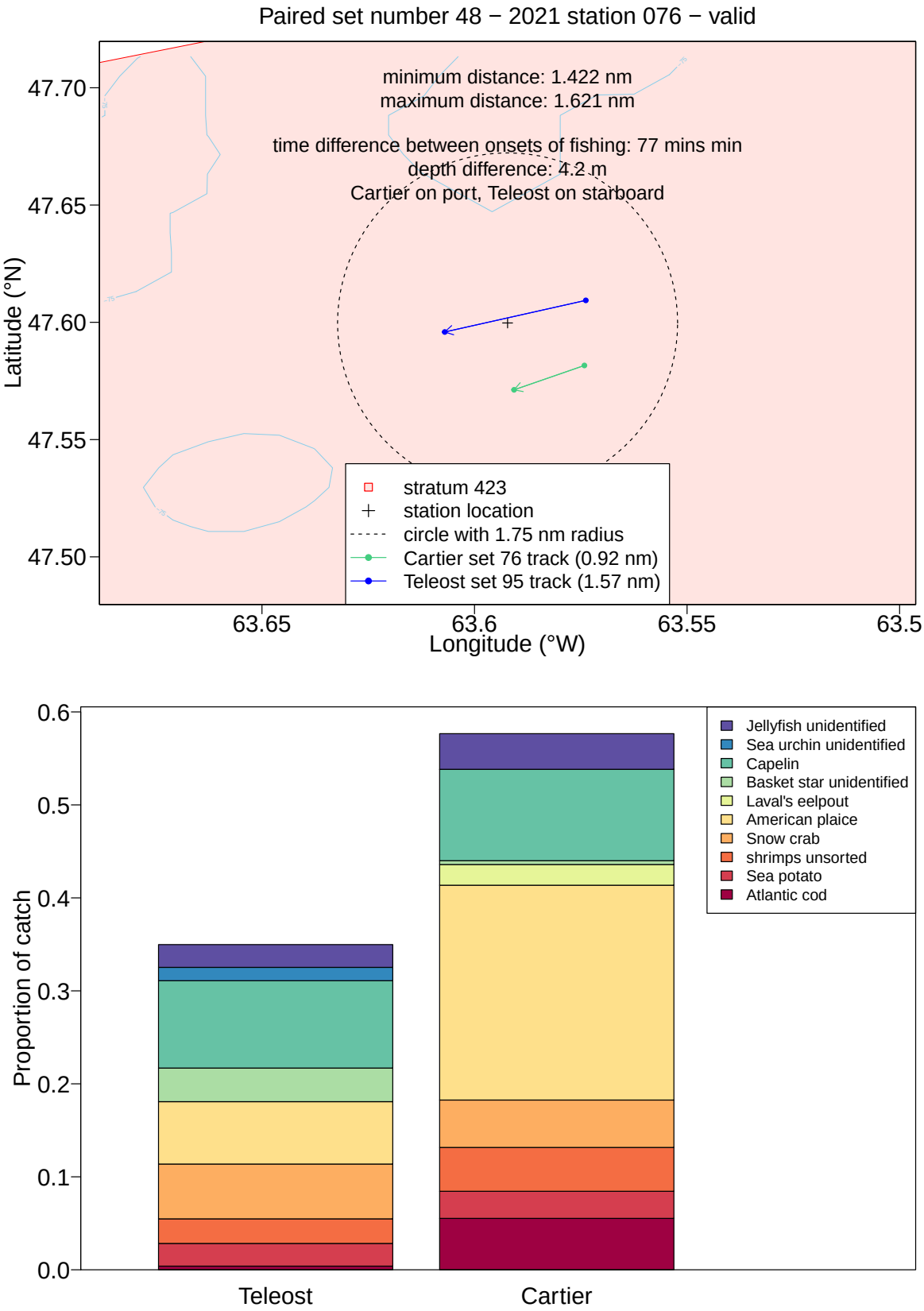

Figure 55. Tow tracks and major species composition for station 076 in 2021.

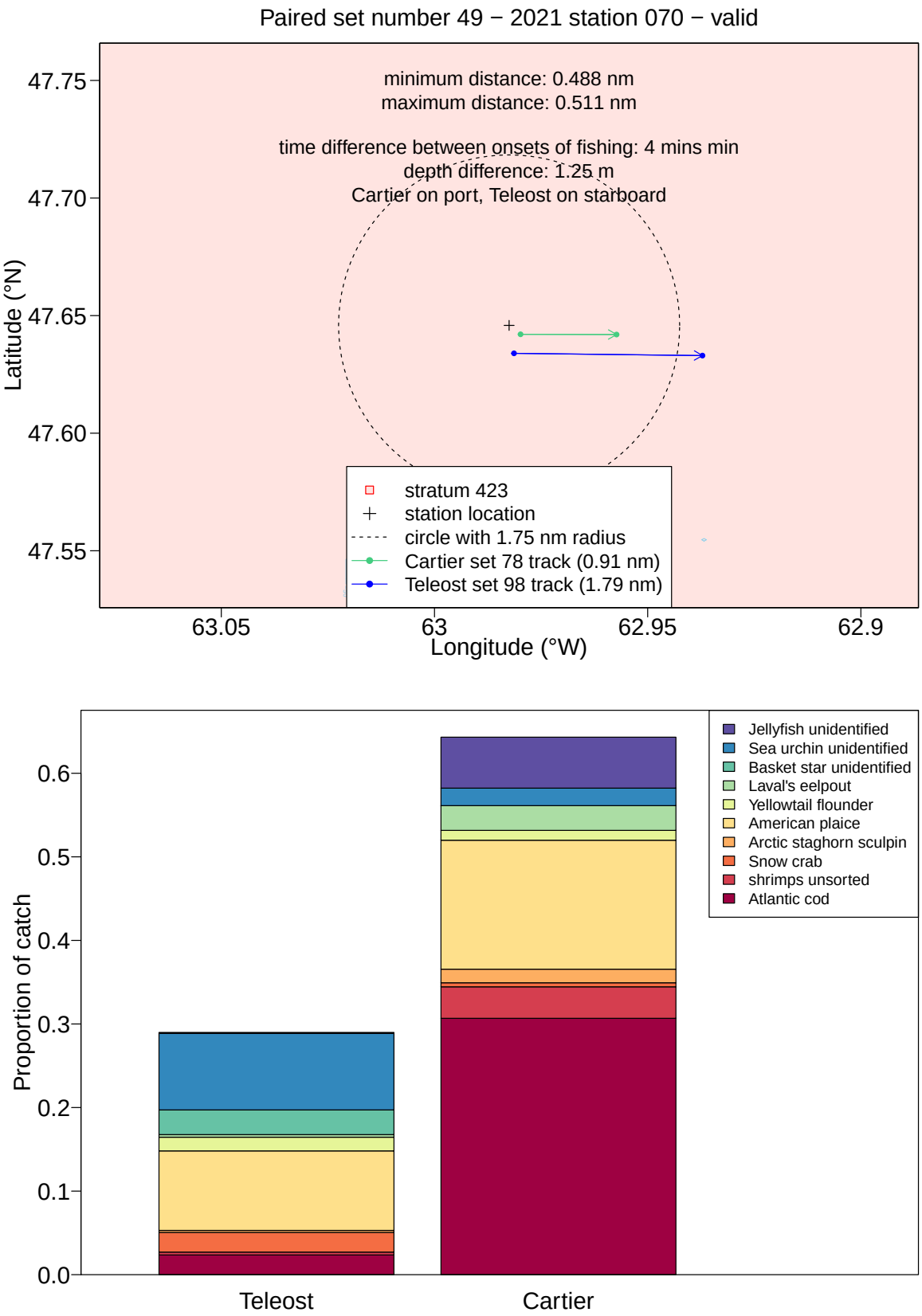

Figure 56. Tow tracks and major species composition for station 070 in 2021.

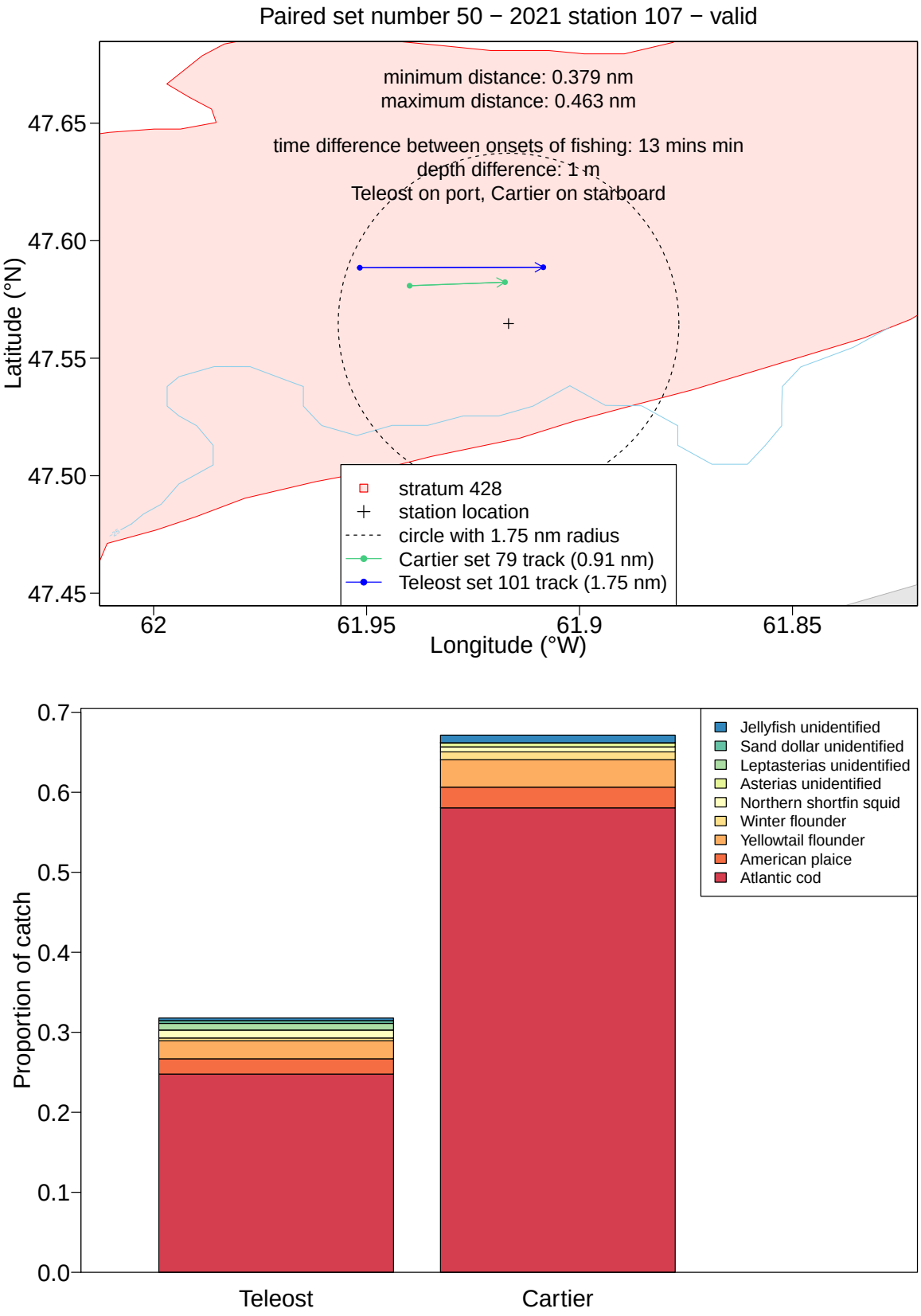

Figure 57. Tow tracks and major species composition for station 107 in 2021.

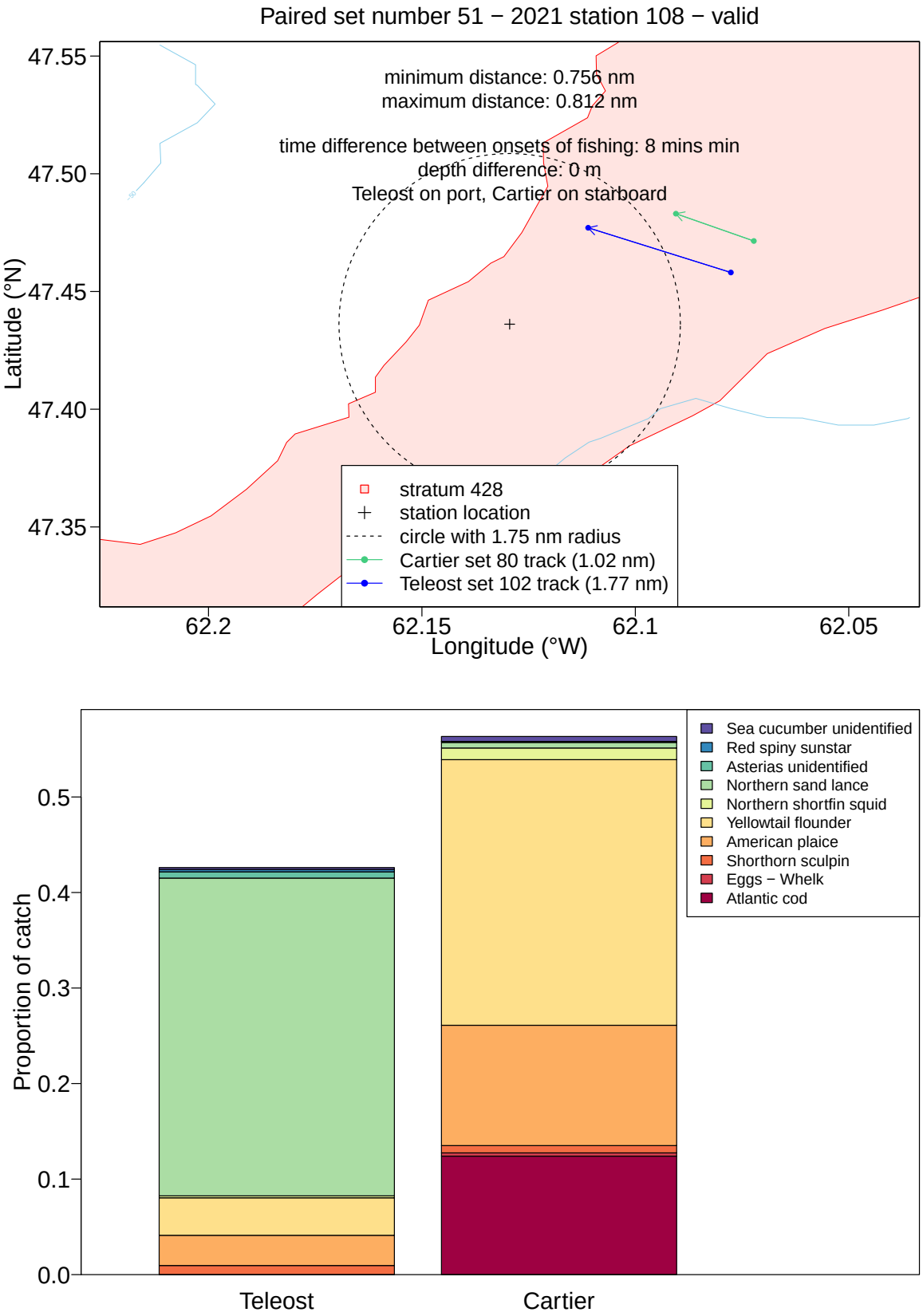

Figure 58. Tow tracks and major species composition for station 108 in 2021.

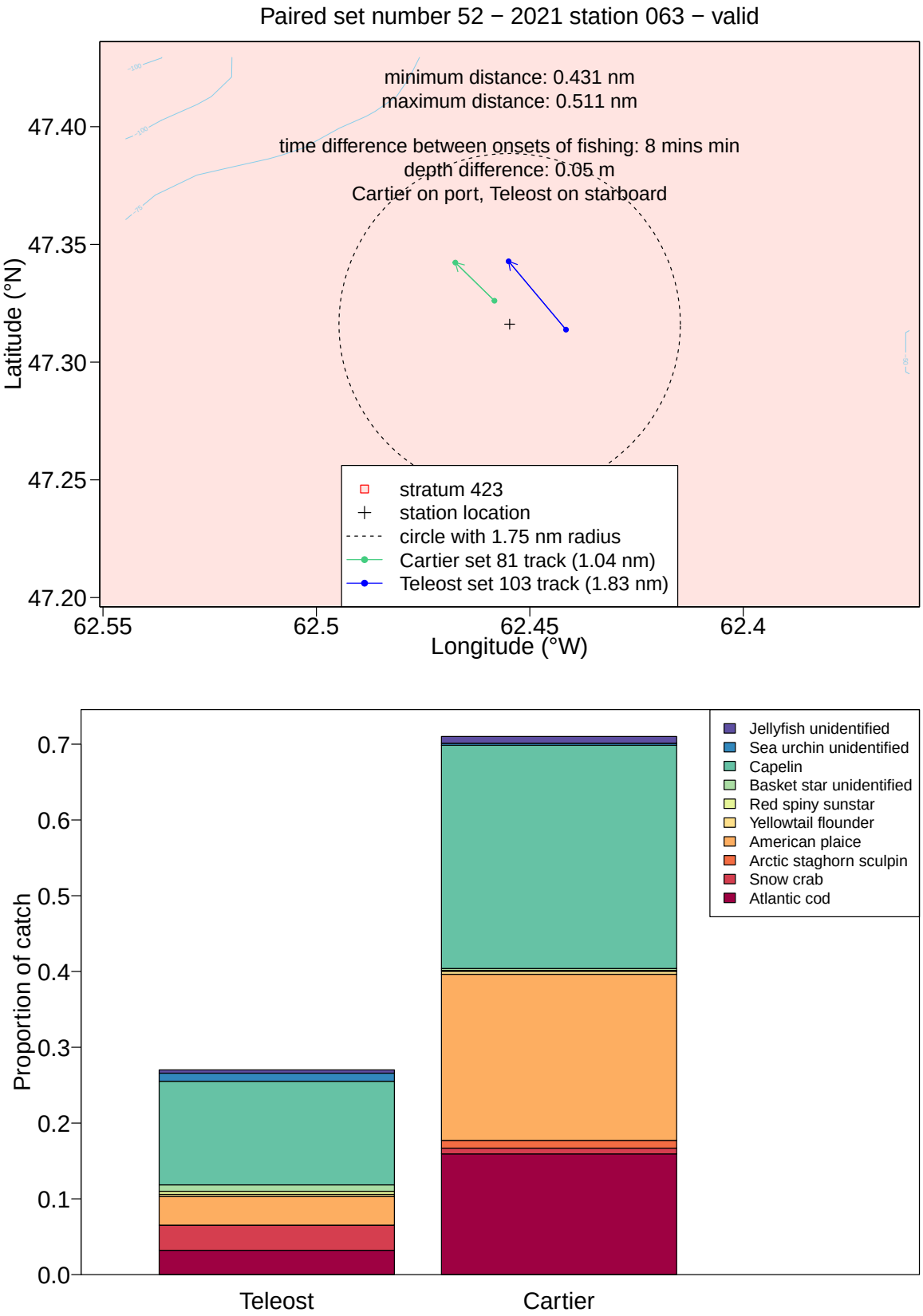

Figure 59. Tow tracks and major species composition for station 063 in 2021.

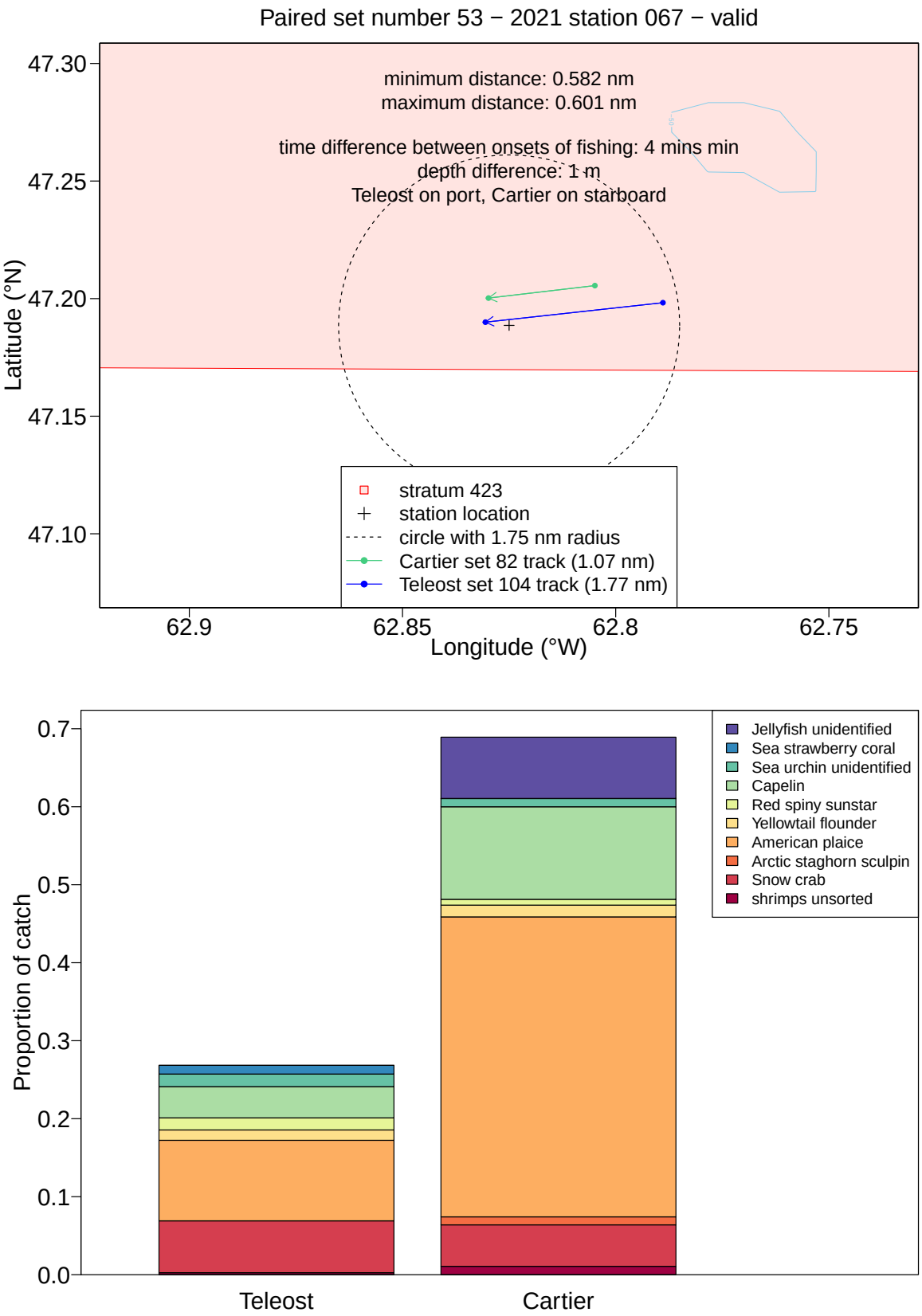

Figure 60. Tow tracks and major species composition for station 067 in 2021.

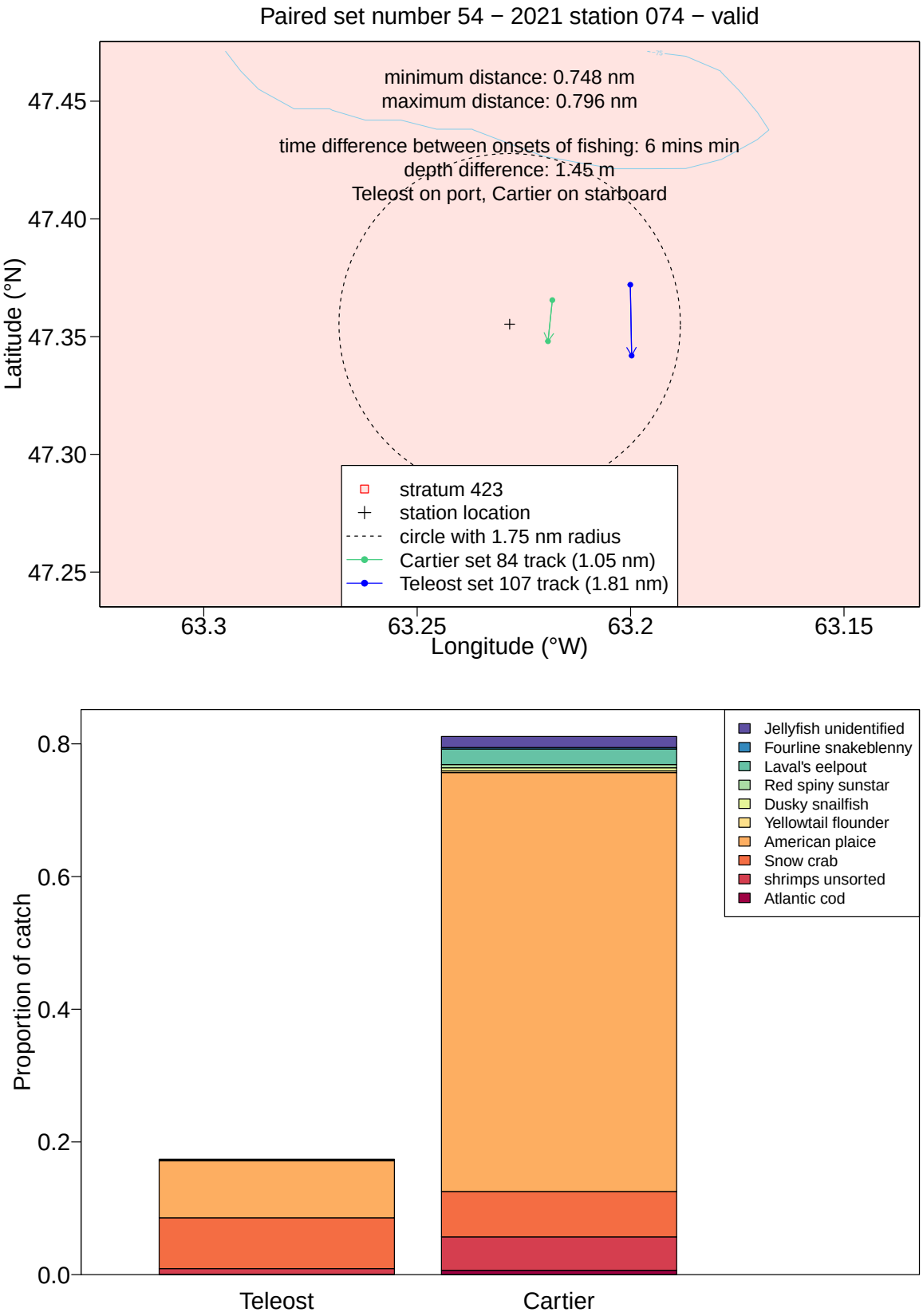

Figure 61. Tow tracks and major species composition for station 074 in 2021.

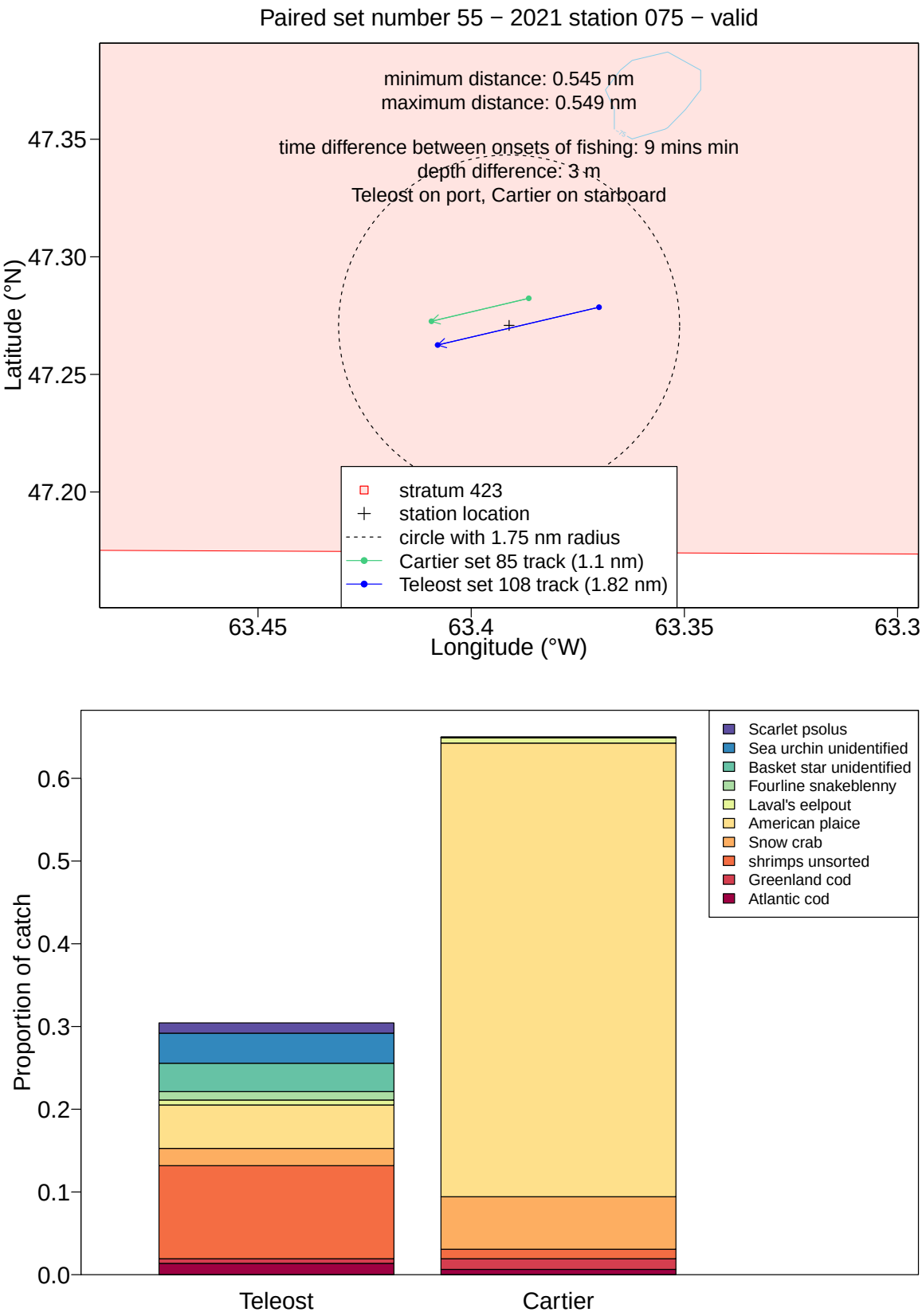

Figure 62. Tow tracks and major species composition for station 075 in 2021.

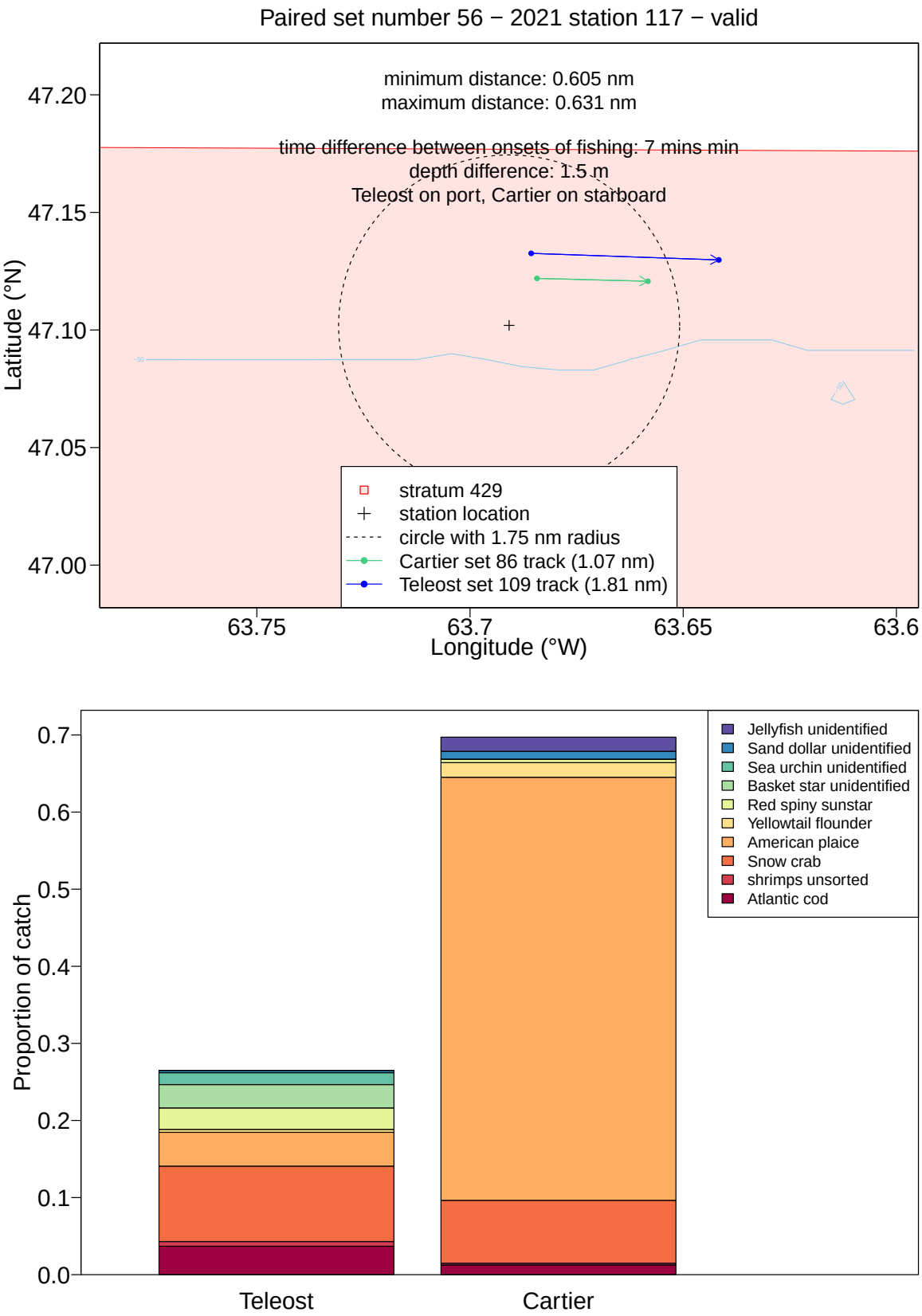

Figure 63. Tow tracks and major species composition for station 117 in 2021.

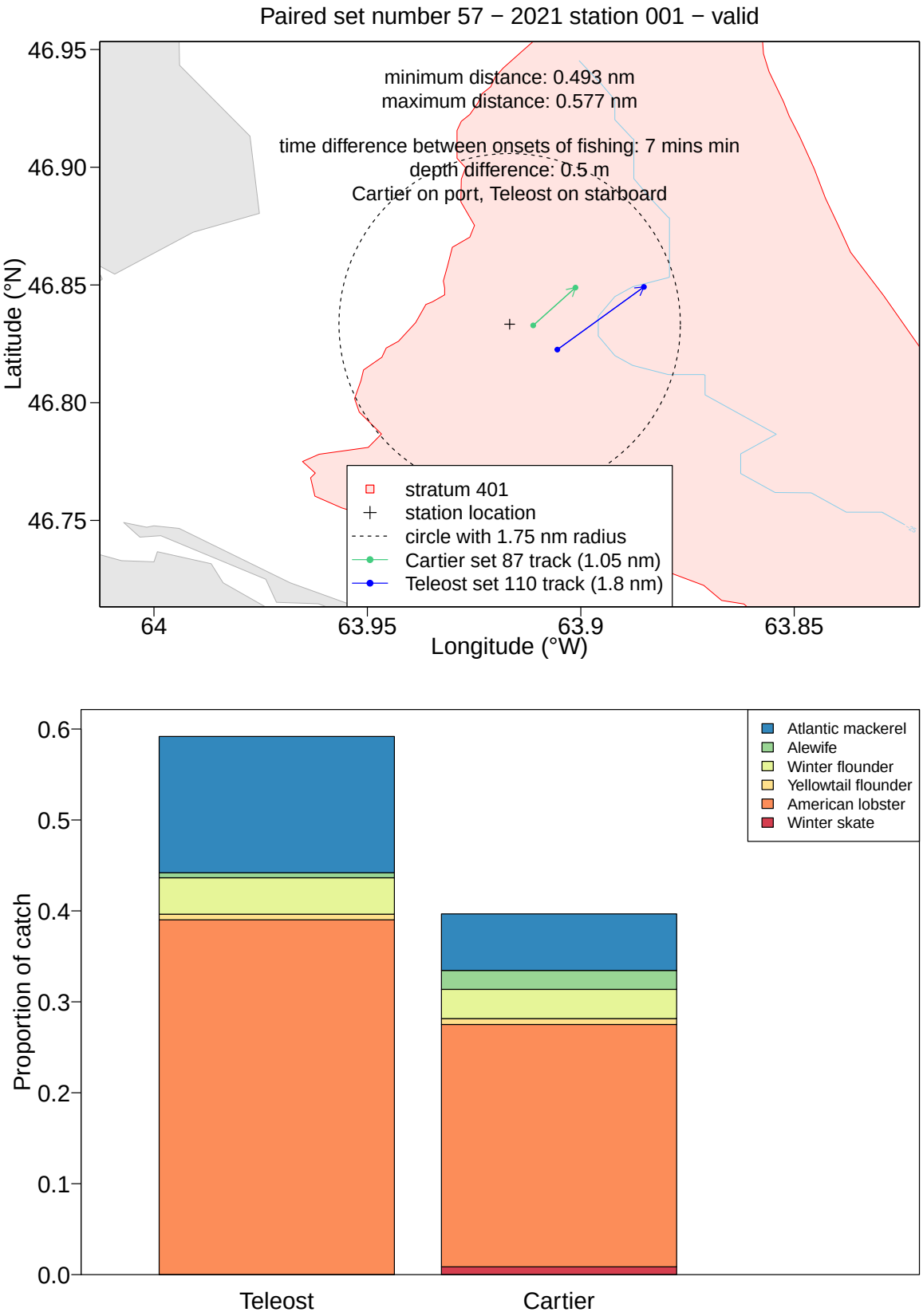

Figure 64. Tow tracks and major species composition for station 001 in 2021.

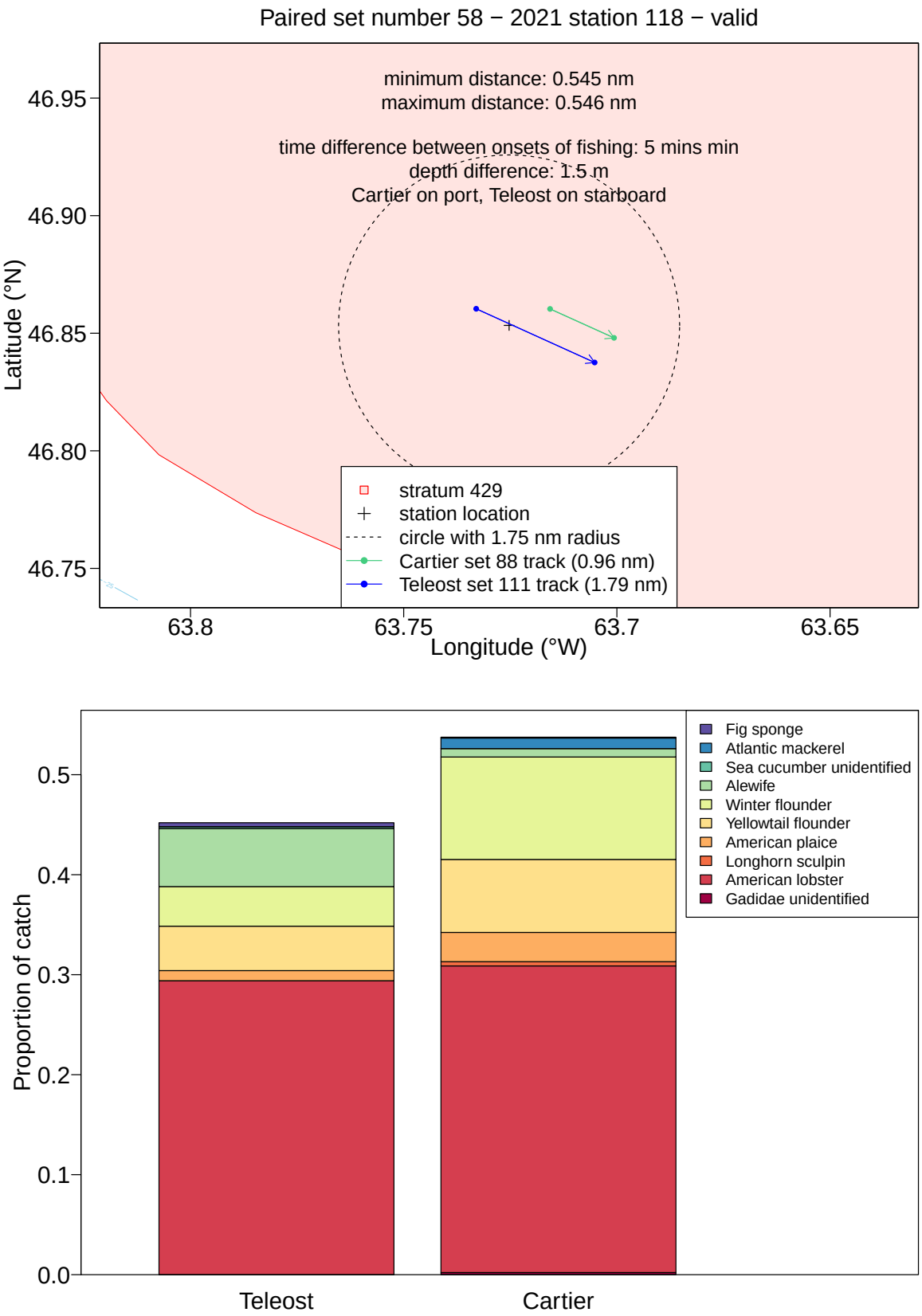

Figure 65. Tow tracks and major species composition for station 118 in 2021.

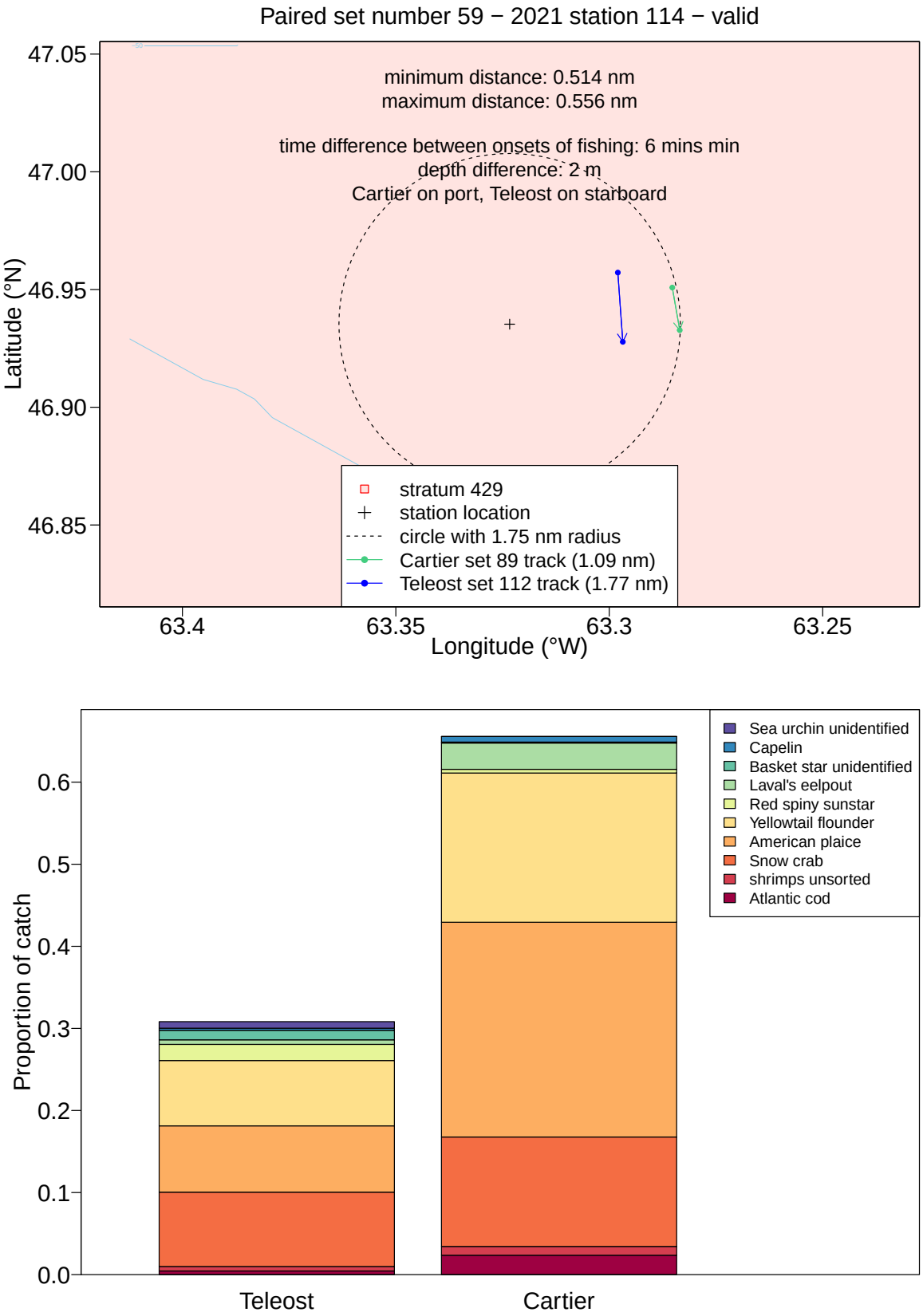

Figure 66. Tow tracks and major species composition for station 114 in 2021.

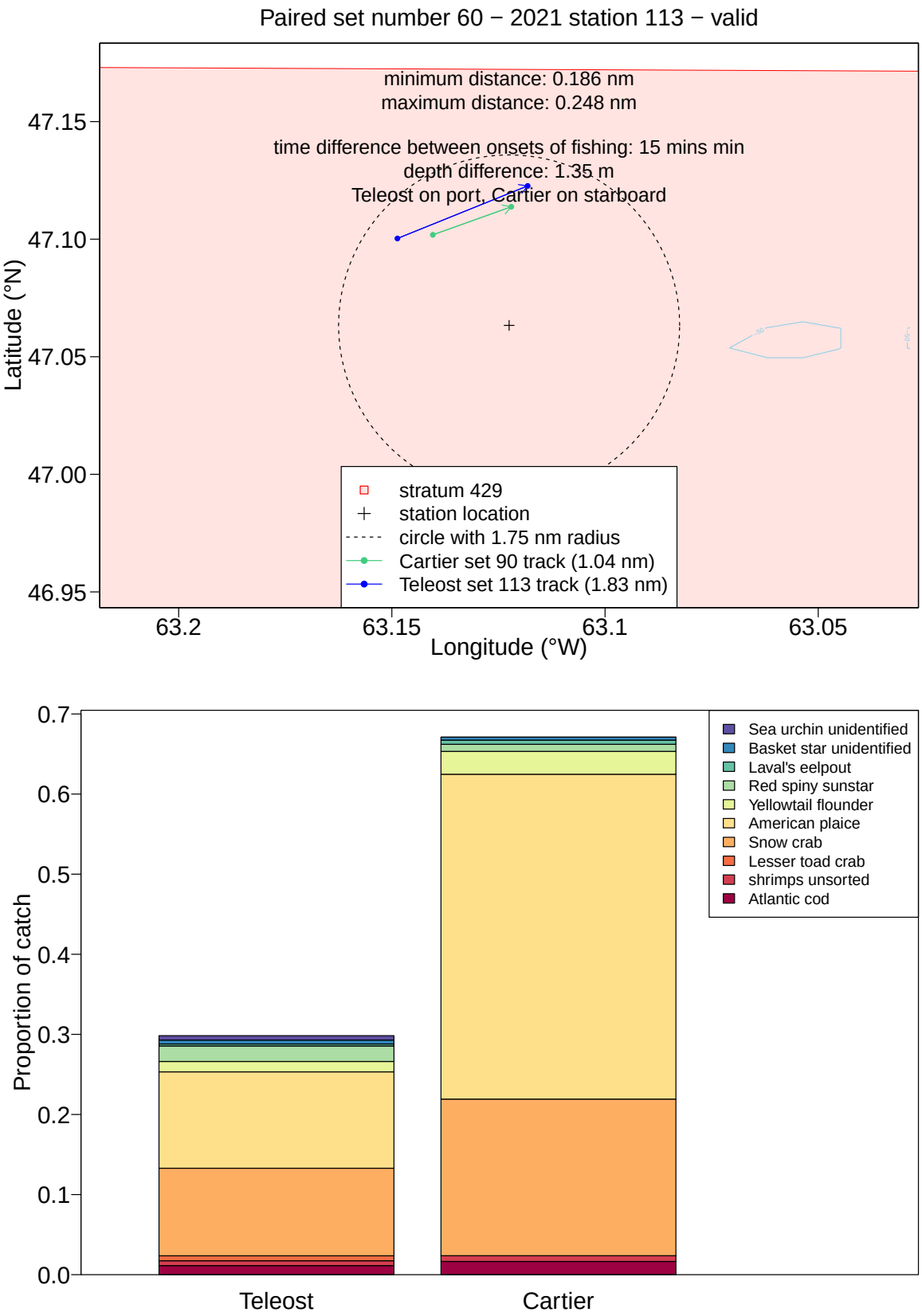

Figure 67. Tow tracks and major species composition for station 113 in 2021.

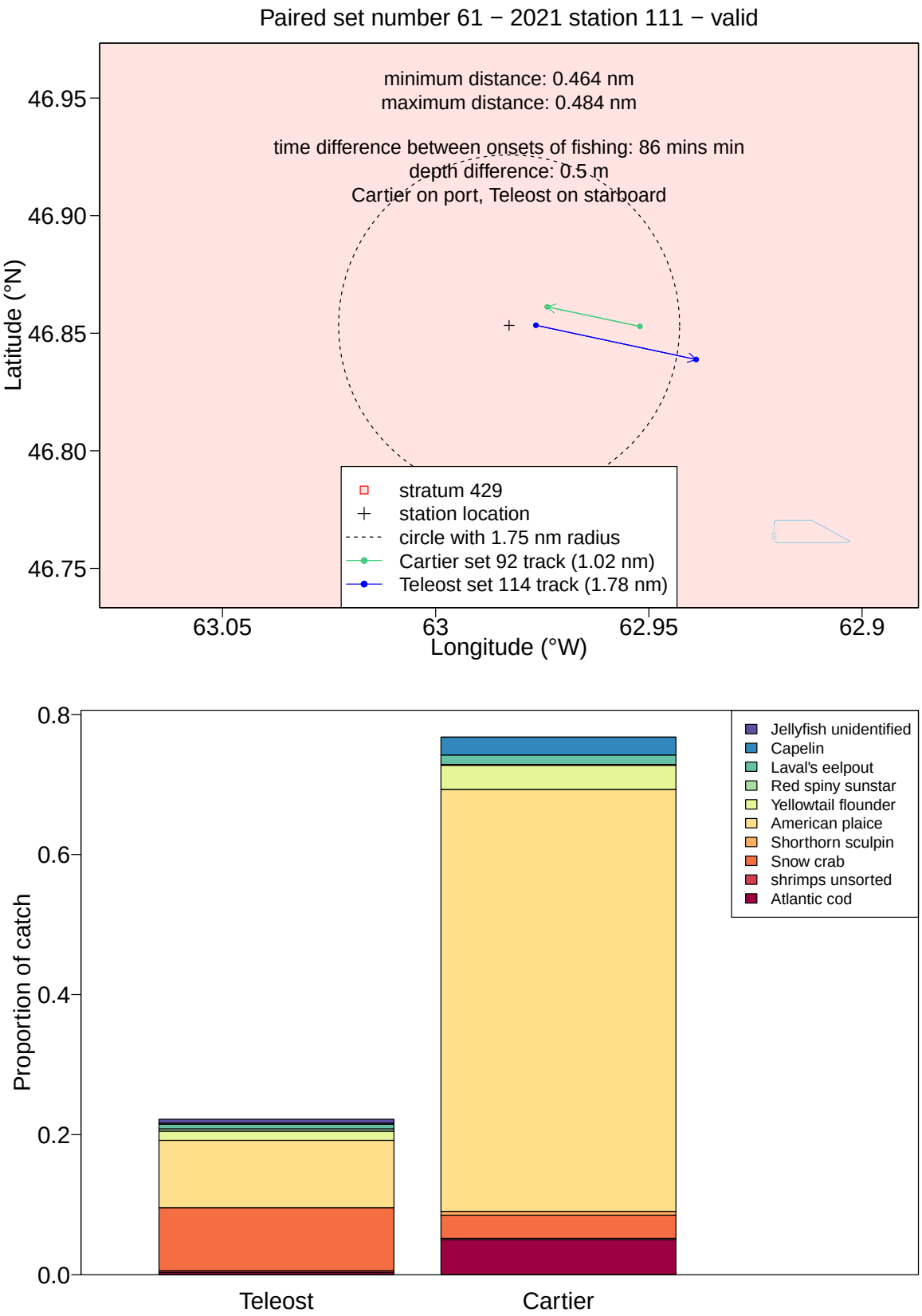

Figure 68. Tow tracks and major species composition for station 111 in 2021.

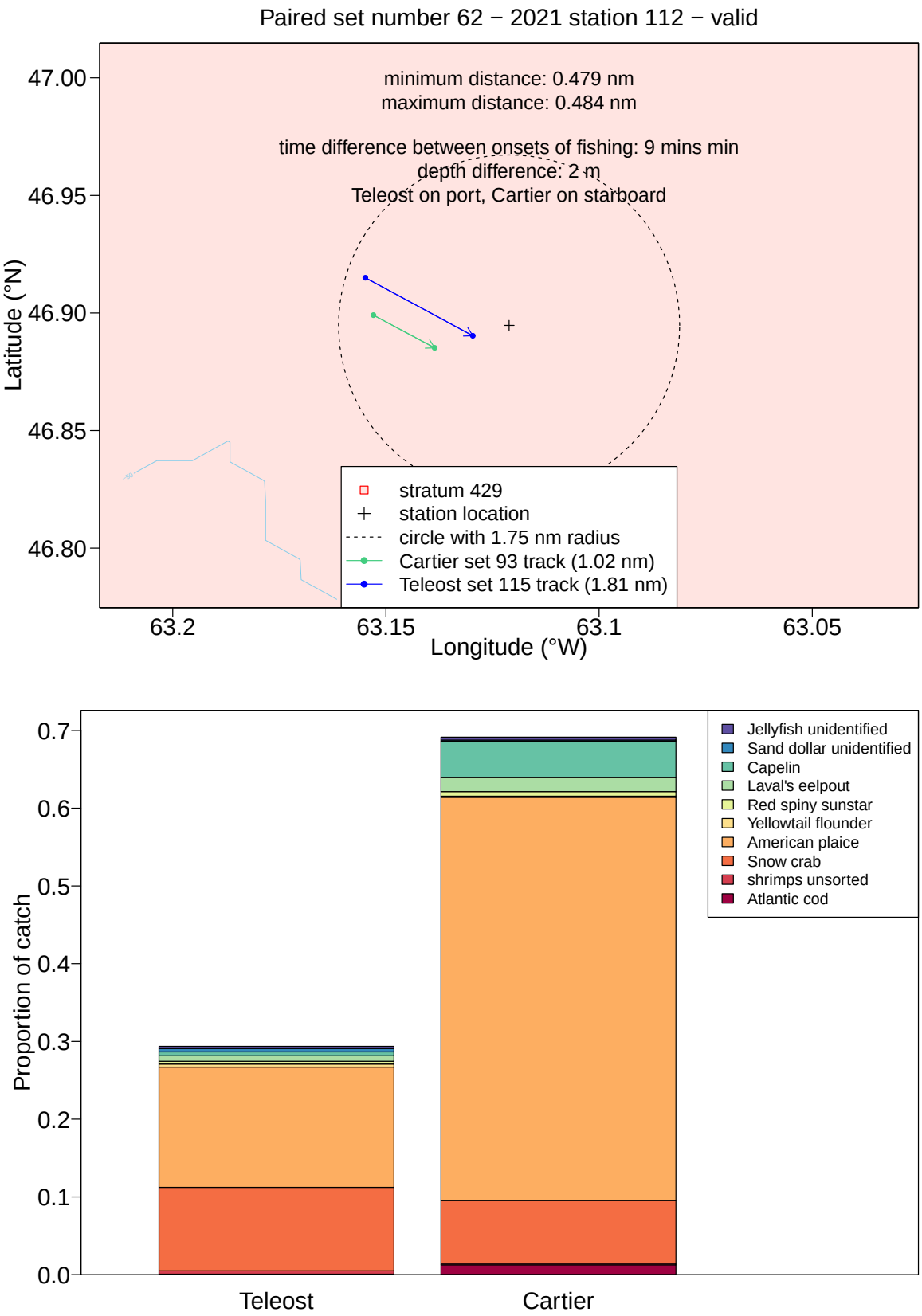

Figure 69. Tow tracks and major species composition for station 112 in 2021.

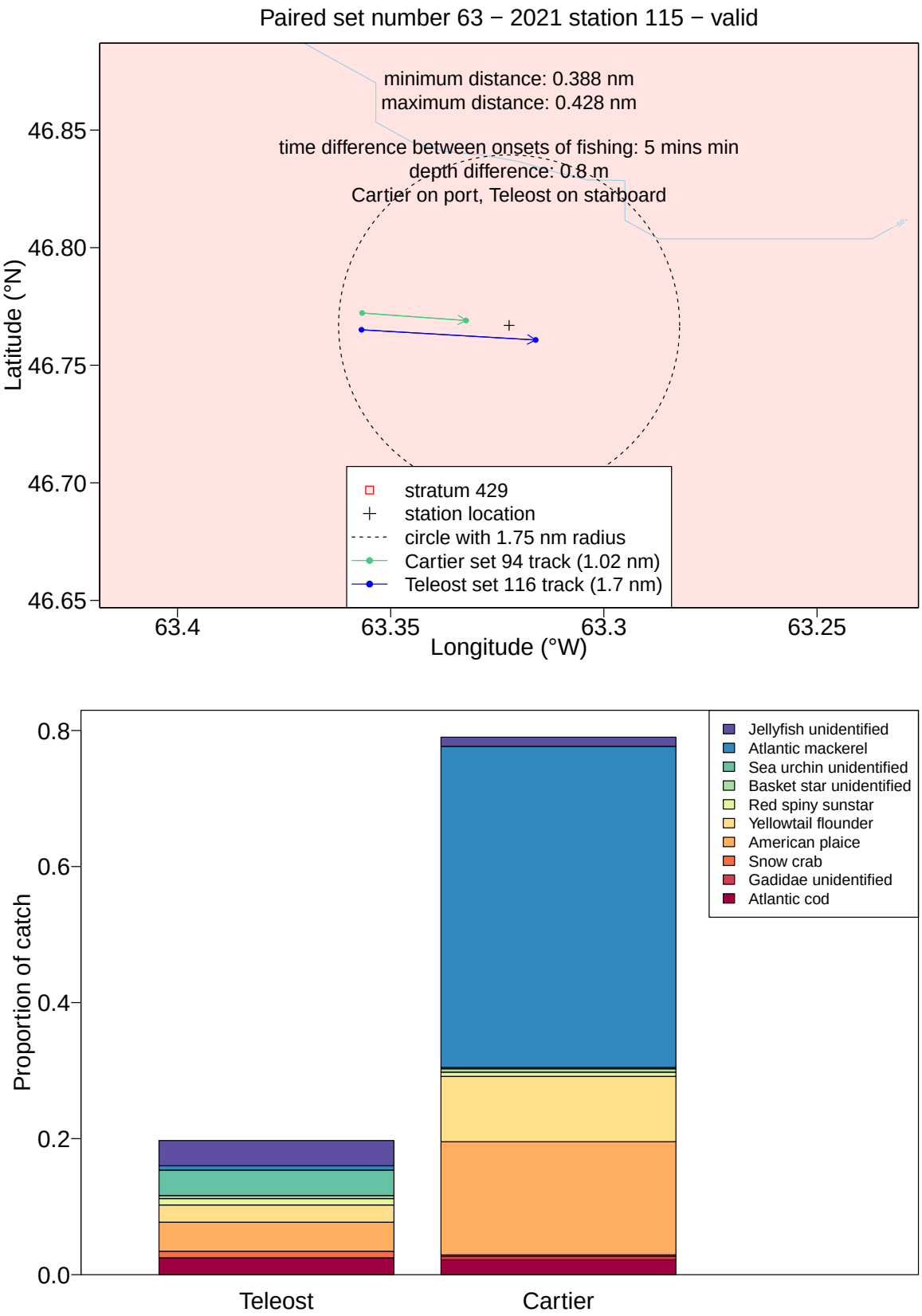

Figure 70. Tow tracks and major species composition for station 115 in 2021.

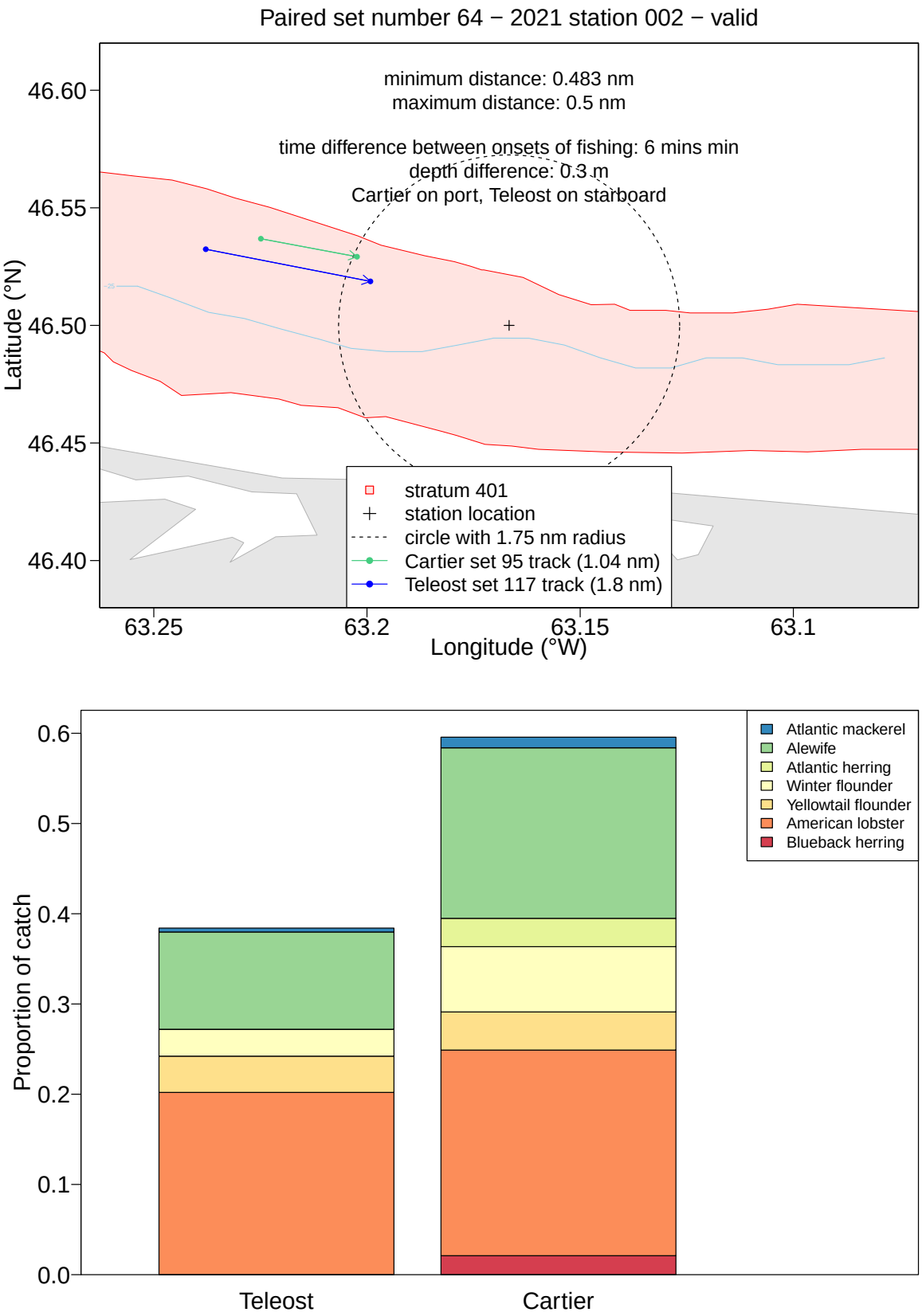

Figure 71. Tow tracks and major species composition for station 002 in 2021.

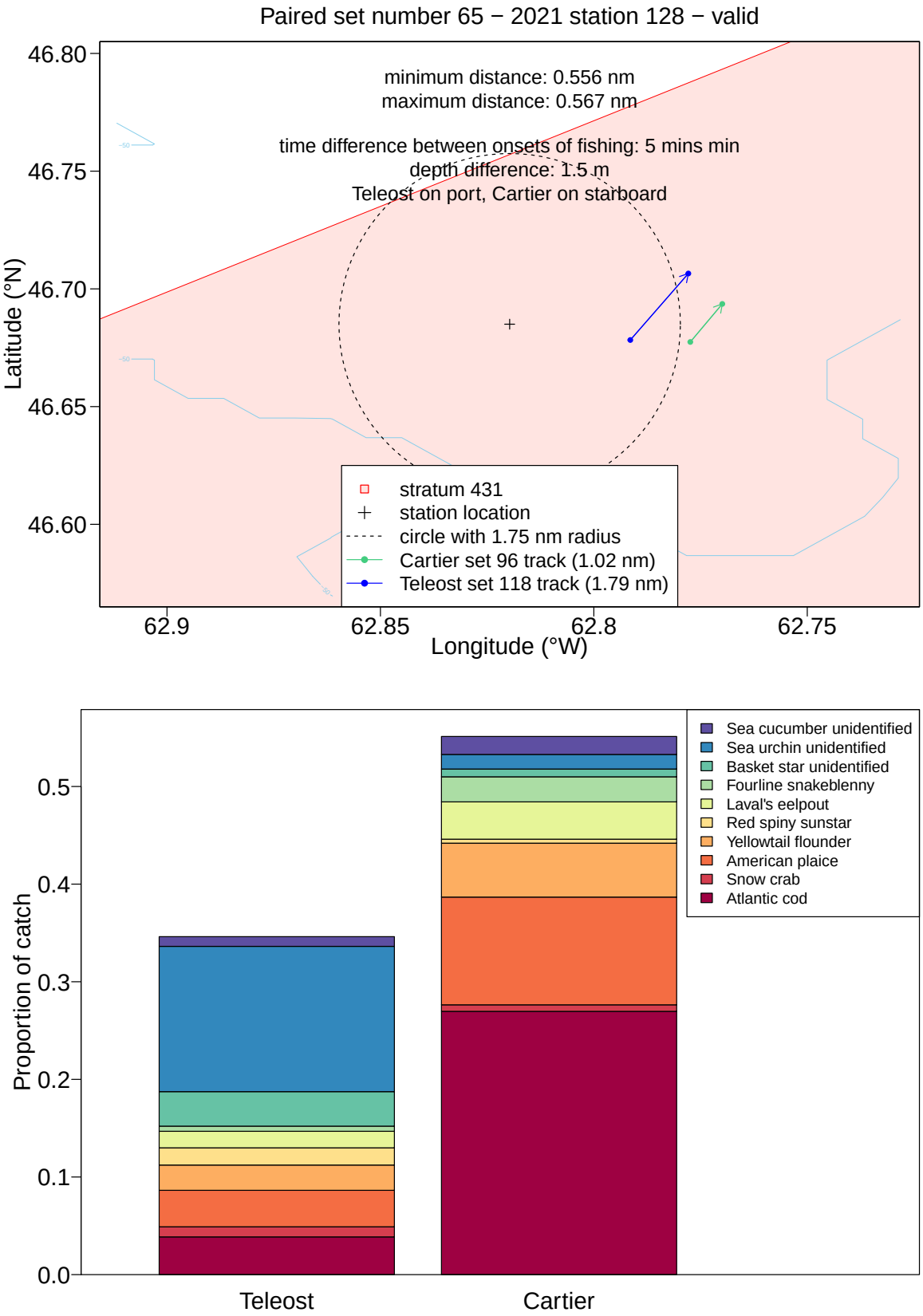

Figure 72. Tow tracks and major species composition for station 128 in 2021.

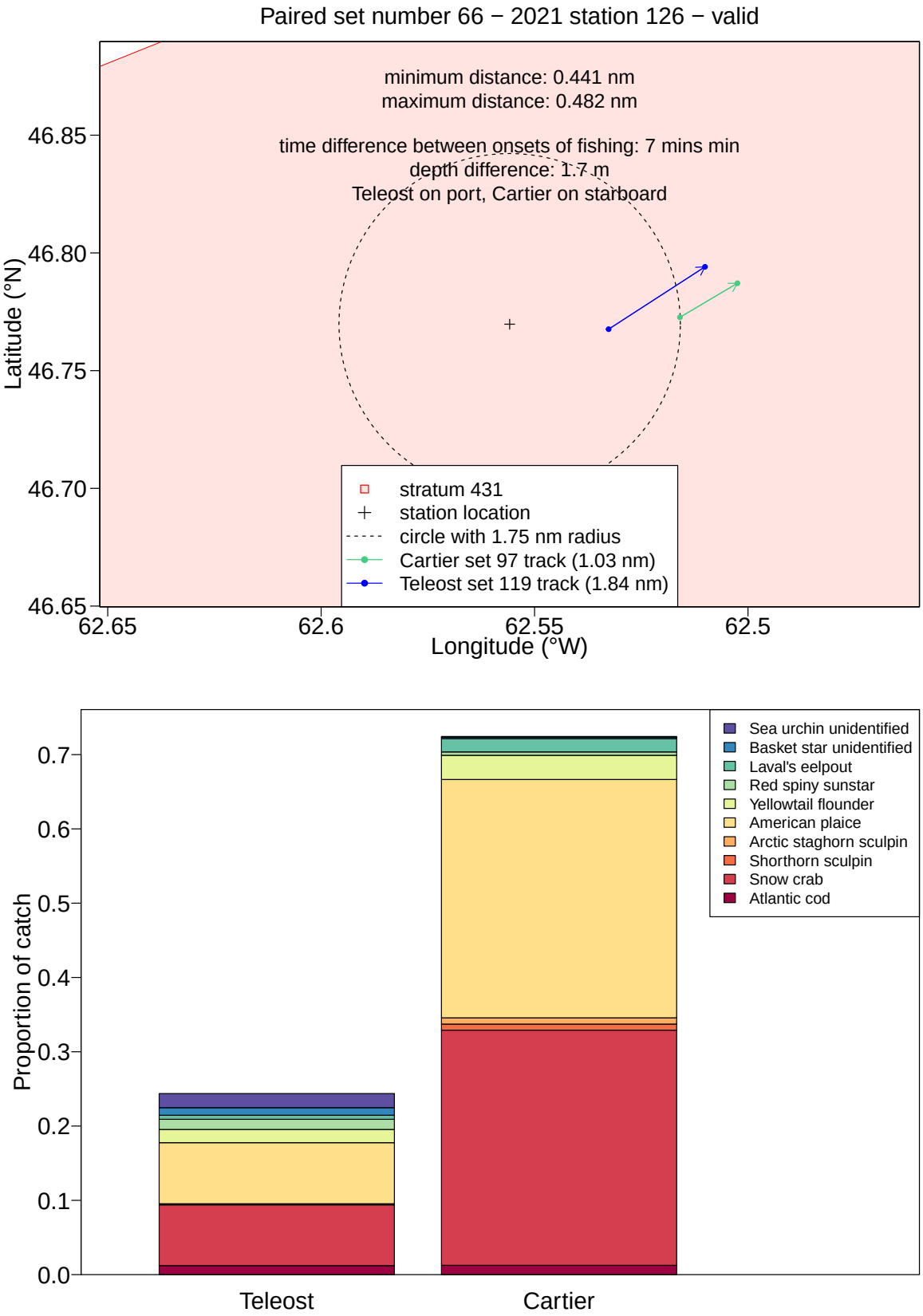

Figure 73. Tow tracks and major species composition for station 126 in 2021.

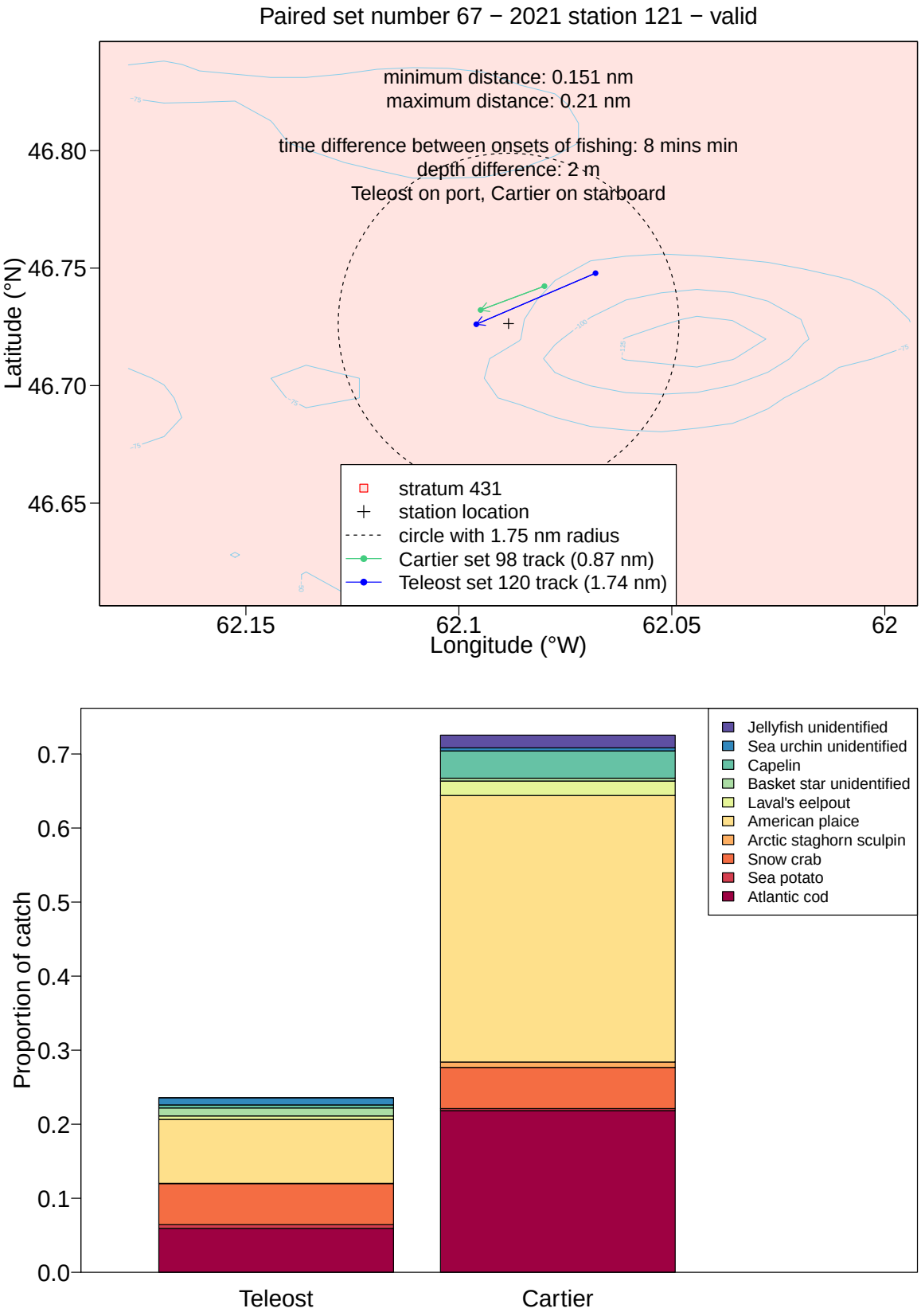

Figure 74. Tow tracks and major species composition for station 121 in 2021.

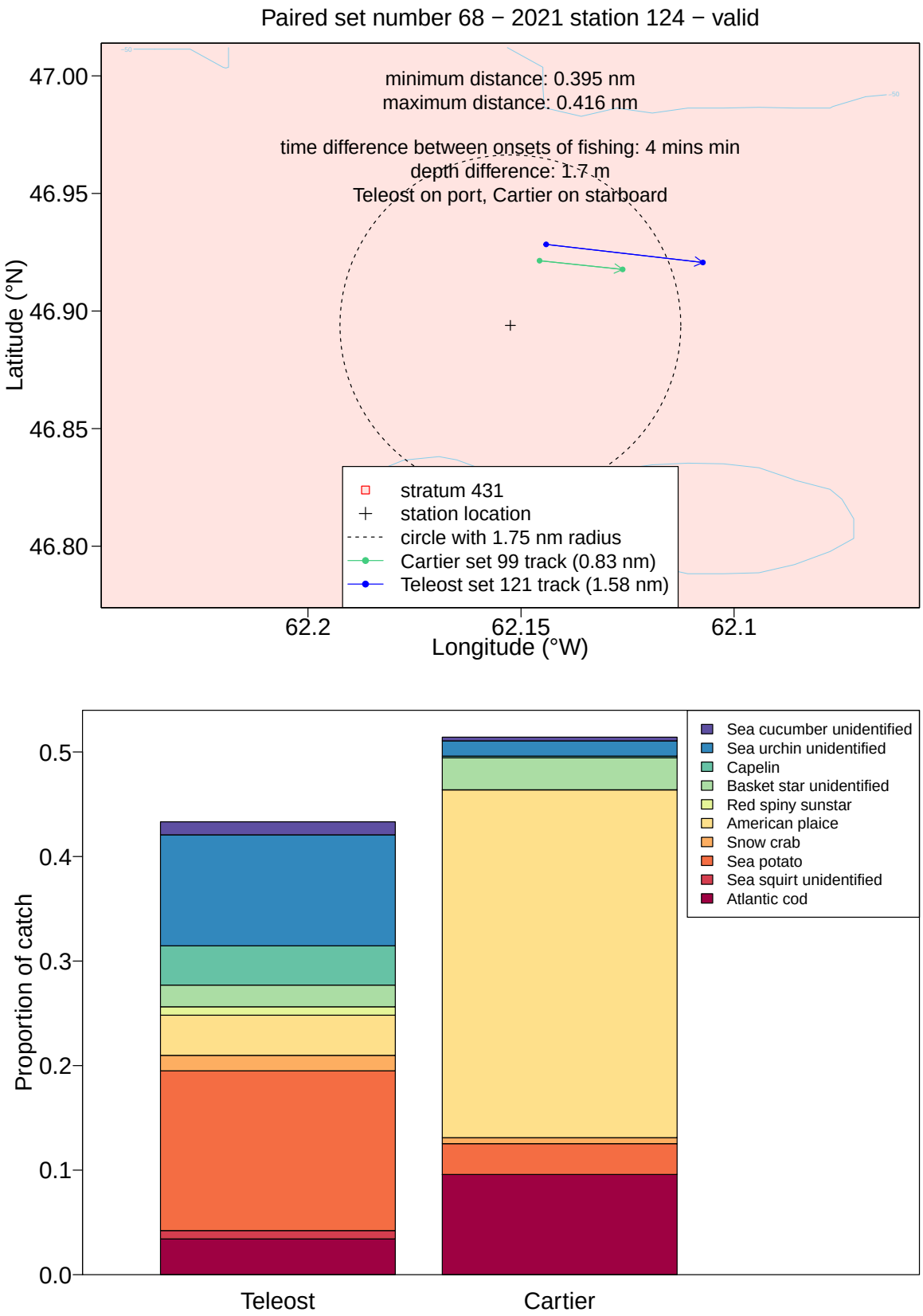

Figure 75. Tow tracks and major species composition for station 124 in 2021.

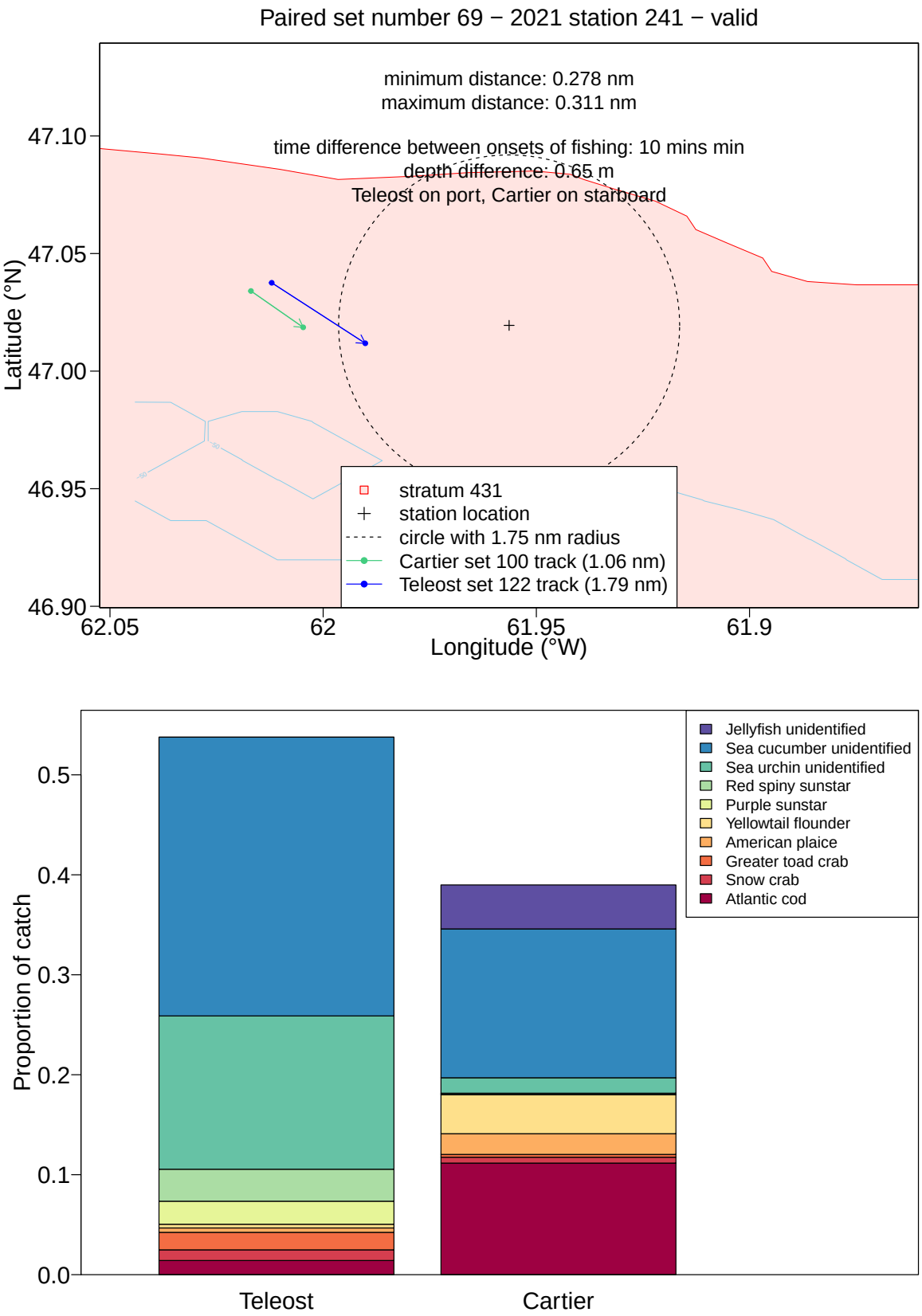

Figure 76. Tow tracks and major species composition for station 241 in 2021.

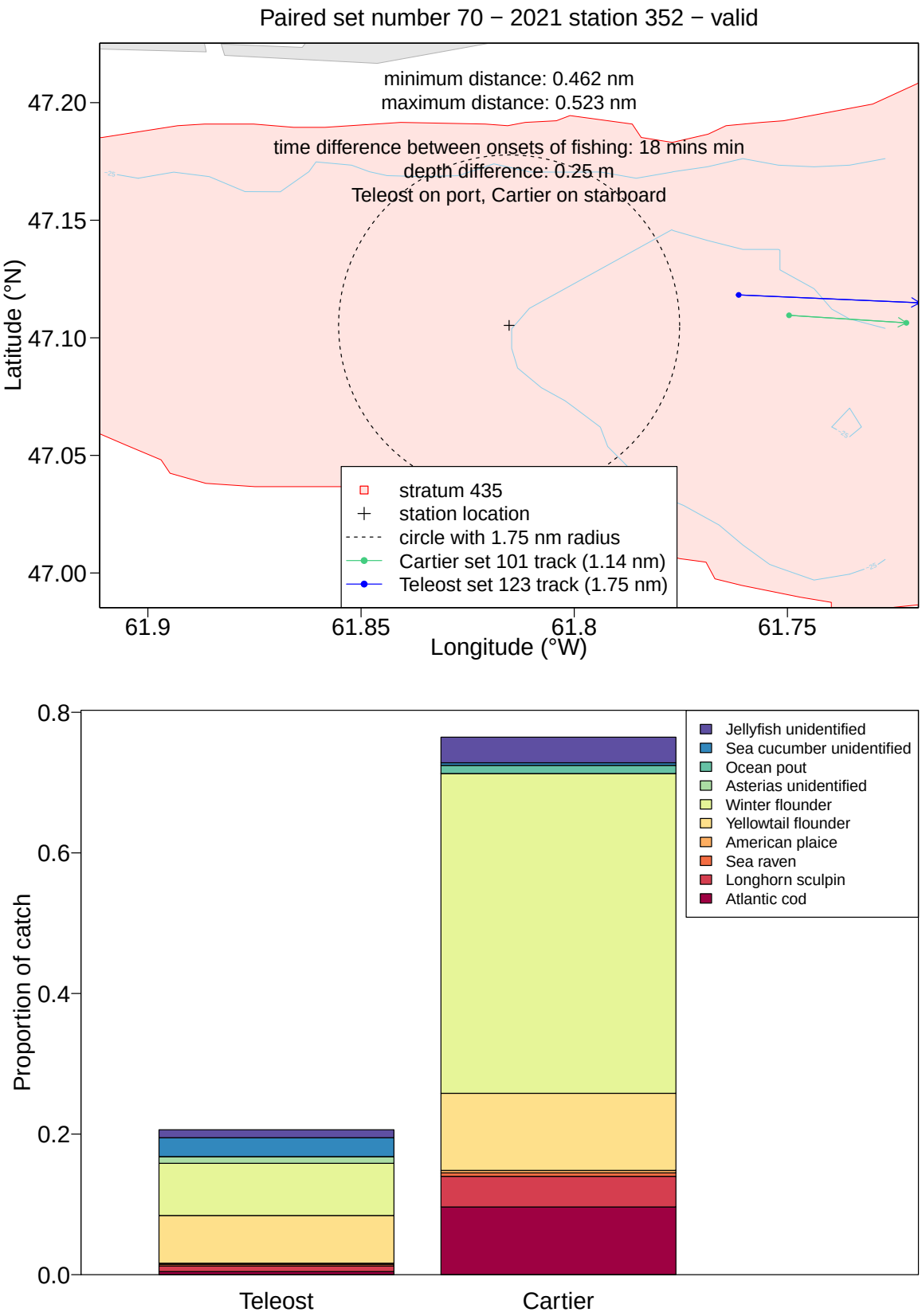

Figure 77. Tow tracks and major species composition for station 352 in 2021.

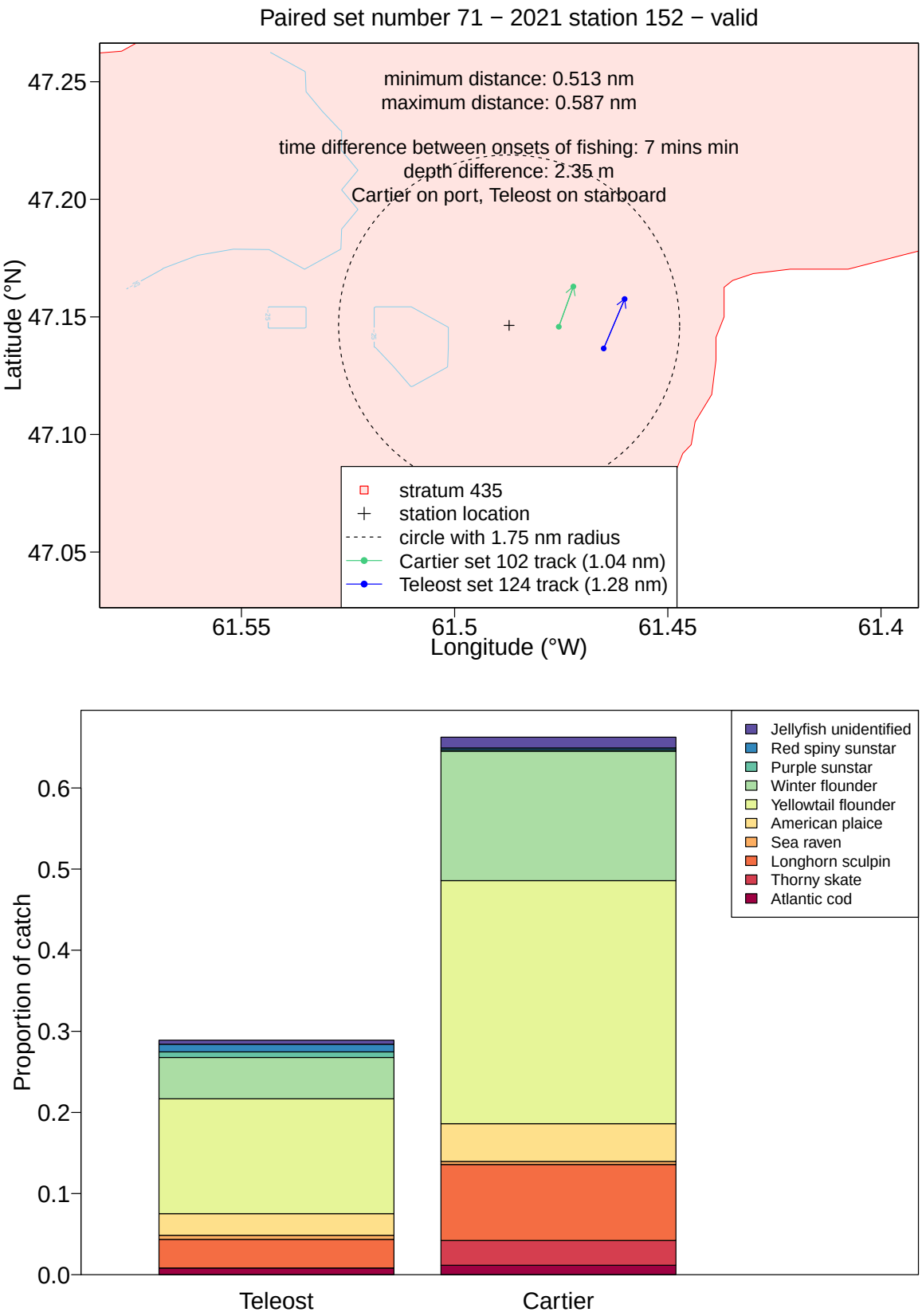

Figure 78. Tow tracks and major species composition for station 152 in 2021.

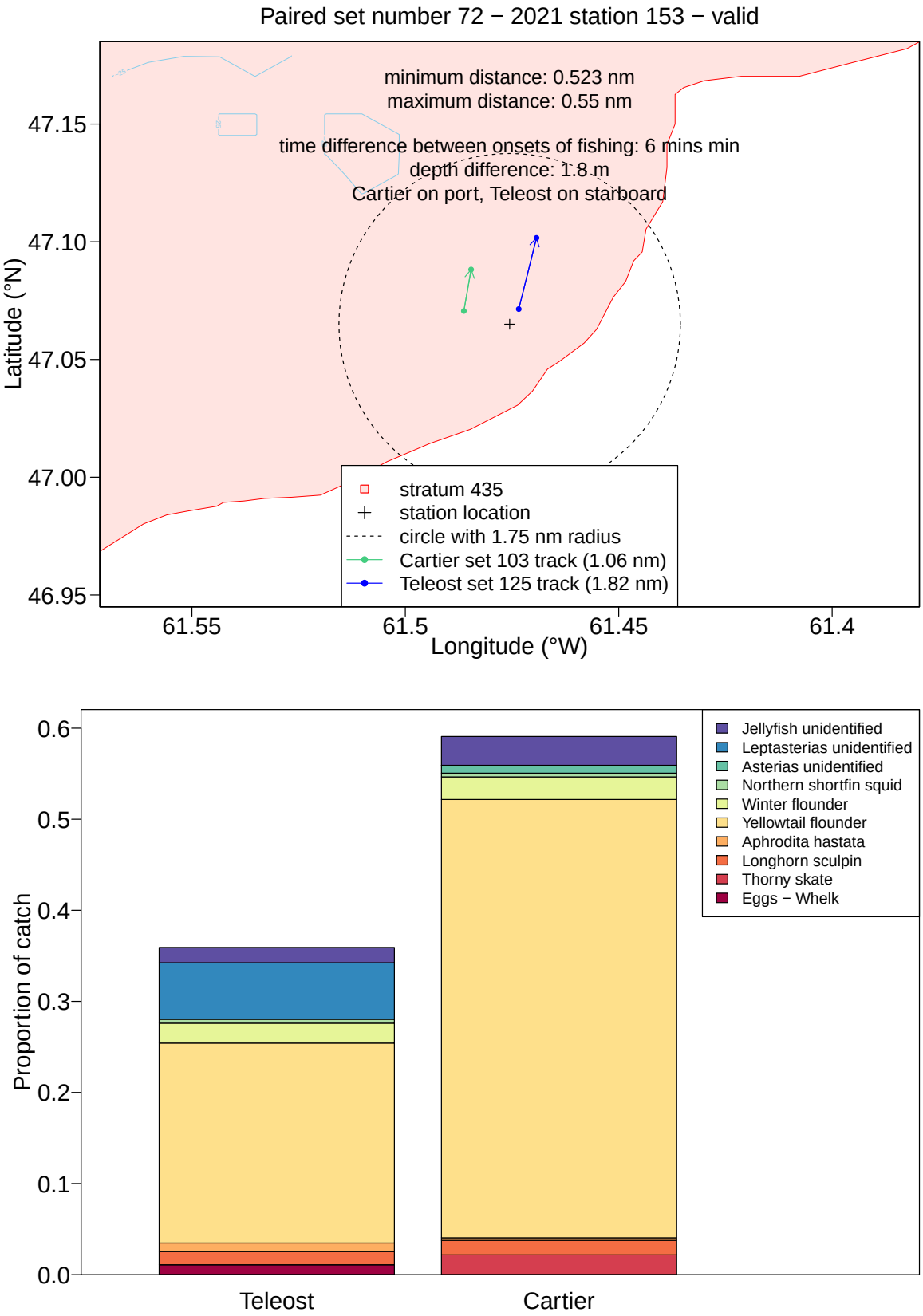

Figure 79. Tow tracks and major species composition for station 153 in 2021.

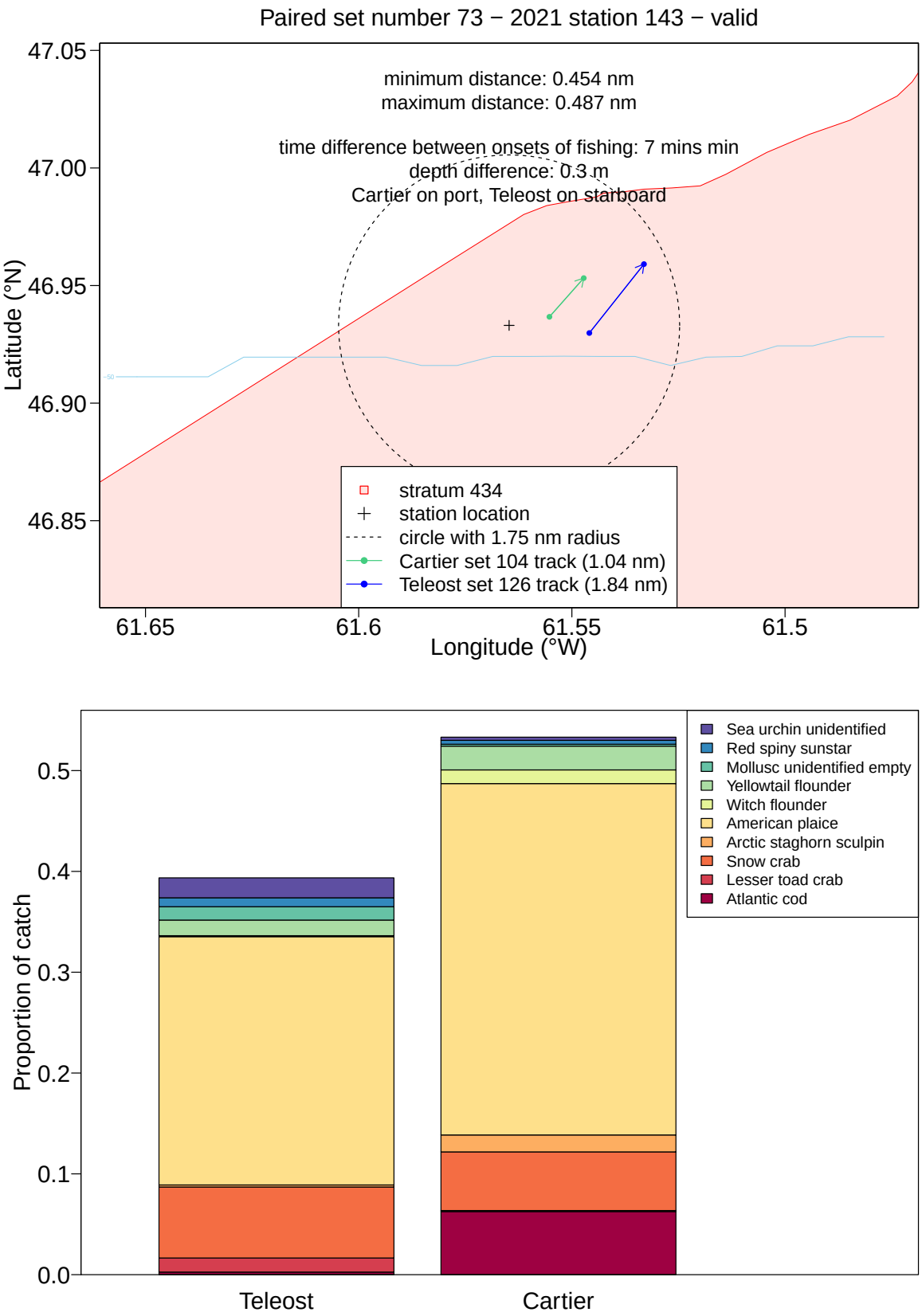

Figure 80. Tow tracks and major species composition for station 143 in 2021.

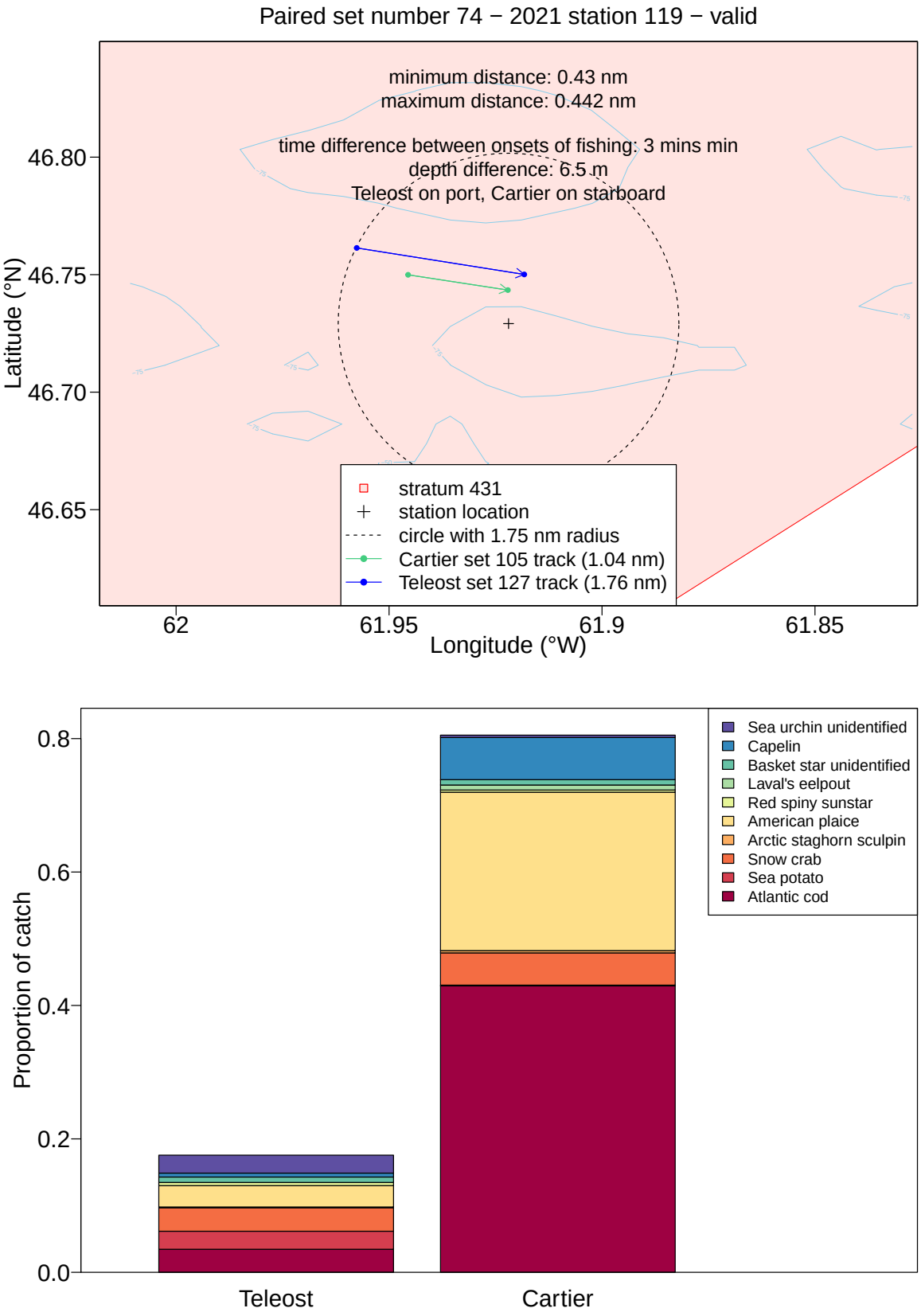

Figure 81. Tow tracks and major species composition for station 119 in 2021.

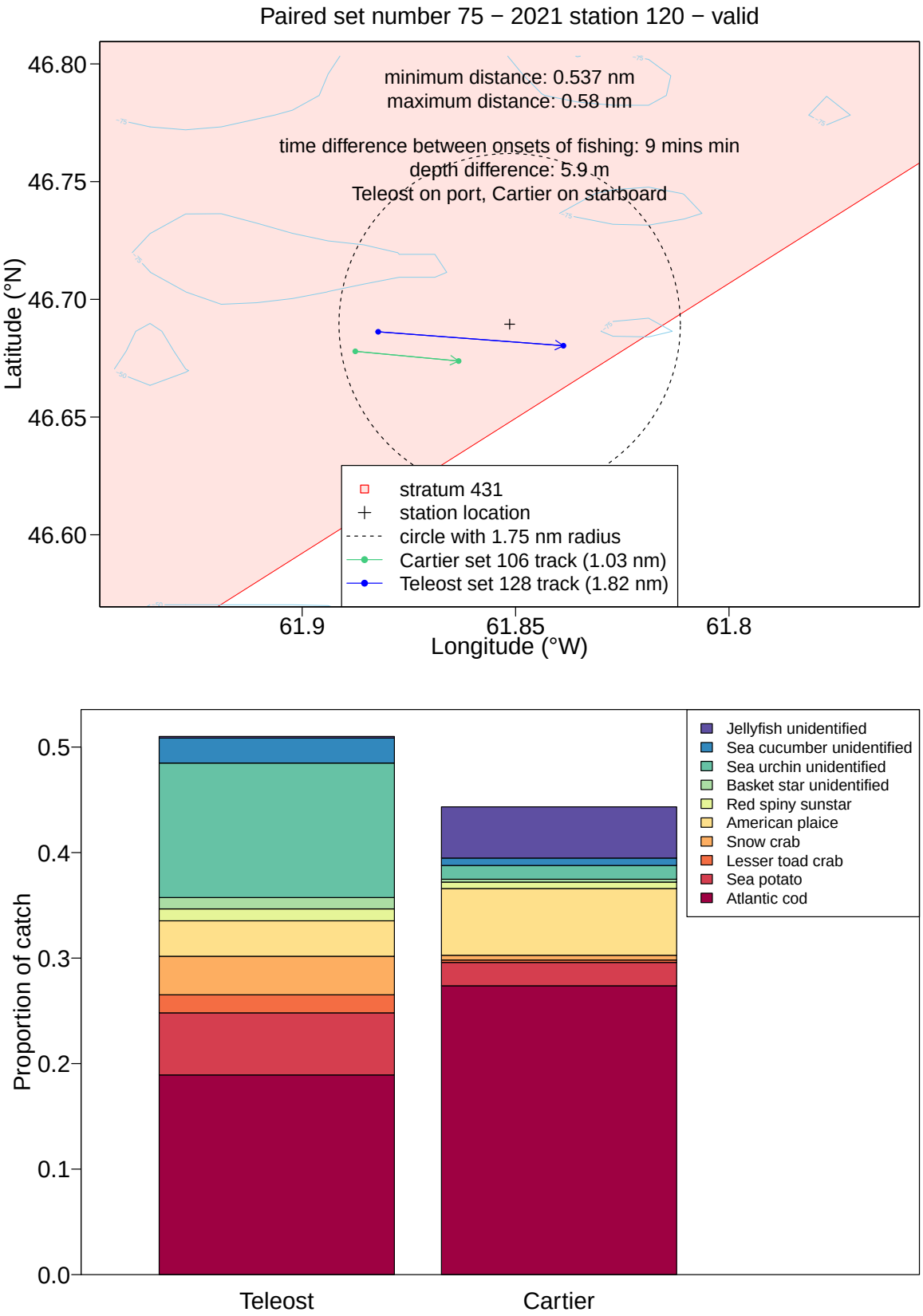

Figure 82. Tow tracks and major species composition for station 120 in 2021.

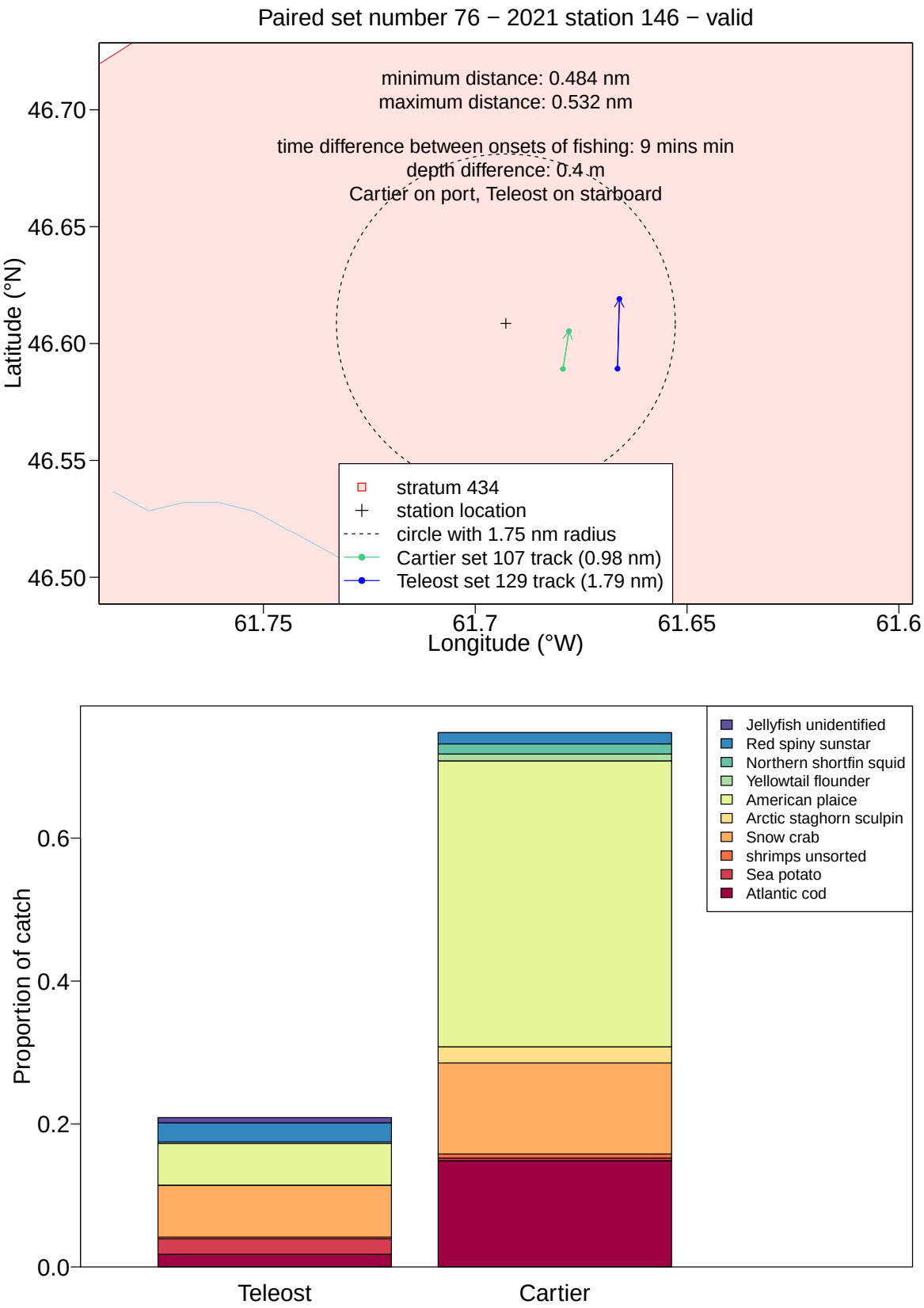

Figure 83. Tow tracks and major species composition for station 146 in 2021.

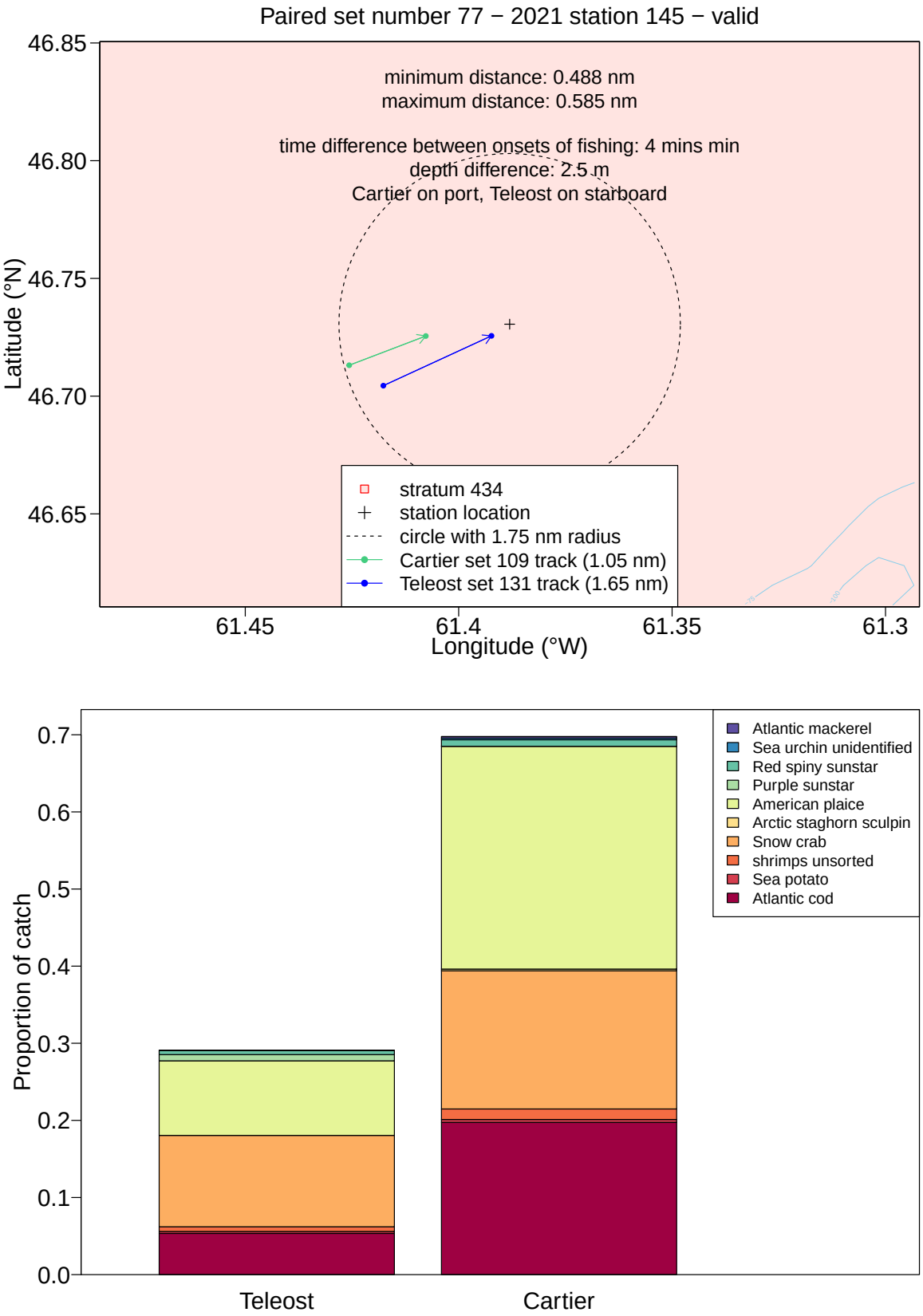

Figure 84. Tow tracks and major species composition for station 145 in 2021.

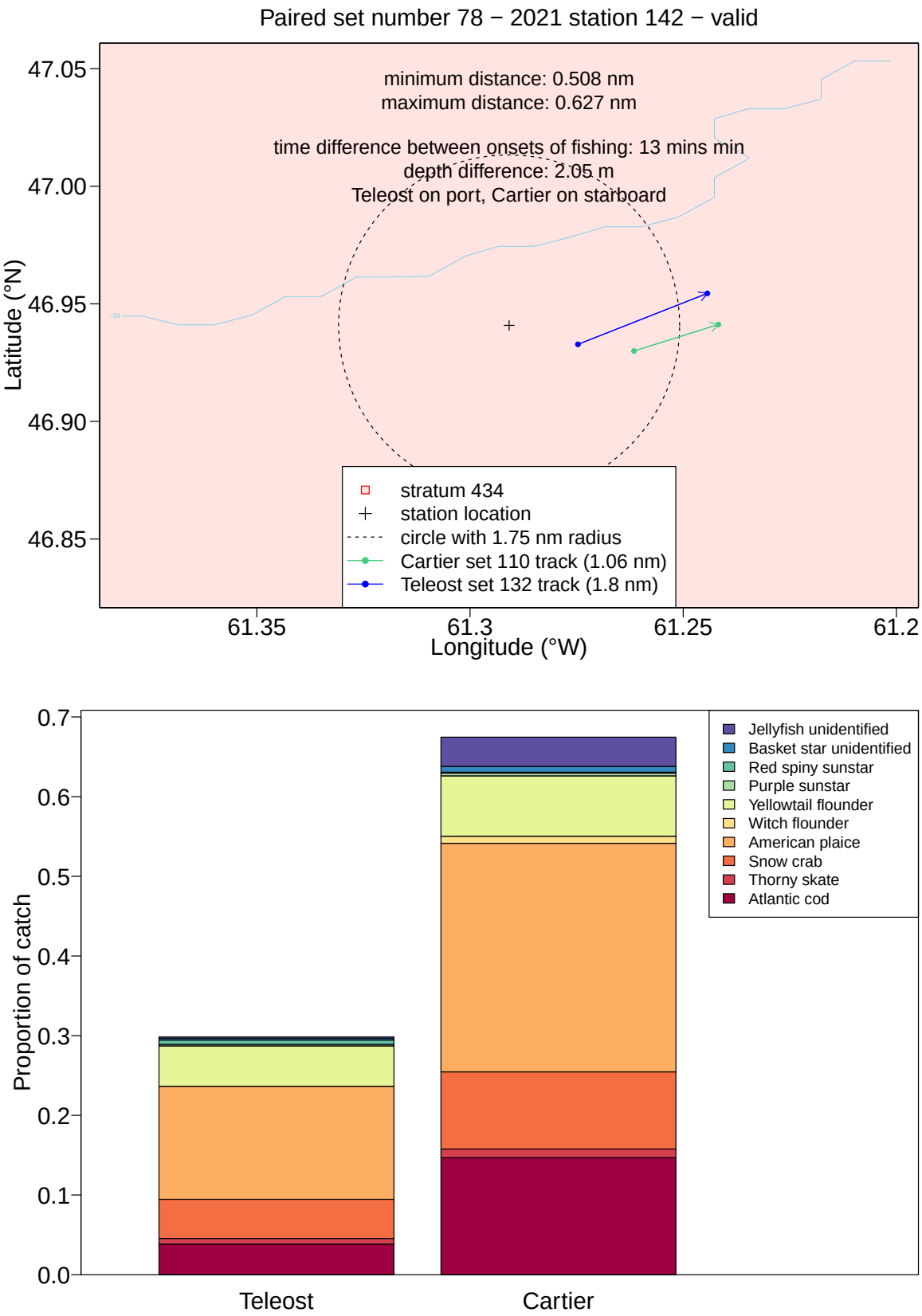

Figure 85. Tow tracks and major species composition for station 142 in 2021.

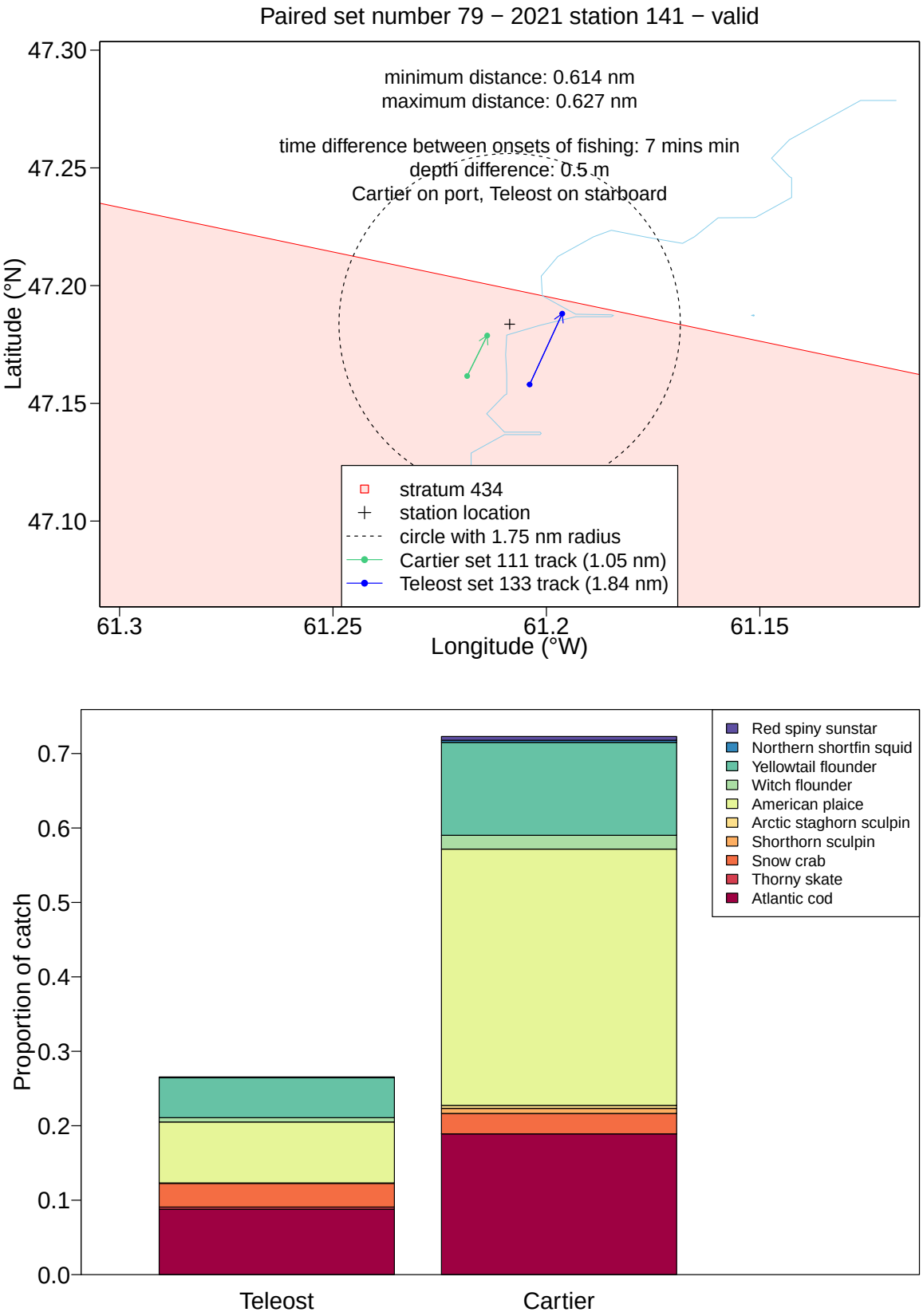

Figure 86. Tow tracks and major species composition for station 141 in 2021.

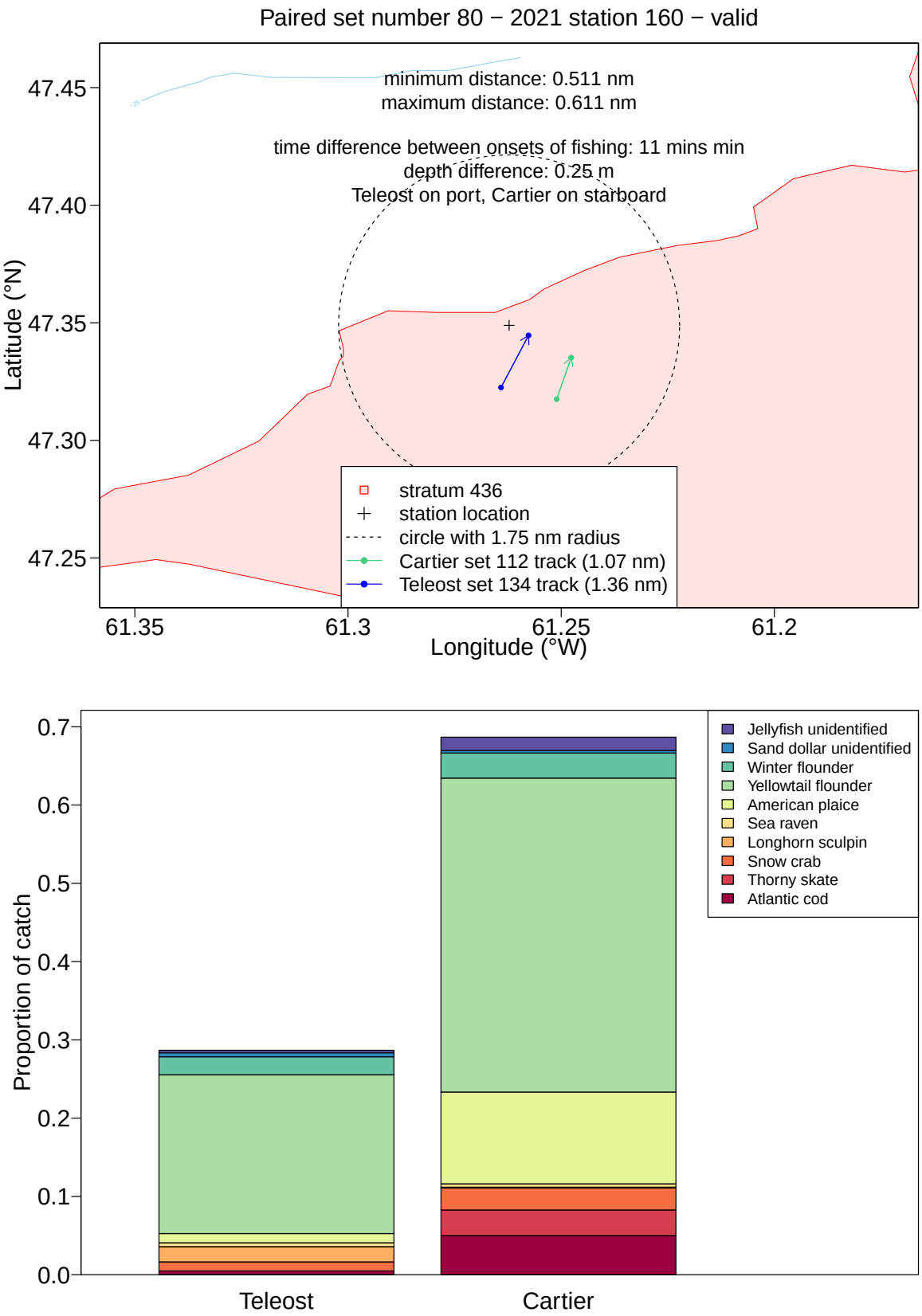

Figure 87. Tow tracks and major species composition for station 160 in 2021.

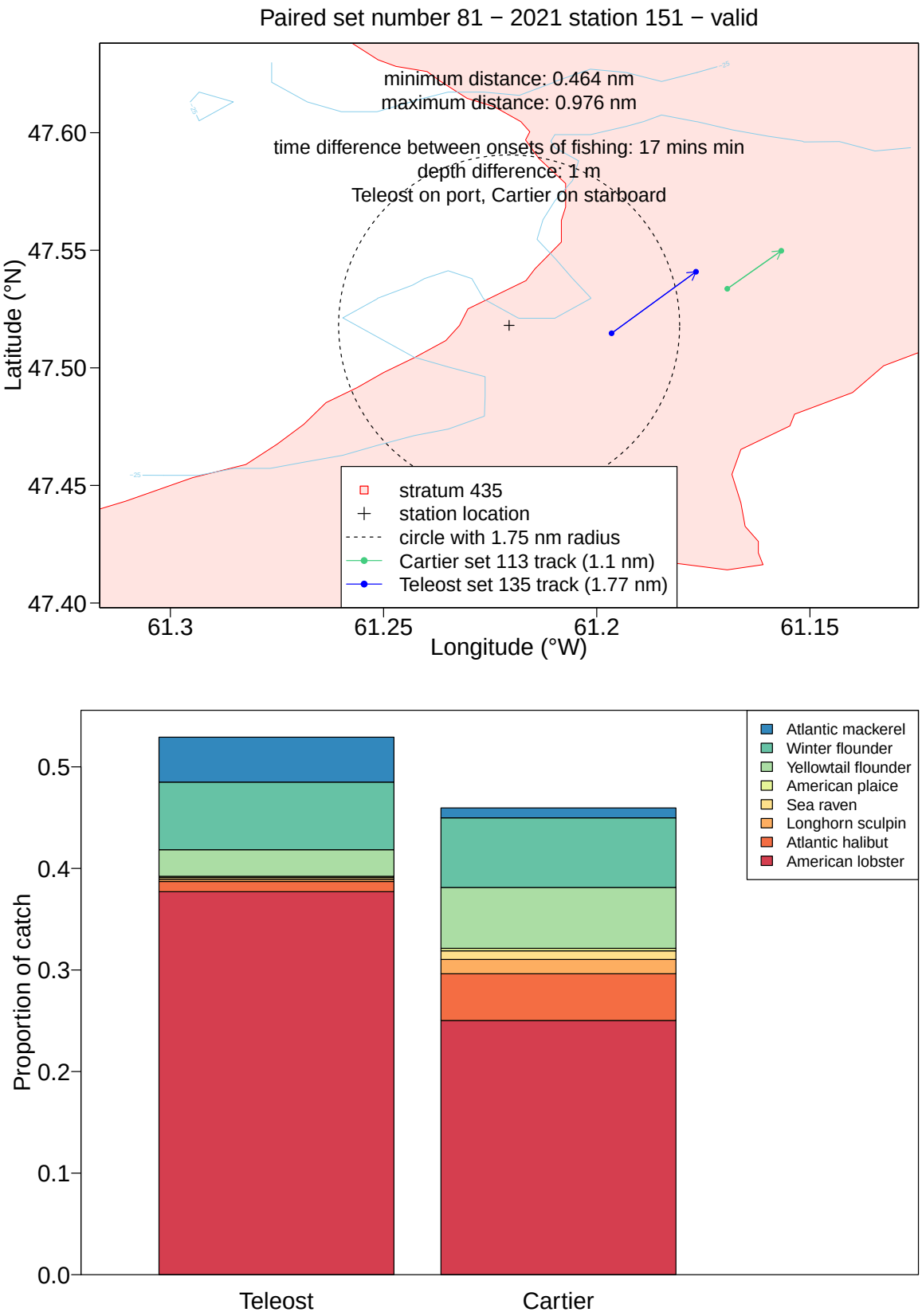

Figure 88. Tow tracks and major species composition for station 151 in 2021.

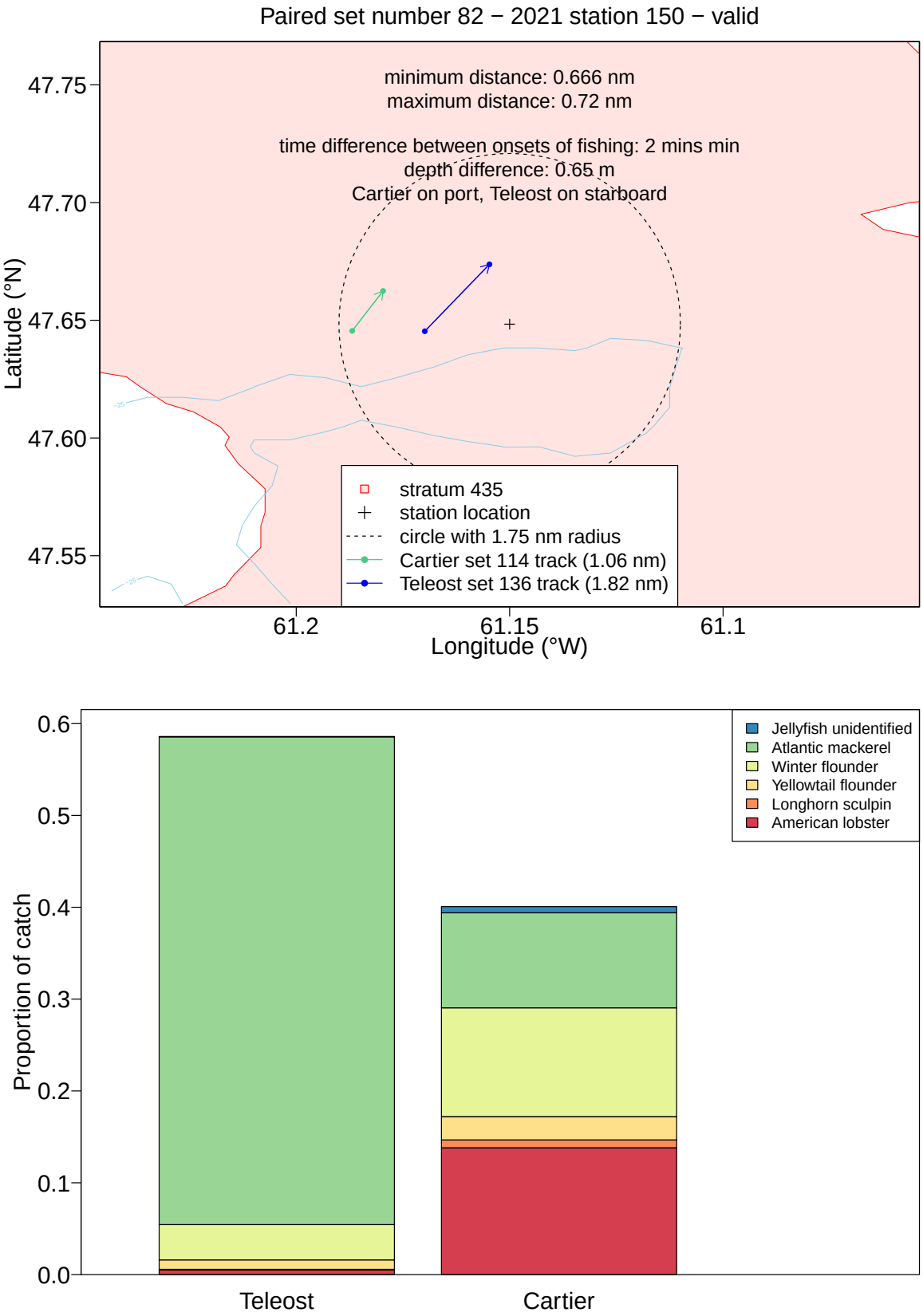

Figure 89. Tow tracks and major species composition for station 150 in 2021.

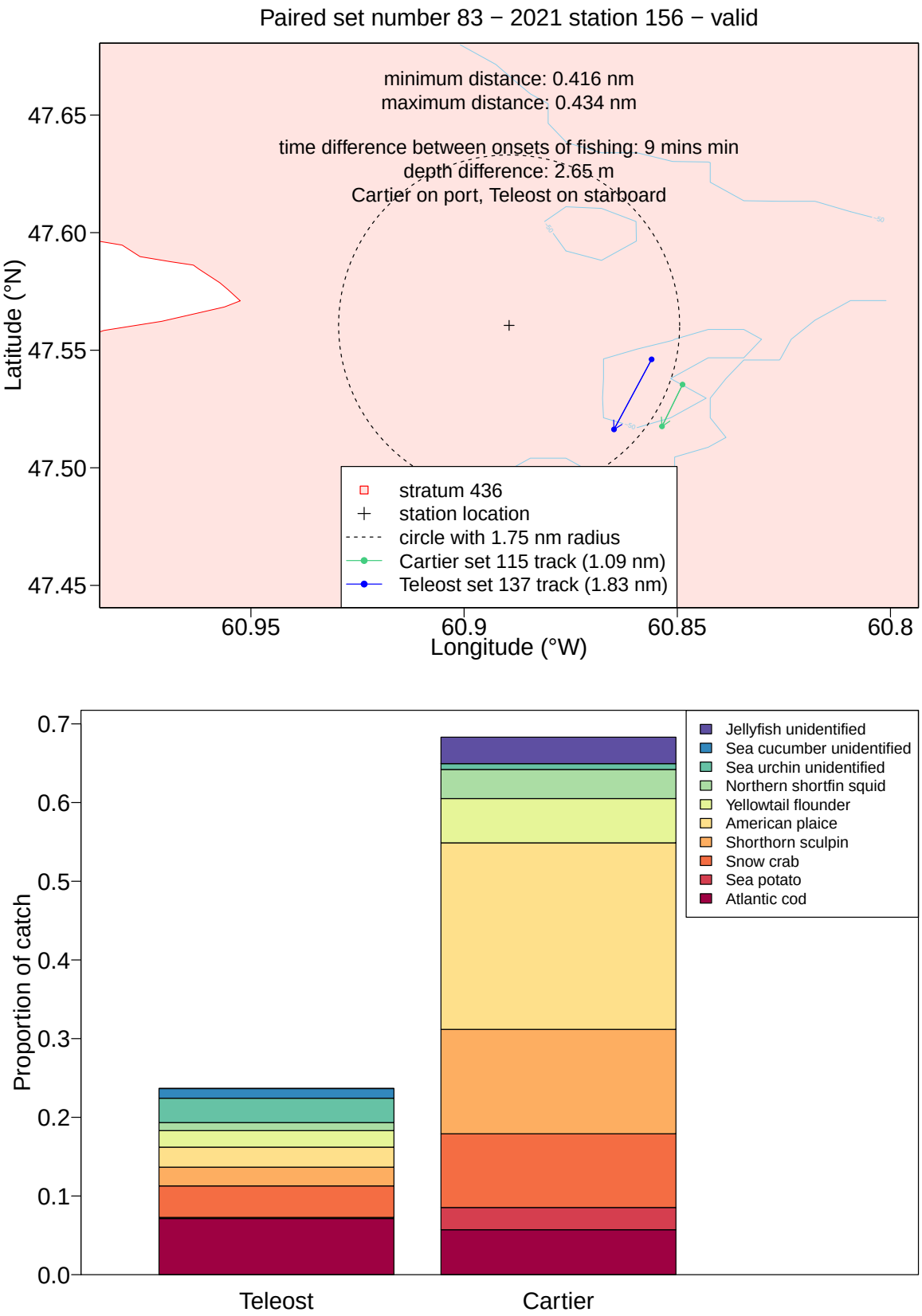

Figure 90. Tow tracks and major species composition for station 156 in 2021.

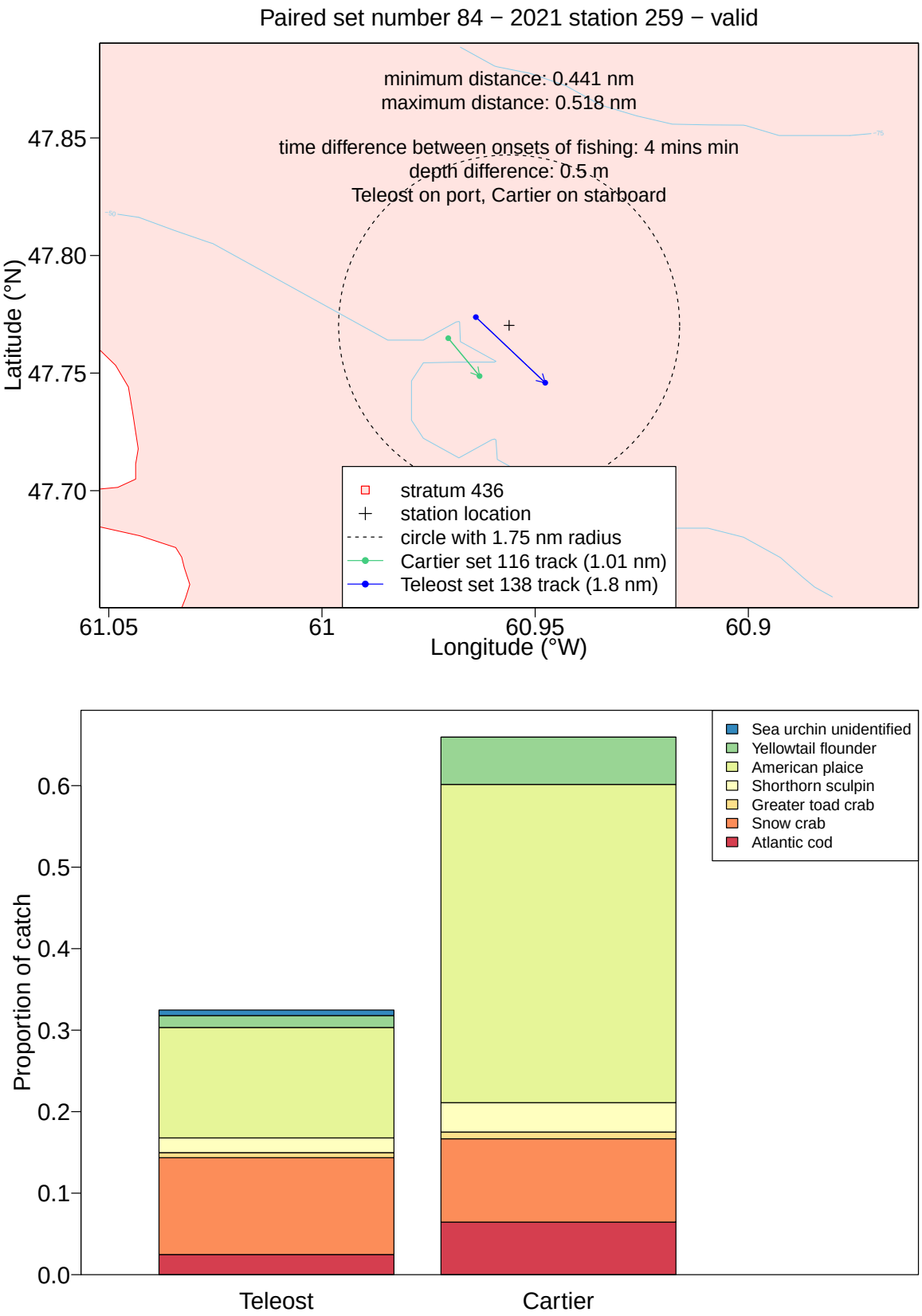

Figure 91. Tow tracks and major species composition for station 259 in 2021.

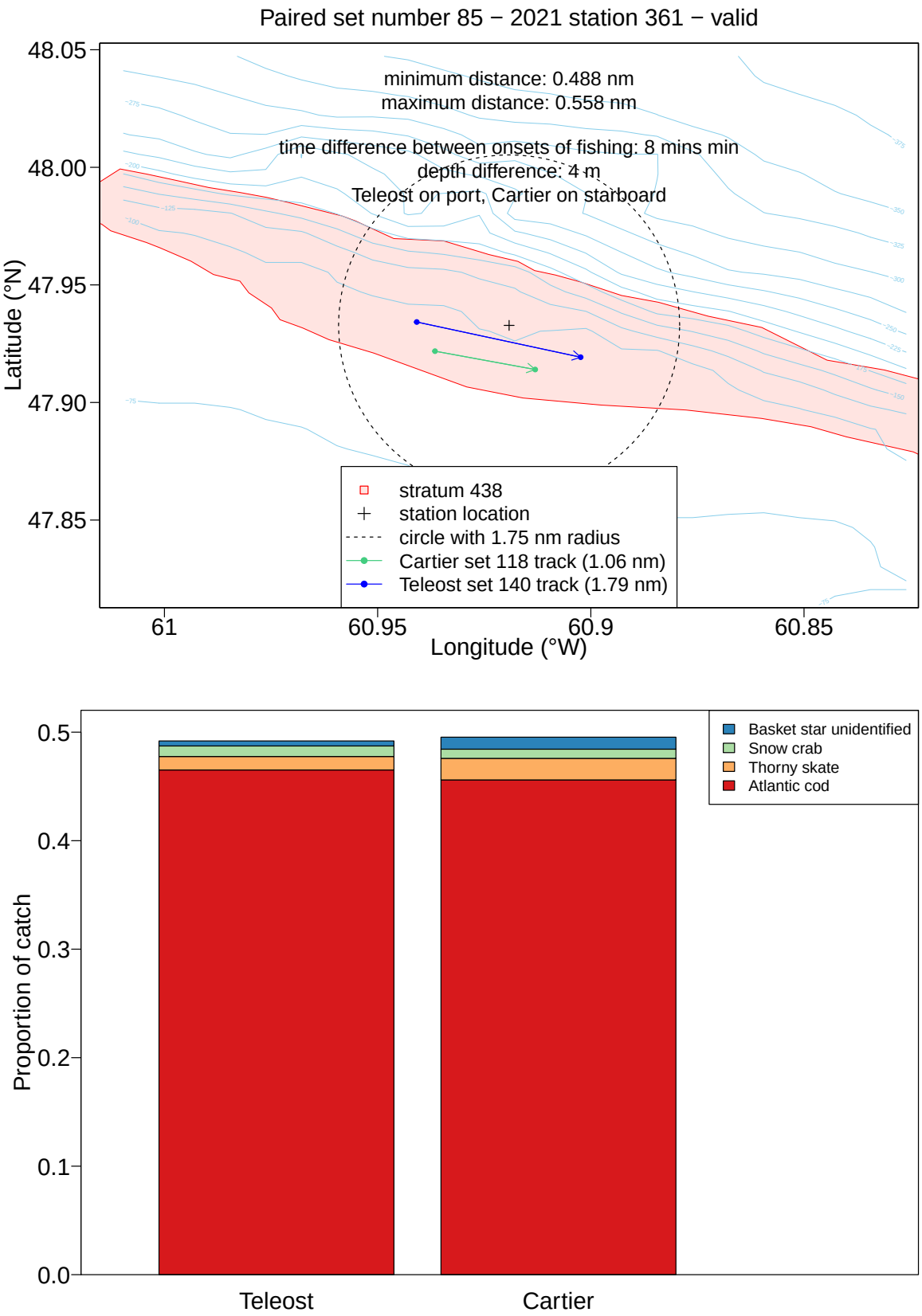

Figure 92. Tow tracks and major species composition for station 361 in 2021.

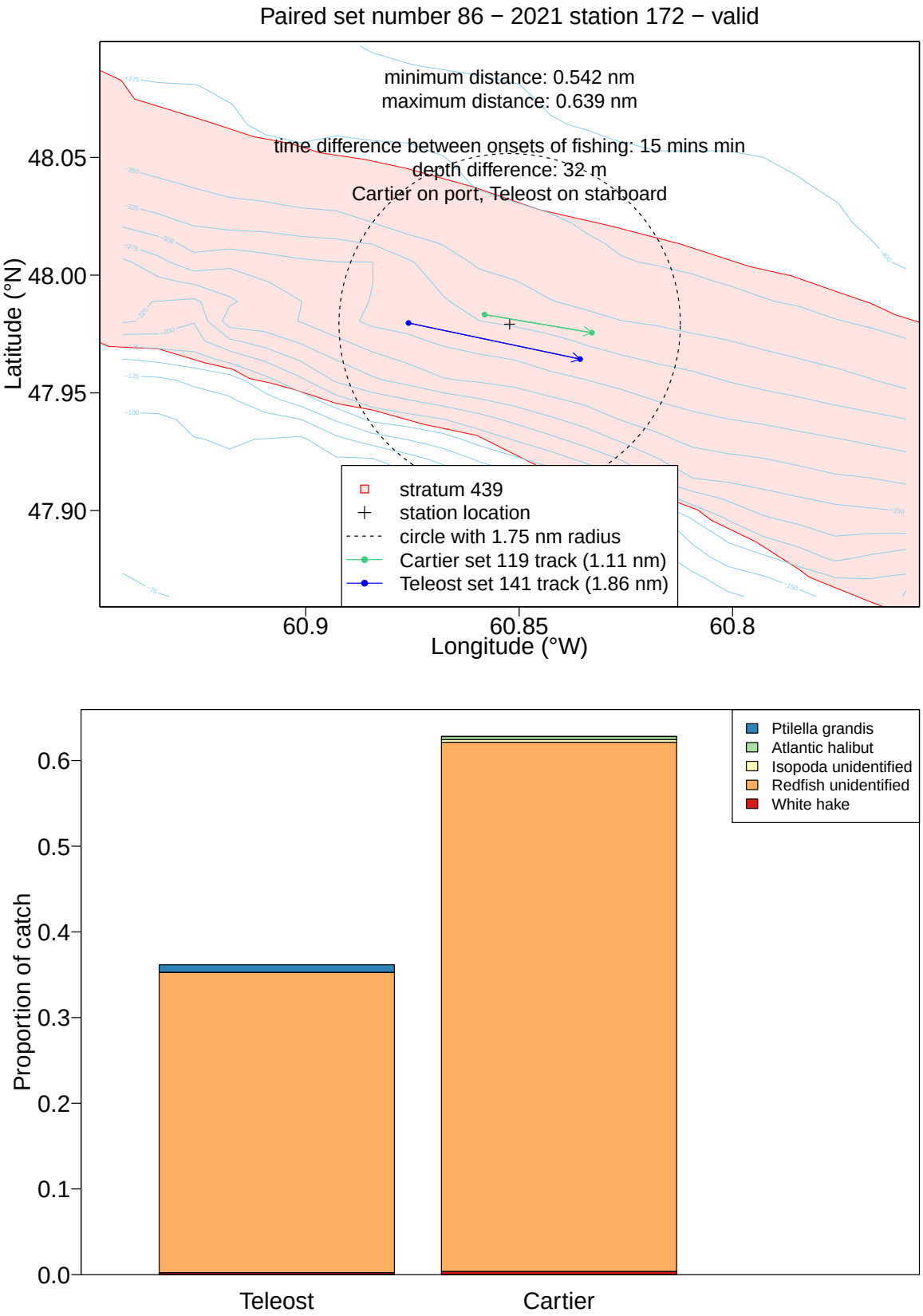

Figure 93. Tow tracks and major species composition for station 172 in 2021.

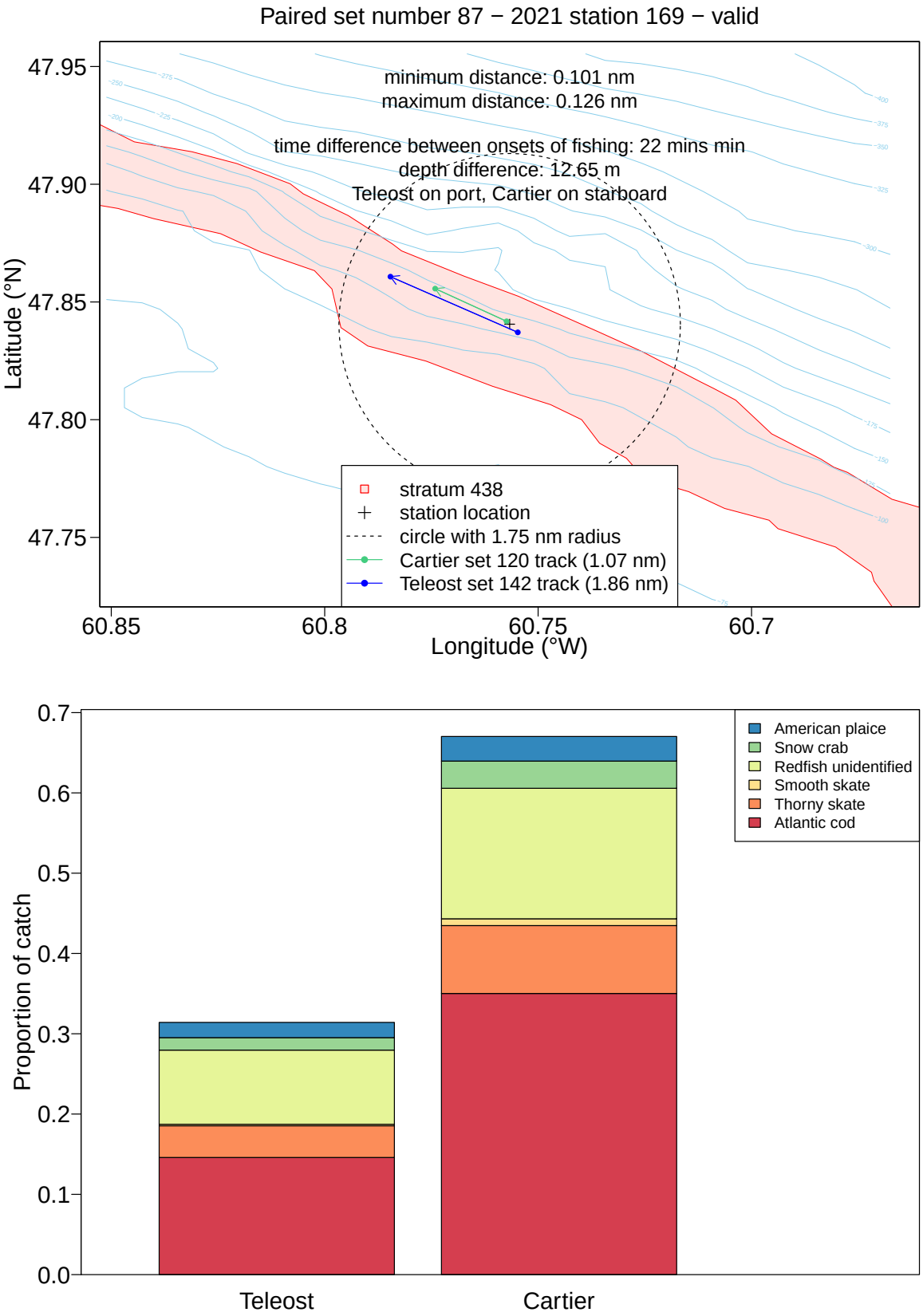

Figure 94. Tow tracks and major species composition for station 169 in 2021.

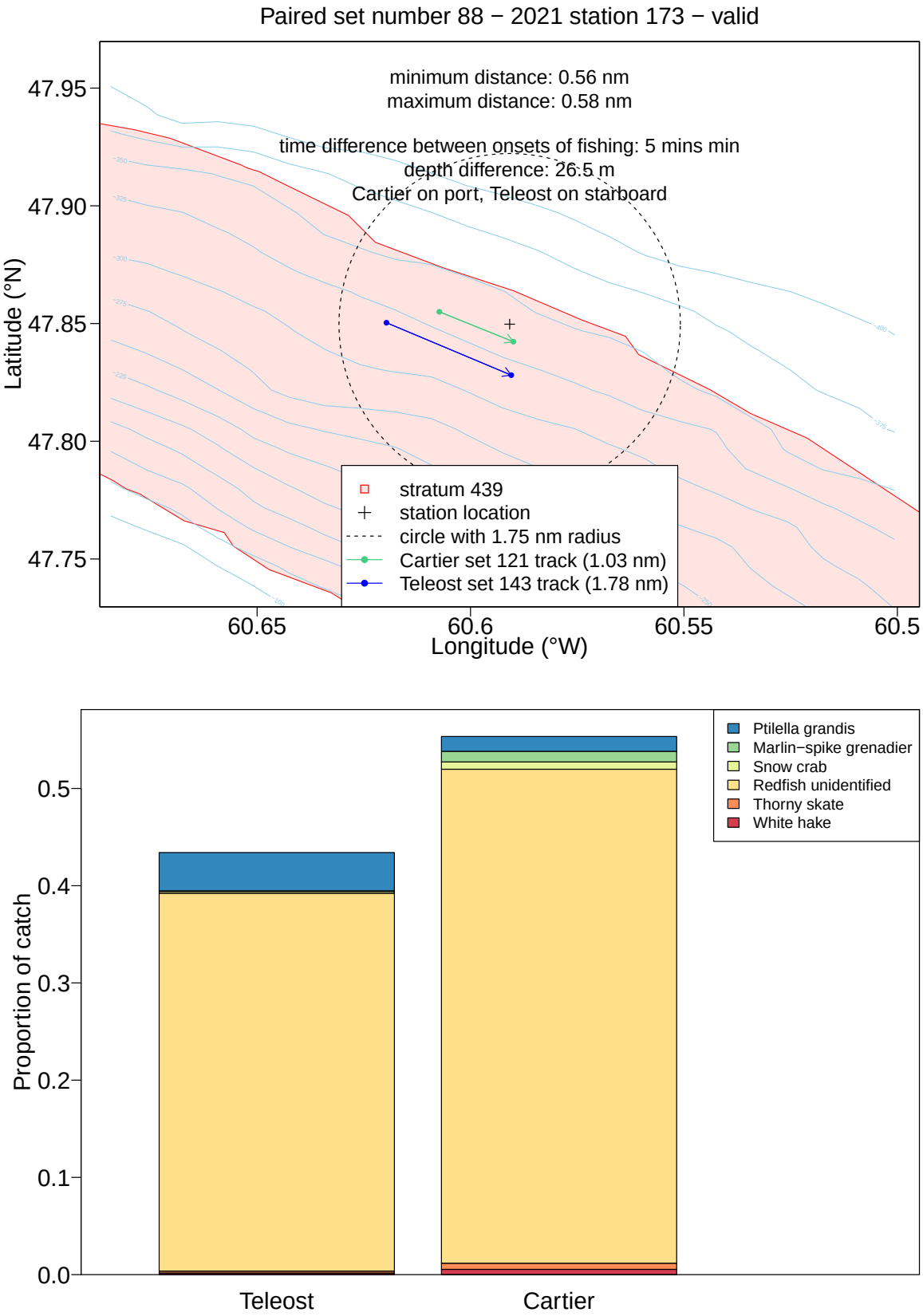

Figure 95. Tow tracks and major species composition for station 173 in 2021.

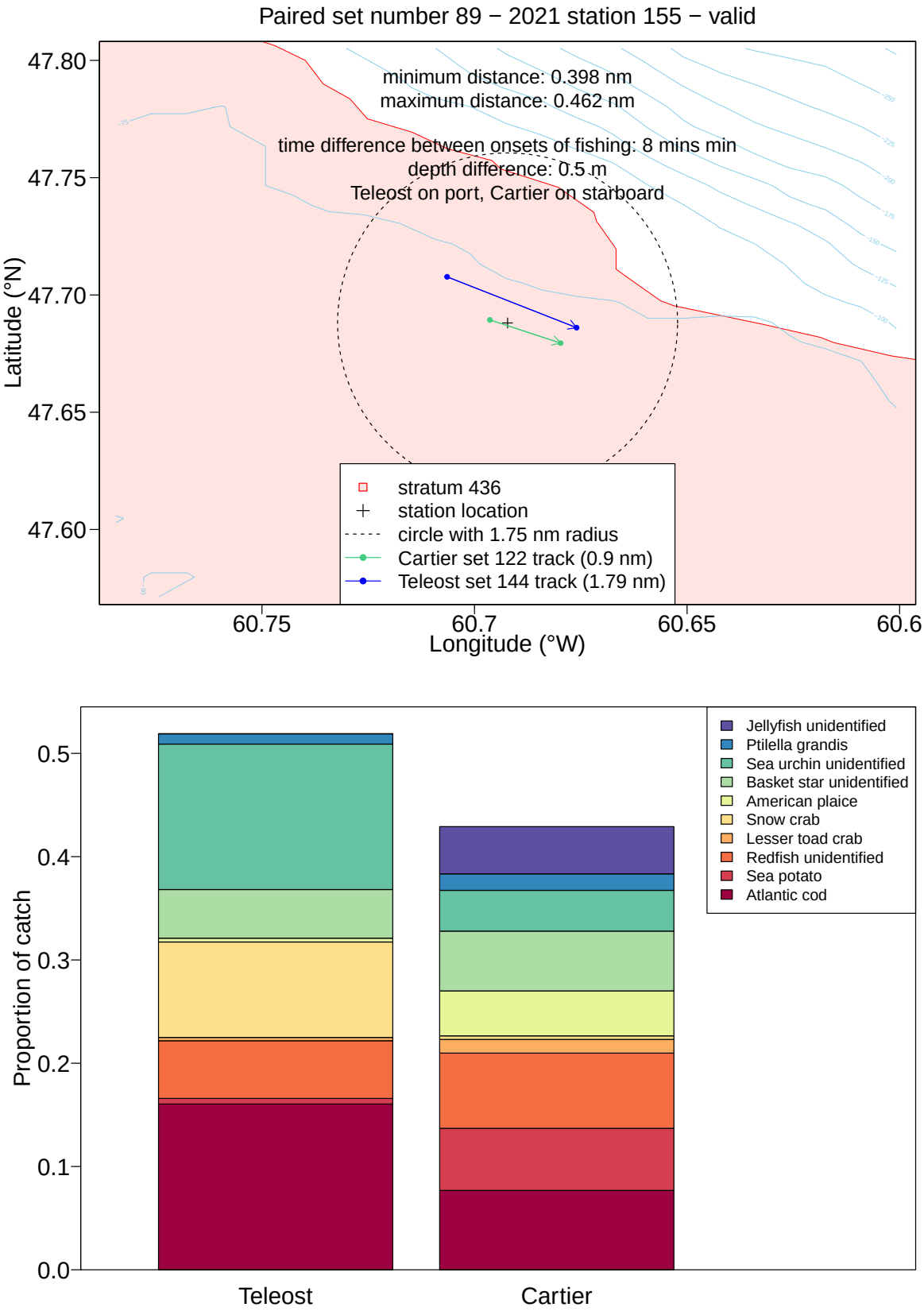

Figure 96. Tow tracks and major species composition for station 155 in 2021.

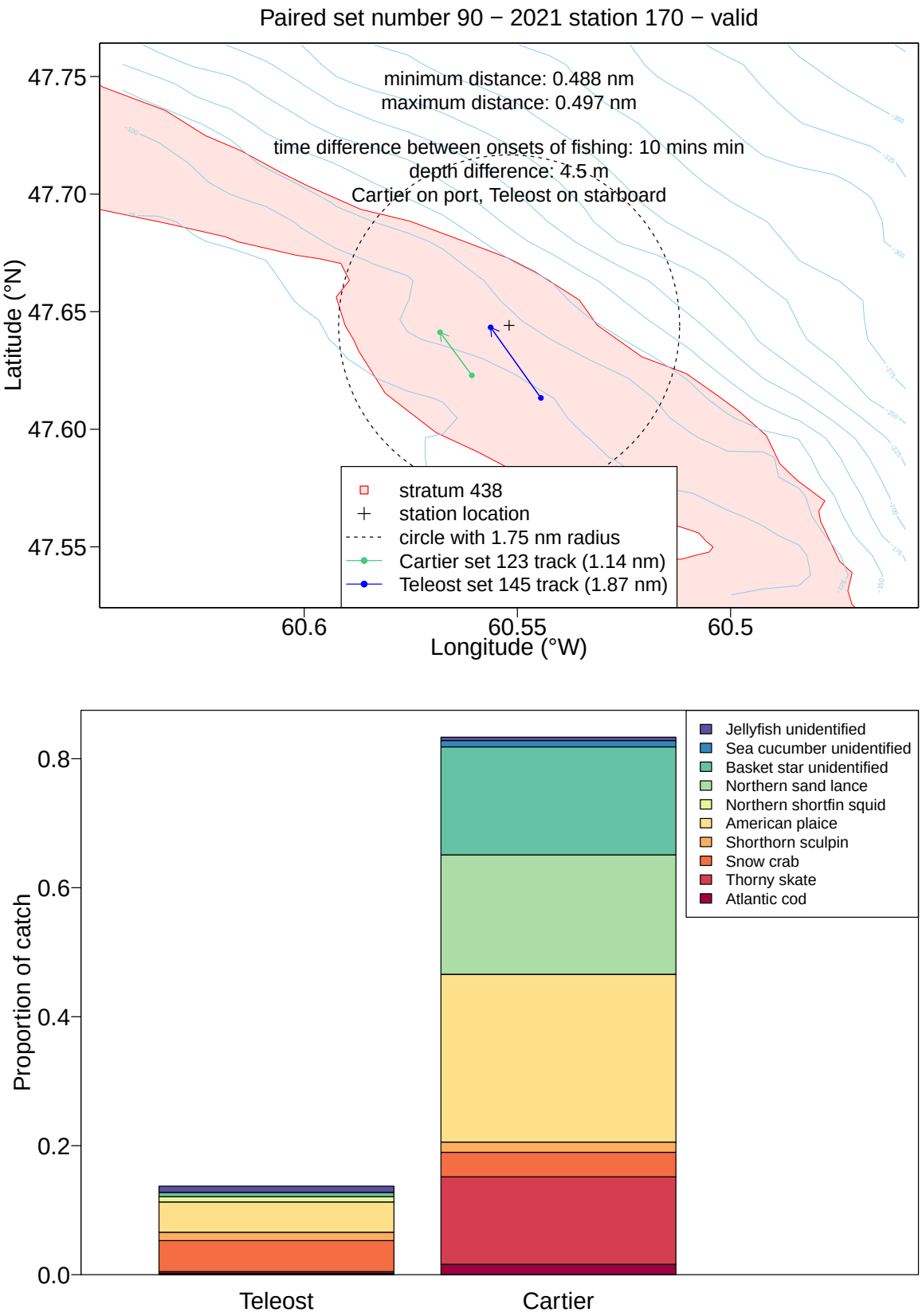

Figure 97. Tow tracks and major species composition for station 170 in 2021.

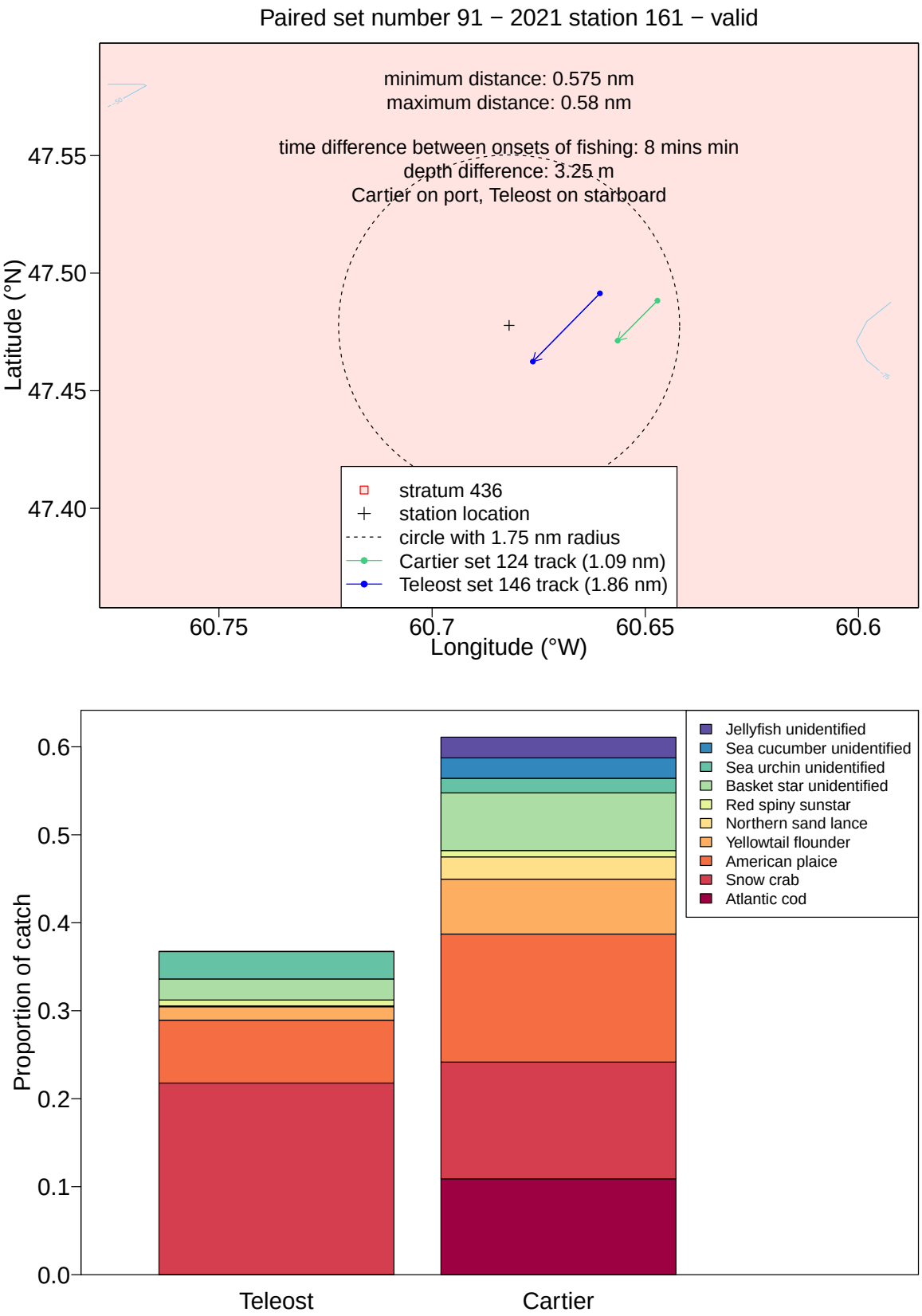

Figure 98. Tow tracks and major species composition for station 161 in 2021.

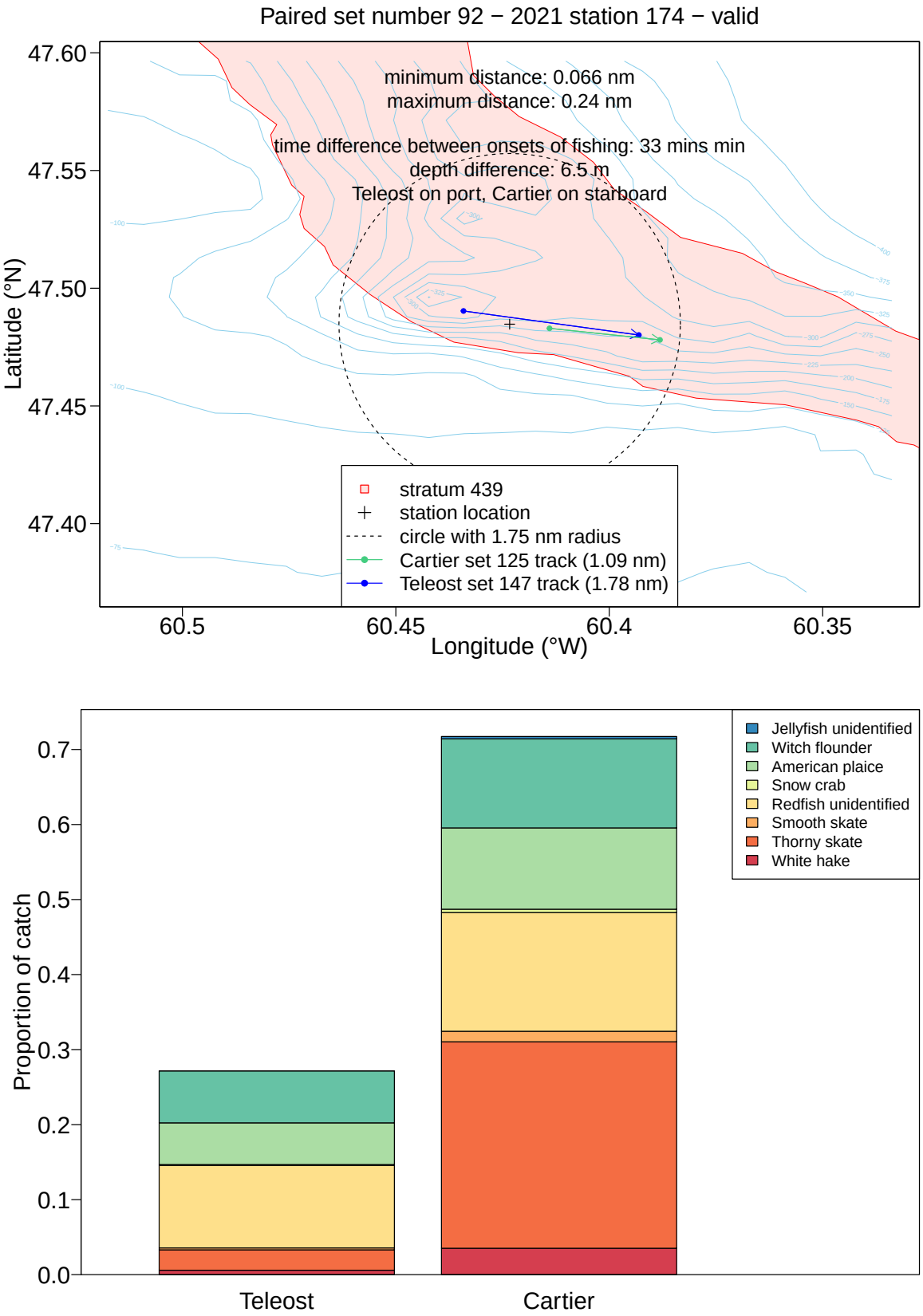

Figure 99. Tow tracks and major species composition for station 174 in 2021.

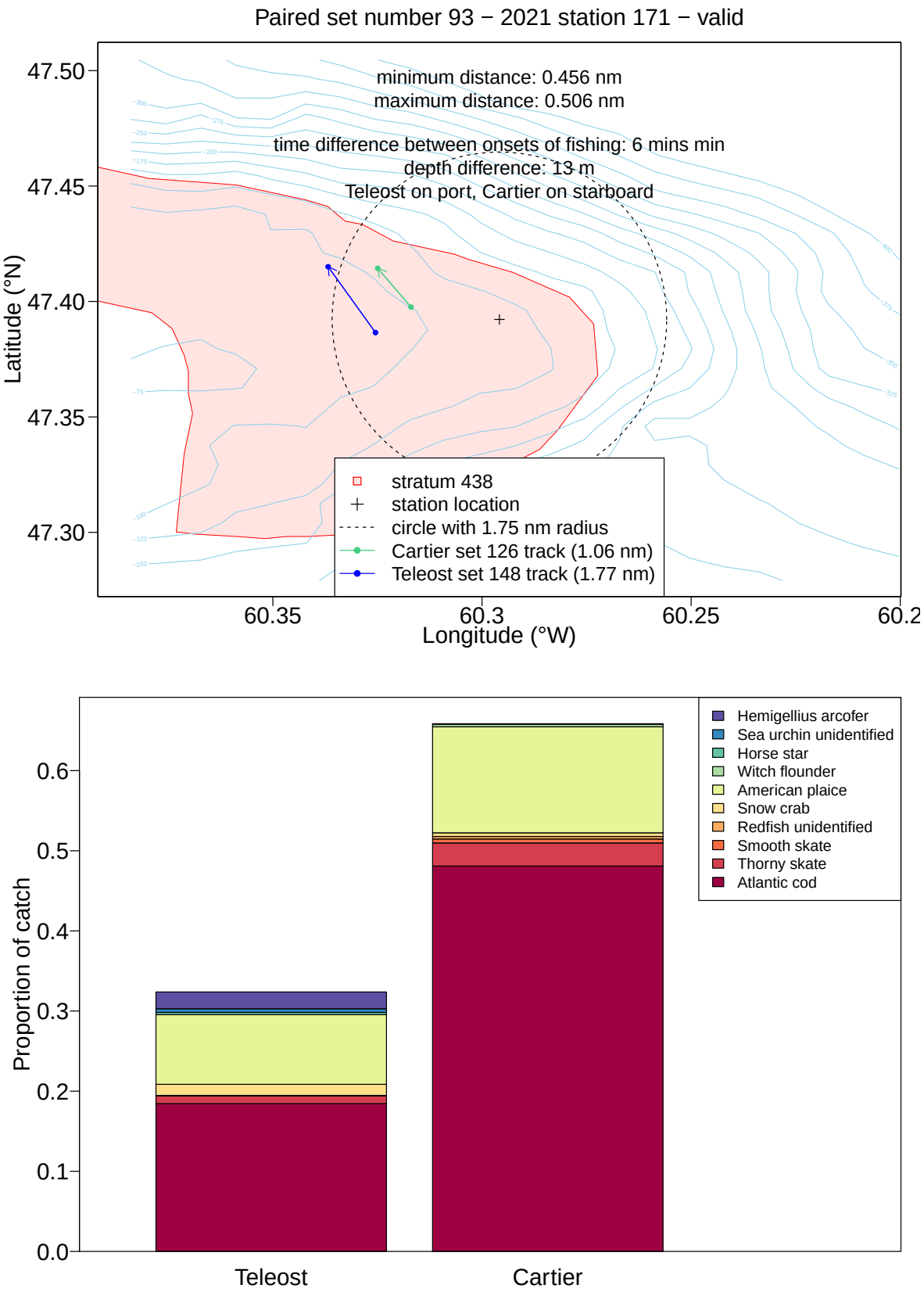

Figure 100. Tow tracks and major species composition for station 171 in 2021.

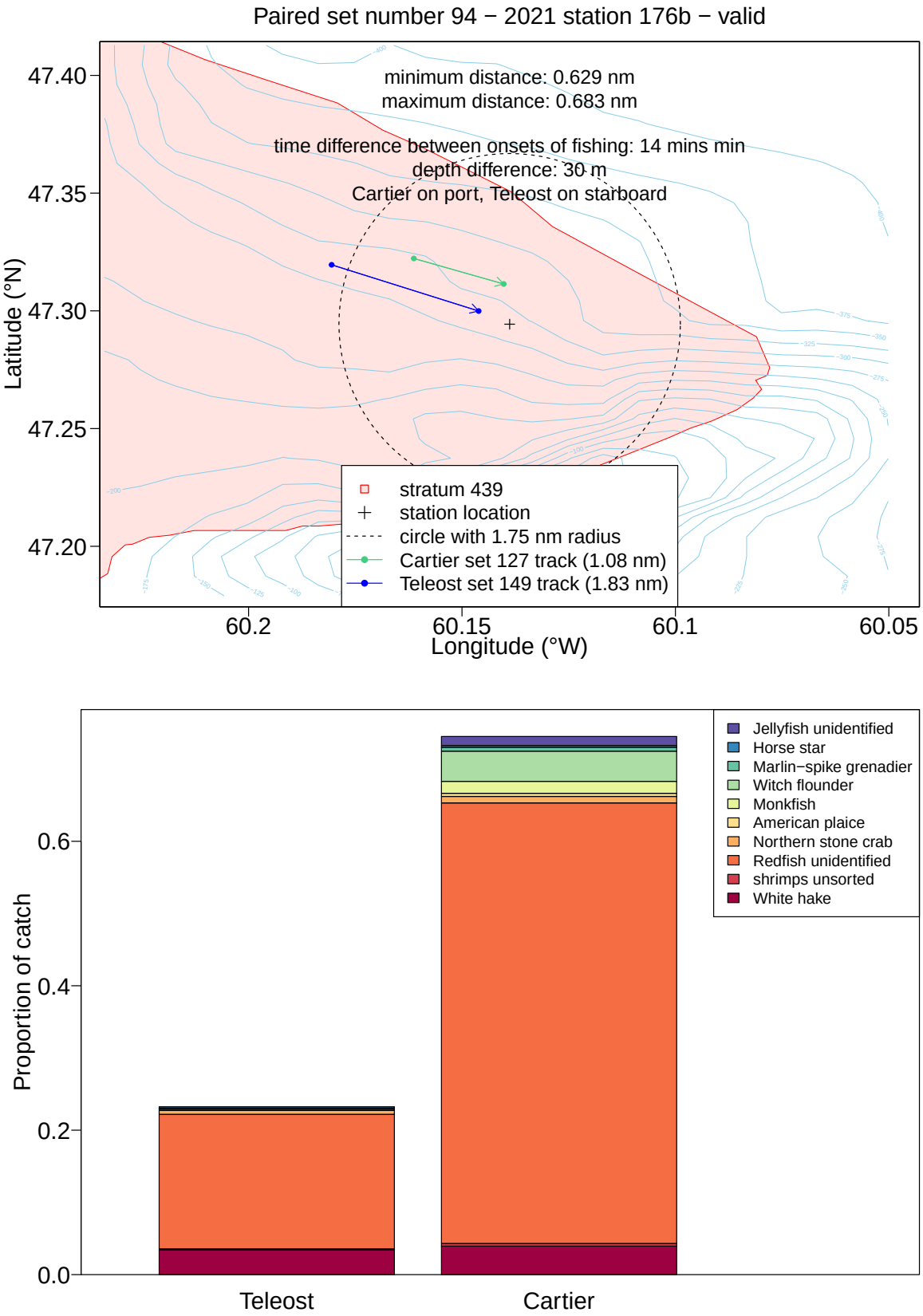

Figure 101. Tow tracks and major species composition for station 176 in 2021.

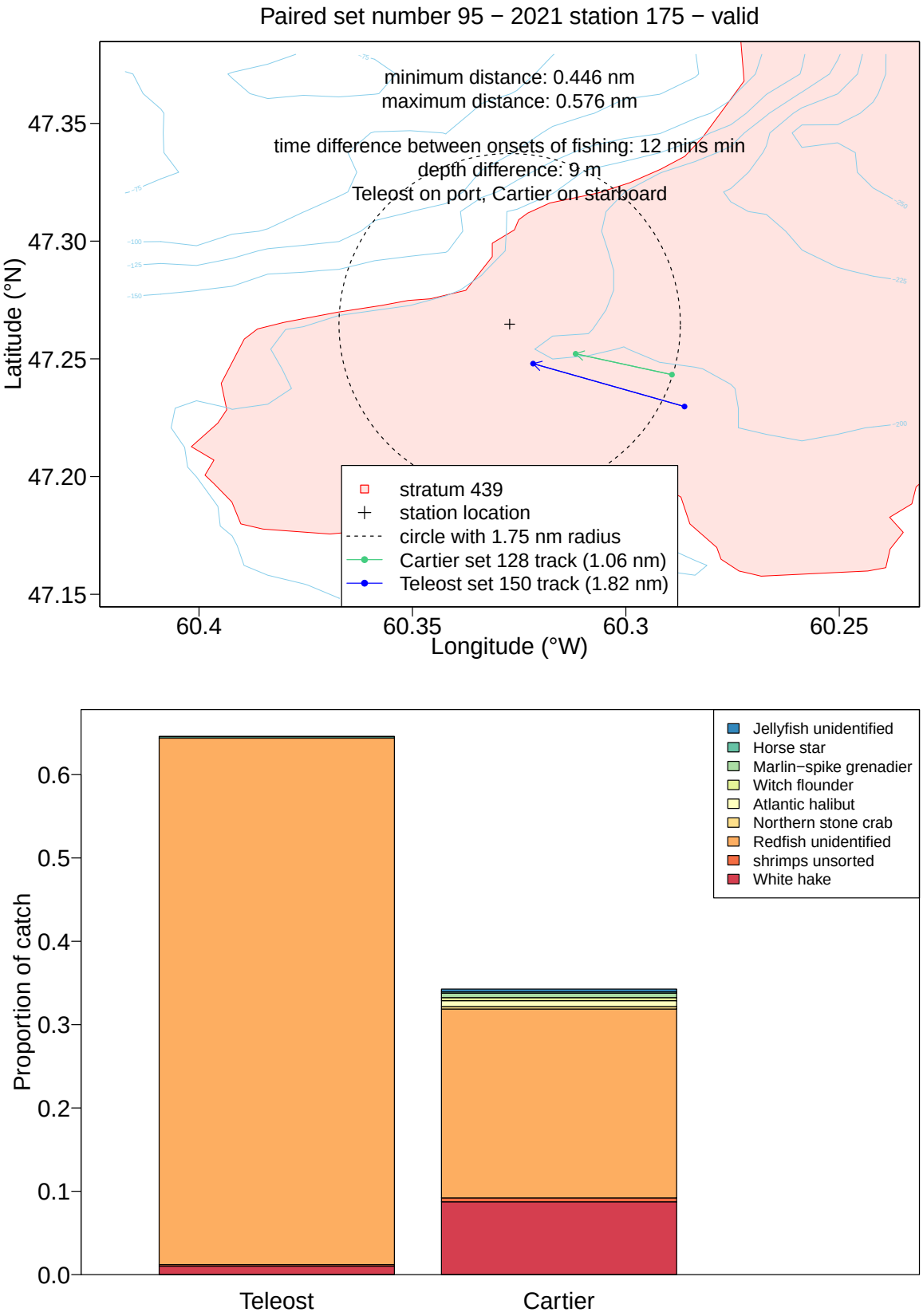

Figure 102. Tow tracks and major species composition for station 175 in 2021.

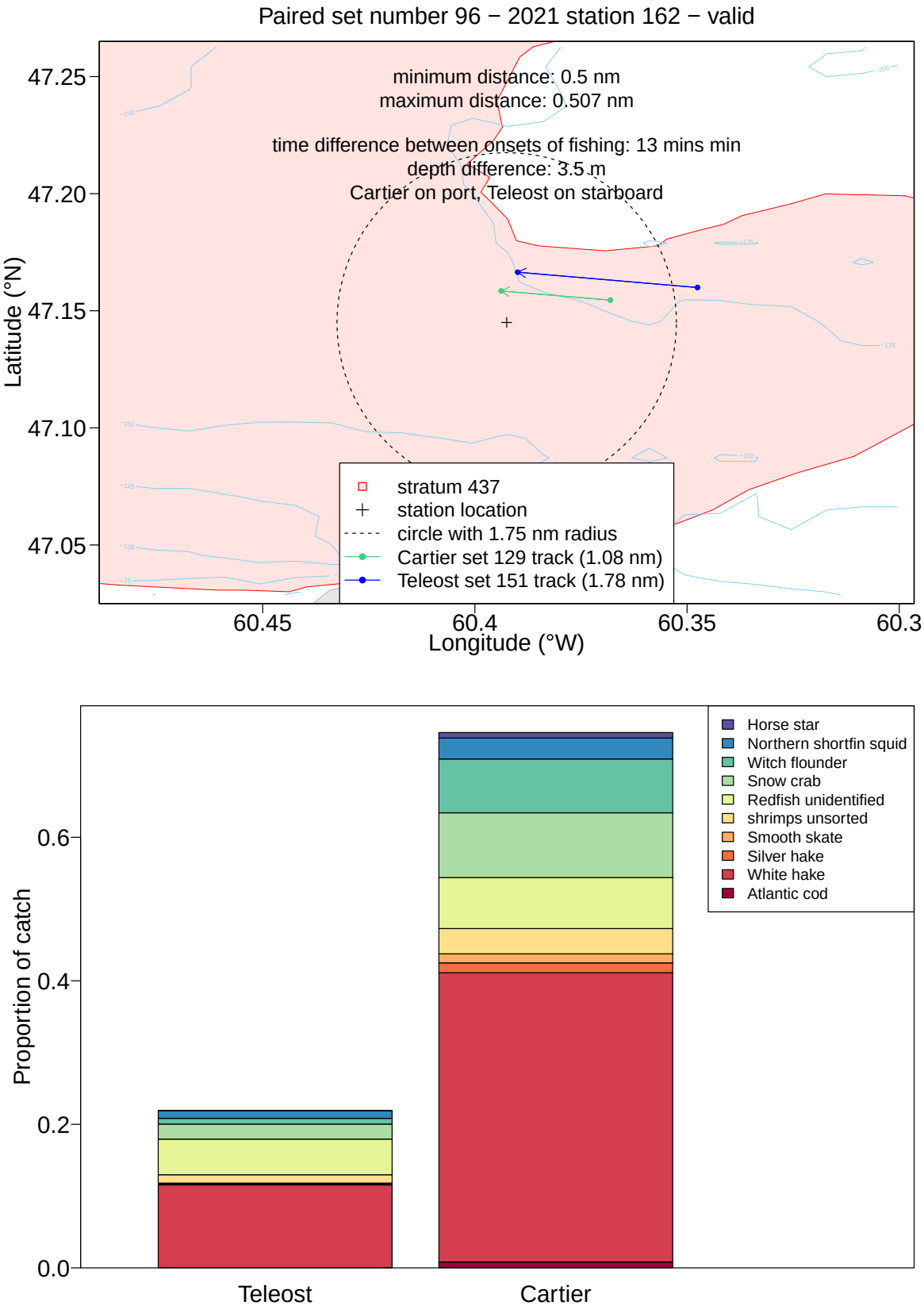

Figure 103. Tow tracks and major species composition for station 162 in 2021.

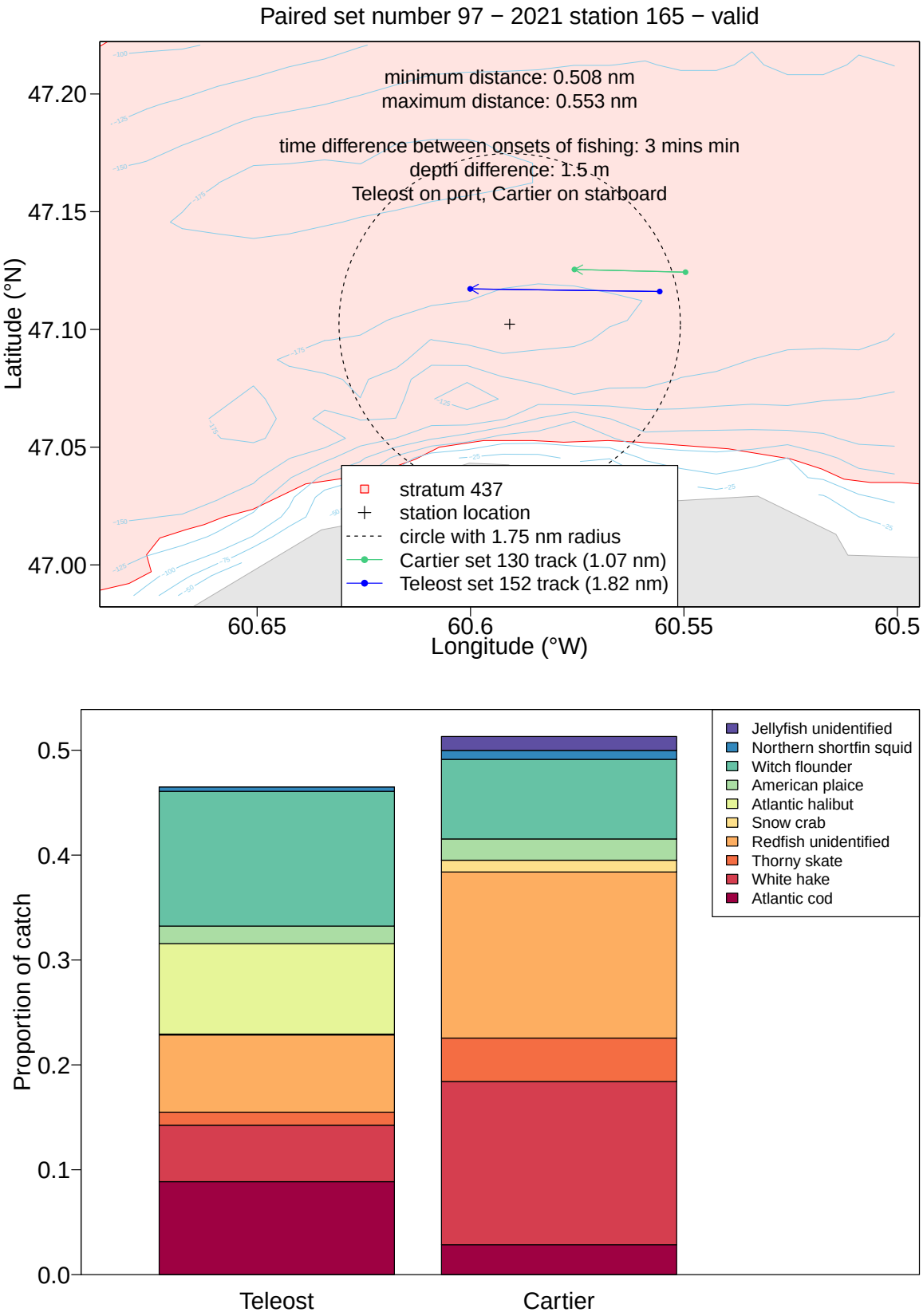

Figure 104. Tow tracks and major species composition for station 165 in 2021.

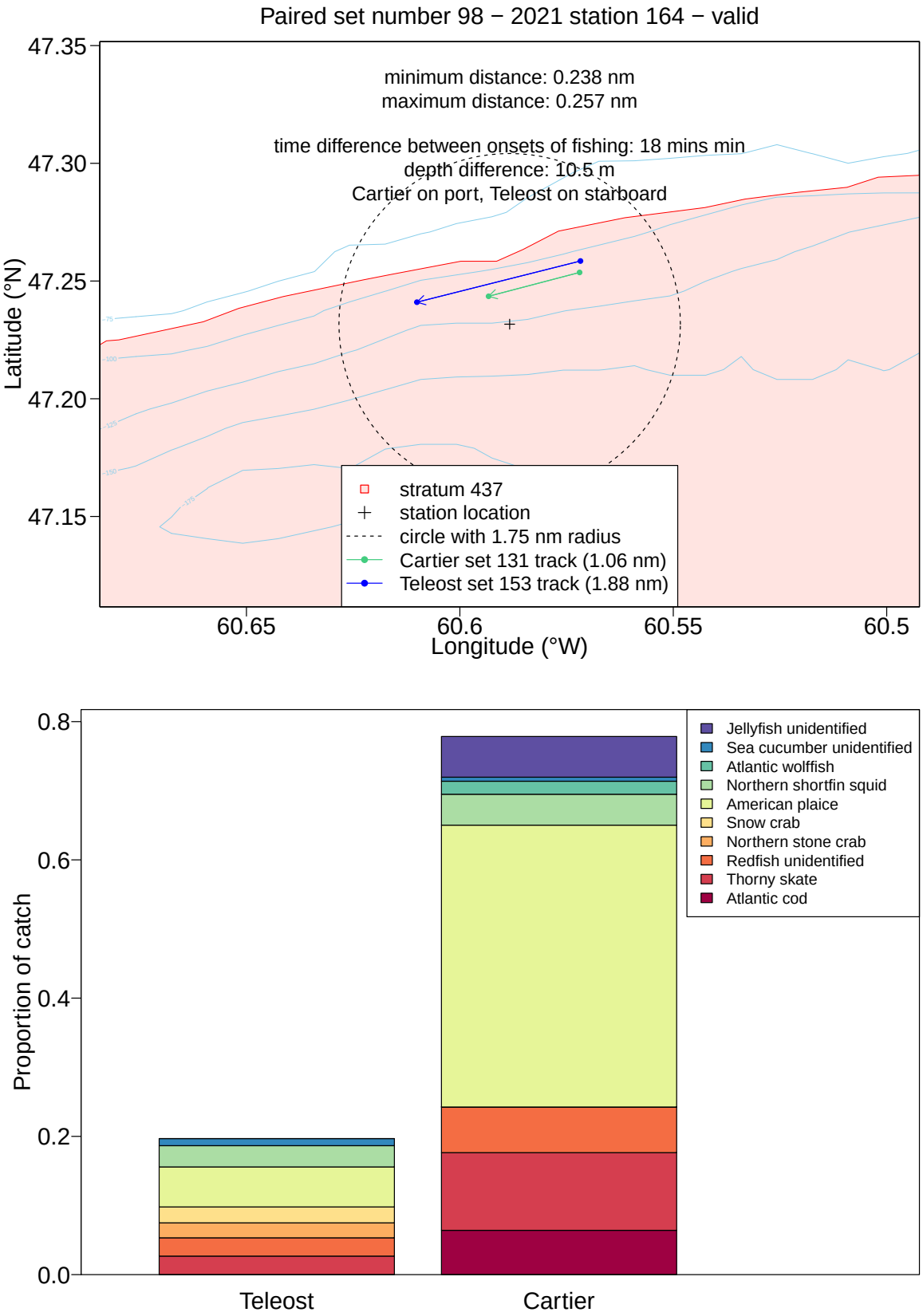

Figure 105. Tow tracks and major species composition for station 164 in 2021.

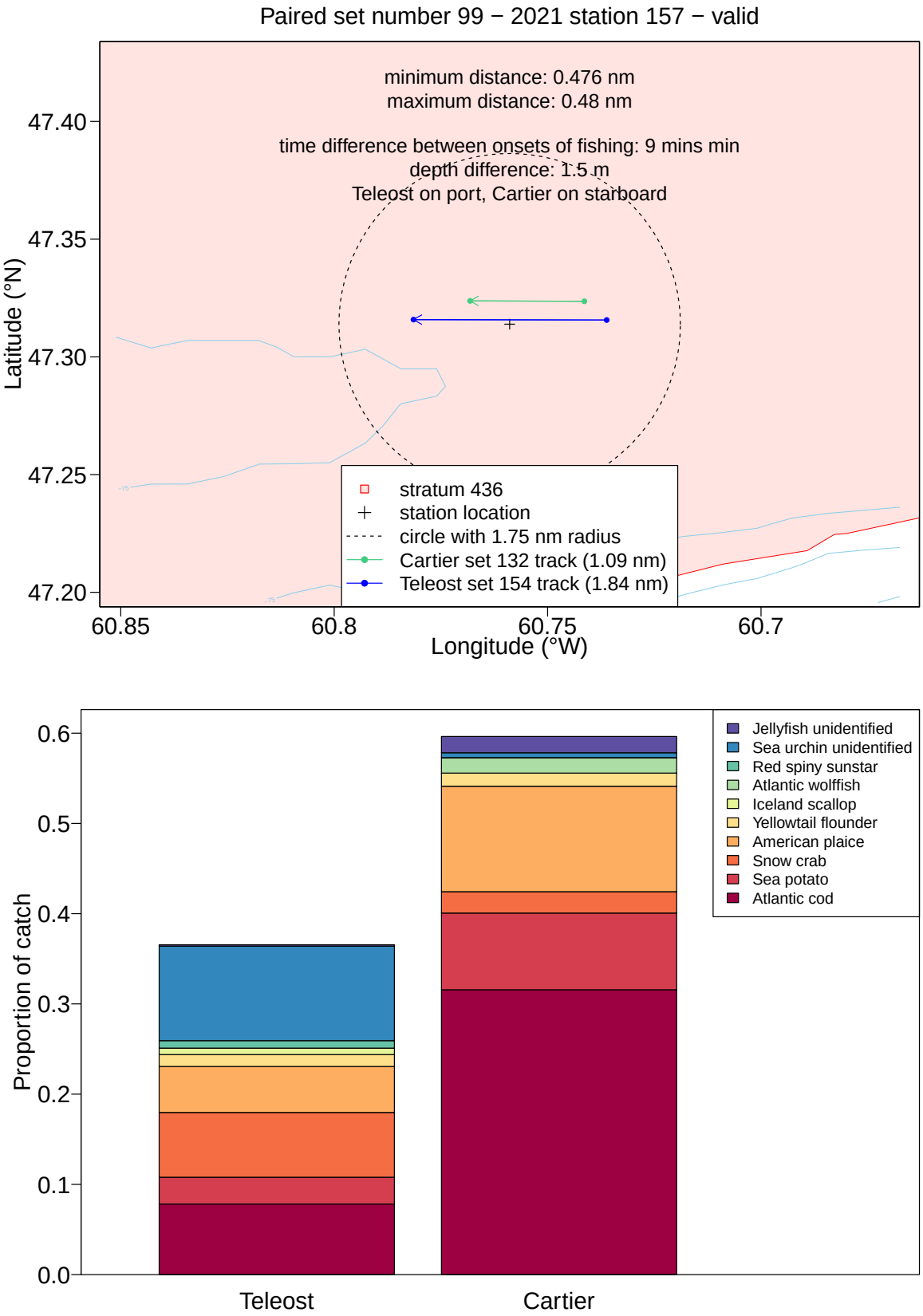

Figure 106. Tow tracks and major species composition for station 157 in 2021.

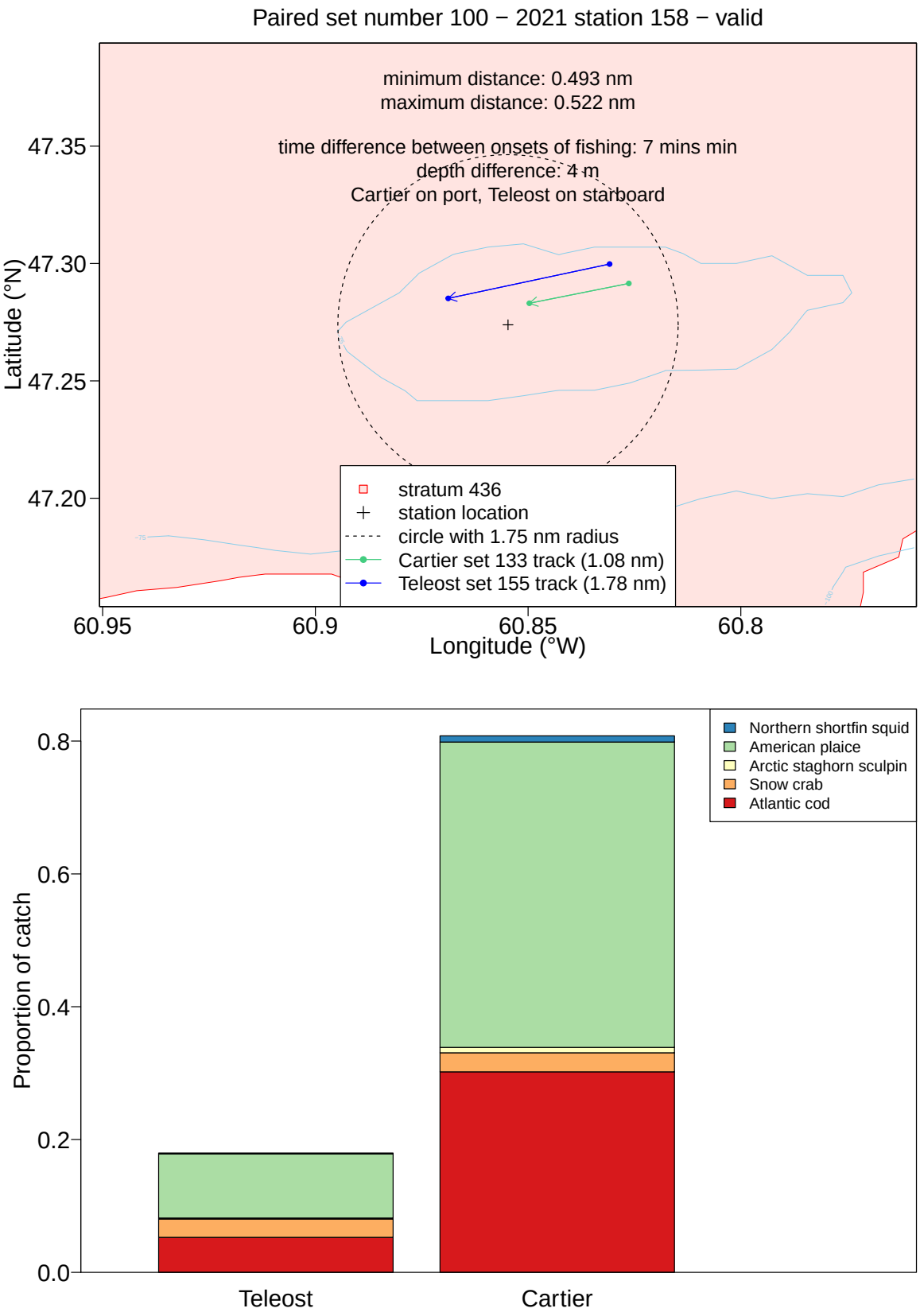

Figure 107. Tow tracks and major species composition for station 158 in 2021.

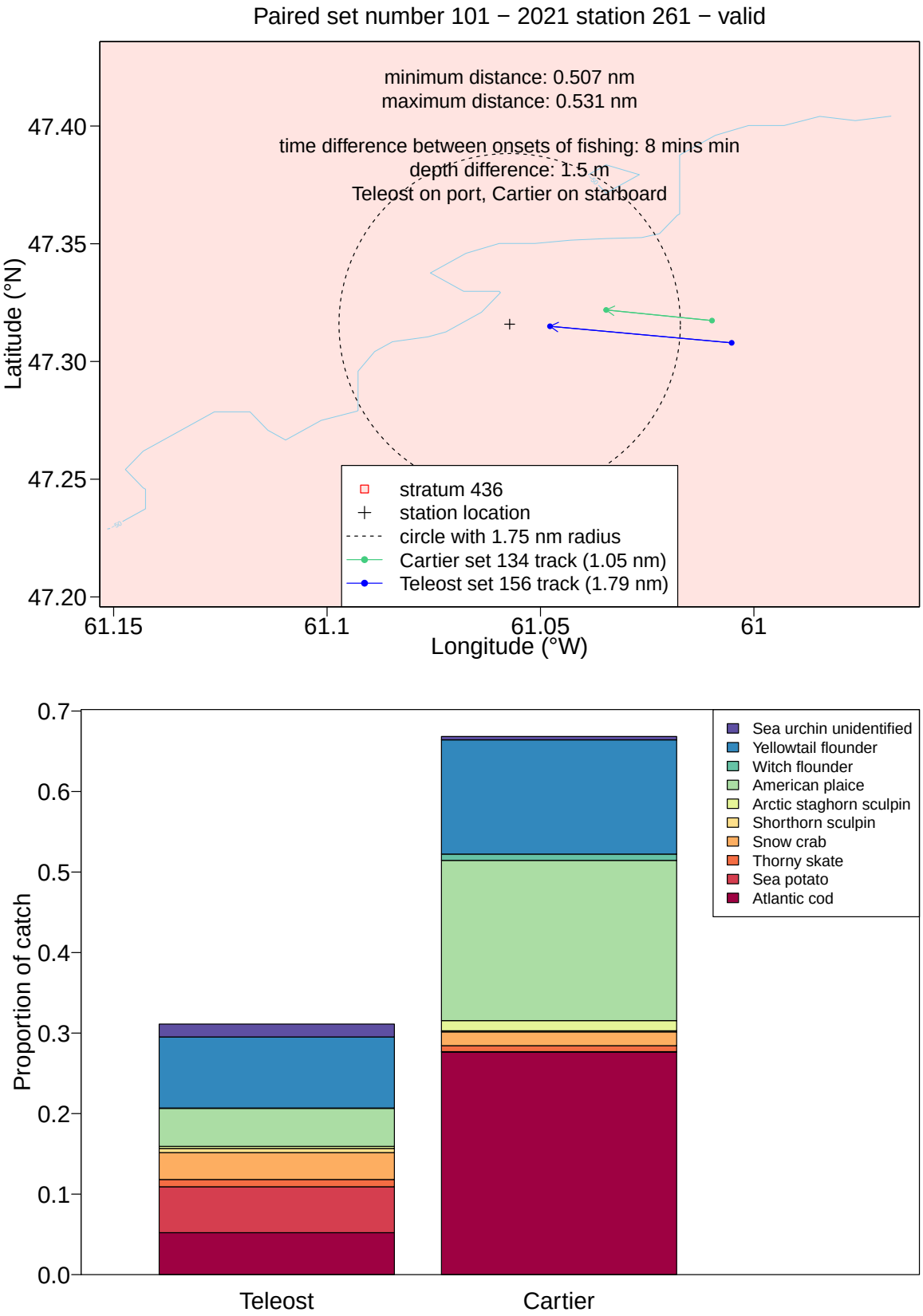

Figure 108. Tow tracks and major species composition for station 261 in 2021.

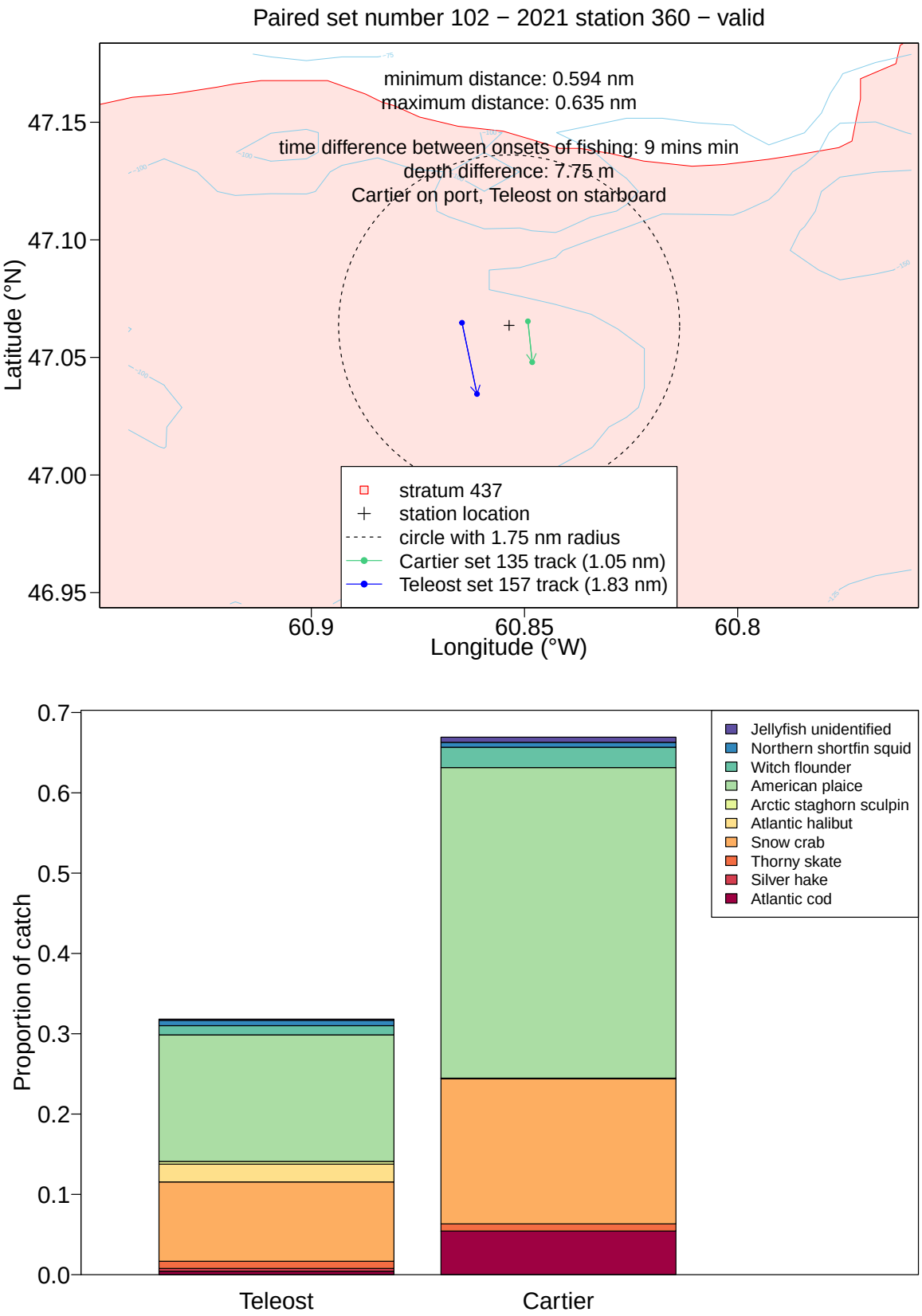

Figure 109. Tow tracks and major species composition for station 360 in 2021.

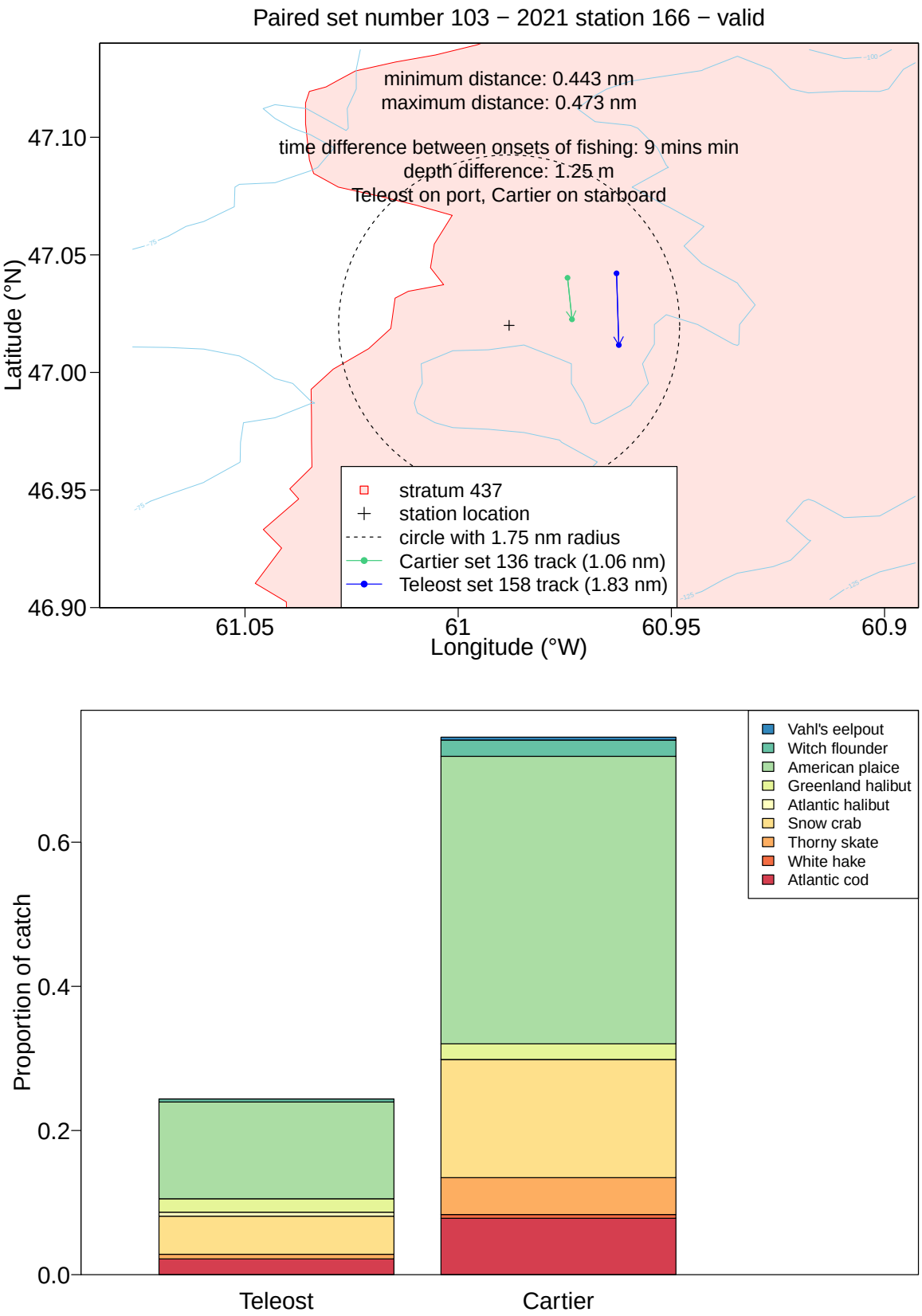

Figure 110. Tow tracks and major species composition for station 166 in 2021.

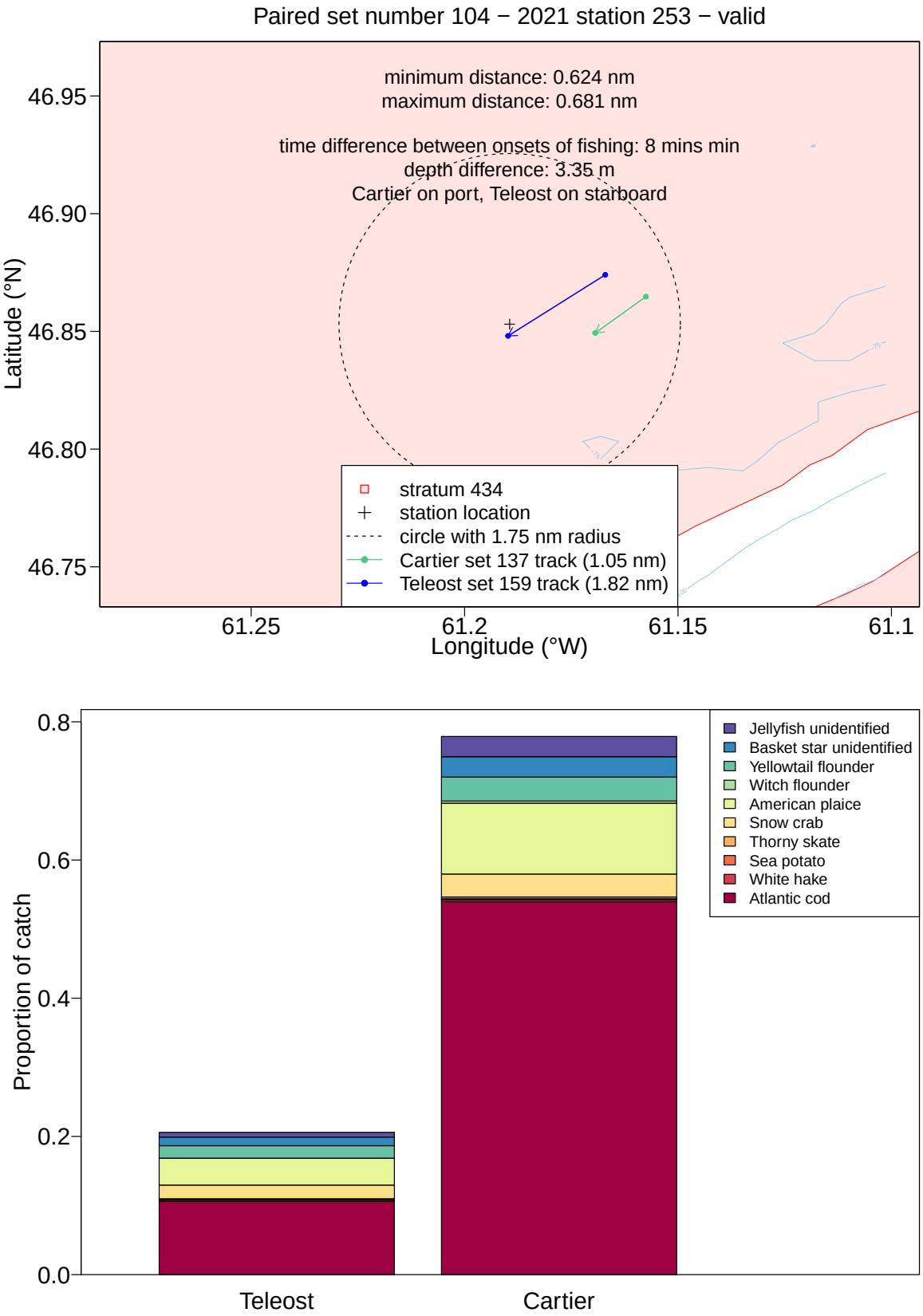

Figure 111. Tow tracks and major species composition for station 253 in 2021.

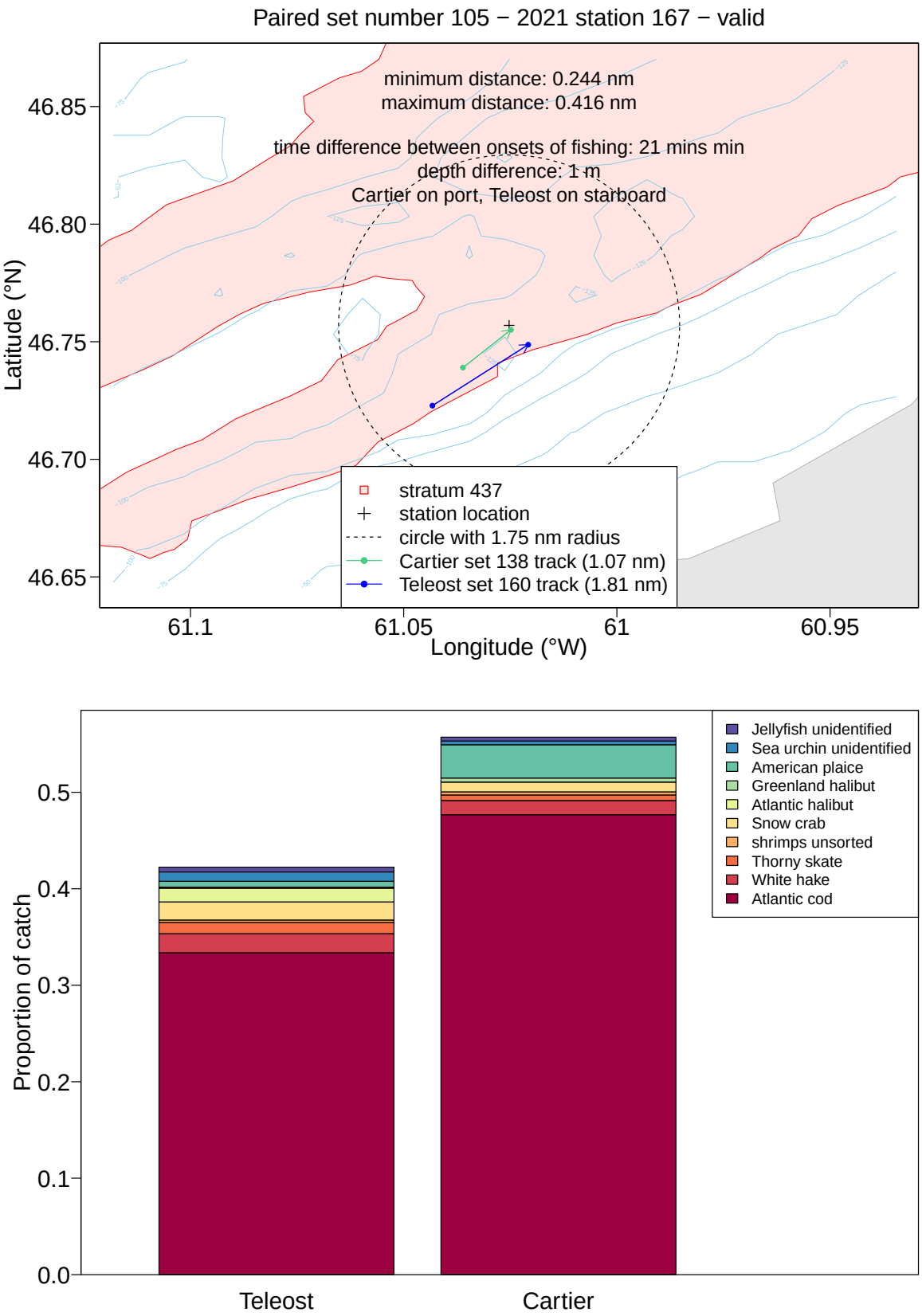

Figure 112. Tow tracks and major species composition for station 167 in 2021.

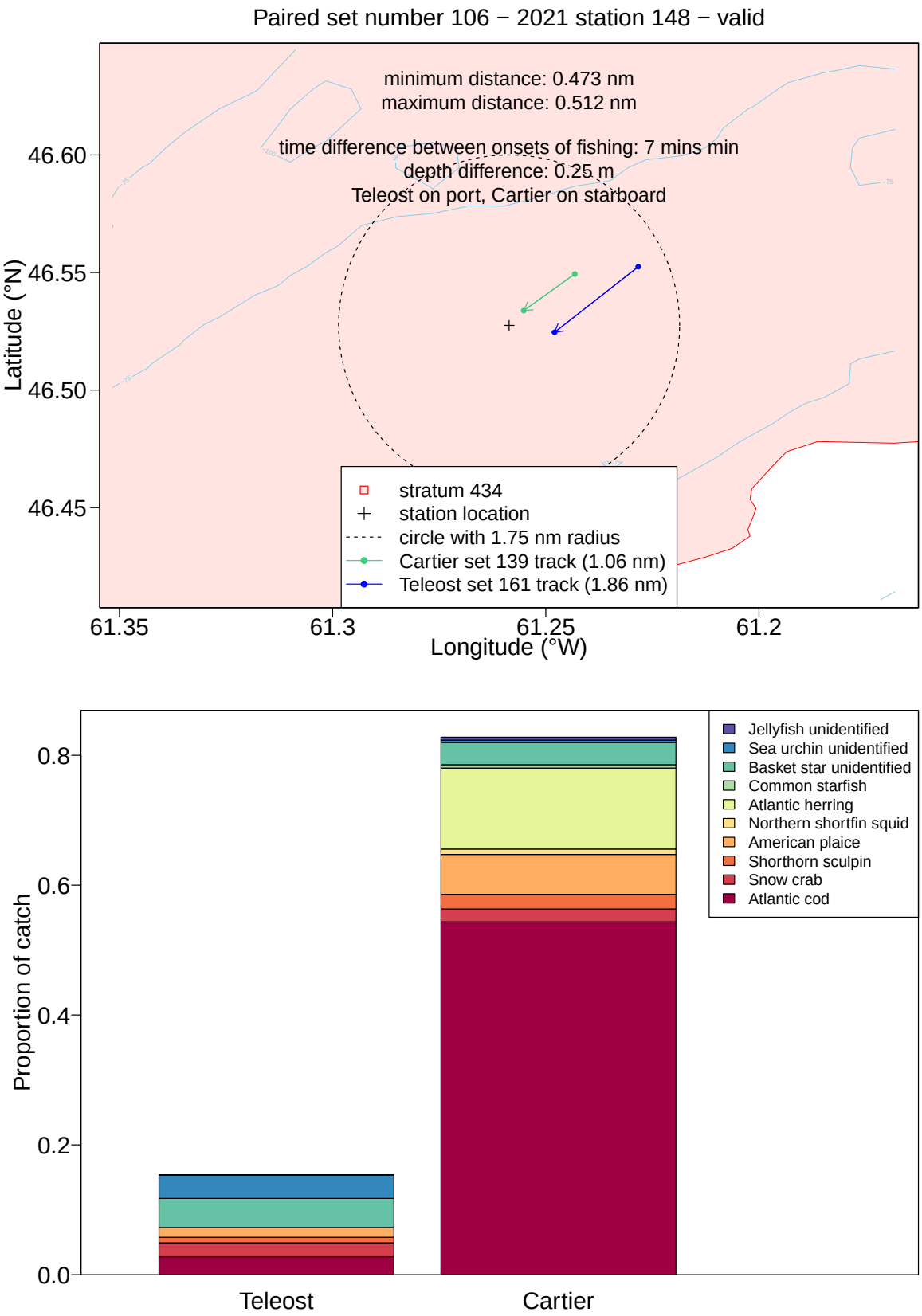

Figure 113. Tow tracks and major species composition for station 148 in 2021.

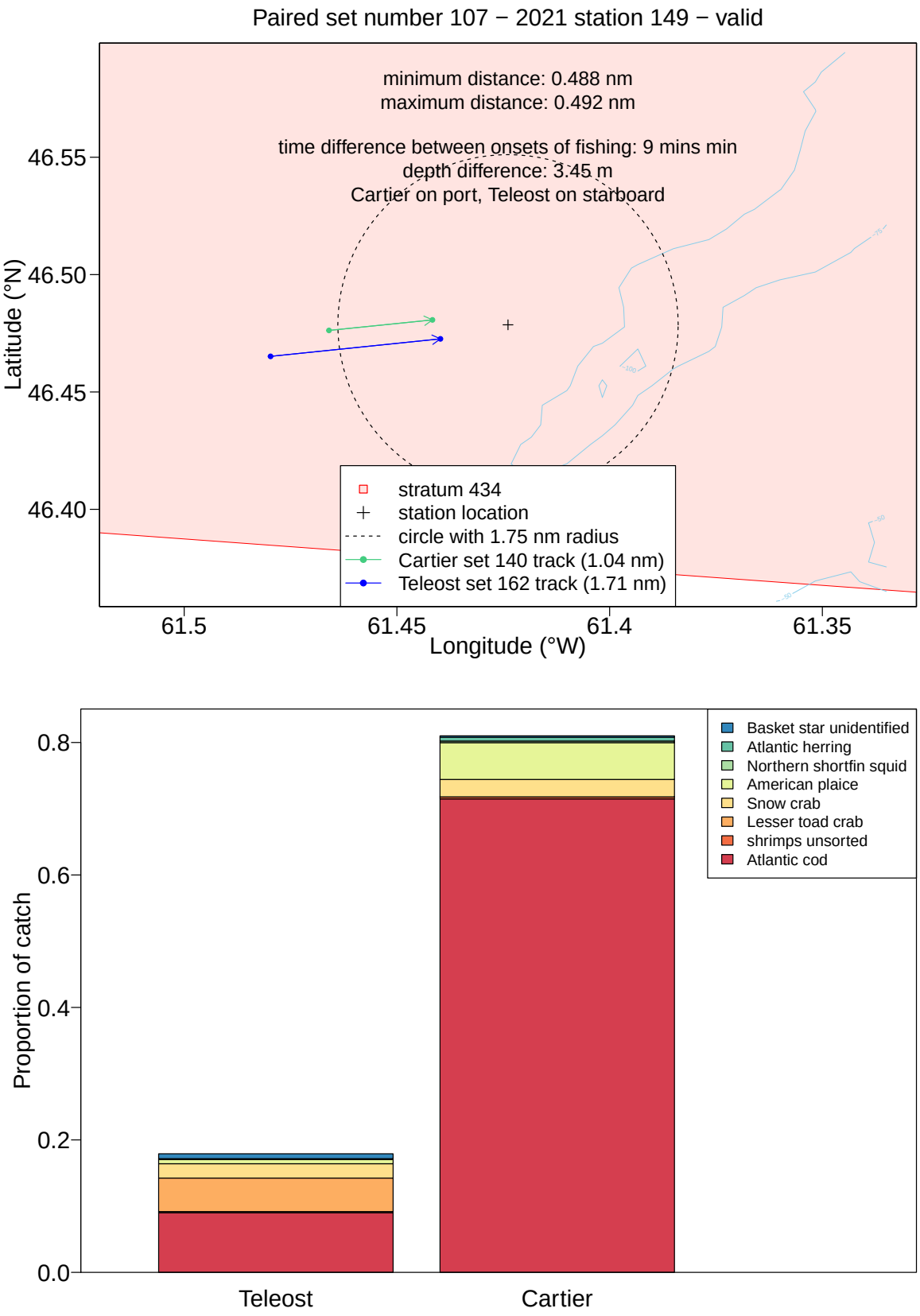

Figure 114. Tow tracks and major species composition for station 149 in 2021.

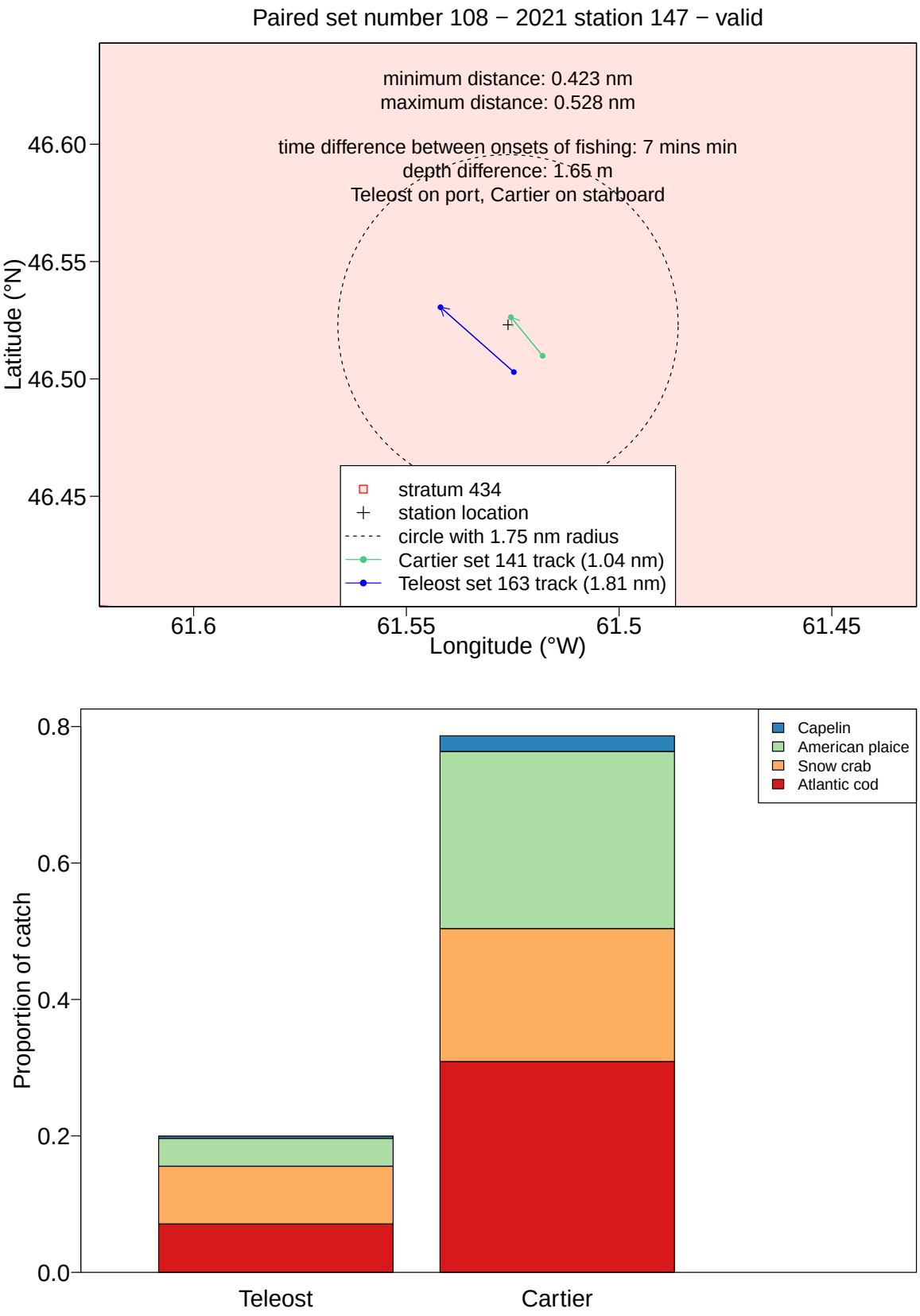

Figure 115. Tow tracks and major species composition for station 147 in 2021.

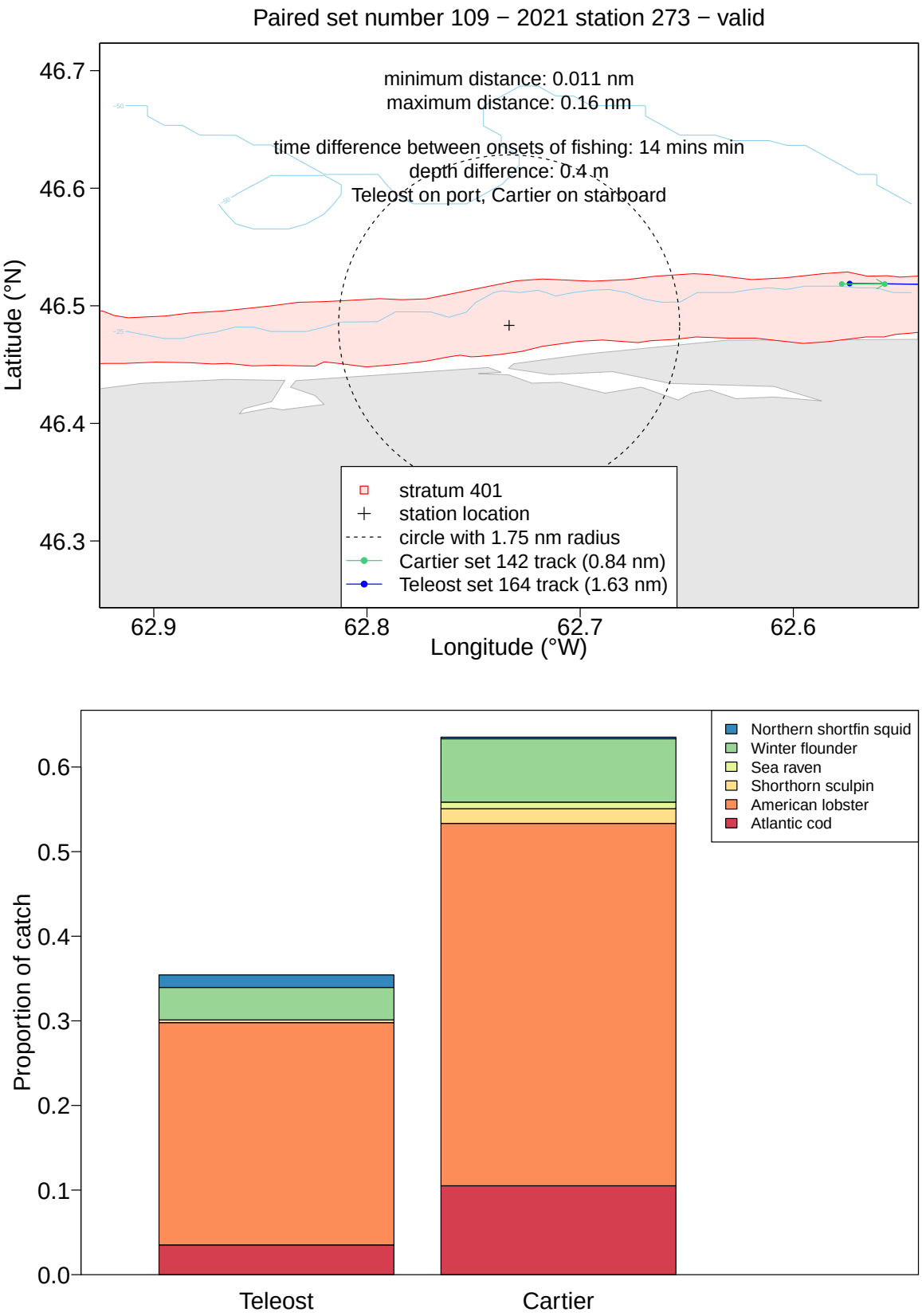

Figure 116. Tow tracks and major species composition for station 273 in 2021.

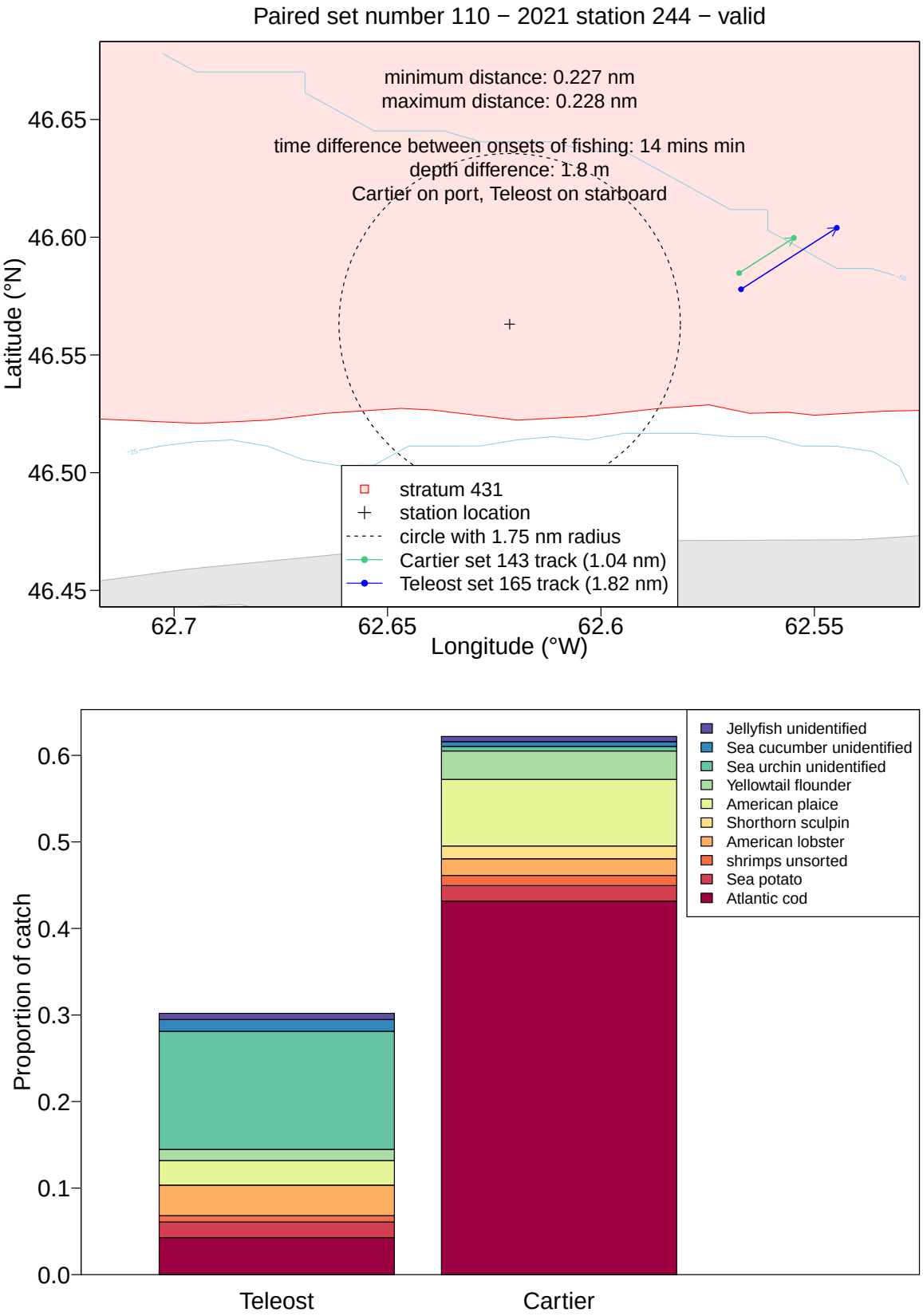

Figure 117. Tow tracks and major species composition for station 244 in 2021.

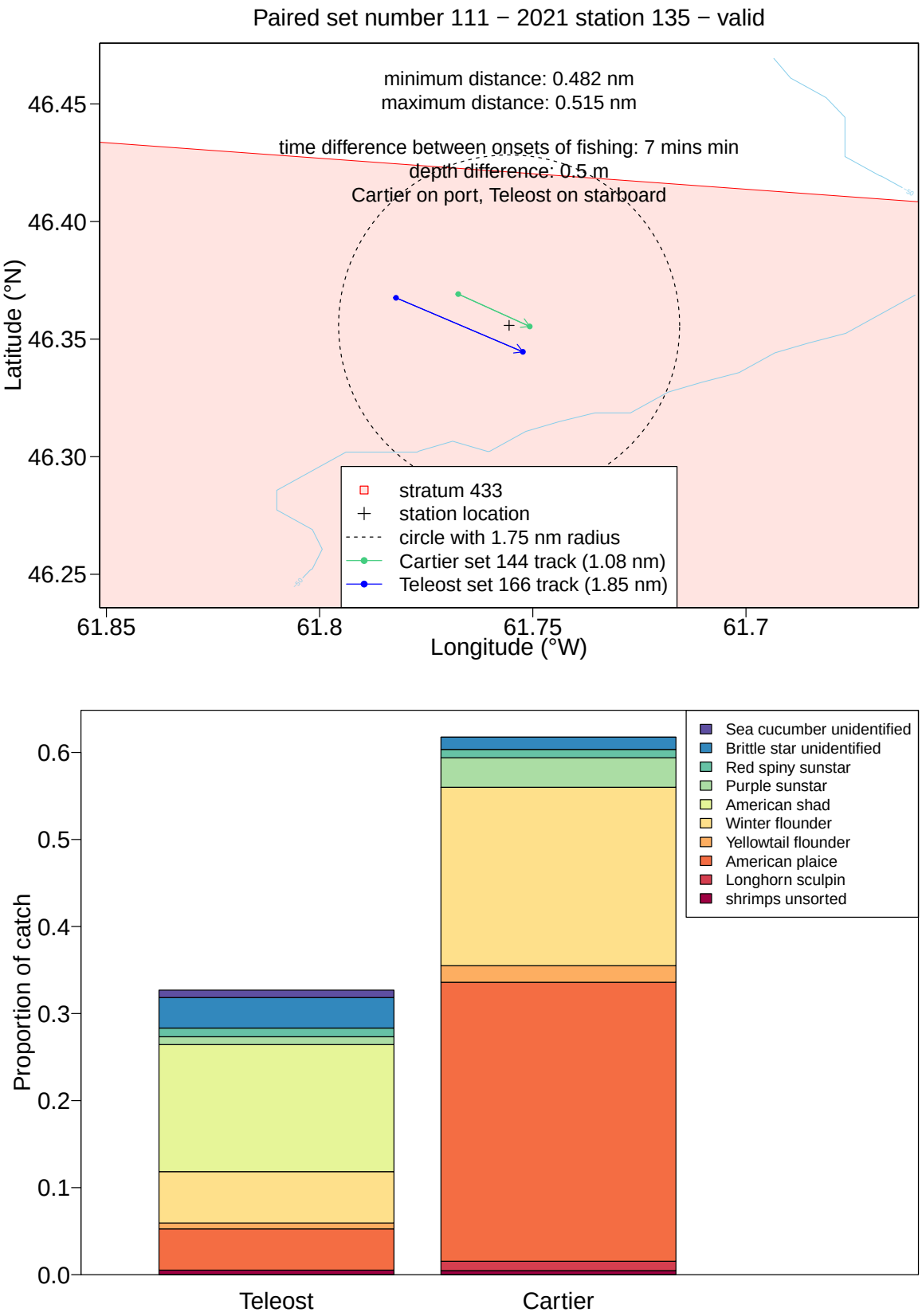

Figure 118. Tow tracks and major species composition for station 135 in 2021.

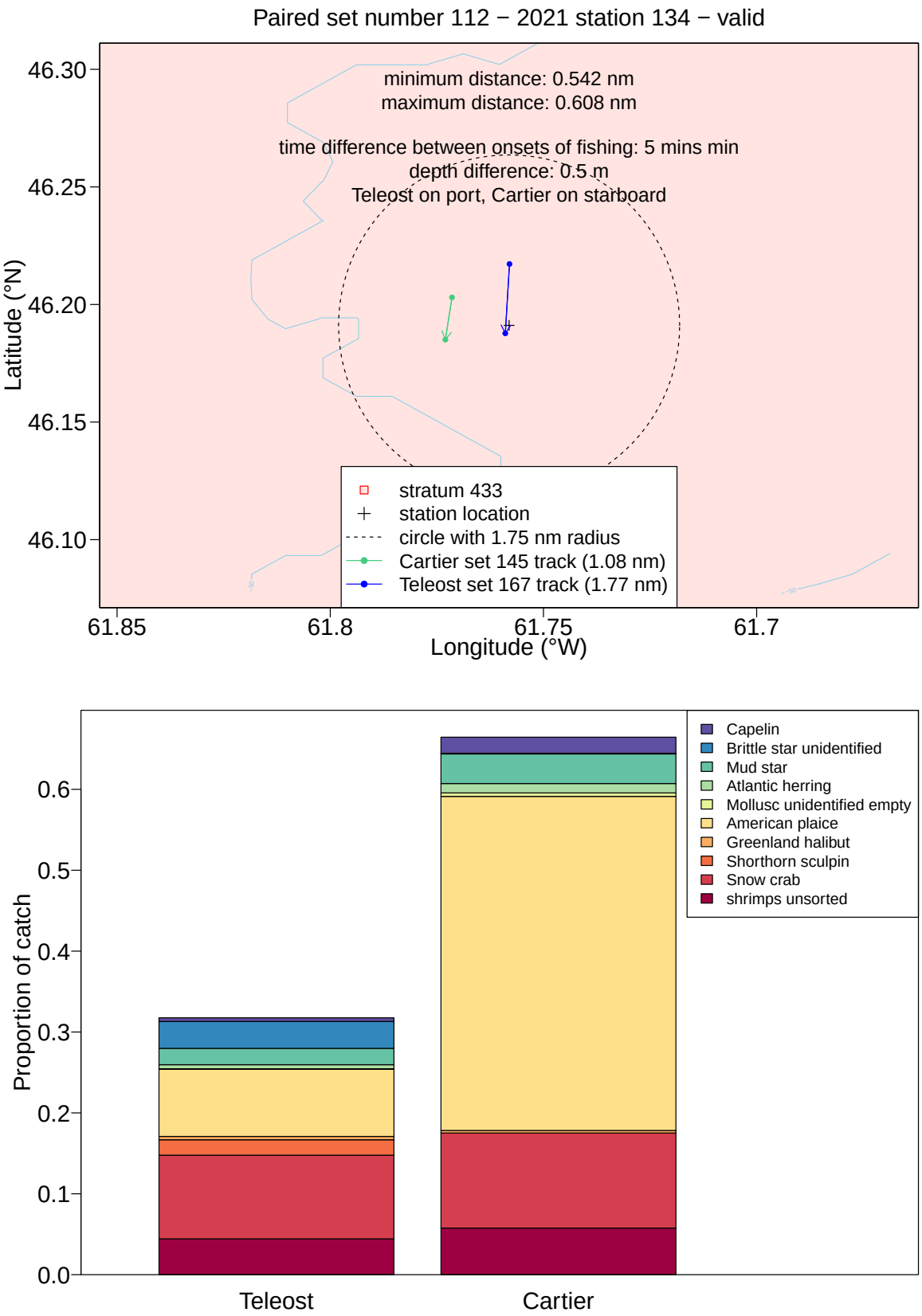

Figure 119. Tow tracks and major species composition for station 134 in 2021.

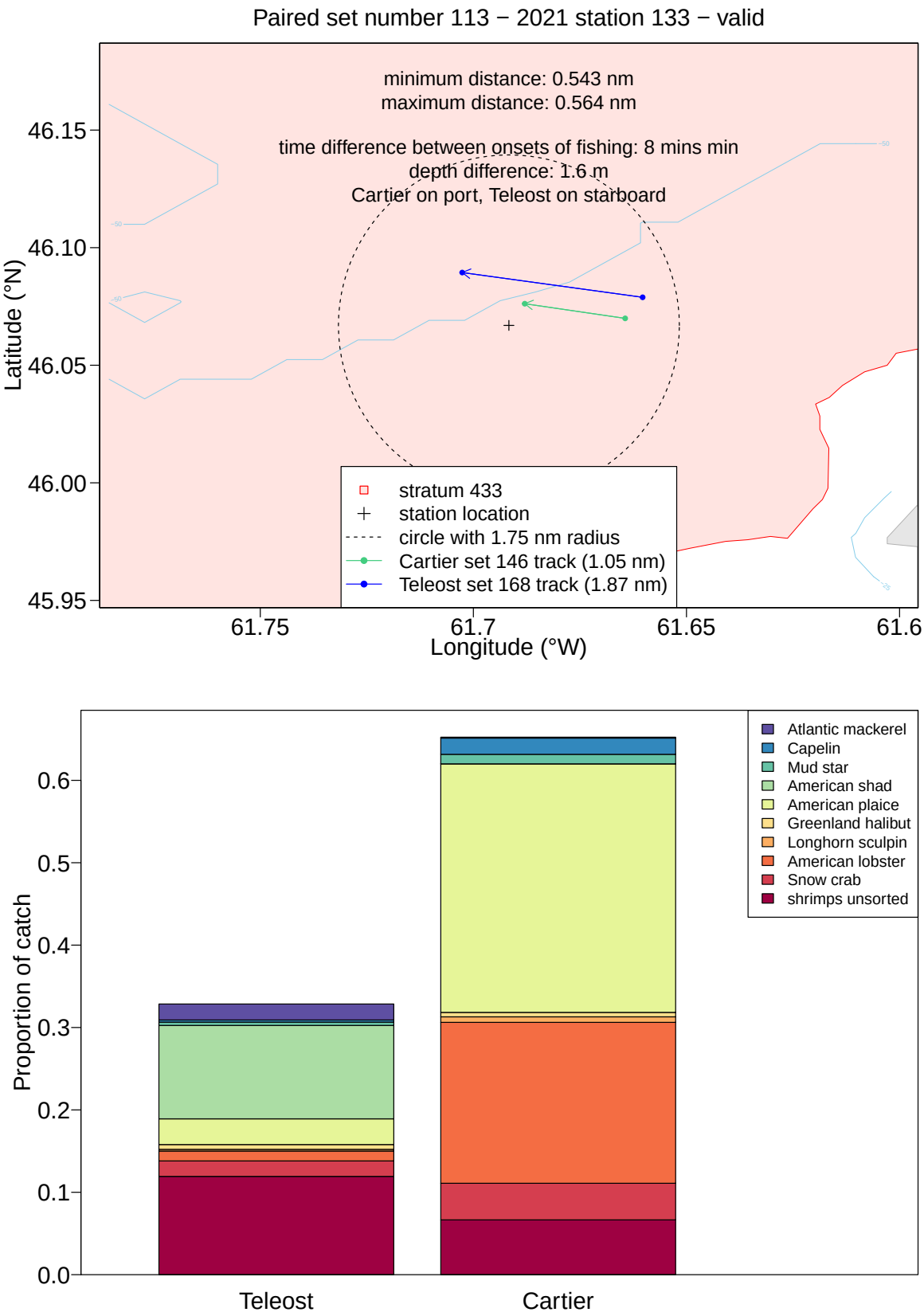

Figure 120. Tow tracks and major species composition for station 133 in 2021.

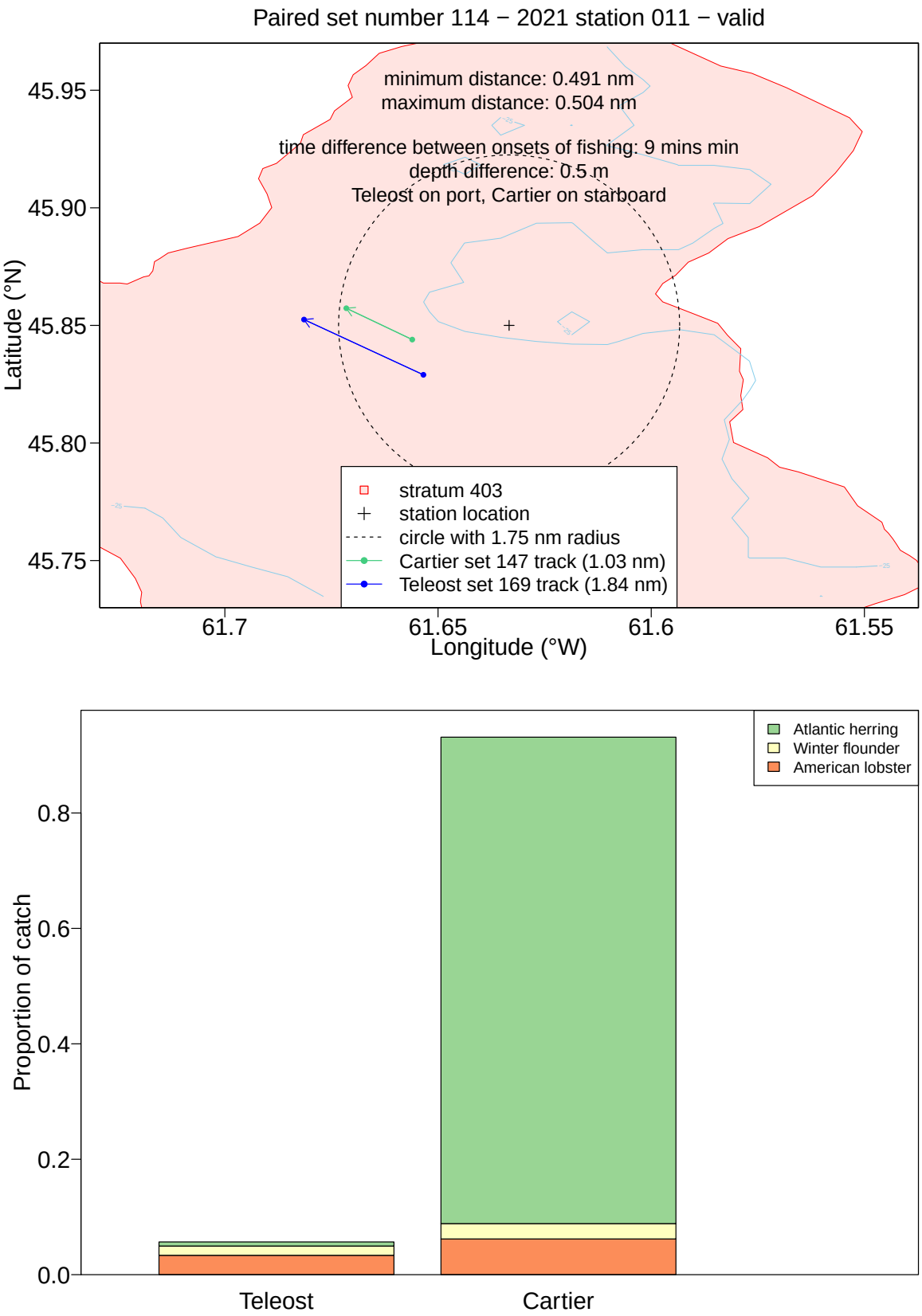

Figure 121. Tow tracks and major species composition for station 011 in 2021.

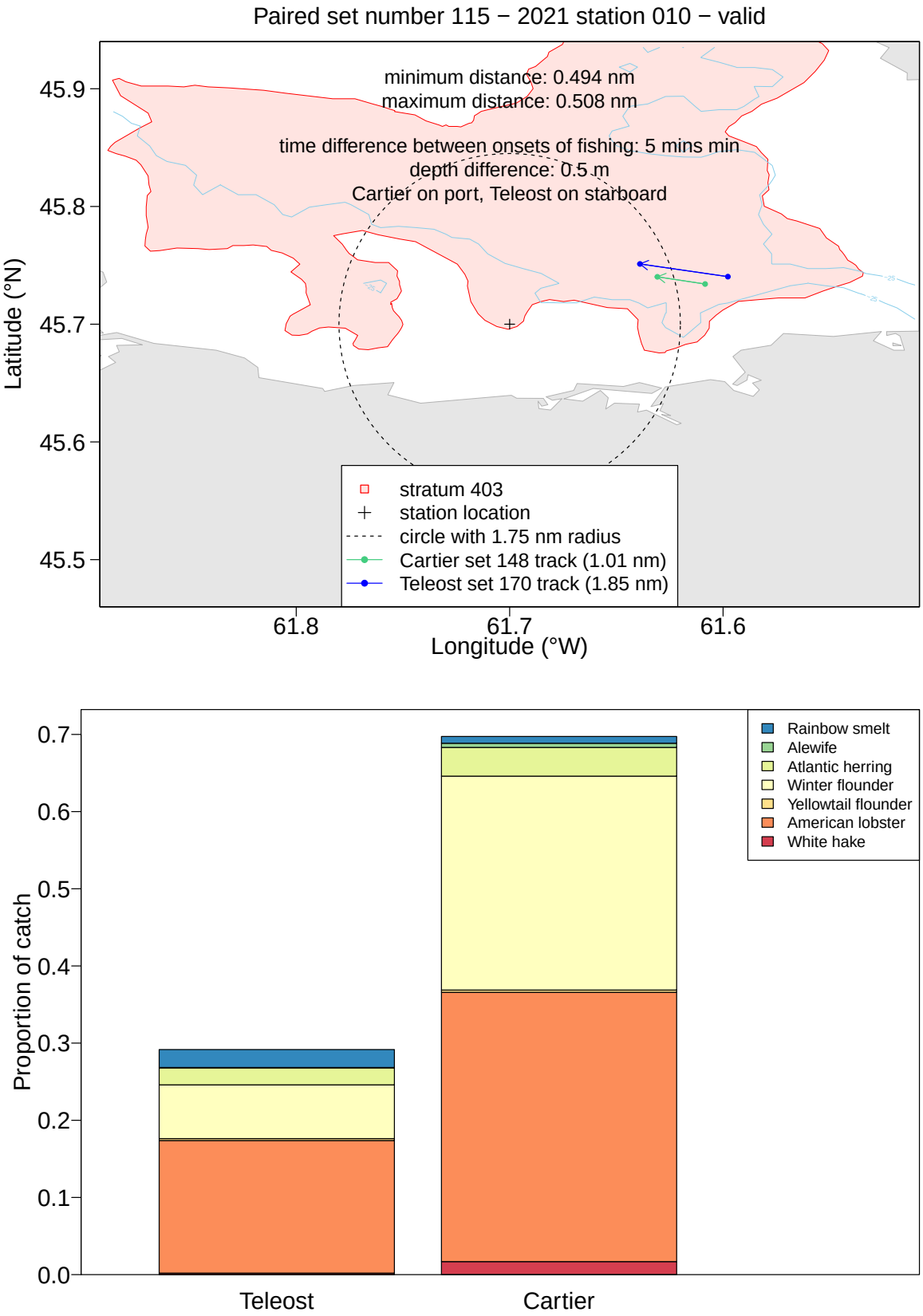

Figure 122. Tow tracks and major species composition for station 010 in 2021.

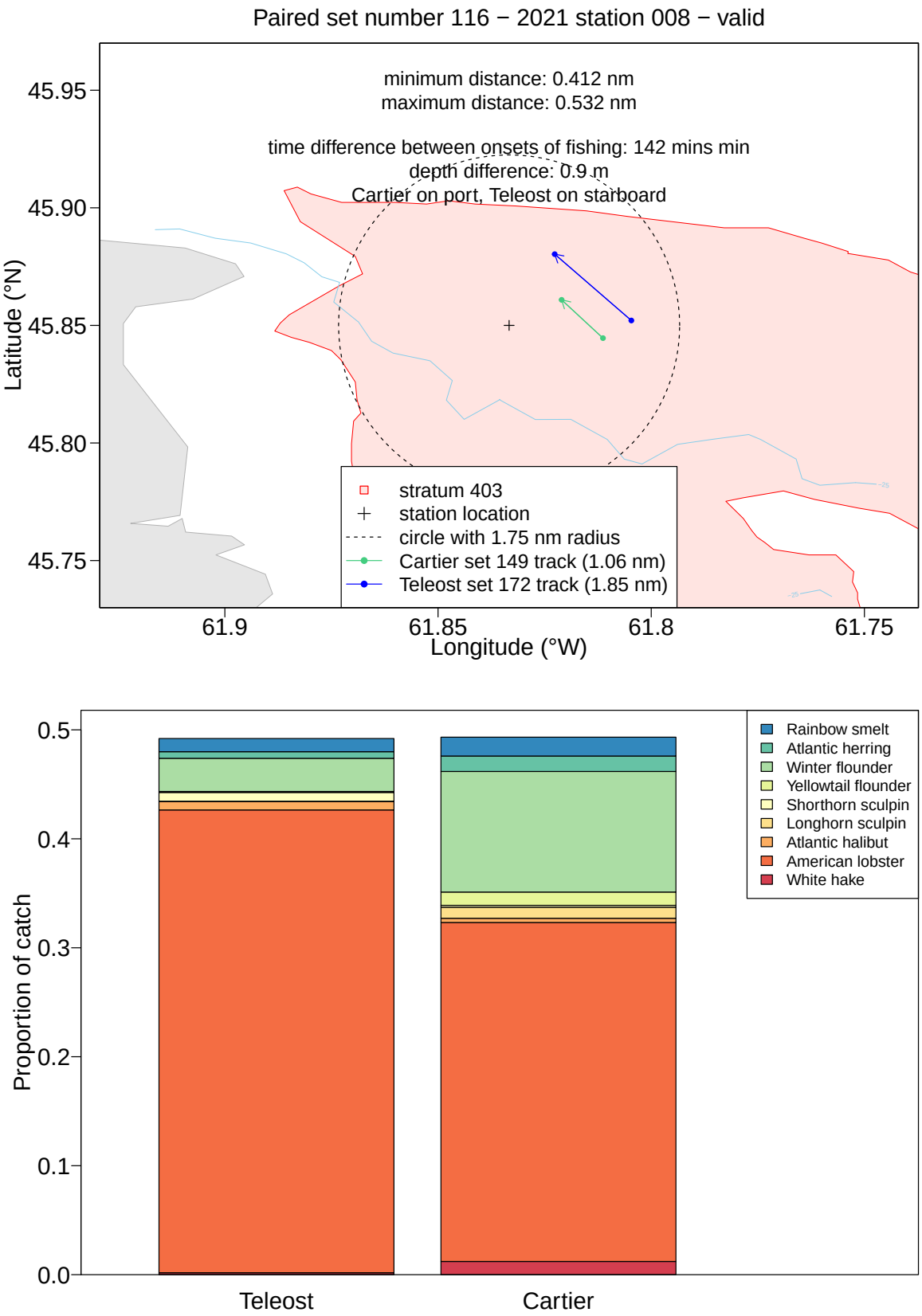

Figure 123. Tow tracks and major species composition for station 008 in 2021.

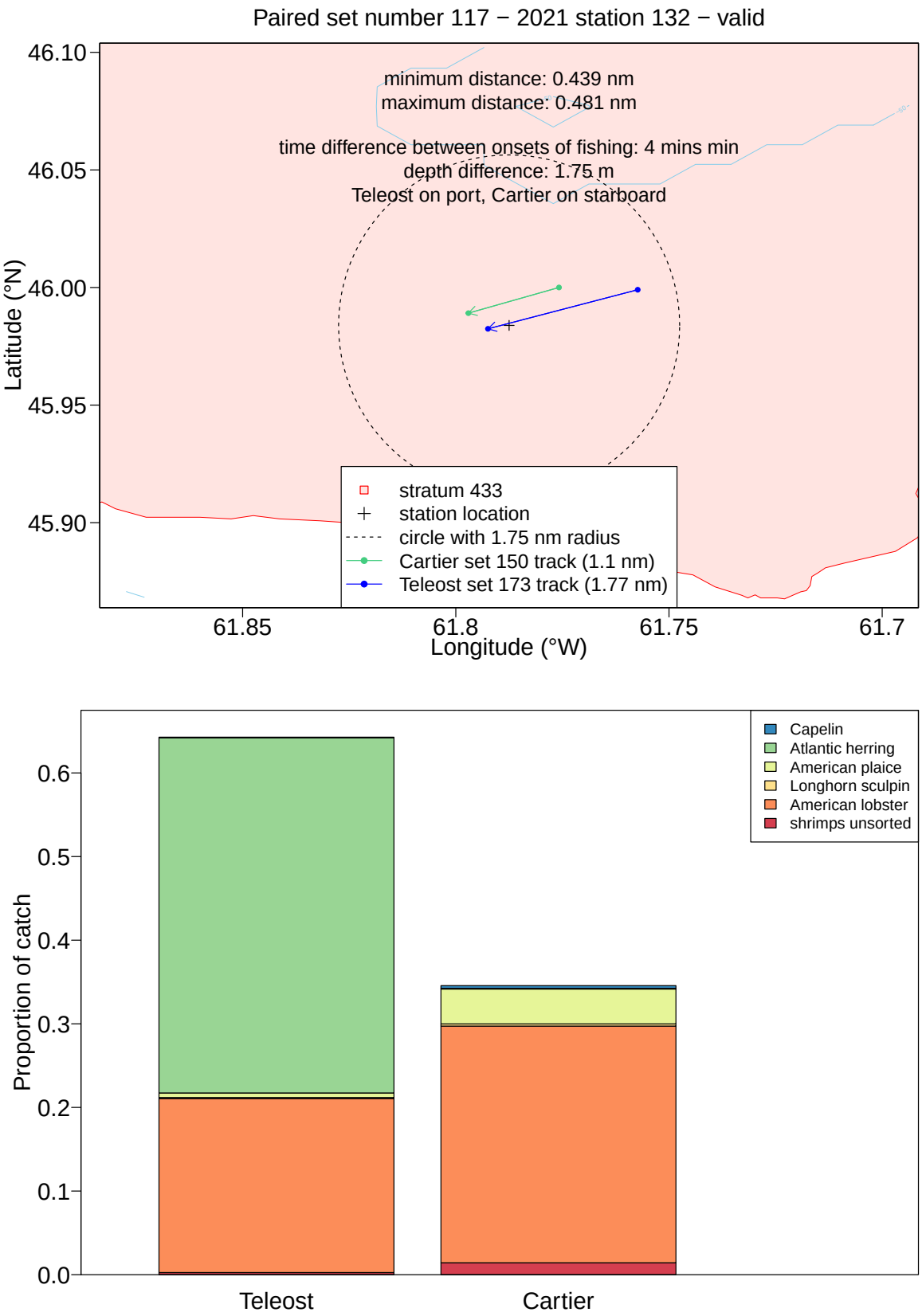

Figure 124. Tow tracks and major species composition for station 132 in 2021.

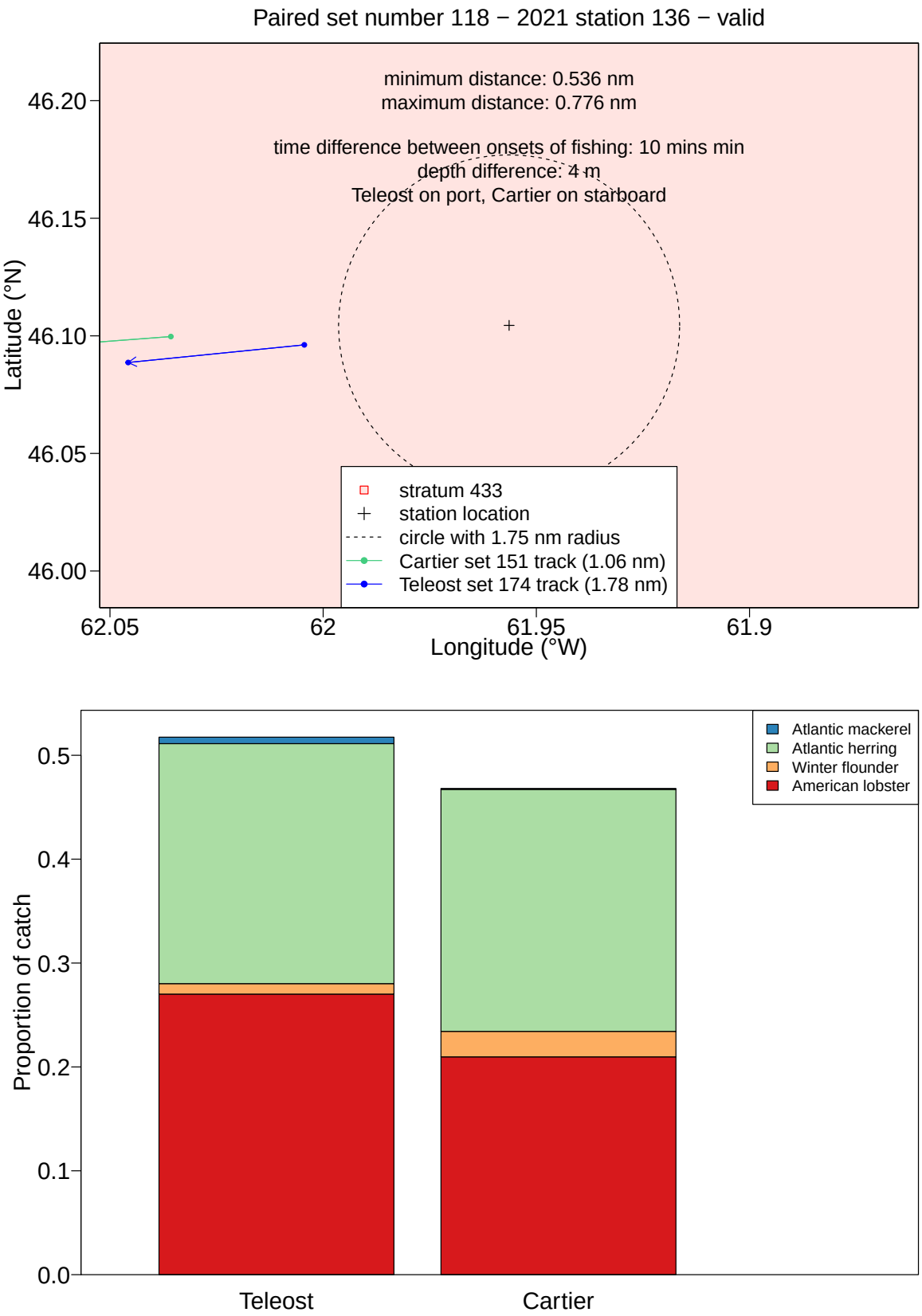

Figure 125. Tow tracks and major species composition for station 136 in 2021.

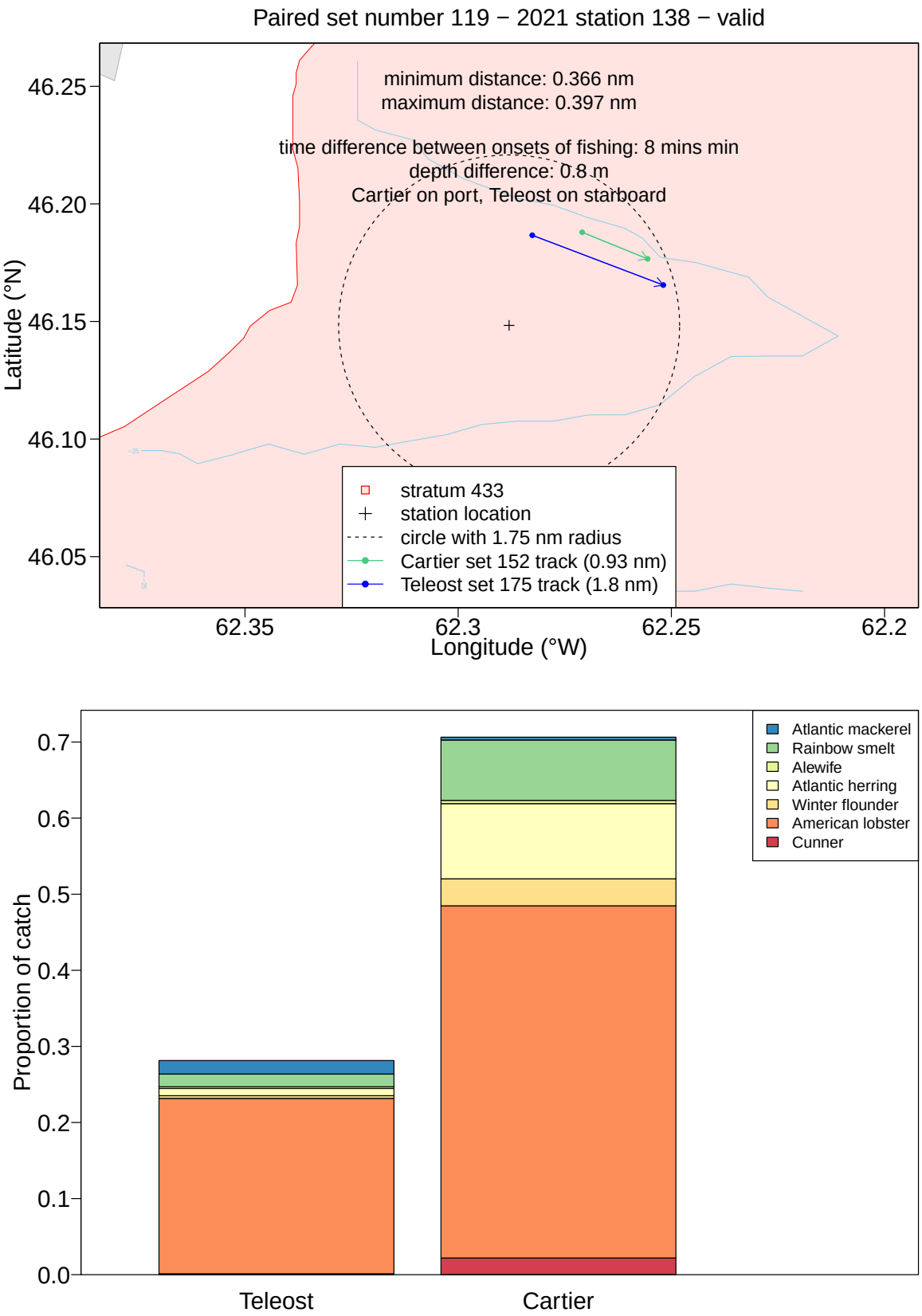

Figure 126. Tow tracks and major species composition for station 138 in 2021.

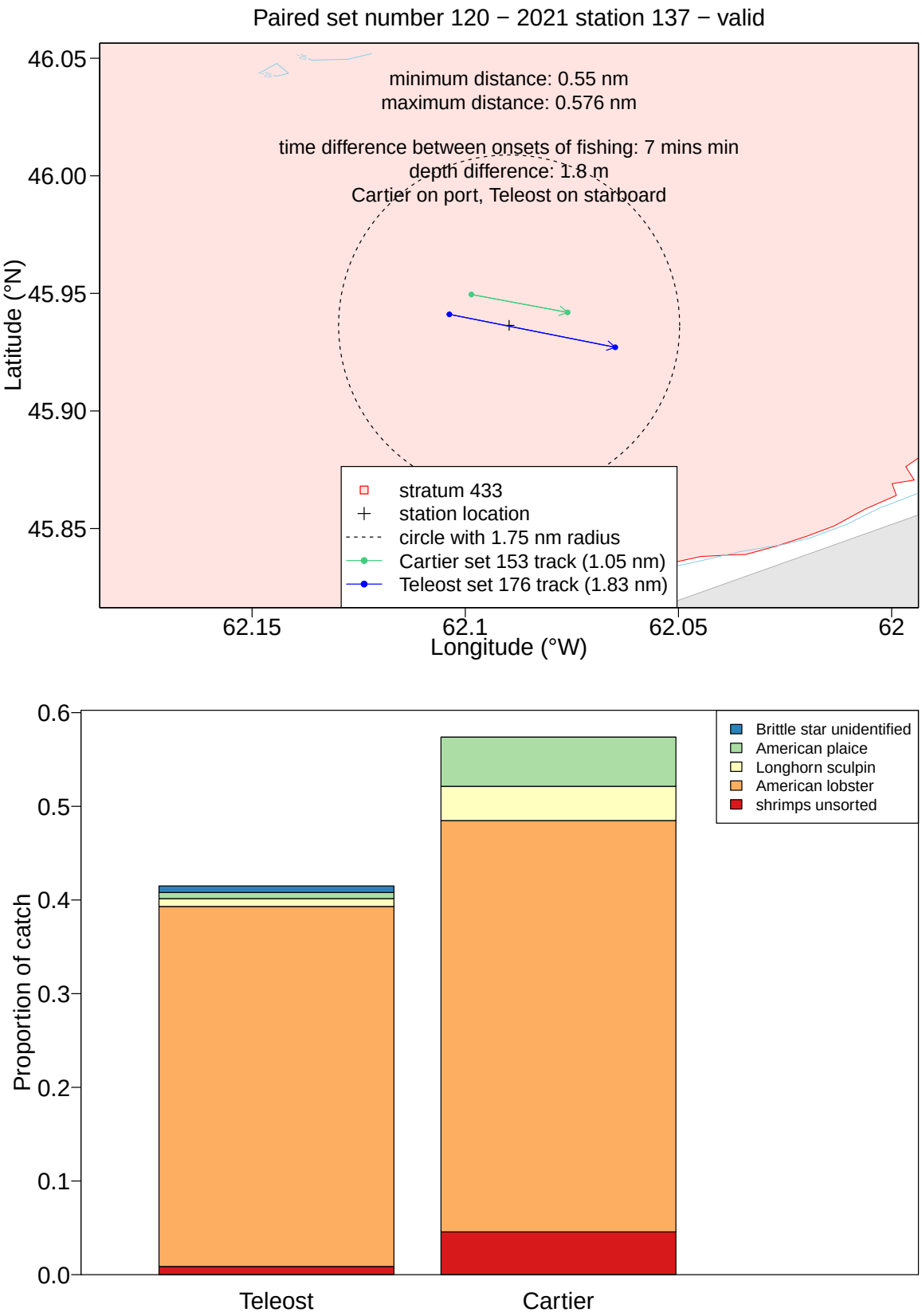

Figure 127. Tow tracks and major species composition for station 137 in 2021.

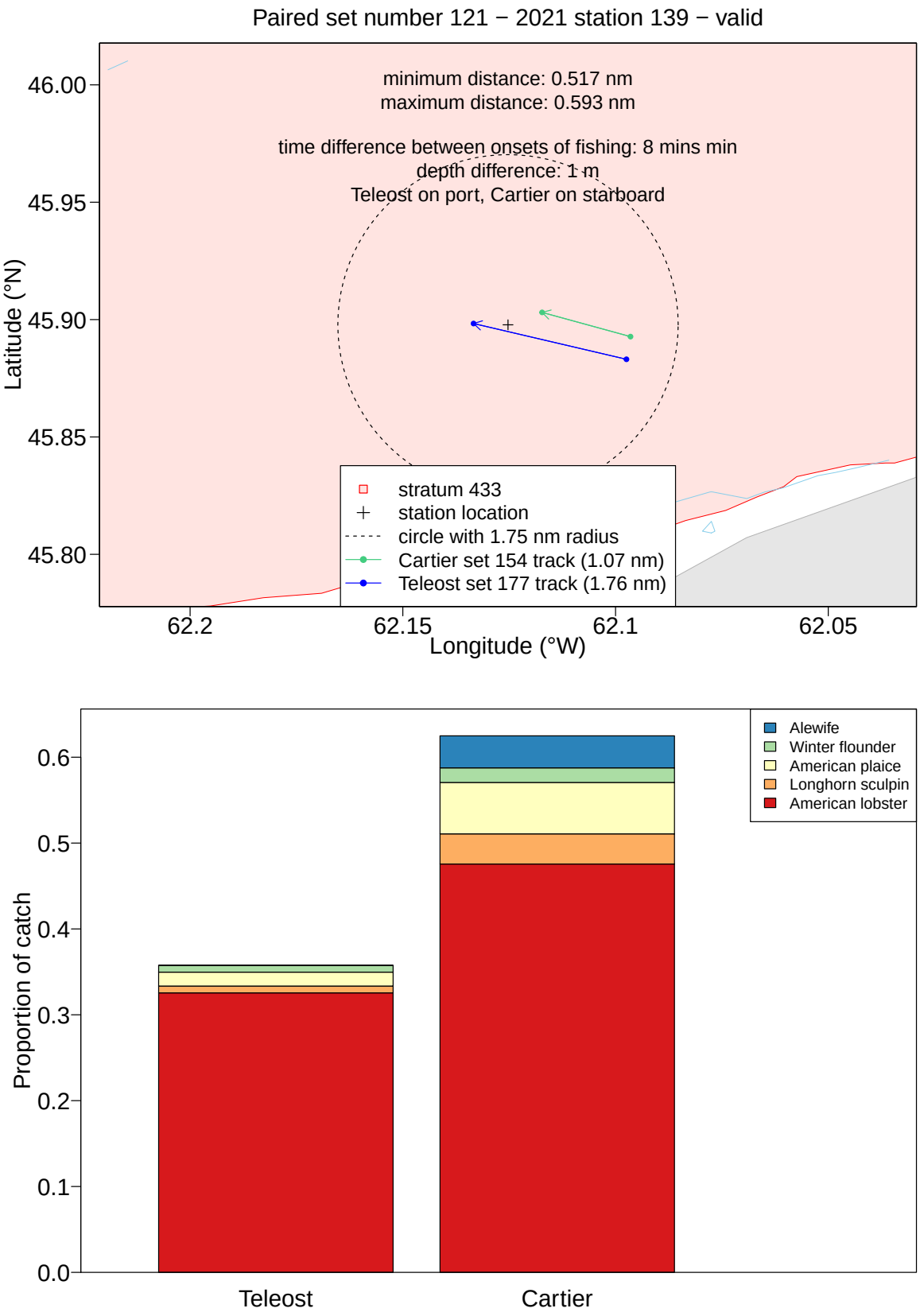

Figure 128. Tow tracks and major species composition for station 139 in 2021.

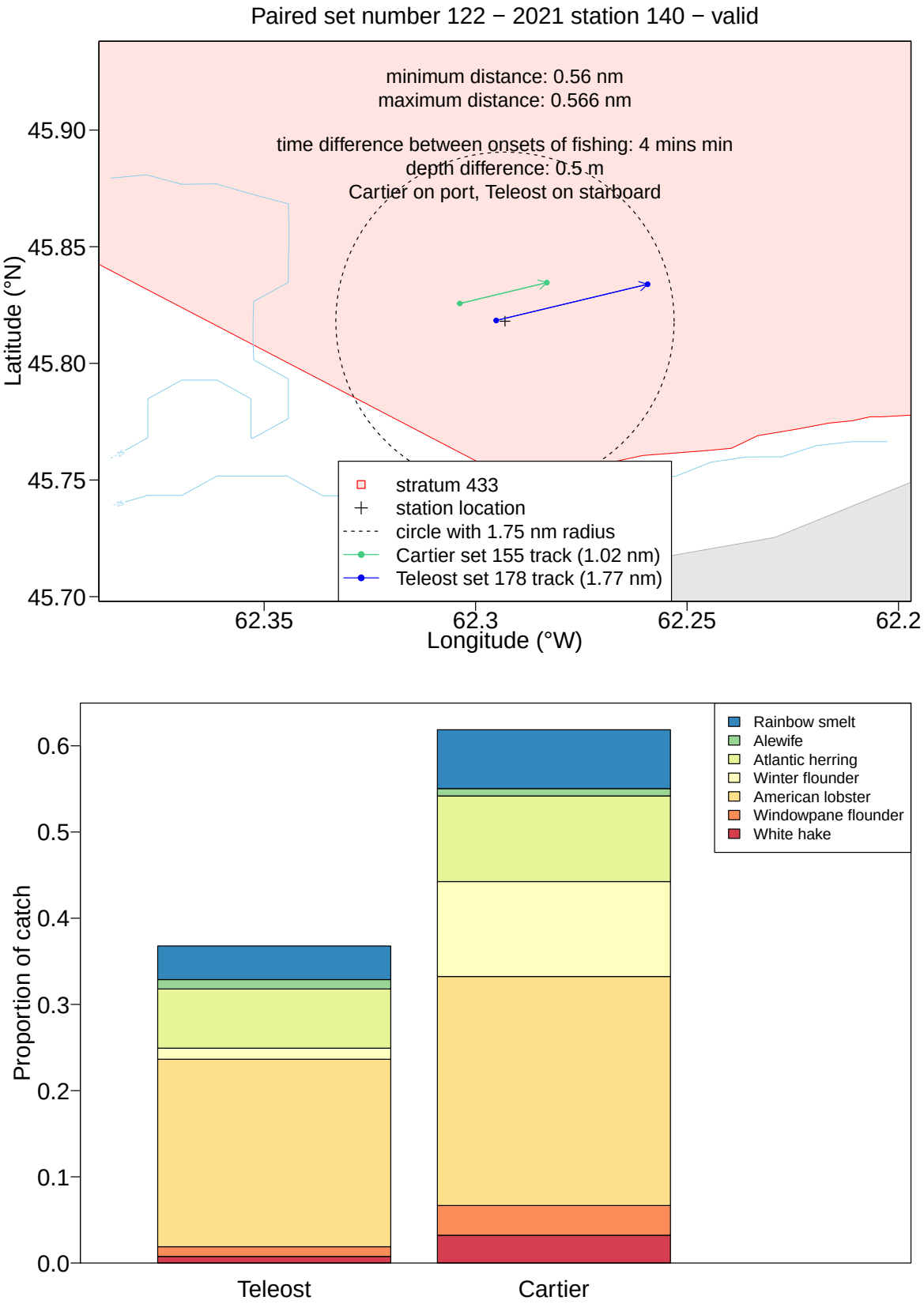

Figure 129. Tow tracks and major species composition for station 140 in 2021.

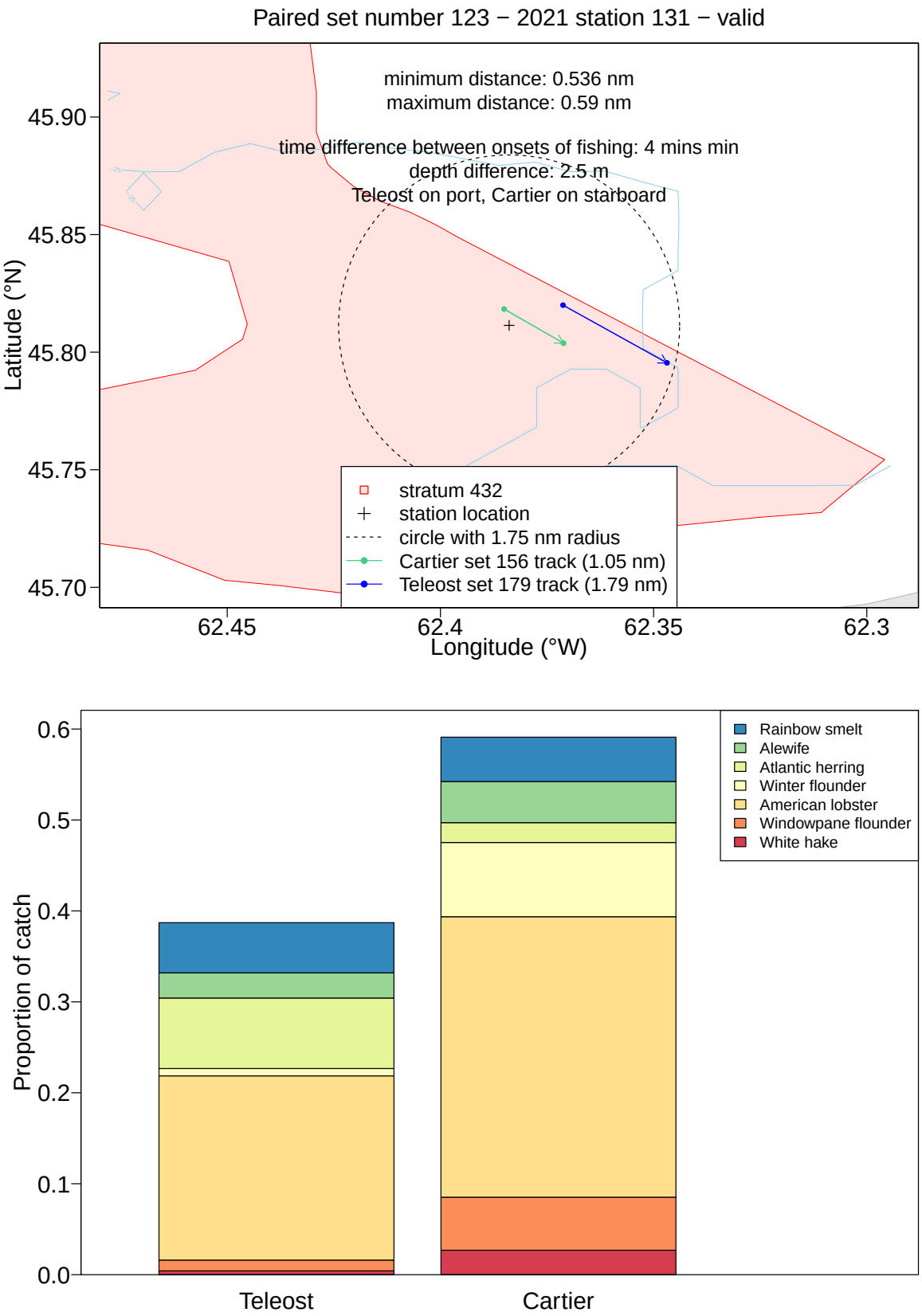

Figure 130. Tow tracks and major species composition for station 131 in 2021.

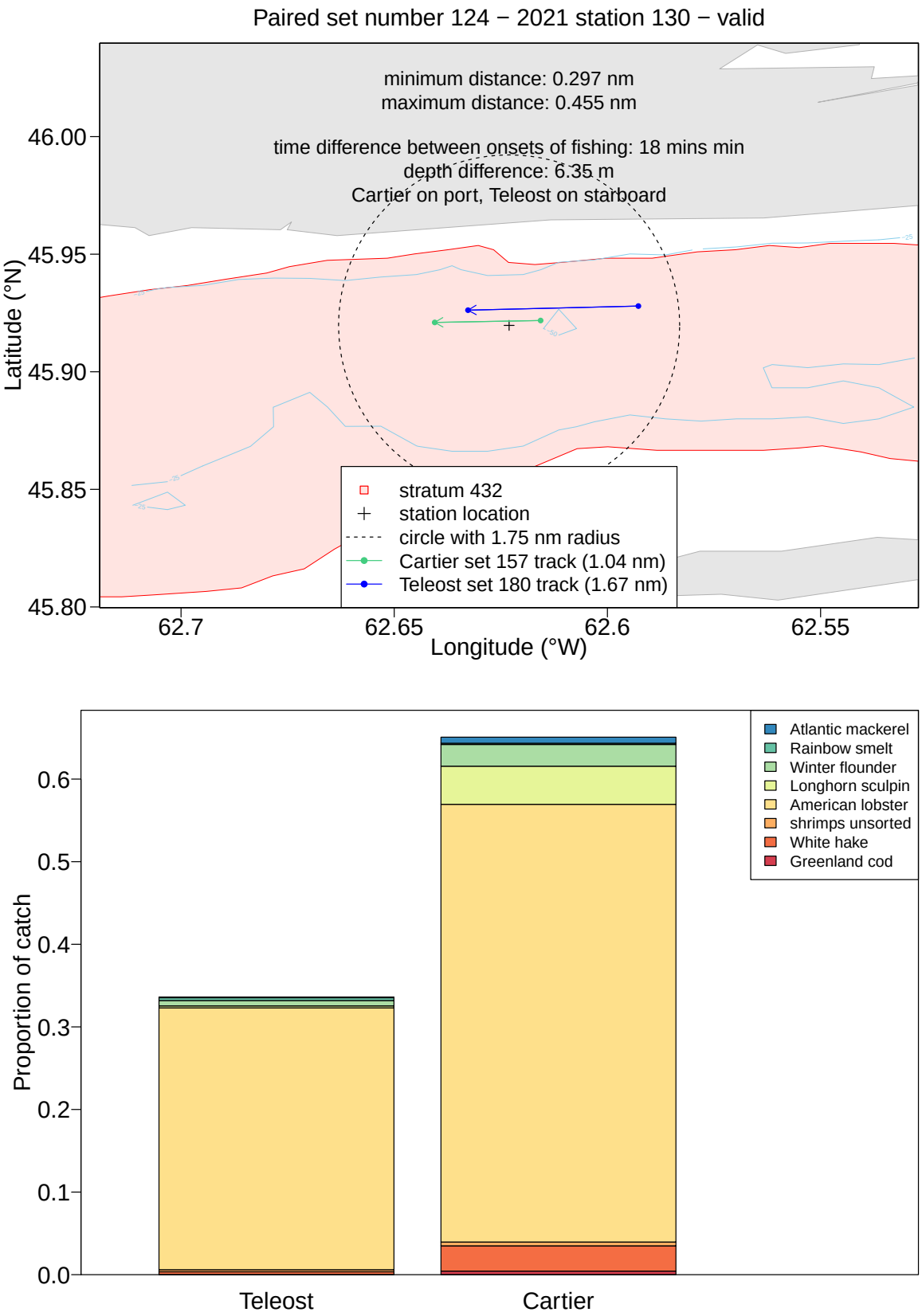

Figure 131. Tow tracks and major species composition for station 130 in 2021.

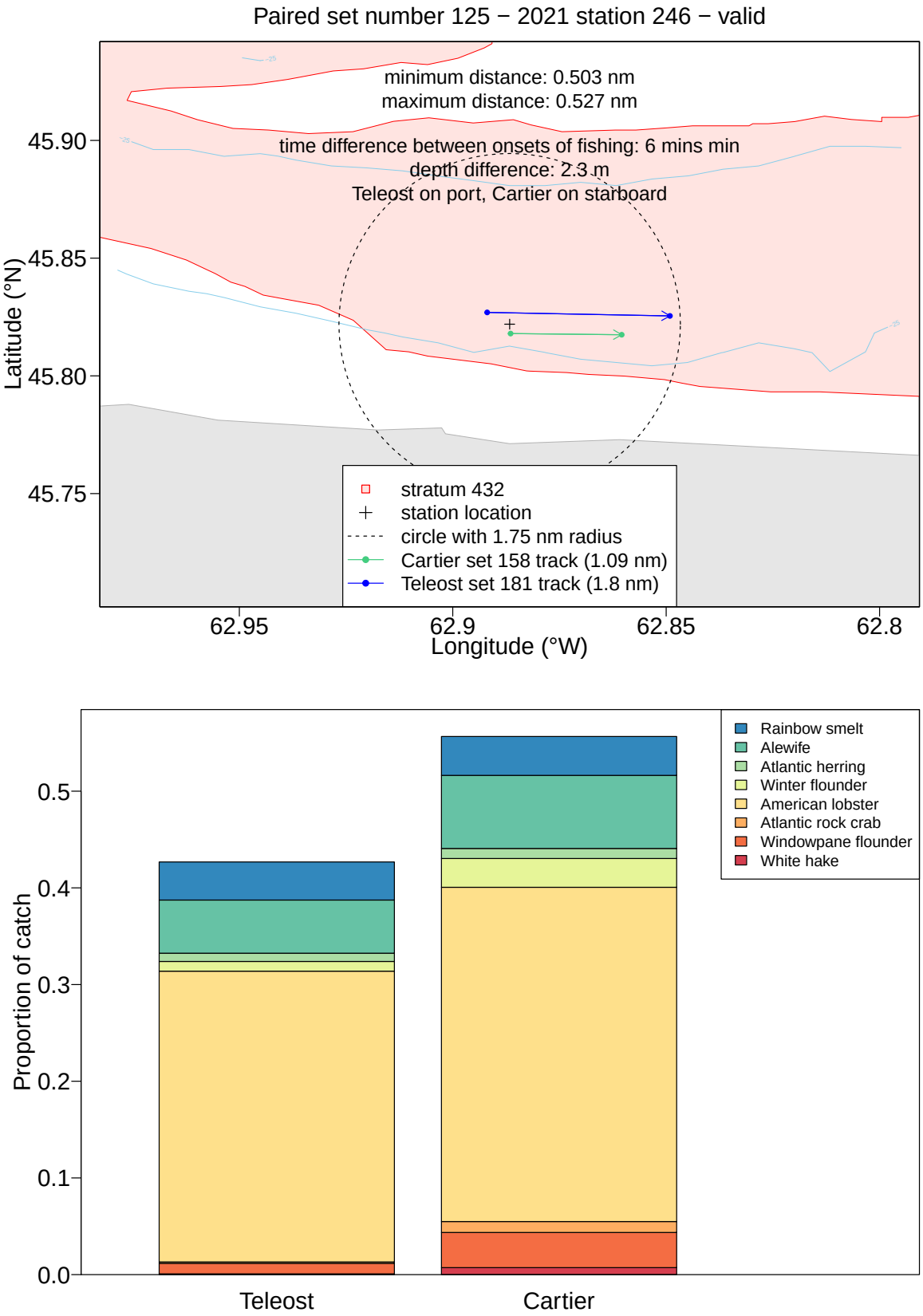

Figure 132. Tow tracks and major species composition for station 246 in 2021.

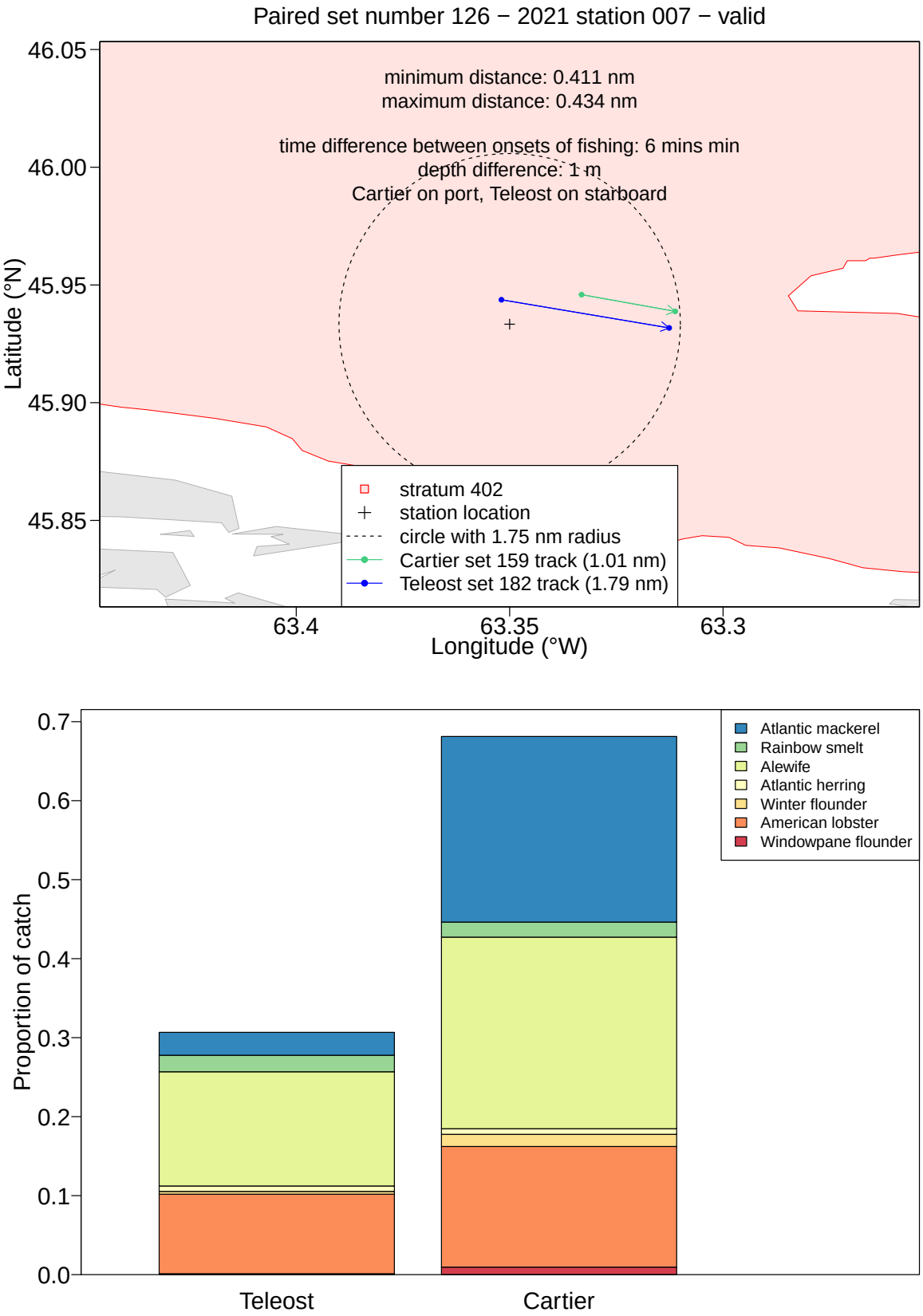

Figure 133. Tow tracks and major species composition for station 007 in 2021.

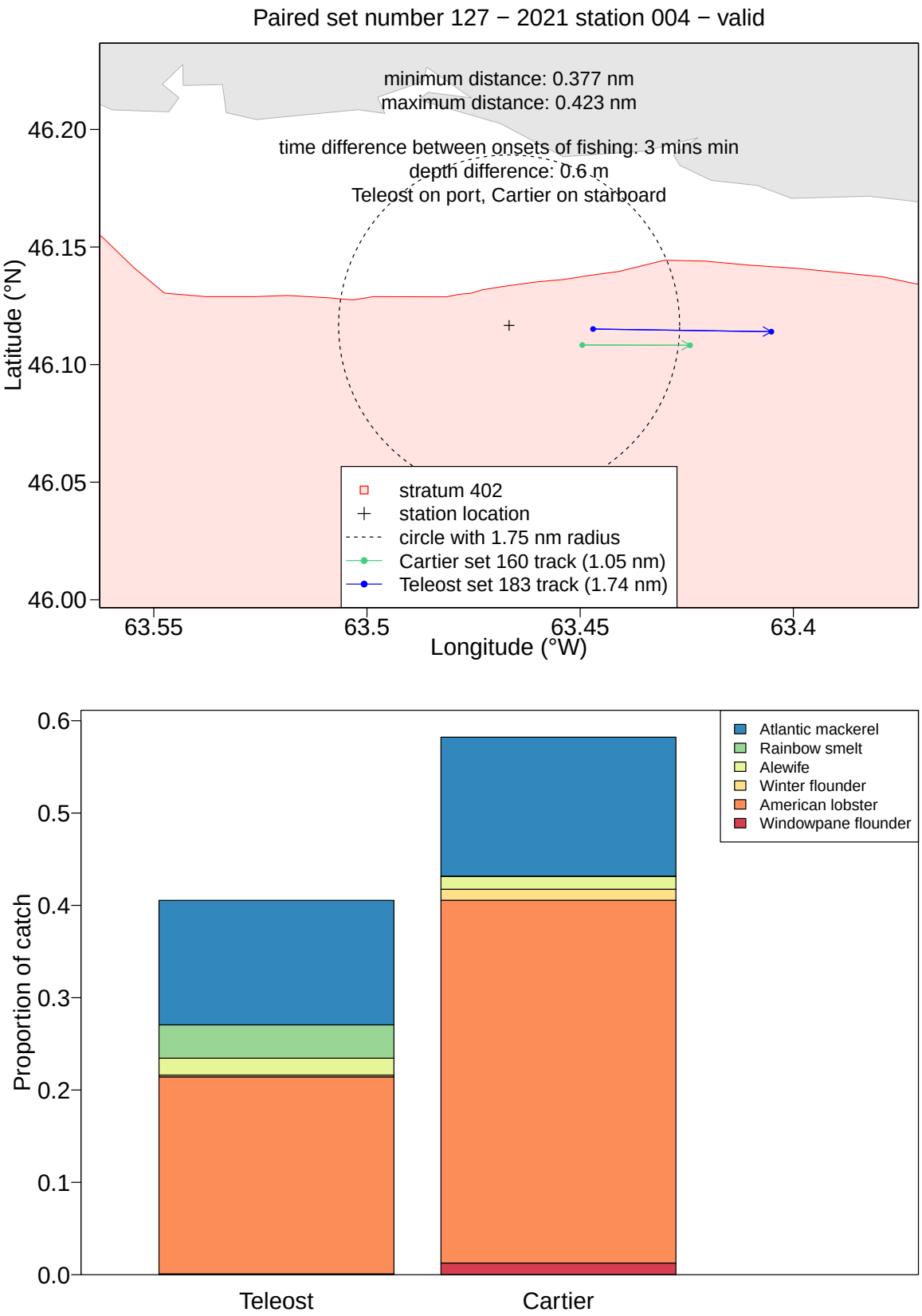

Figure 134. Tow tracks and major species composition for station 004 in 2021.

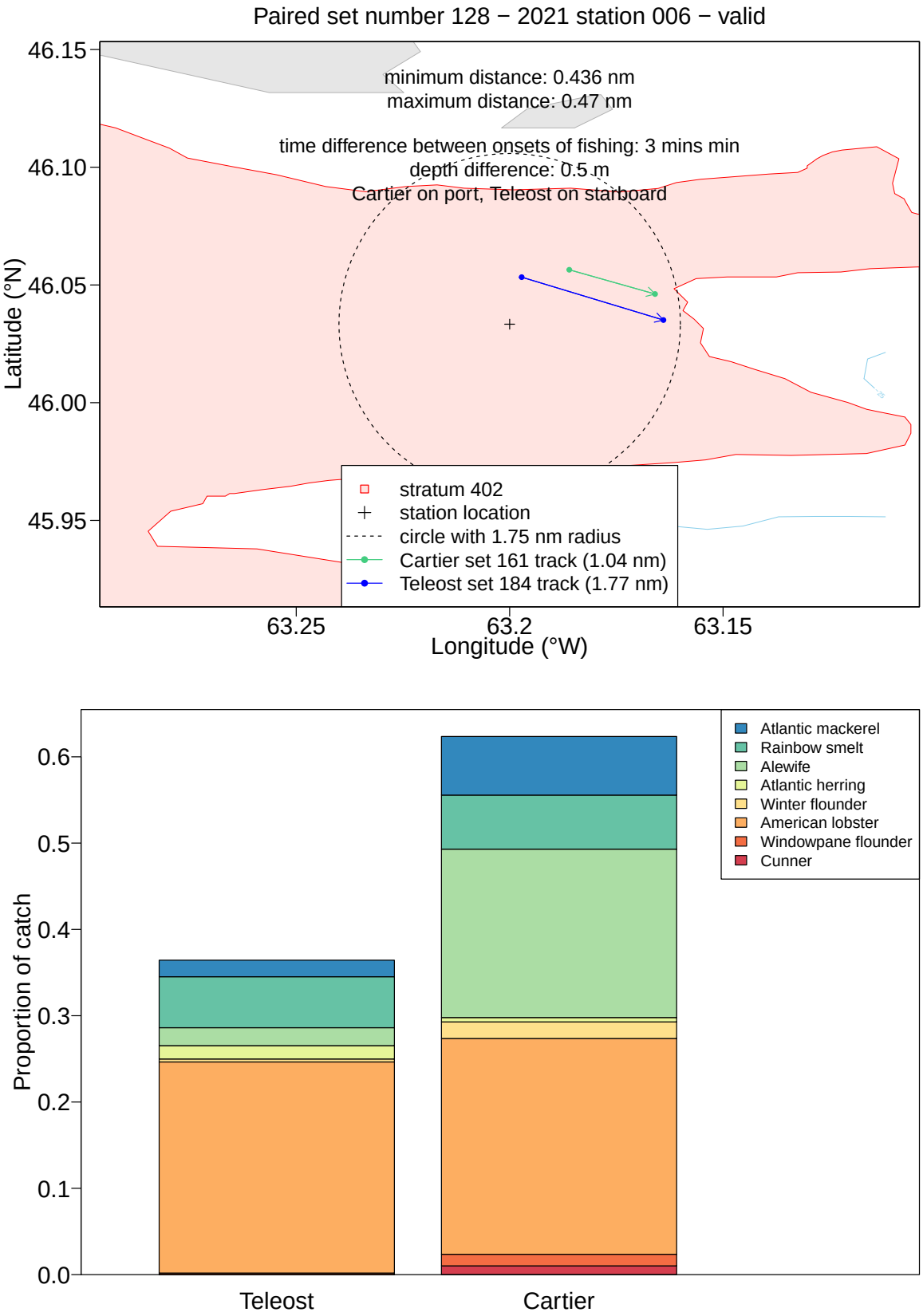

Figure 135. Tow tracks and major species composition for station 006 in 2021.

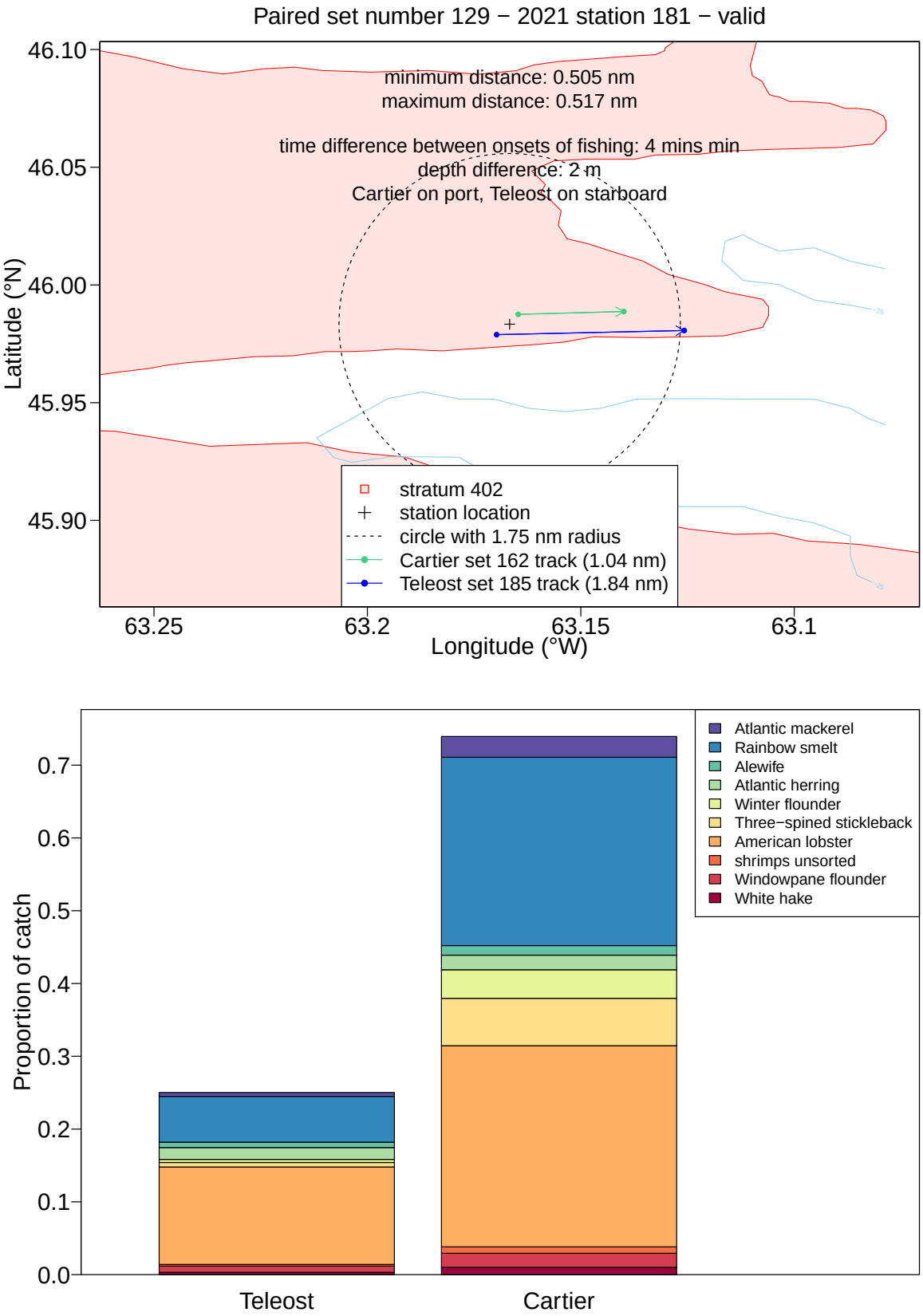

Figure 136. Tow tracks and major species composition for station 181 in 2021.

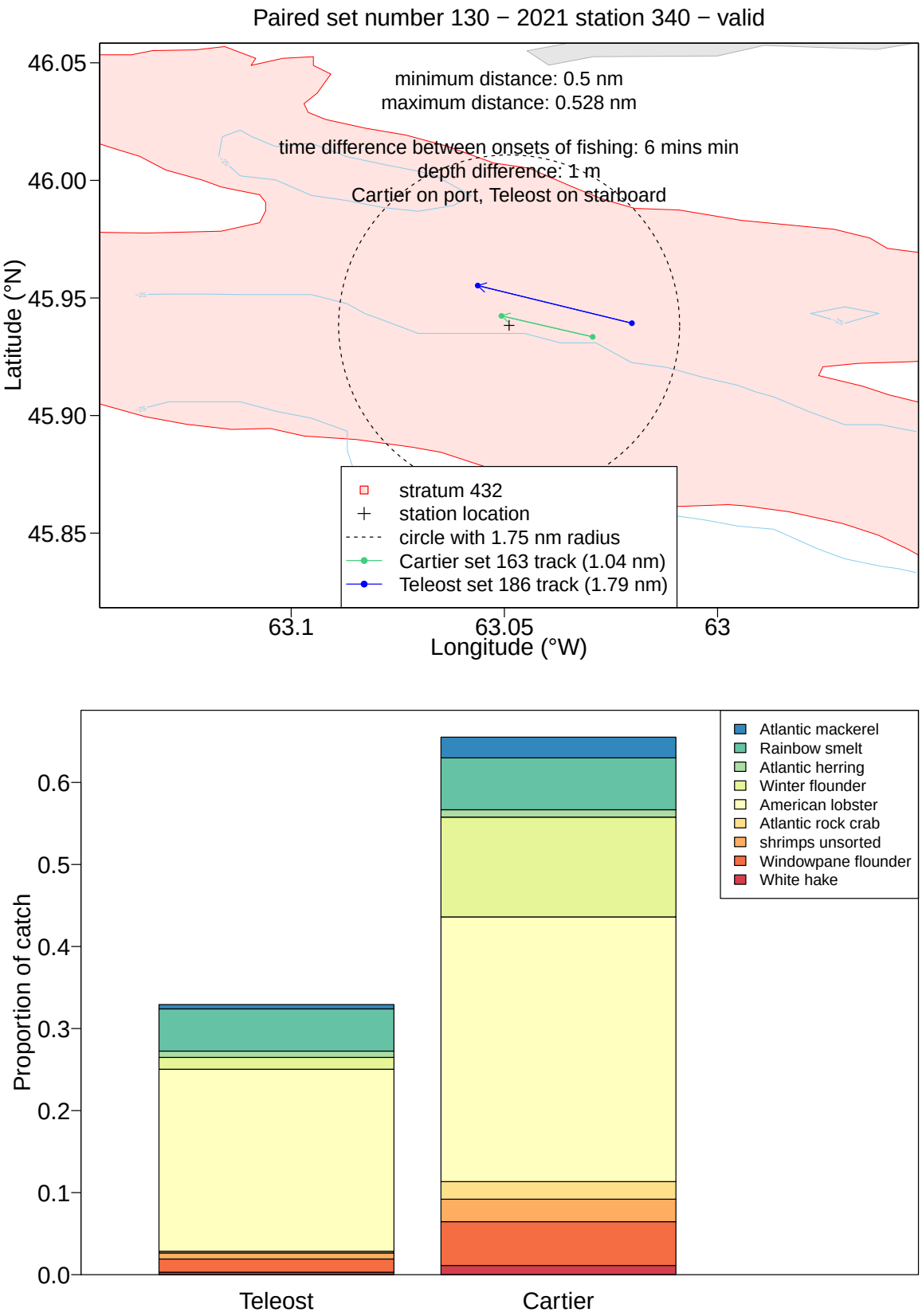

Figure 137. Tow tracks and major species composition for station 340 in 2021.

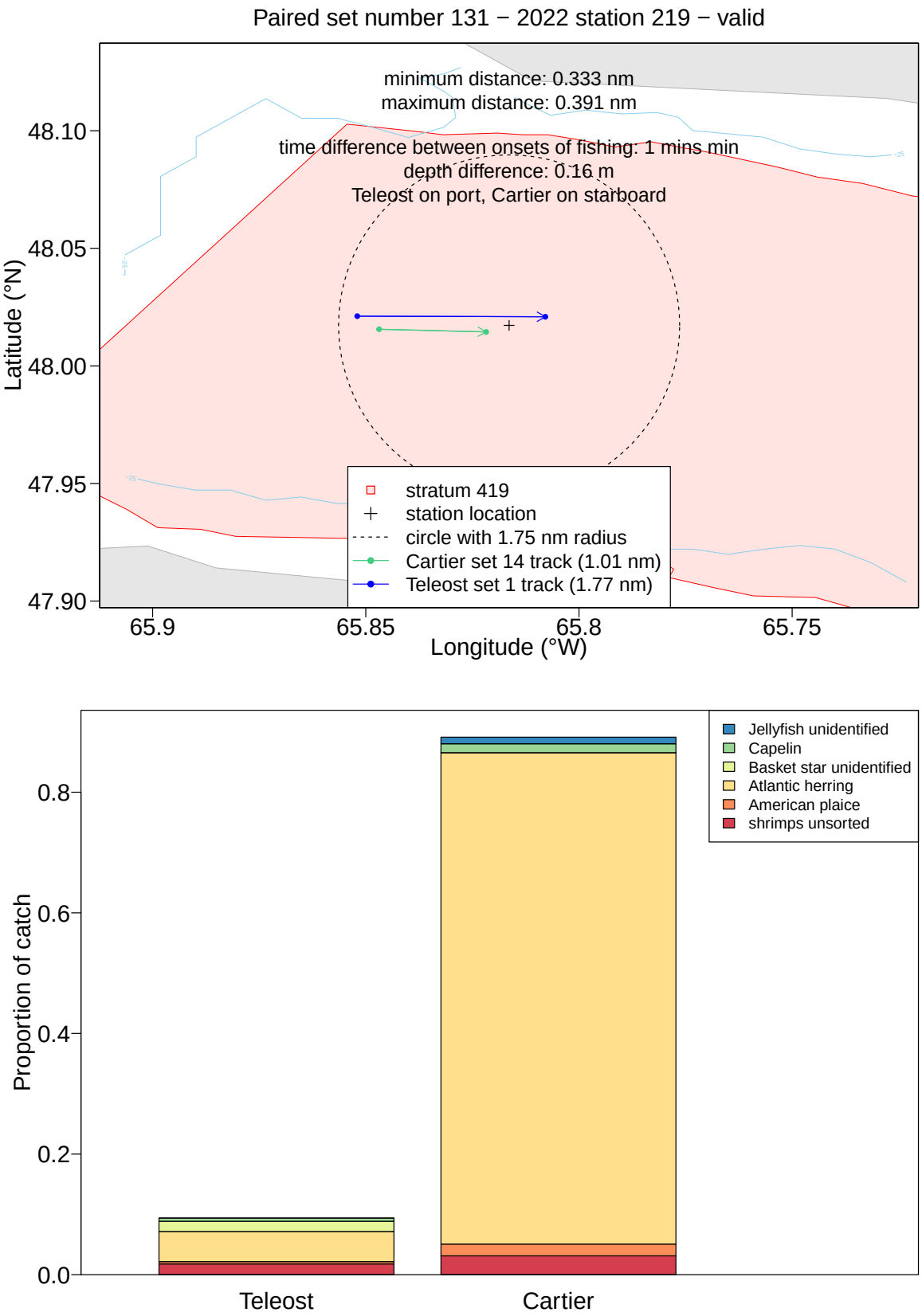

Figure 138. Tow tracks and major species composition for station 219 in 2022.

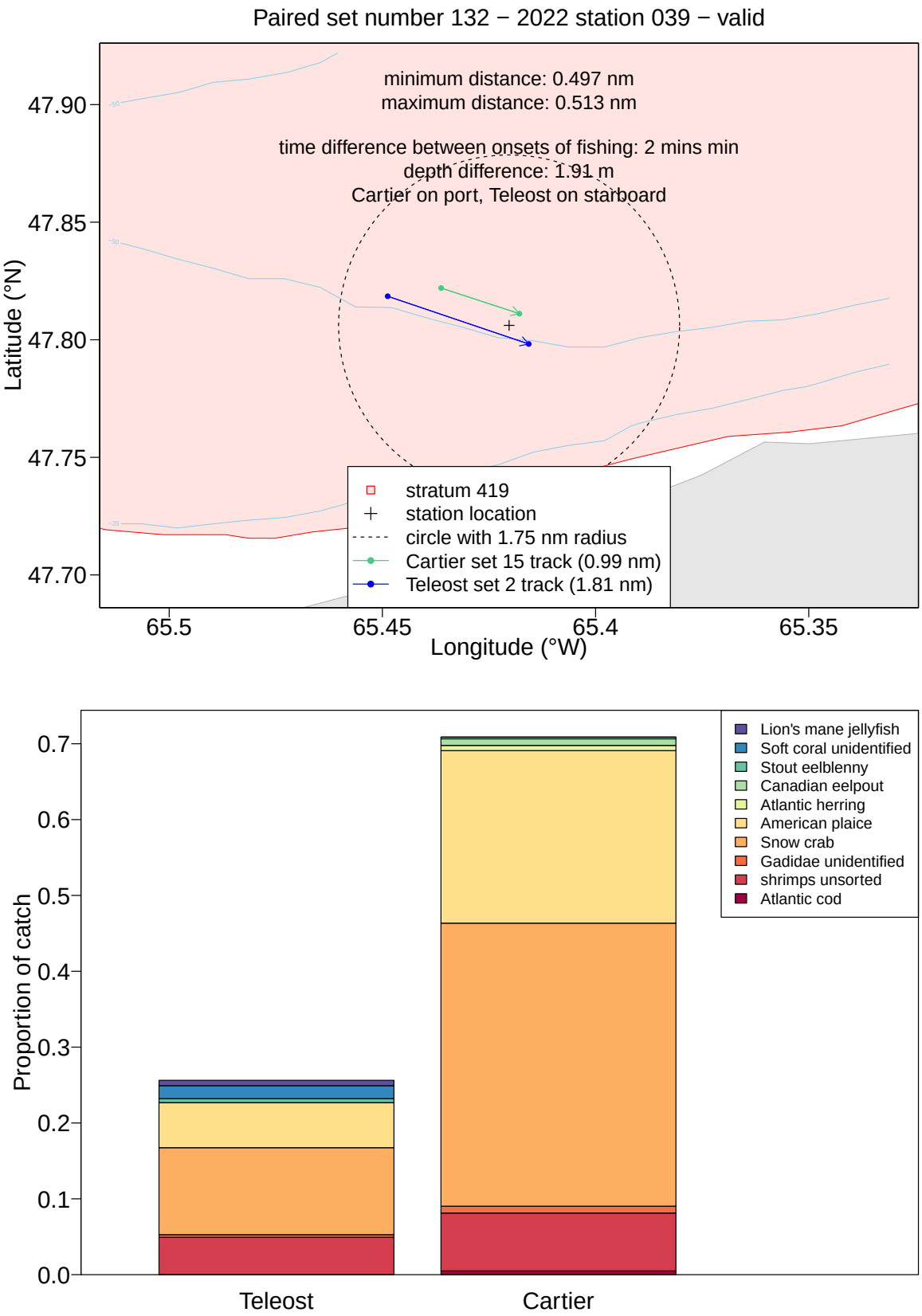

Figure 139. Tow tracks and major species composition for station 039 in 2022.

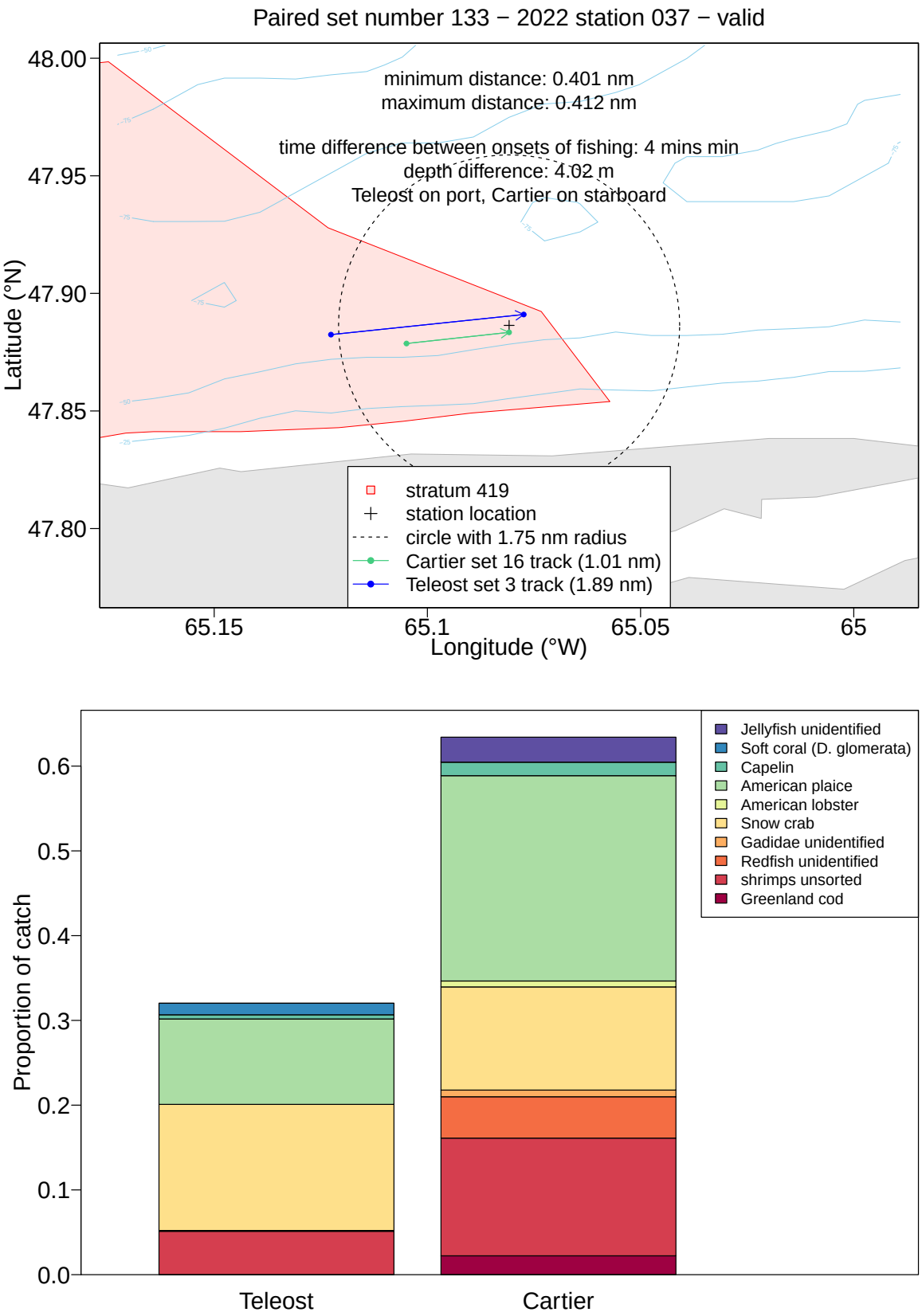

Figure 140. Tow tracks and major species composition for station 037 in 2022.

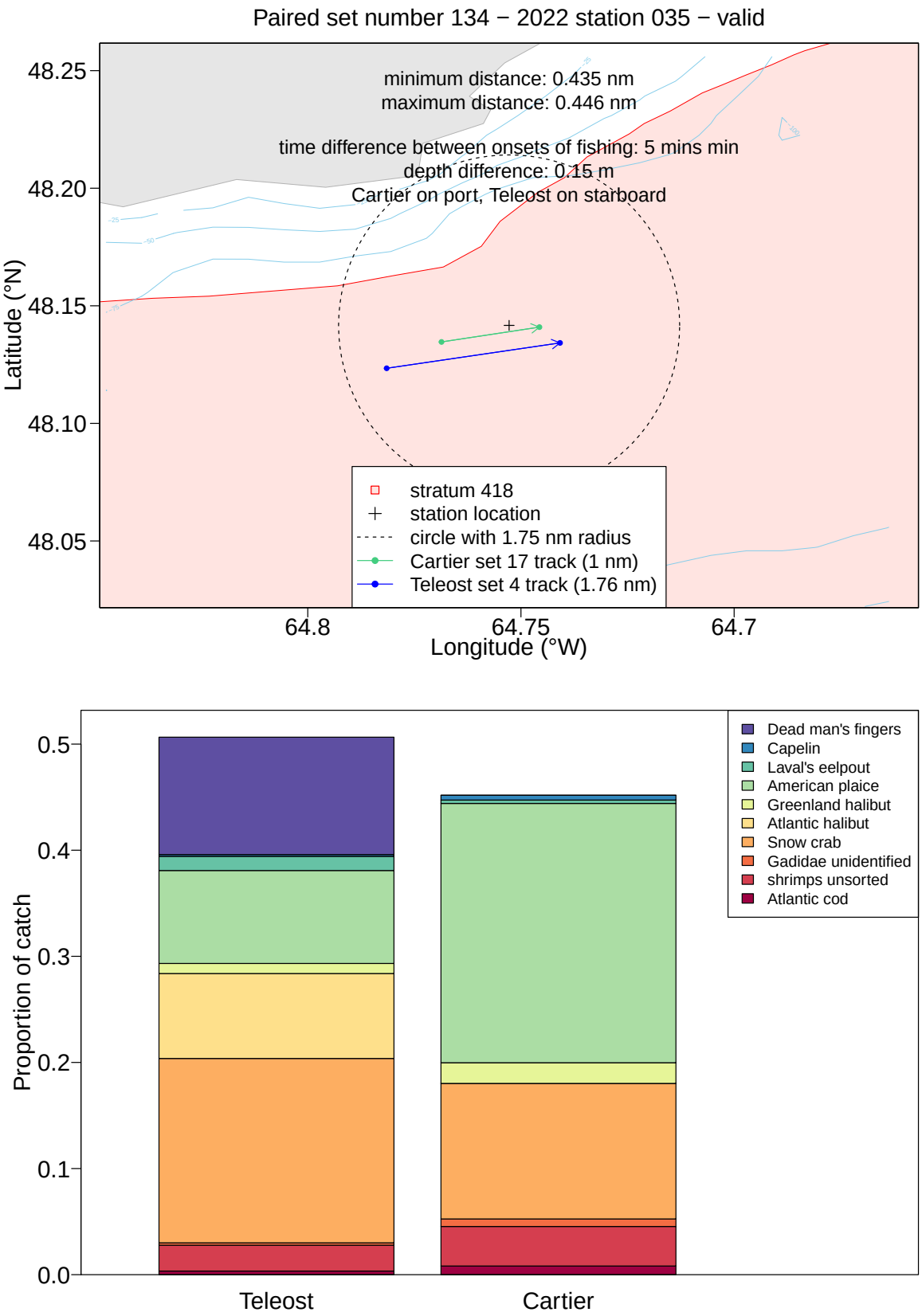

Figure 141. Tow tracks and major species composition for station 035 in 2022.

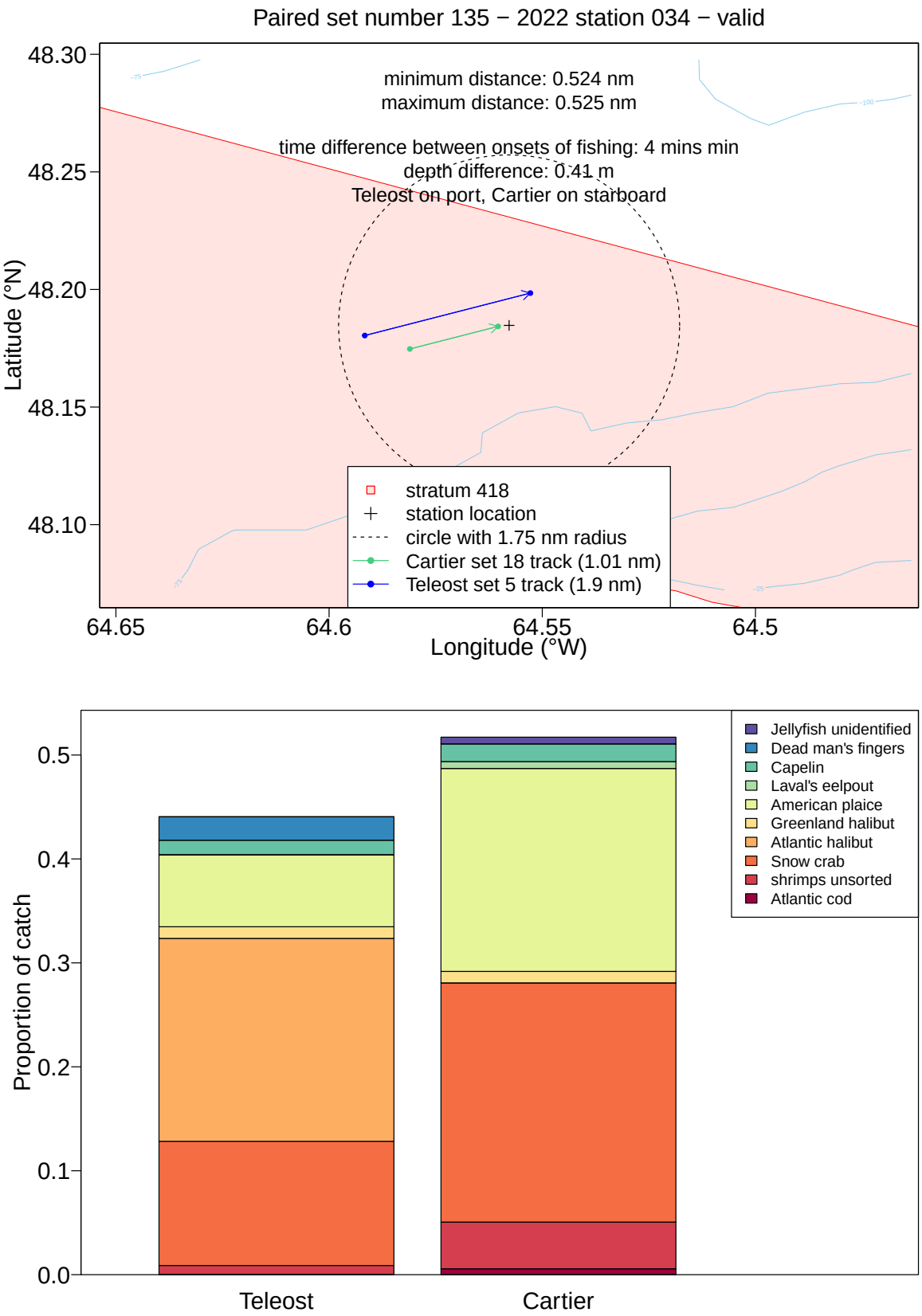

Figure 142. Tow tracks and major species composition for station 034 in 2022.

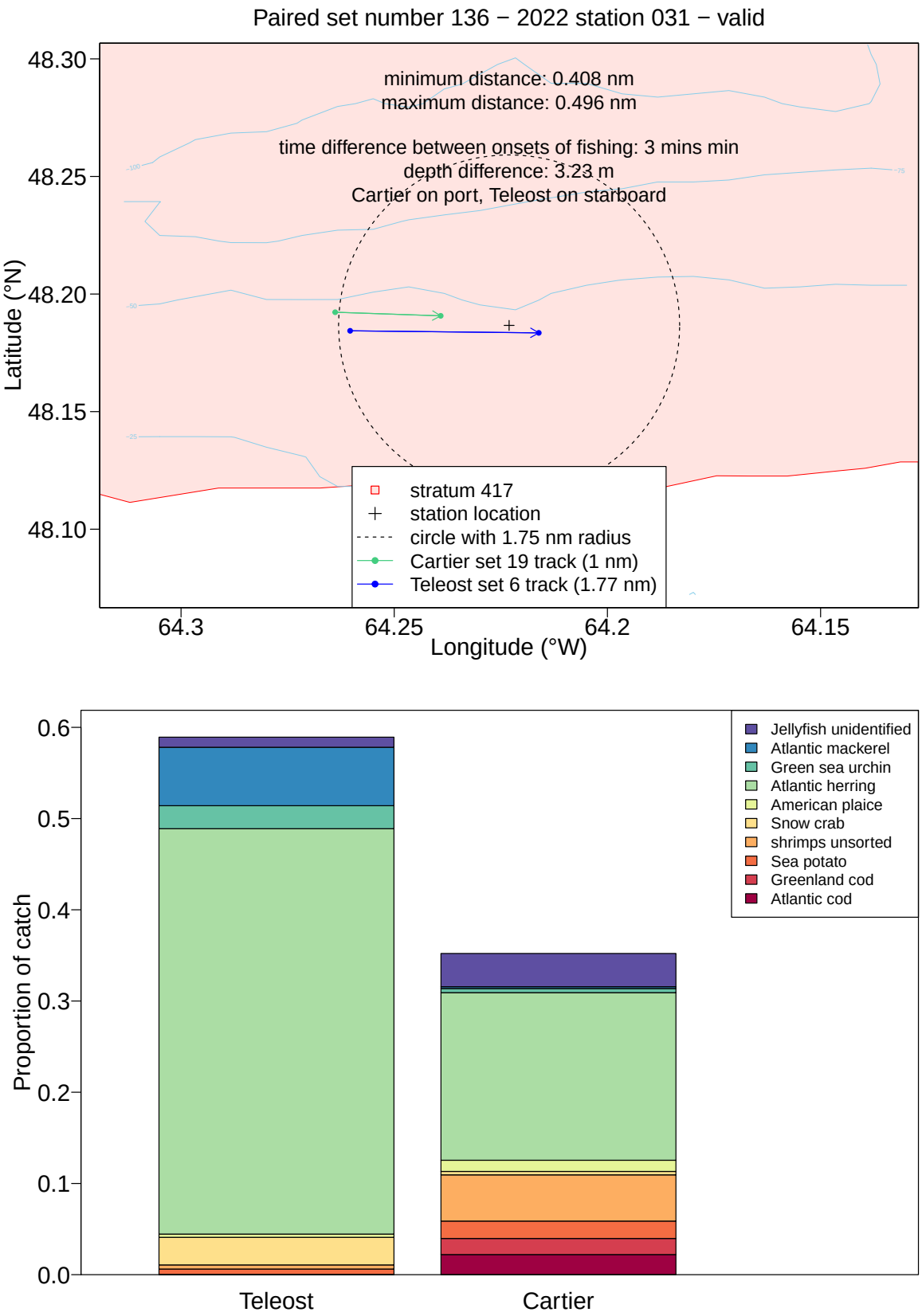

Figure 143. Tow tracks and major species composition for station 031 in 2022.

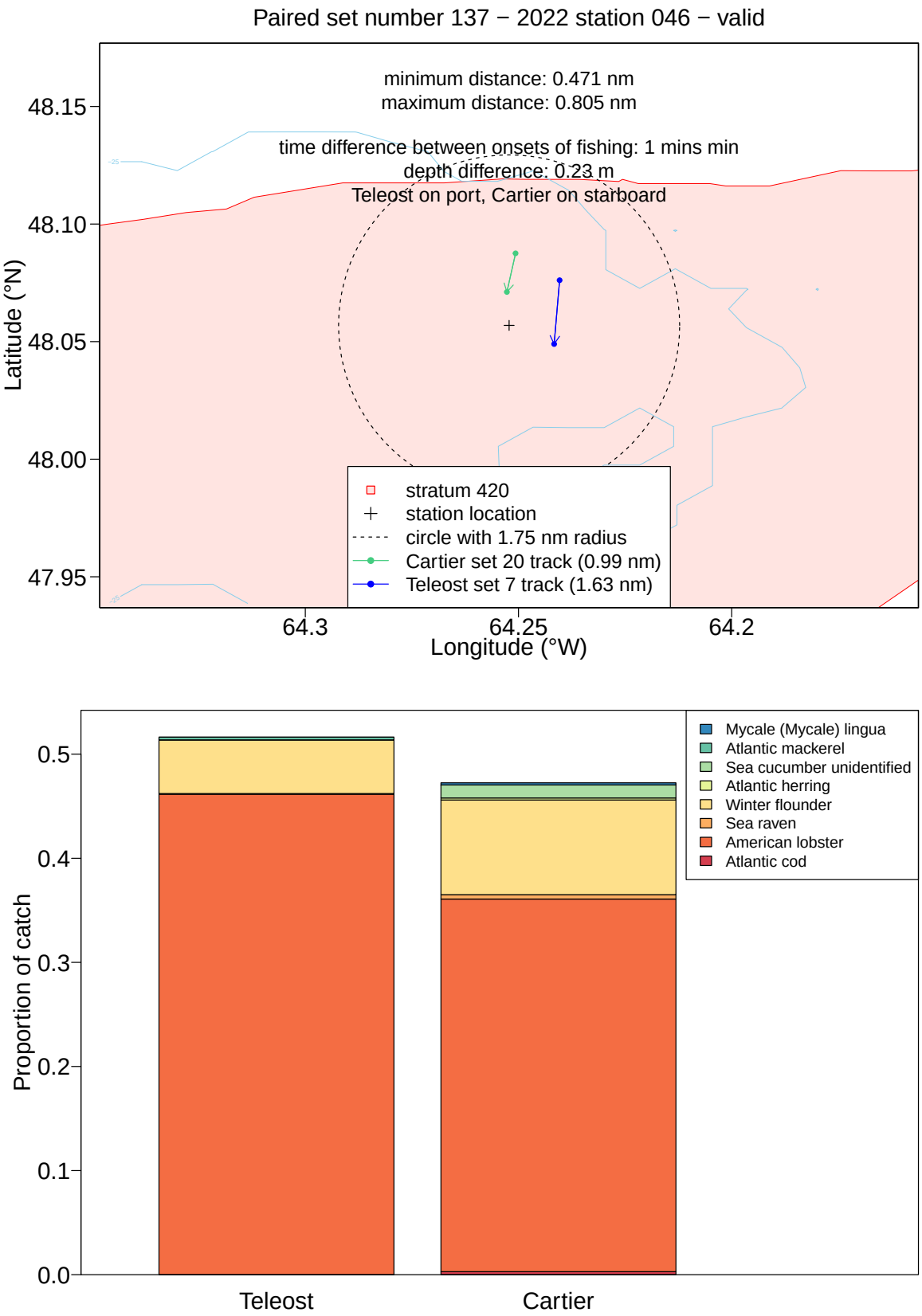

Figure 144. Tow tracks and major species composition for station 046 in 2022.

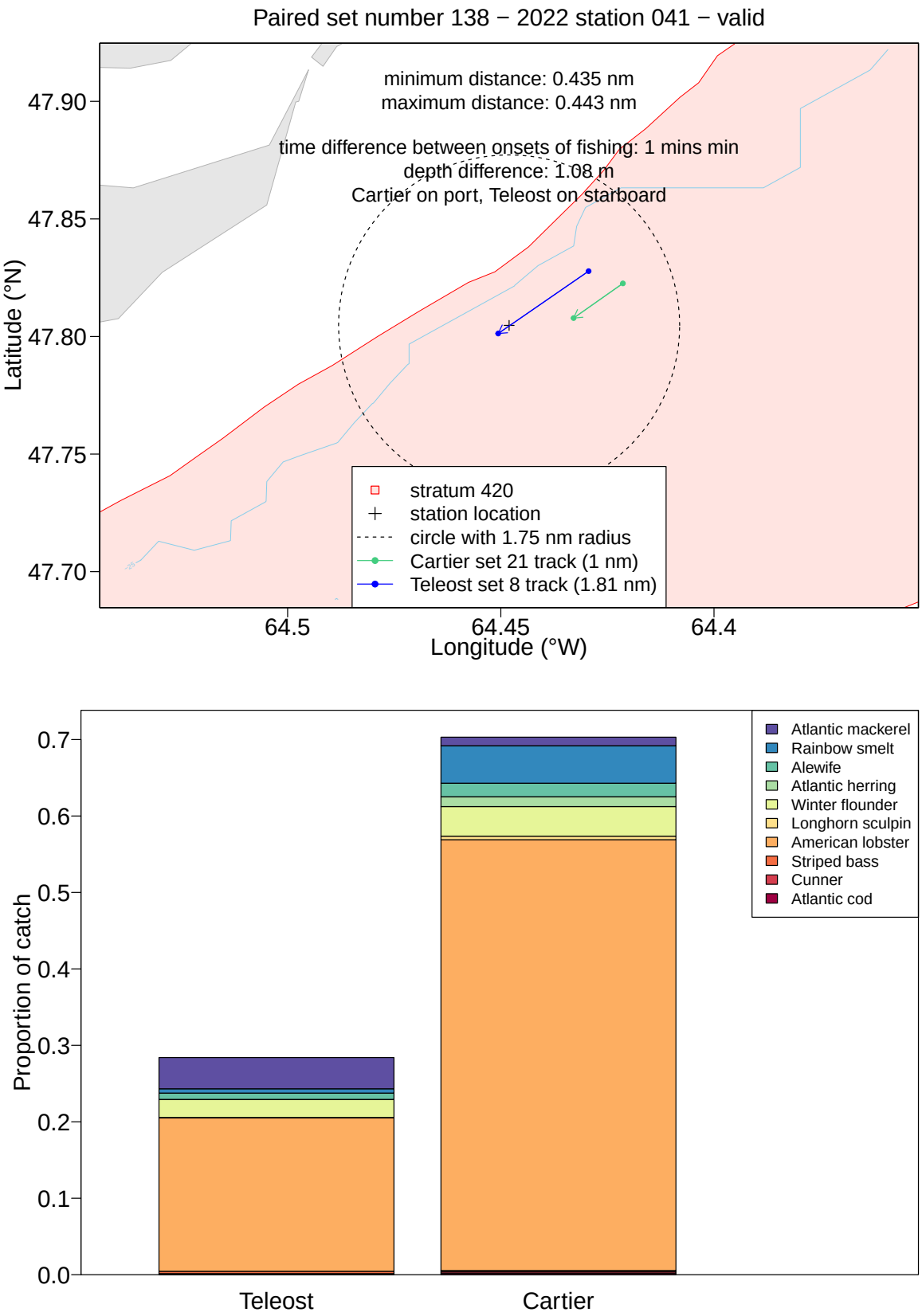

Figure 145. Tow tracks and major species composition for station 041 in 2022.

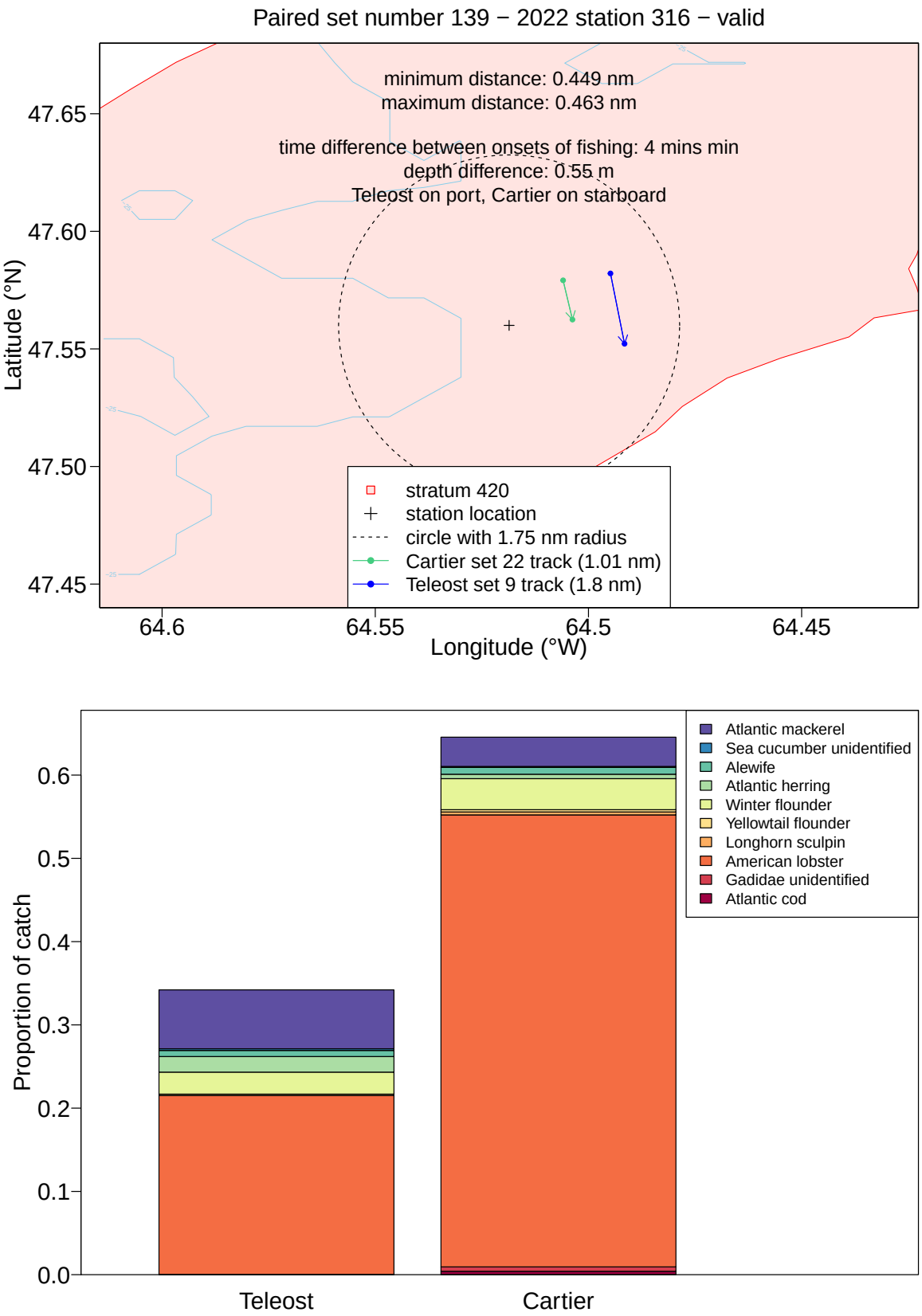

Figure 146. Tow tracks and major species composition for station 316 in 2022.

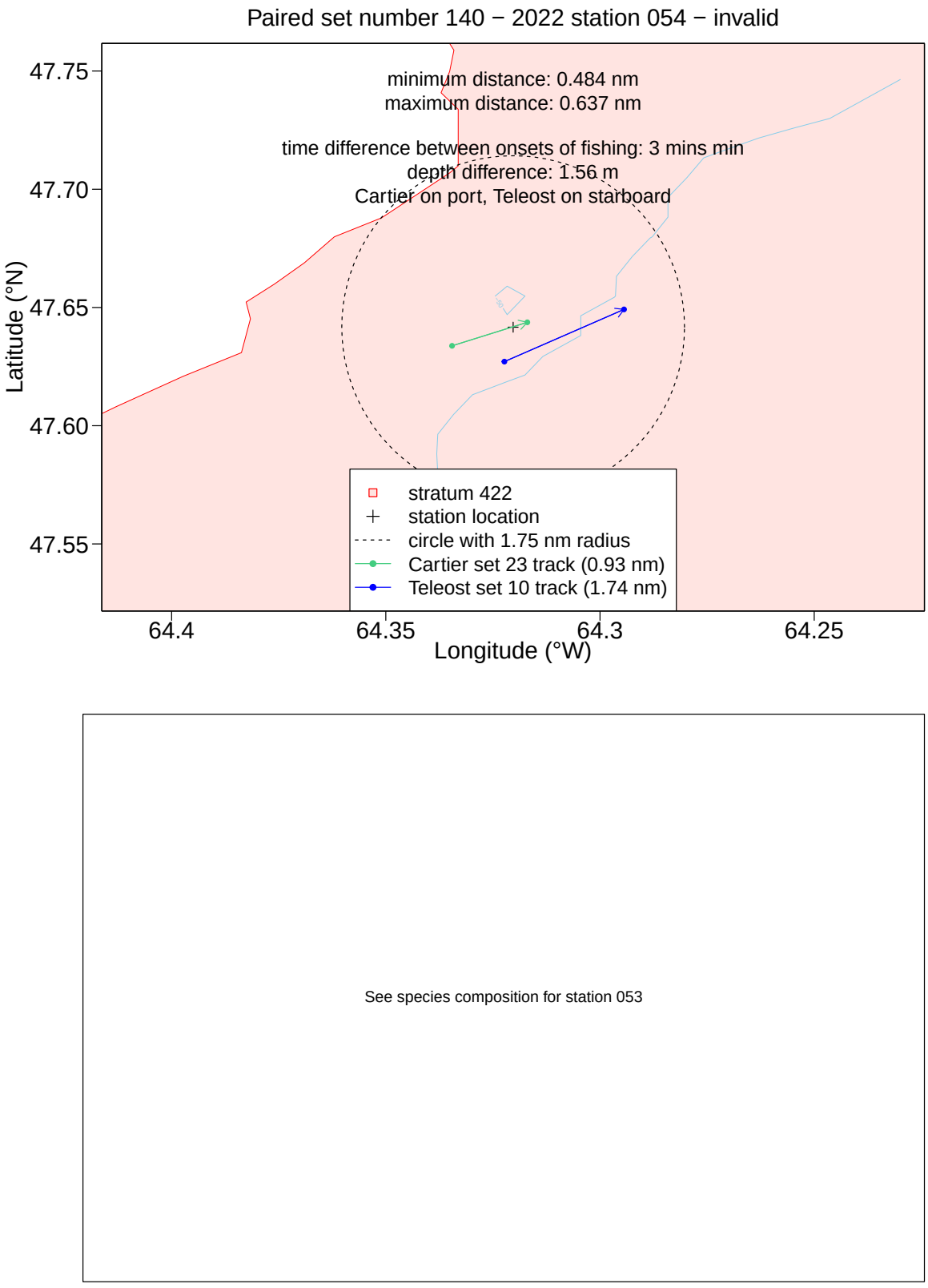

Figure 147. Tow tracks and major species composition for station 054 in 2022.

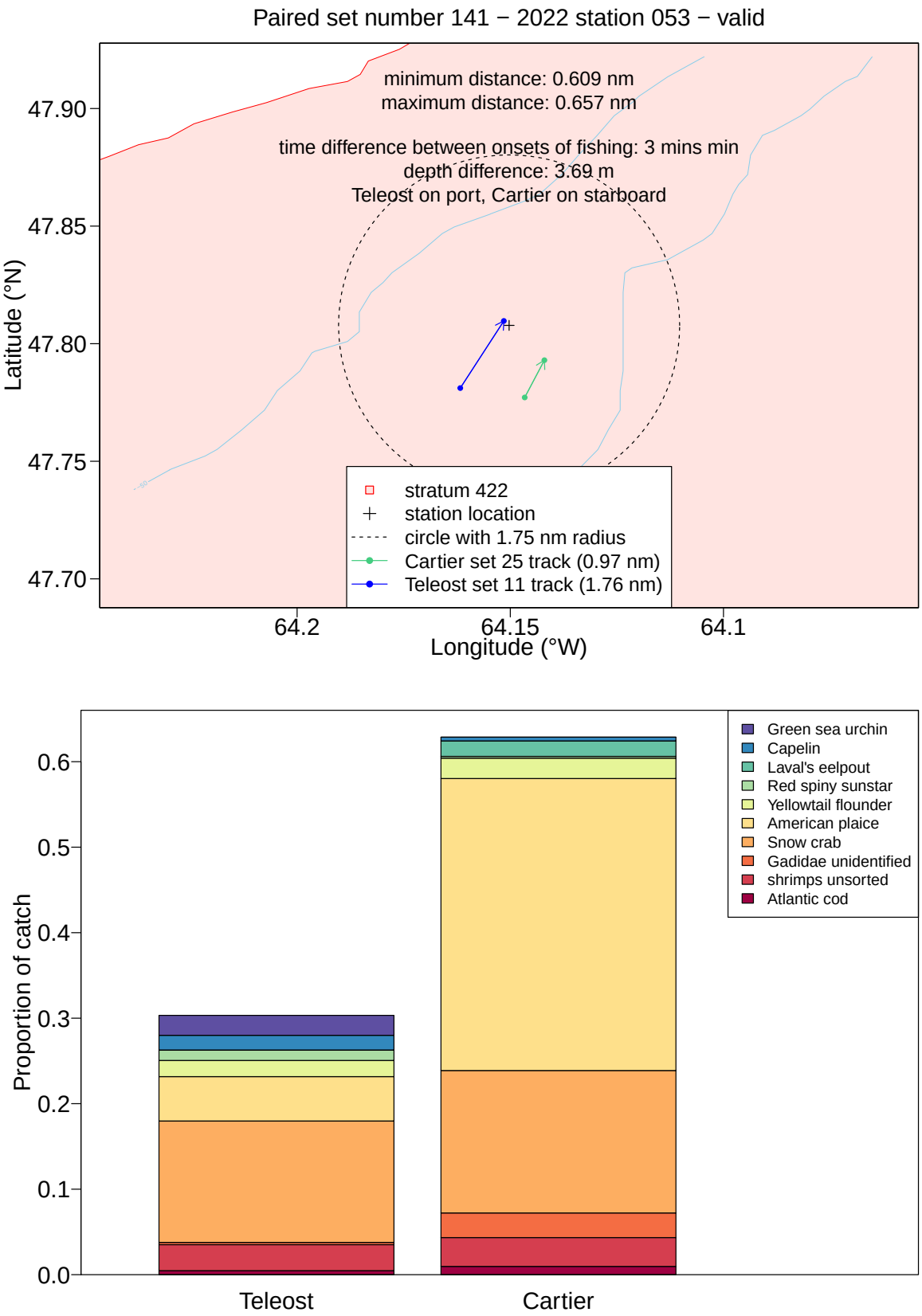

Figure 148. Tow tracks and major species composition for station 053 in 2022.

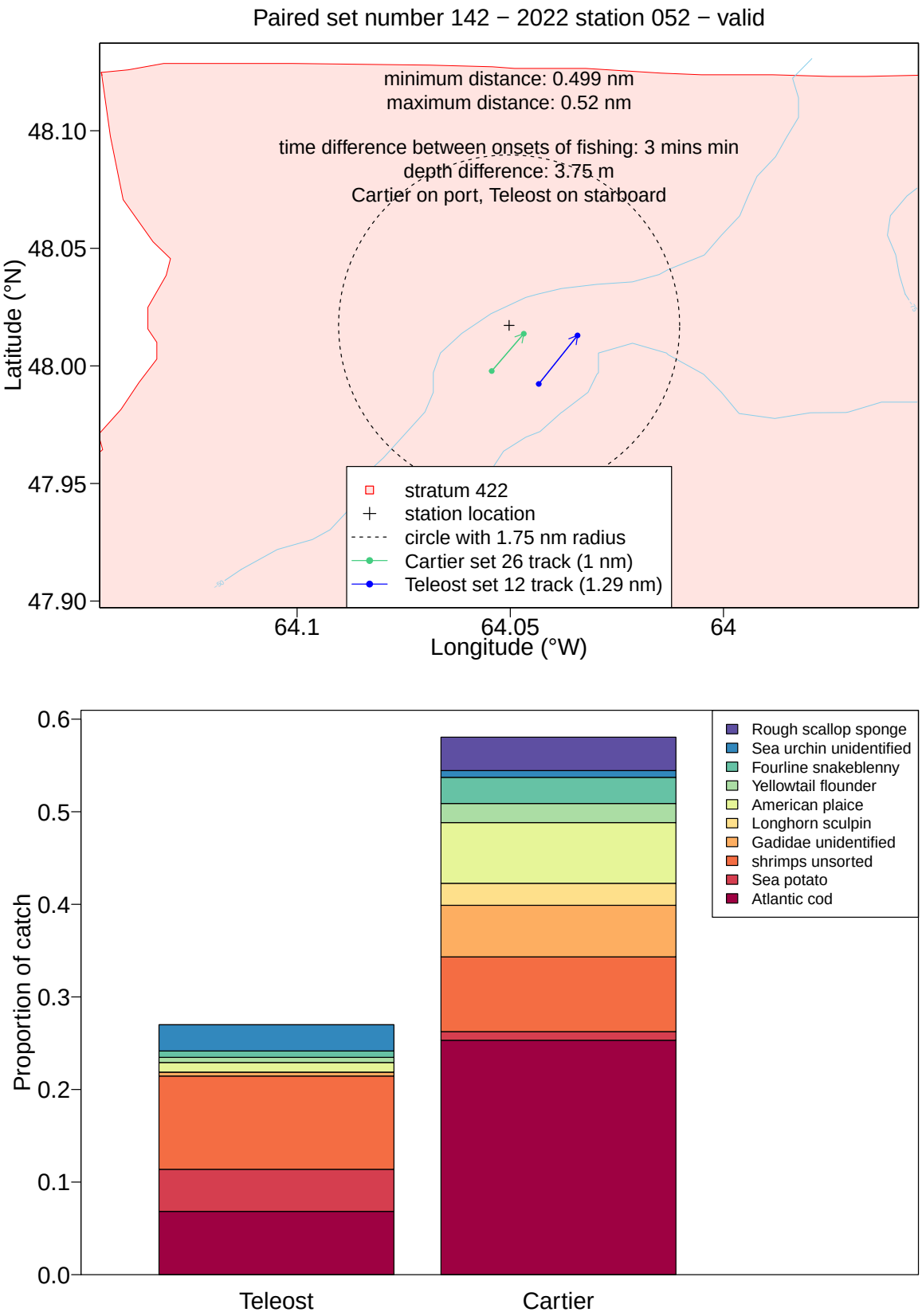

Figure 149. Tow tracks and major species composition for station 052 in 2022.

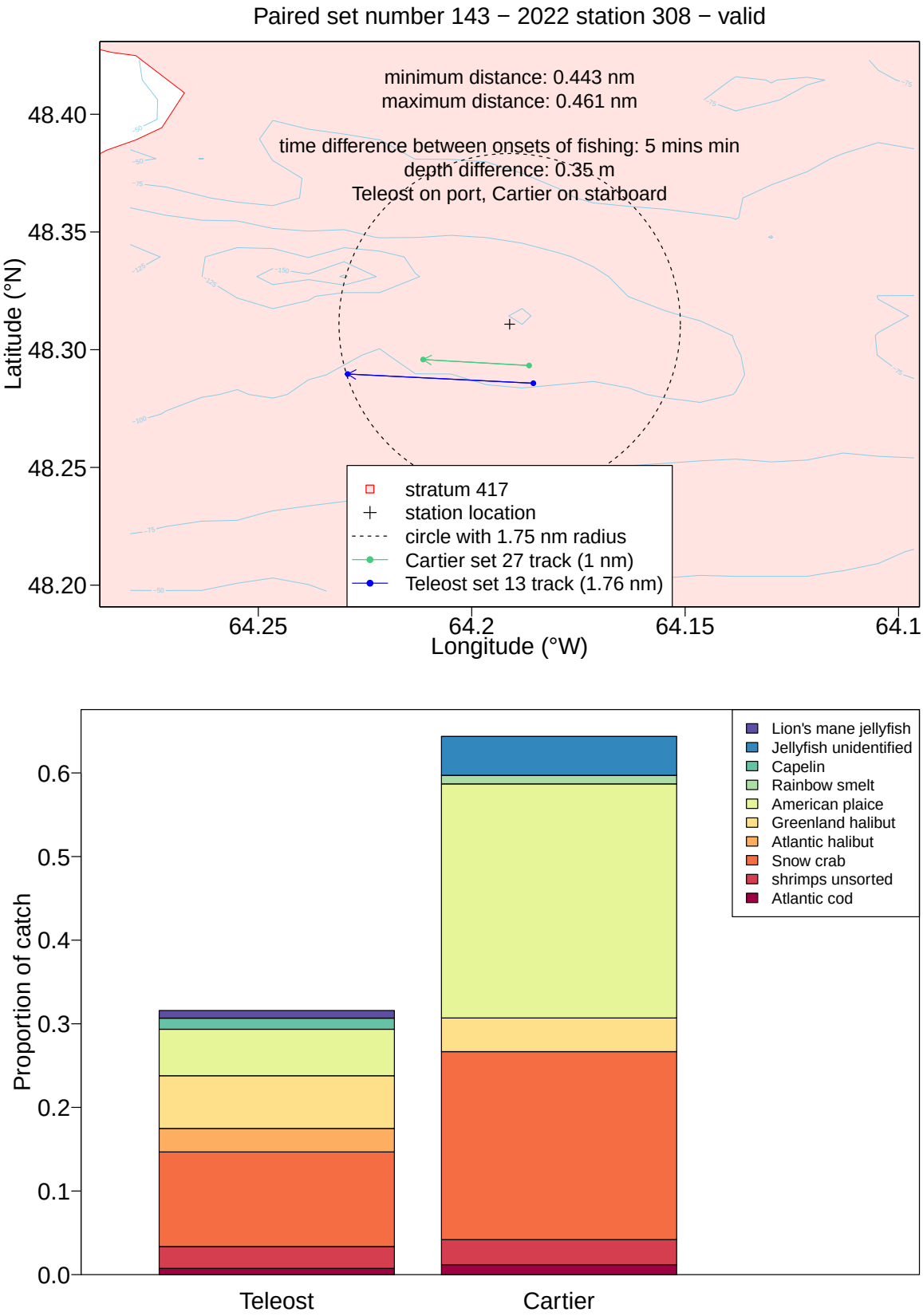

Figure 150. Tow tracks and major species composition for station 308 in 2022.

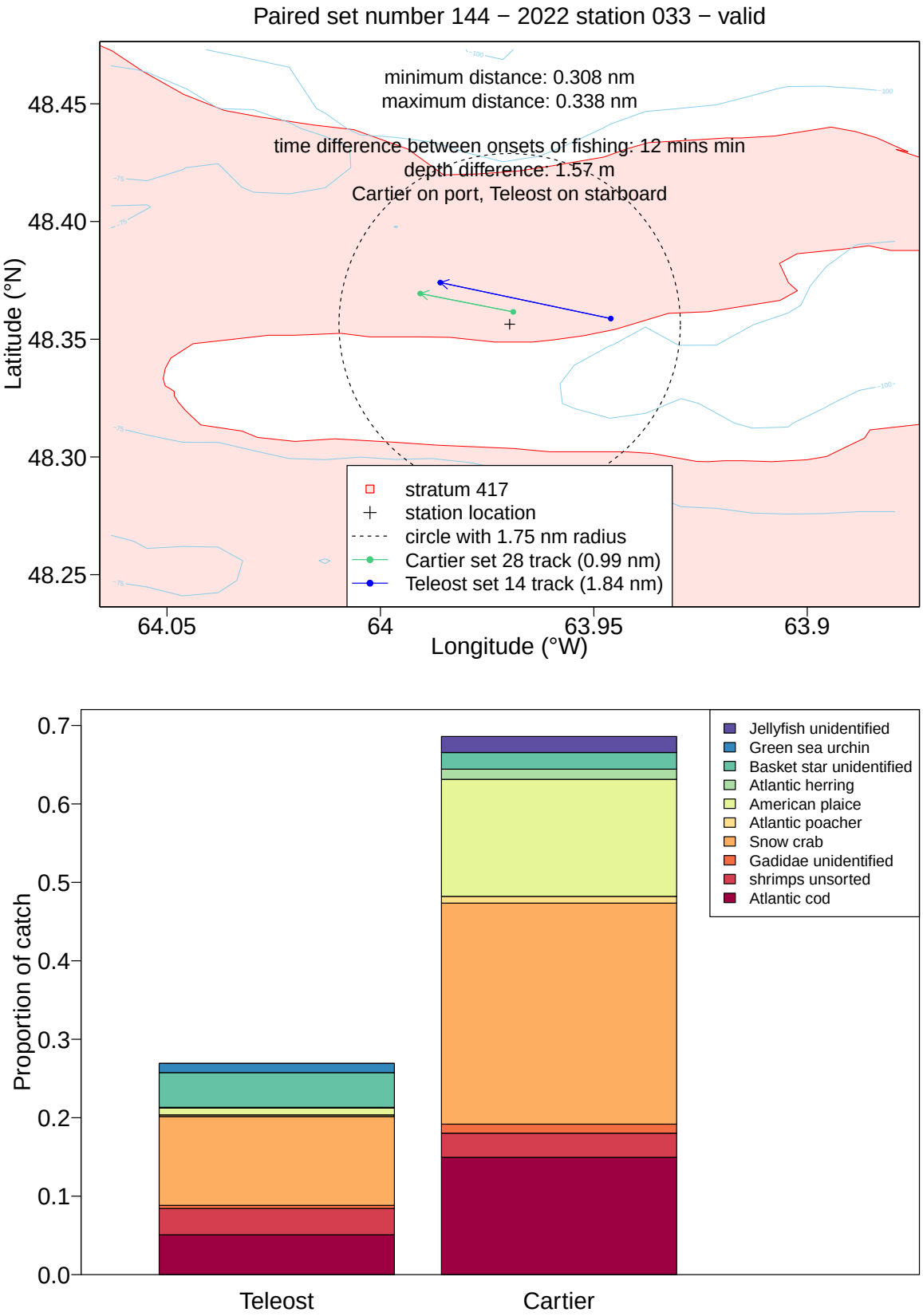

Figure 151. Tow tracks and major species composition for station 033 in 2022.

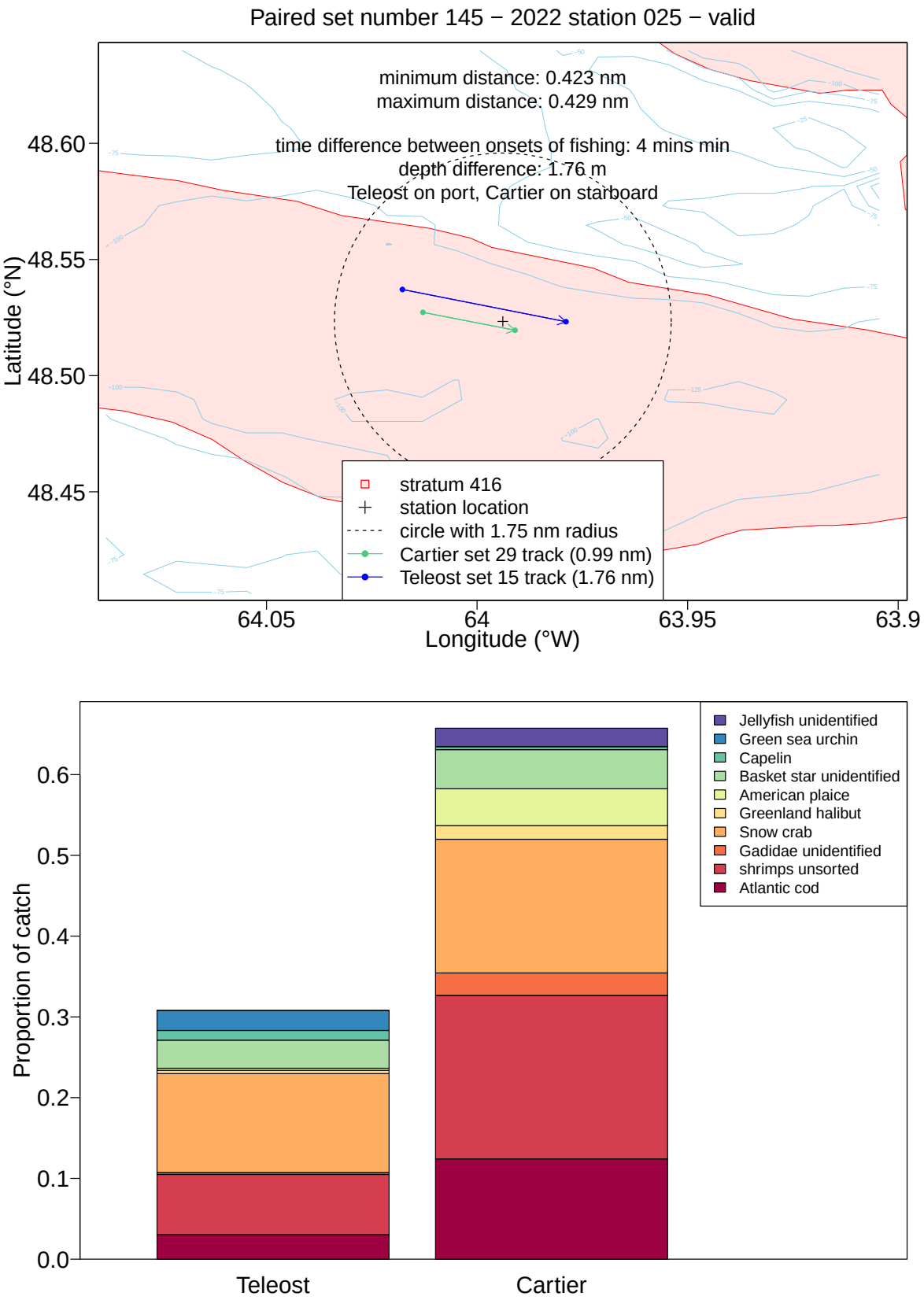

Figure 152. Tow tracks and major species composition for station 025 in 2022.

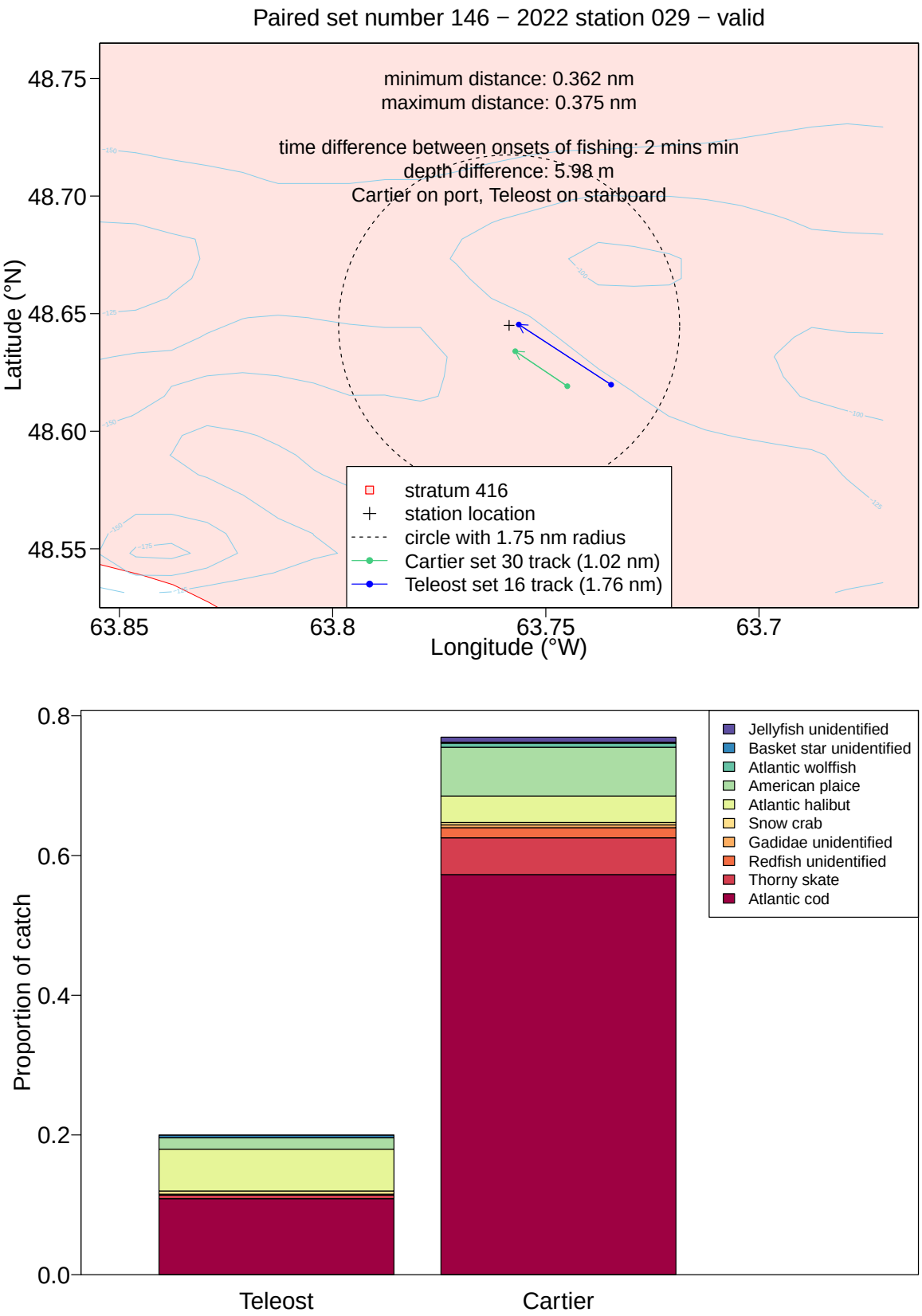

Figure 153. Tow tracks and major species composition for station 029 in 2022.

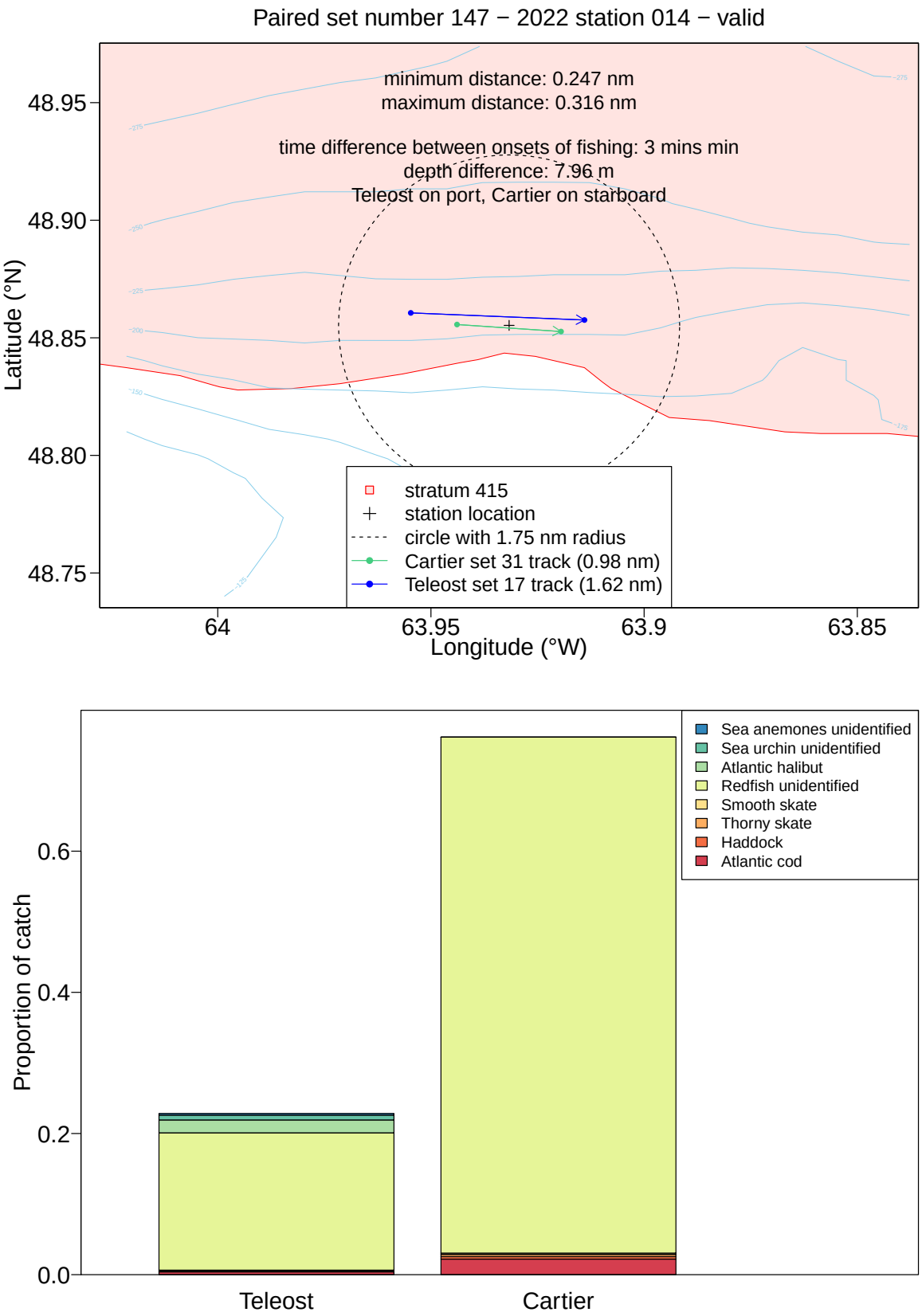

Figure 154. Tow tracks and major species composition for station 014 in 2022.

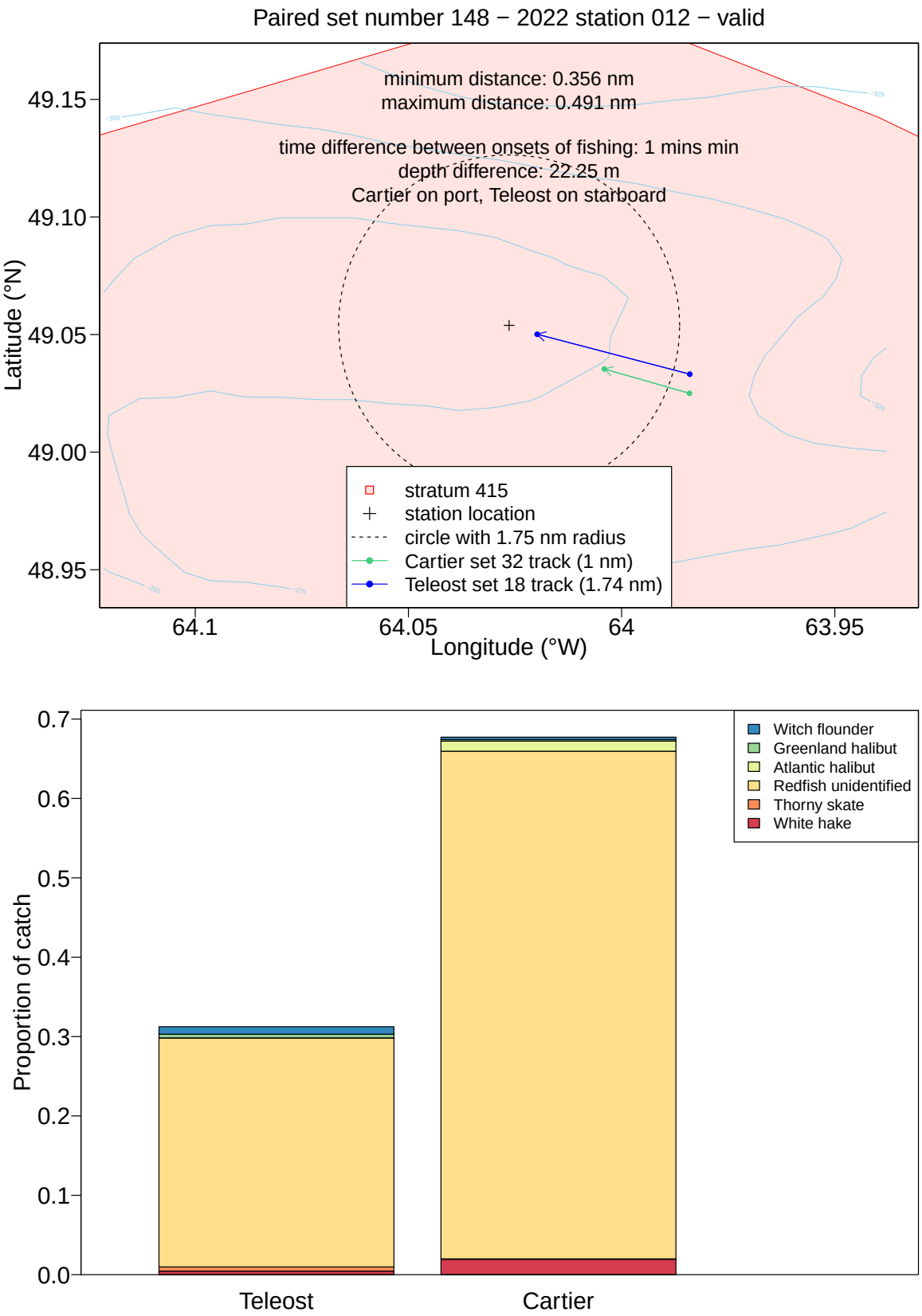

Figure 155. Tow tracks and major species composition for station 012 in 2022.

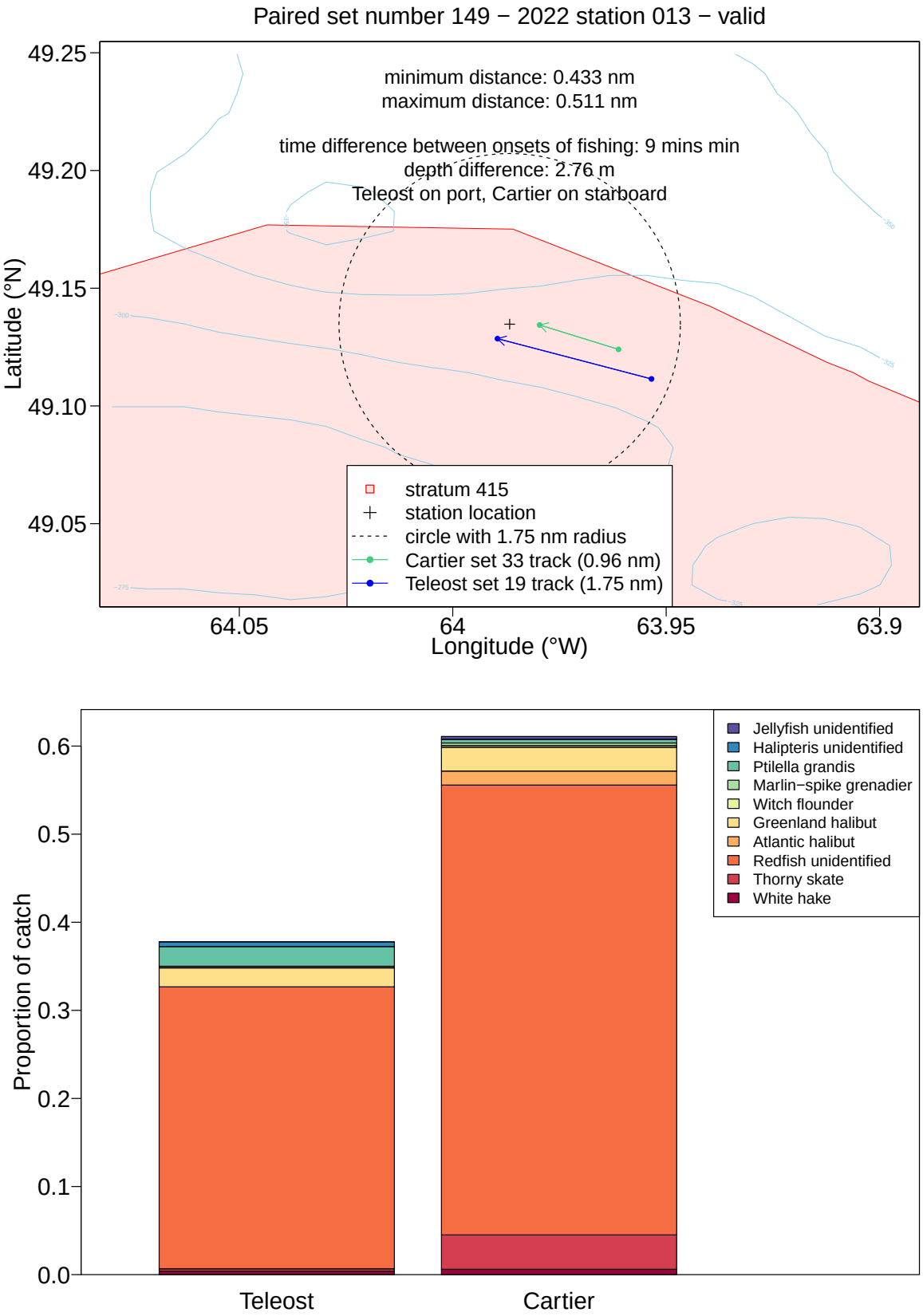

Figure 156. Tow tracks and major species composition for station 013 in 2022.

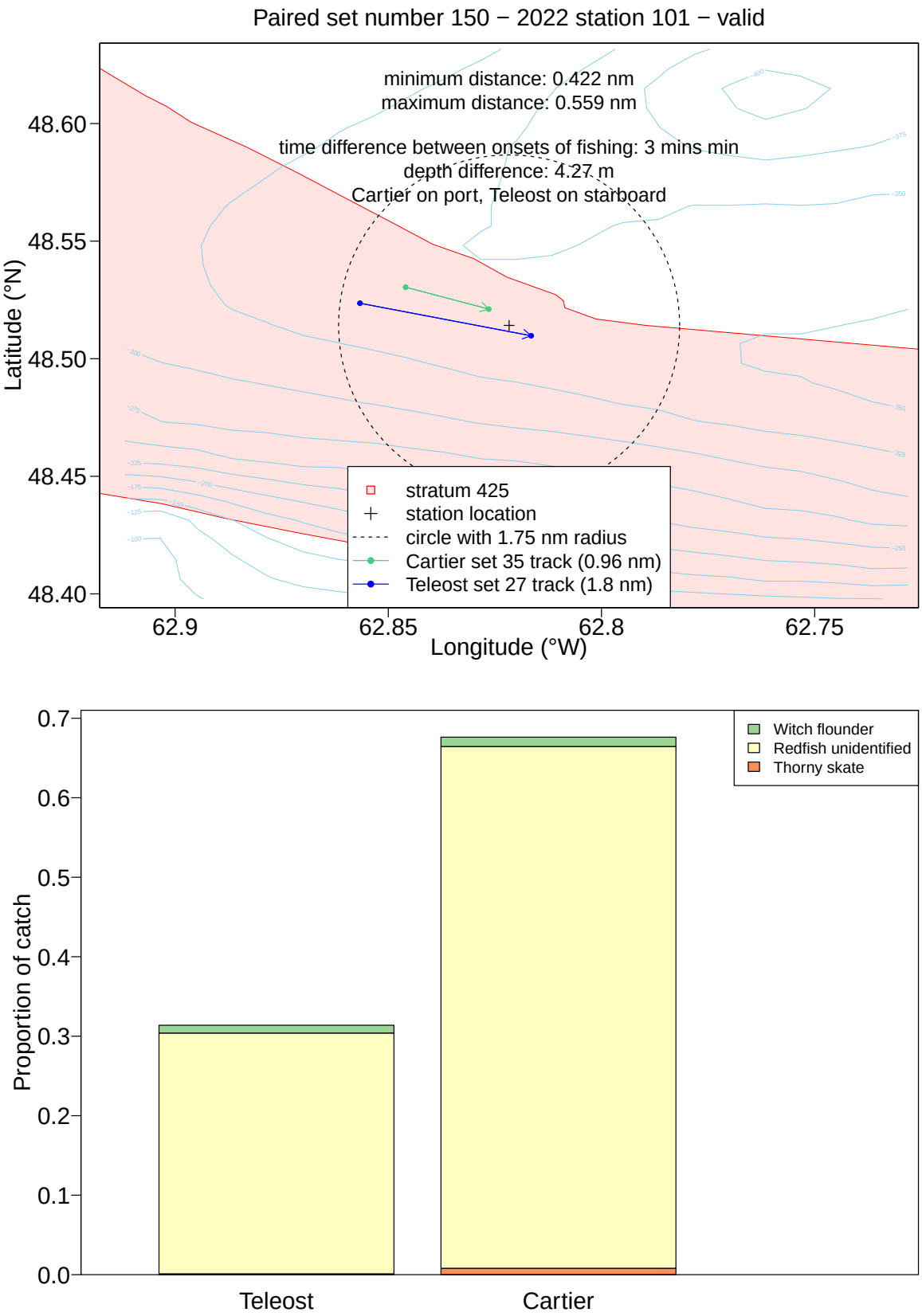

Figure 157. Tow tracks and major species composition for station 101 in 2022.

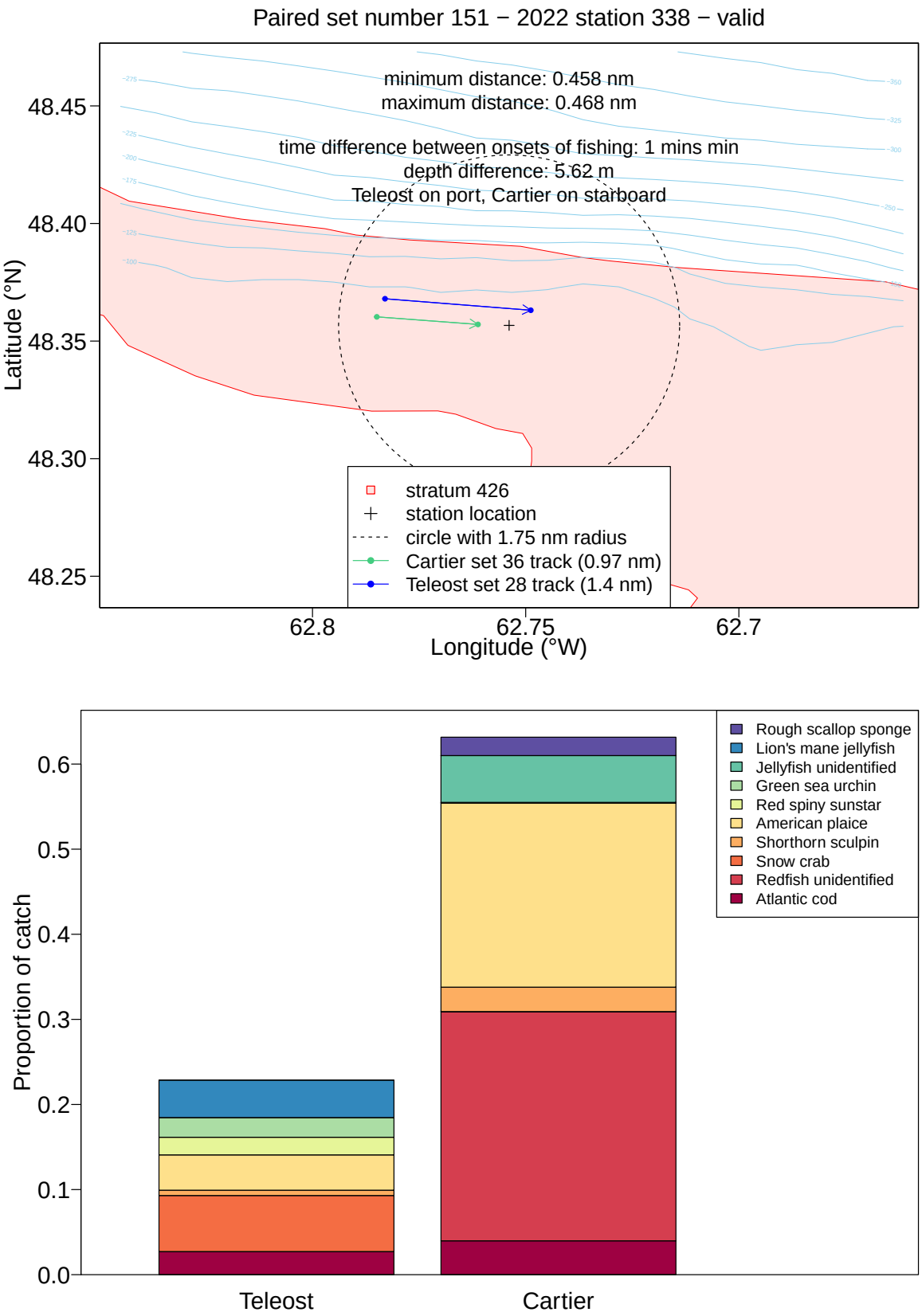

Figure 158. Tow tracks and major species composition for station 338 in 2022.

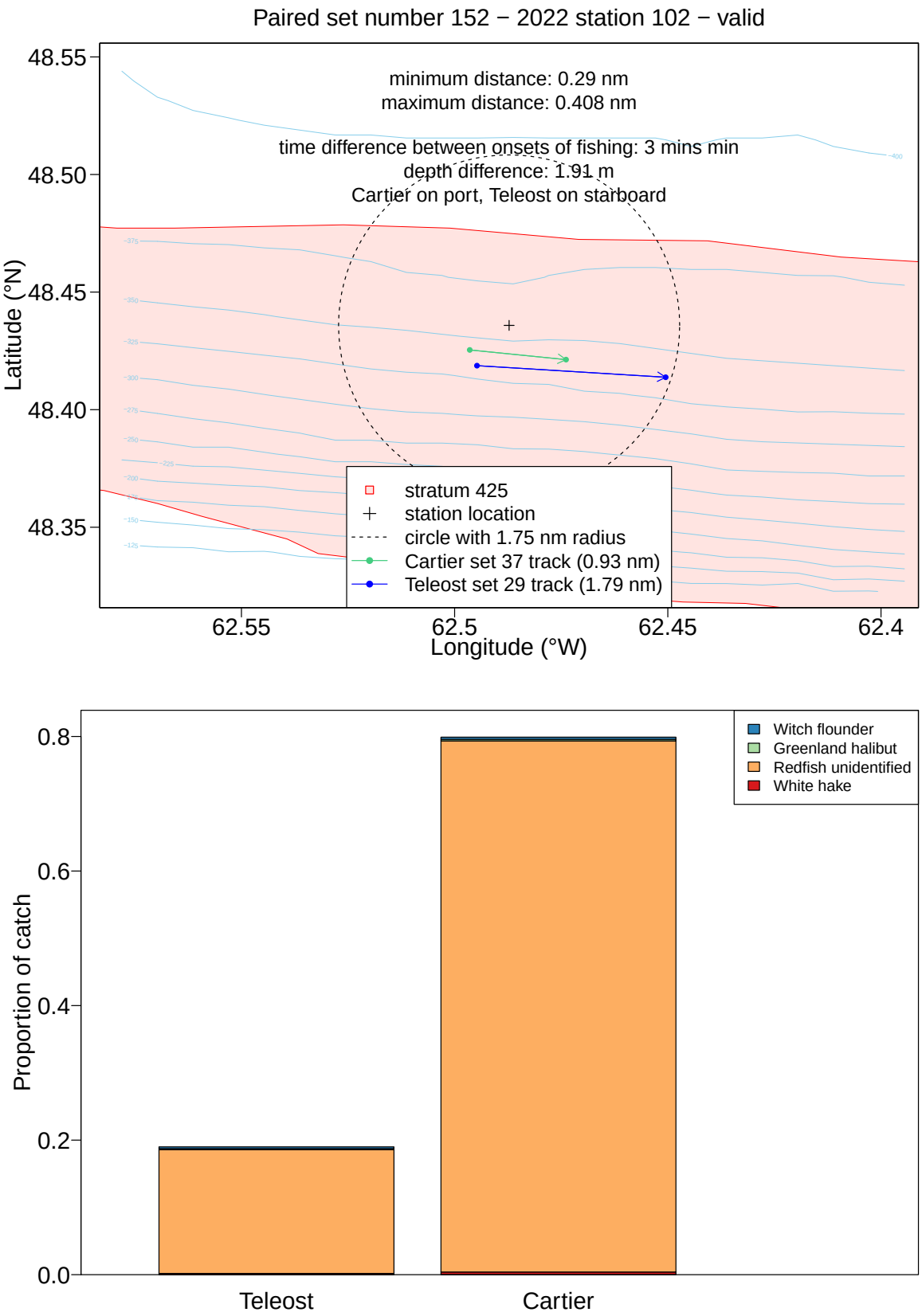

Figure 159. Tow tracks and major species composition for station 102 in 2022.

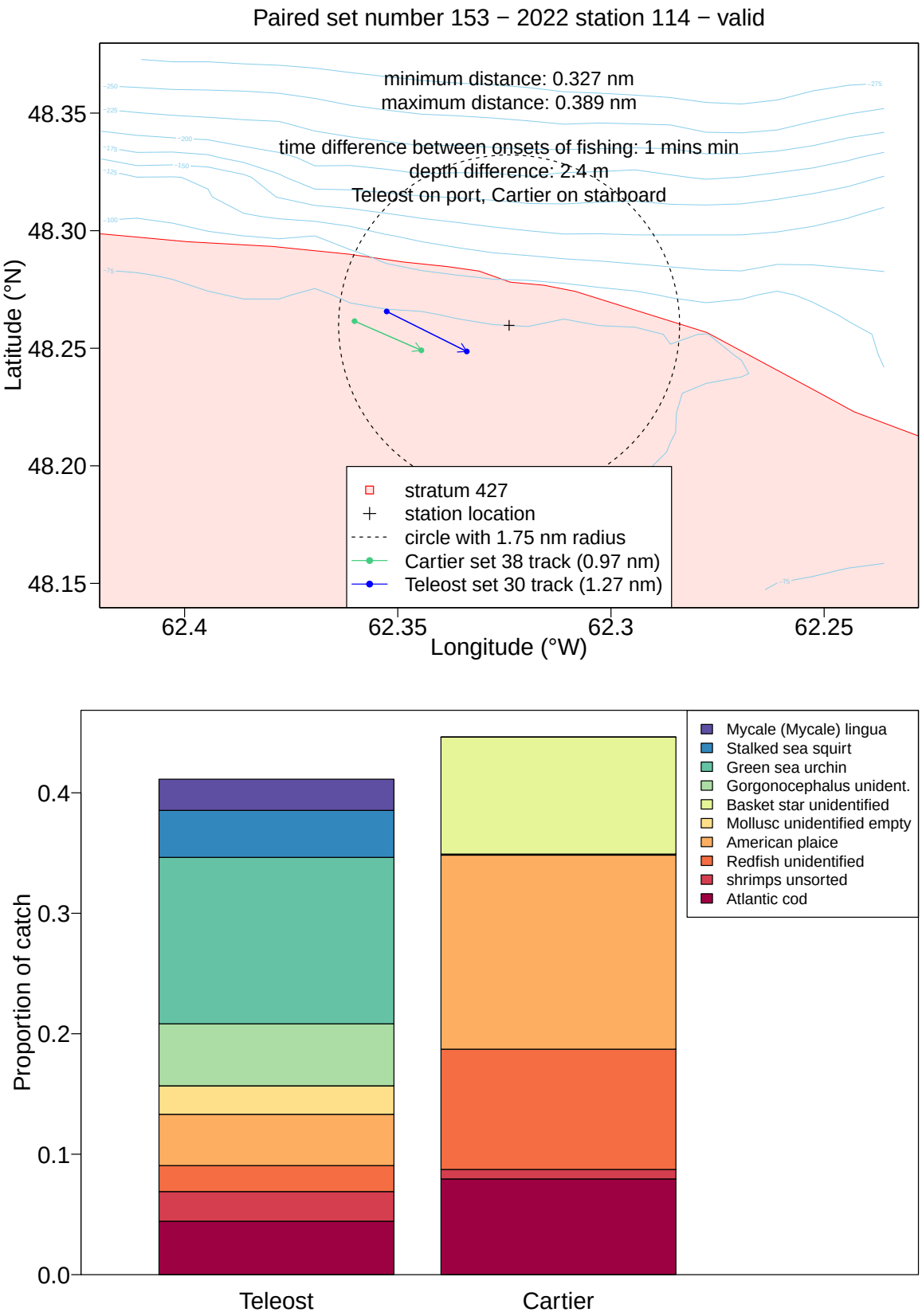

Figure 160. Tow tracks and major species composition for station 114 in 2022.

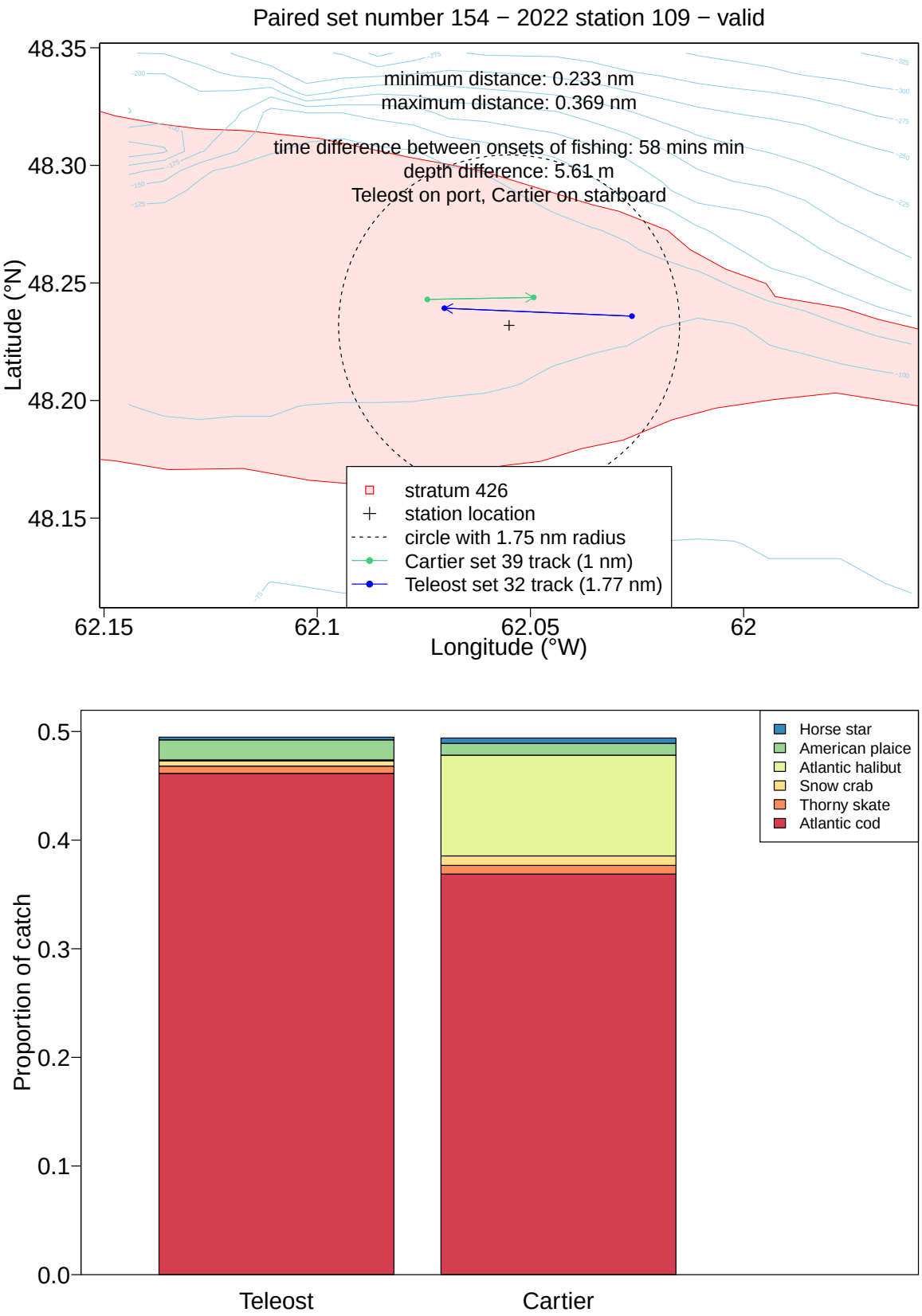

Figure 161. Tow tracks and major species composition for station 109 in 2022.

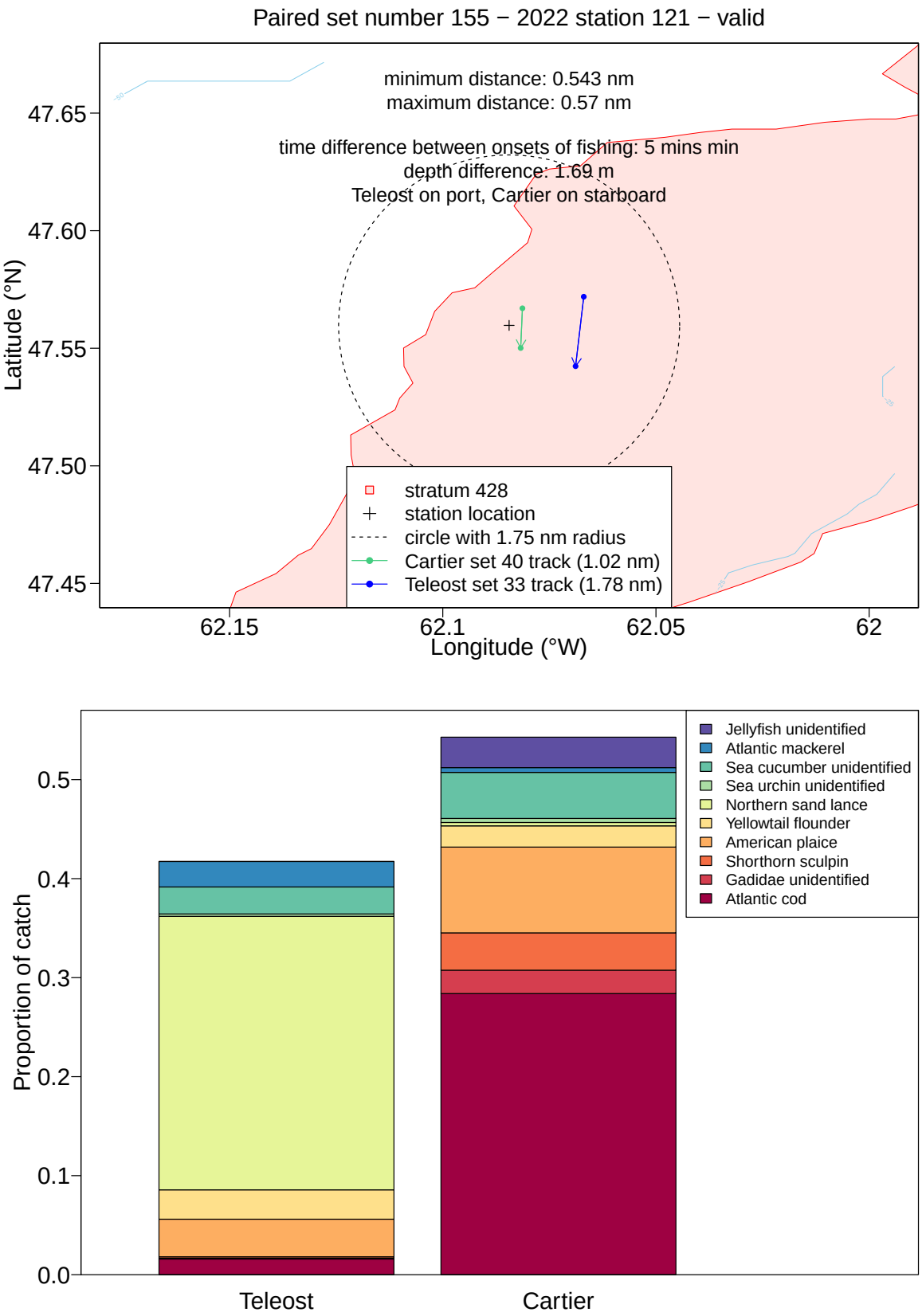

Figure 162. Tow tracks and major species composition for station 121 in 2022.

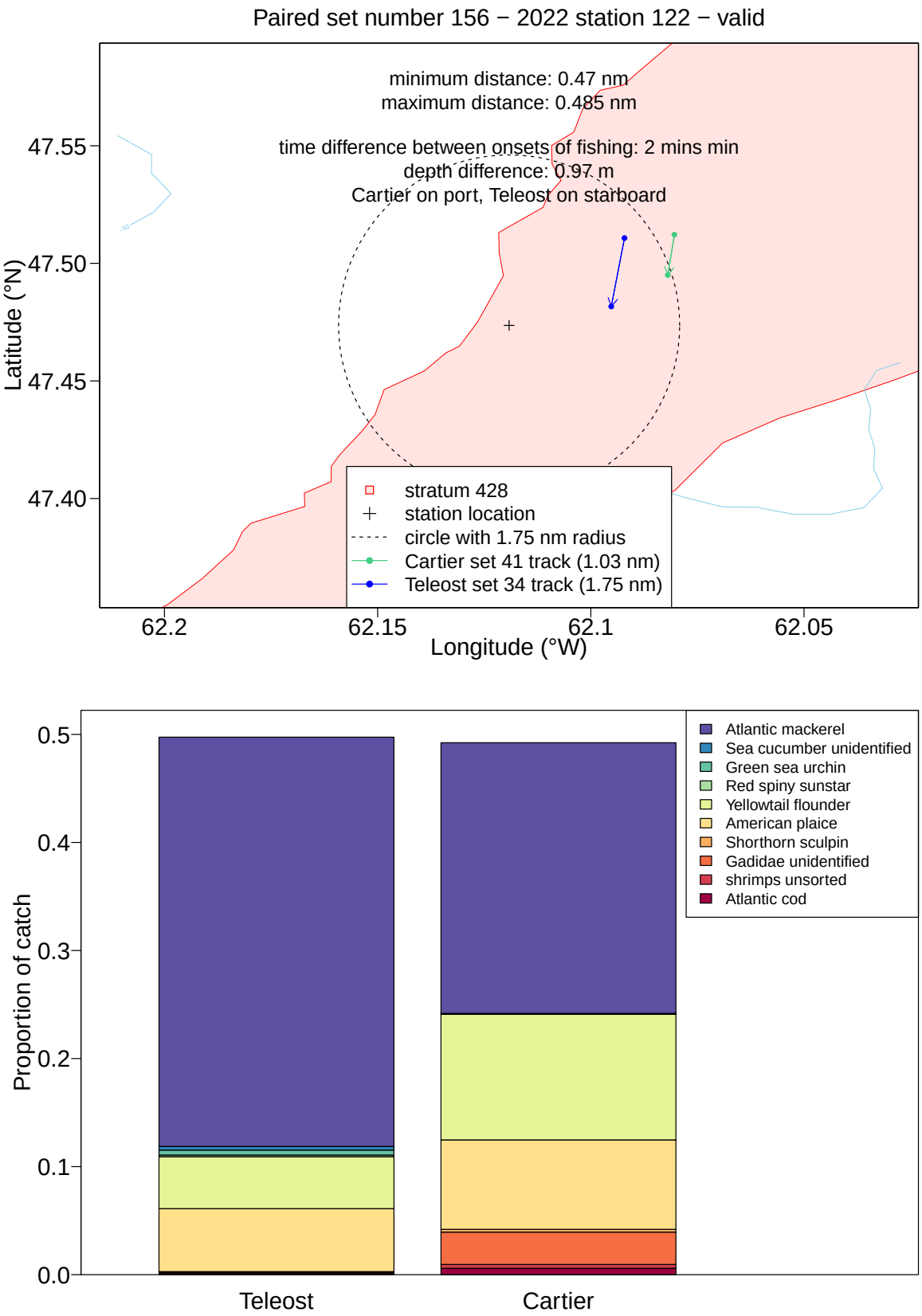

Figure 163. Tow tracks and major species composition for station 122 in 2022.

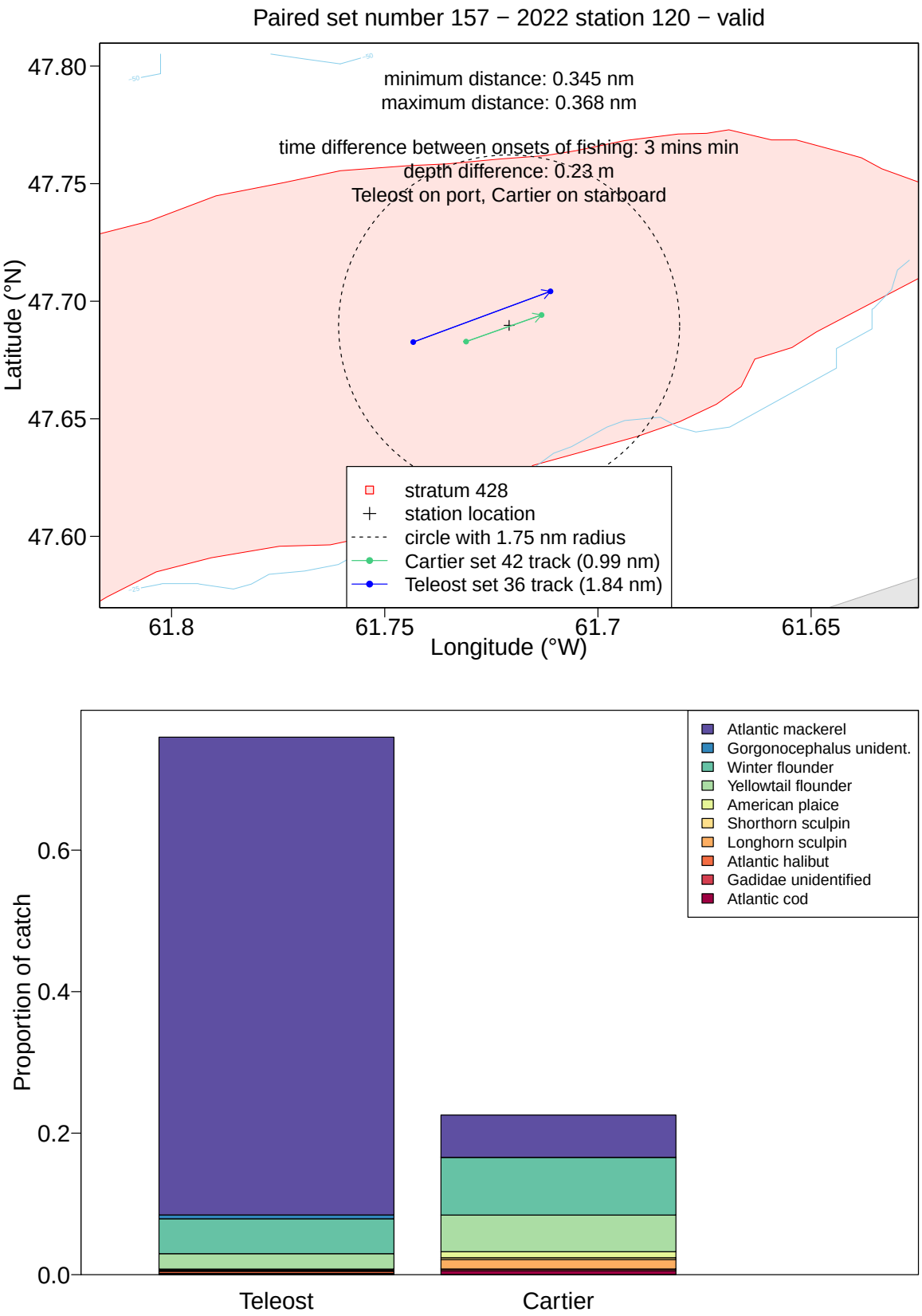

Figure 164. Tow tracks and major species composition for station 120 in 2022.

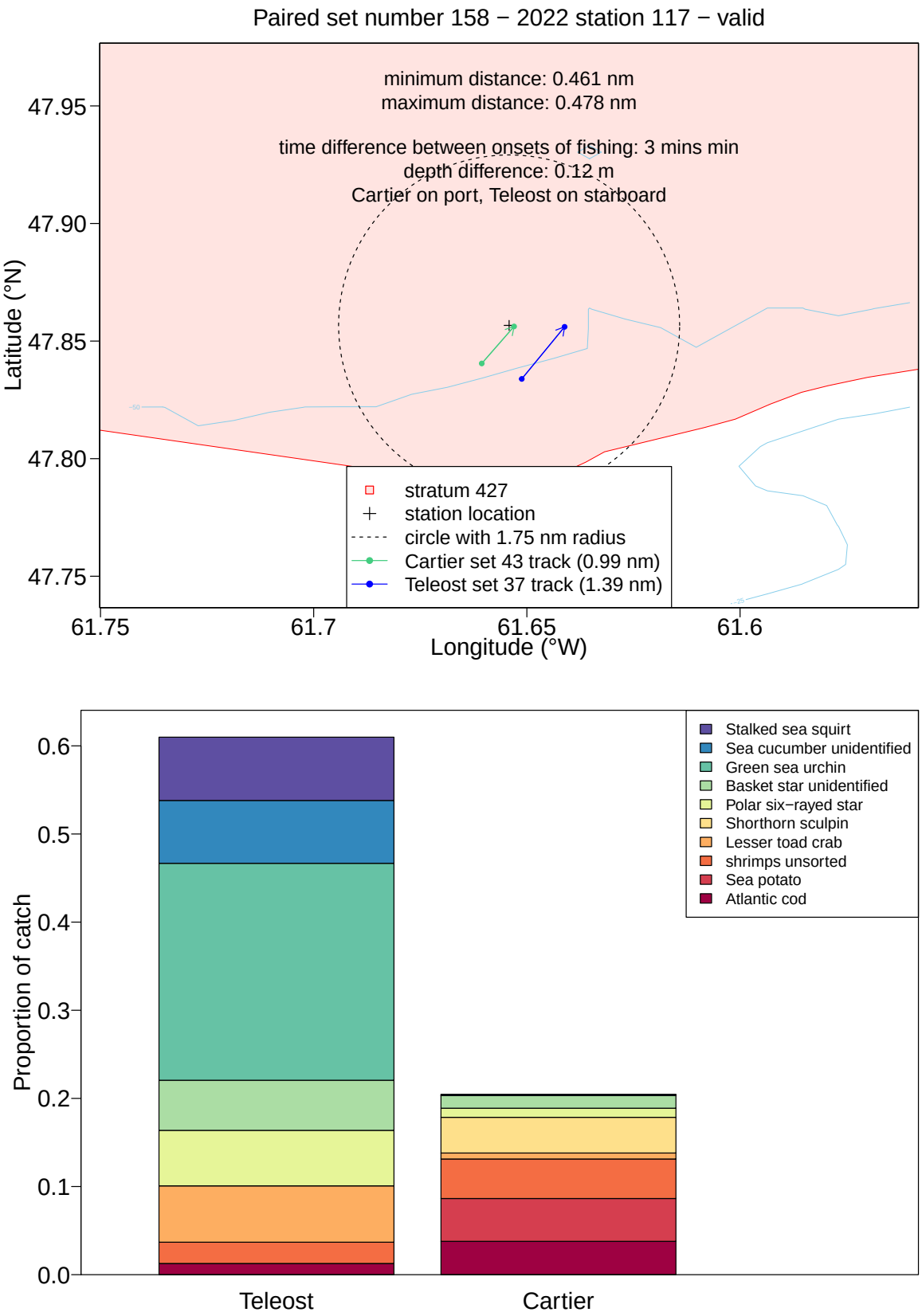

Figure 165. Tow tracks and major species composition for station 117 in 2022.

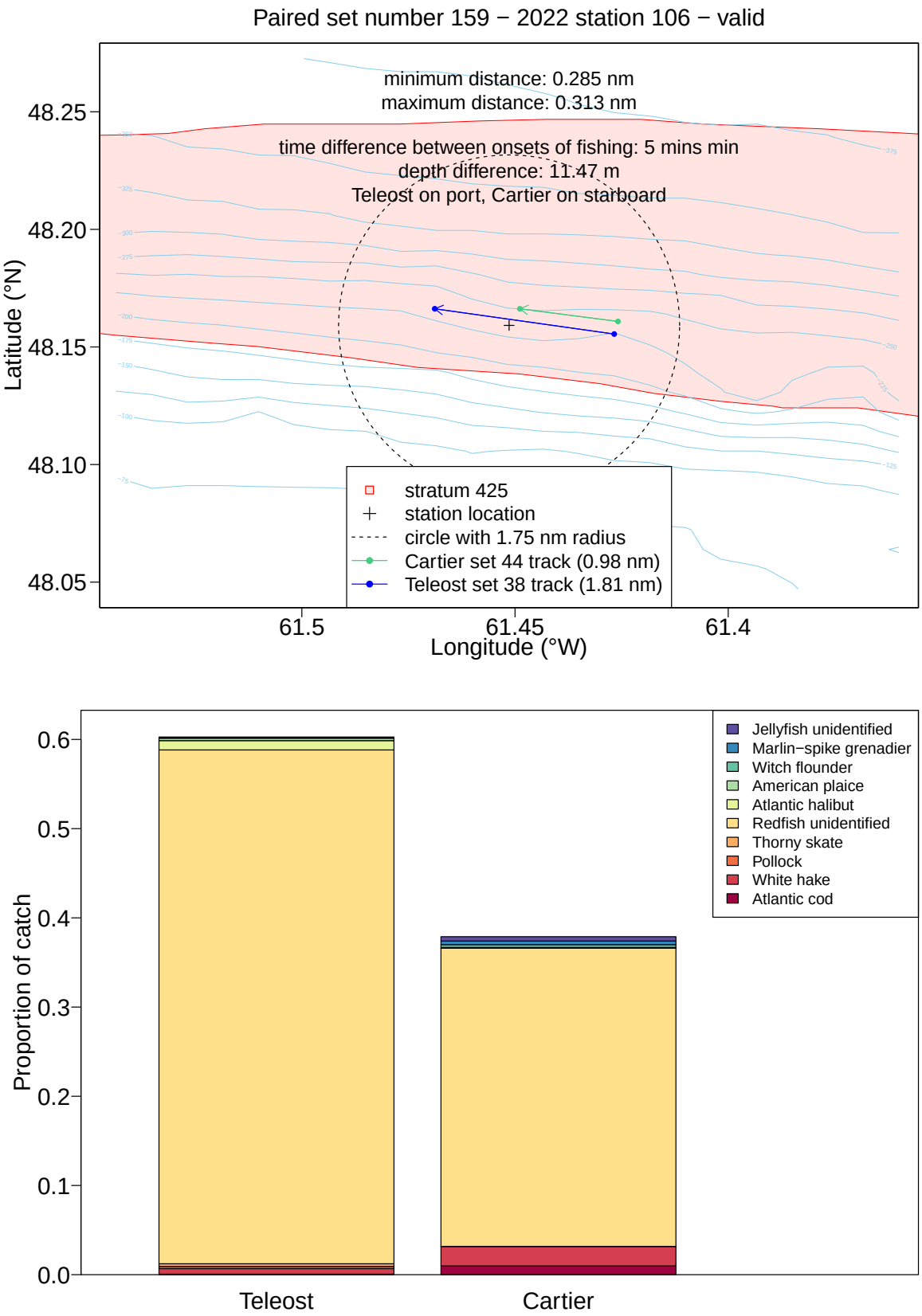

Figure 166. Tow tracks and major species composition for station 106 in 2022.

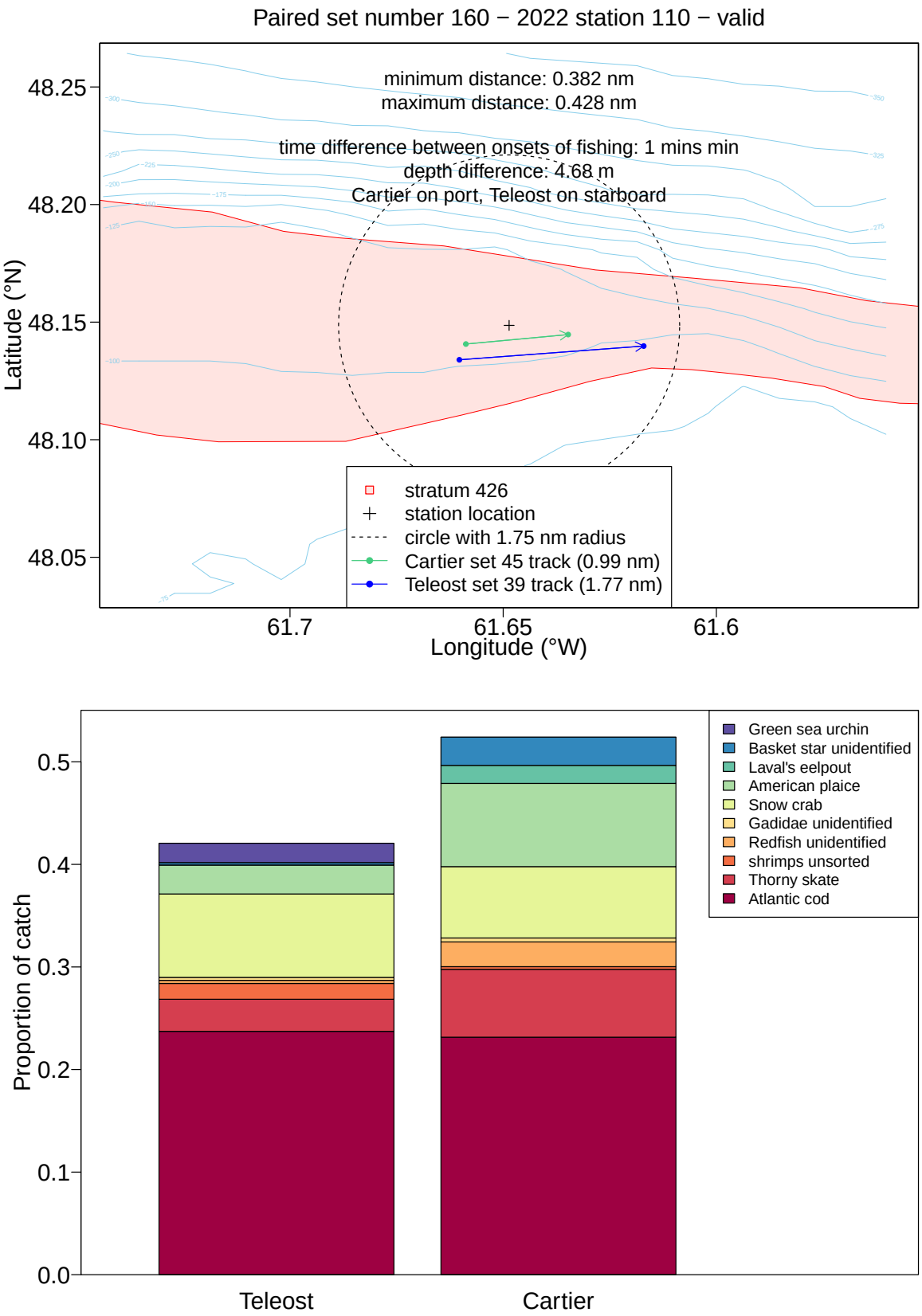

Figure 167. Tow tracks and major species composition for station 110 in 2022.

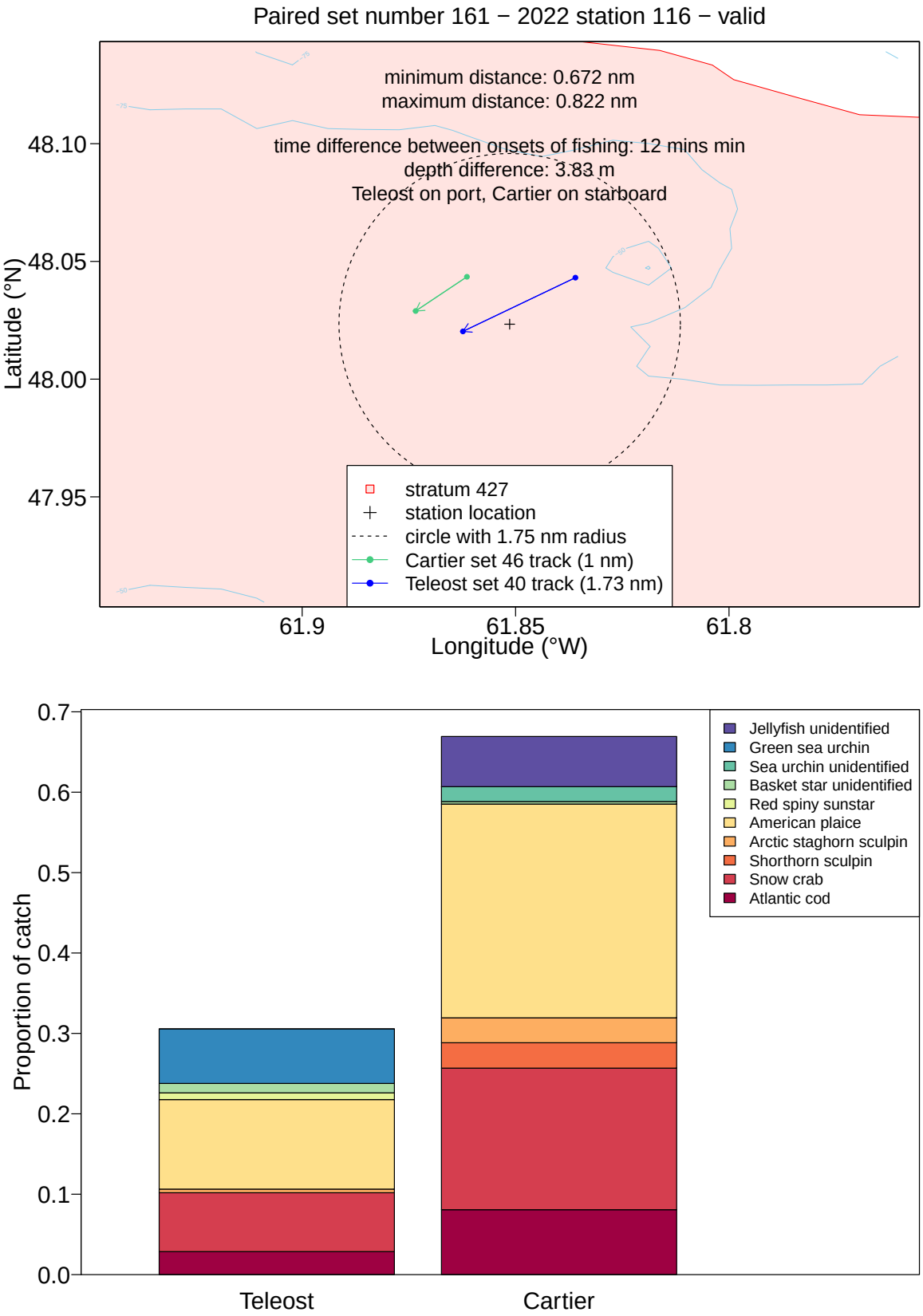

Figure 168. Tow tracks and major species composition for station 116 in 2022.

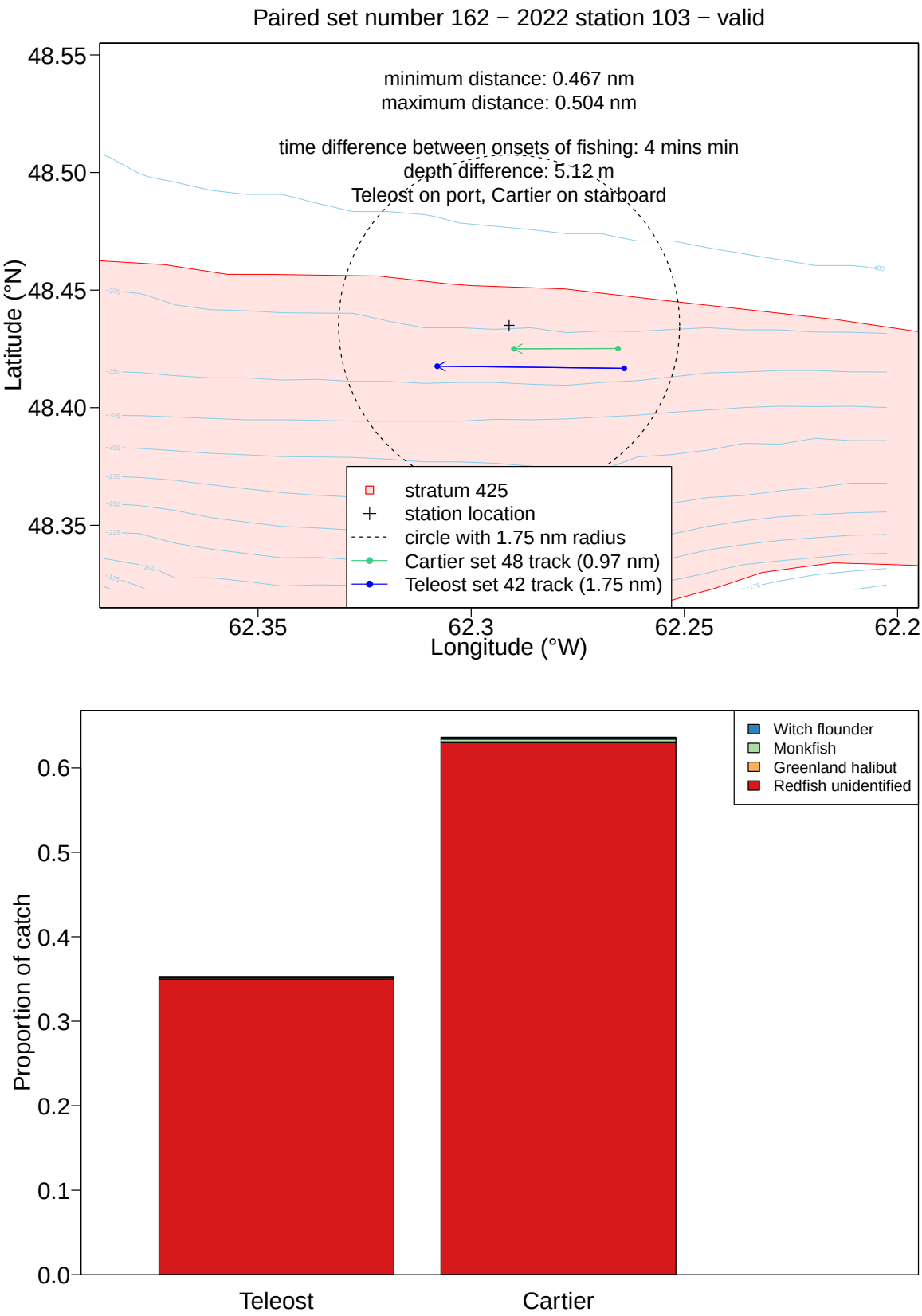

Figure 169. Tow tracks and major species composition for station 103 in 2022.

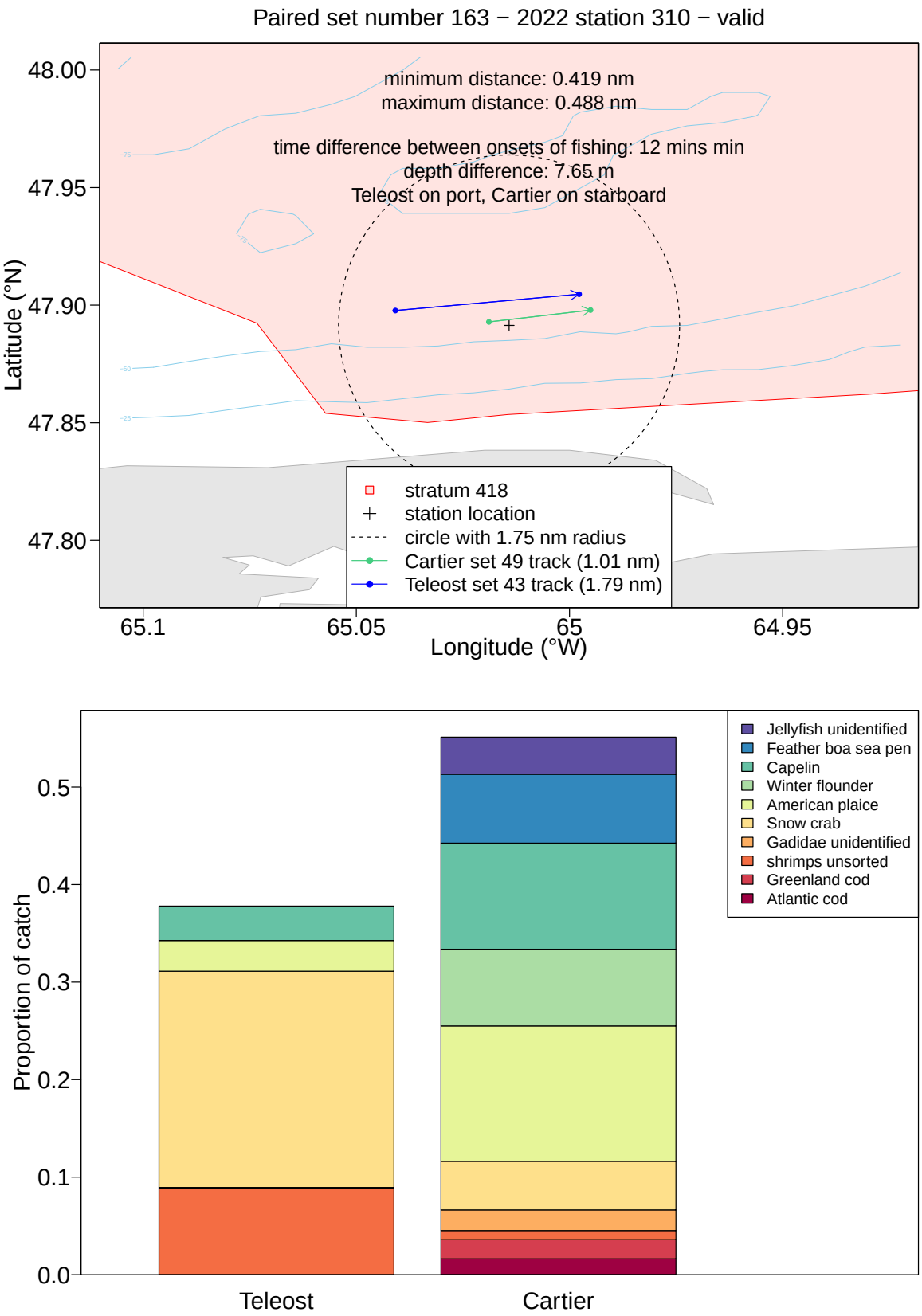

Figure 170. Tow tracks and major species composition for station 310 in 2022.

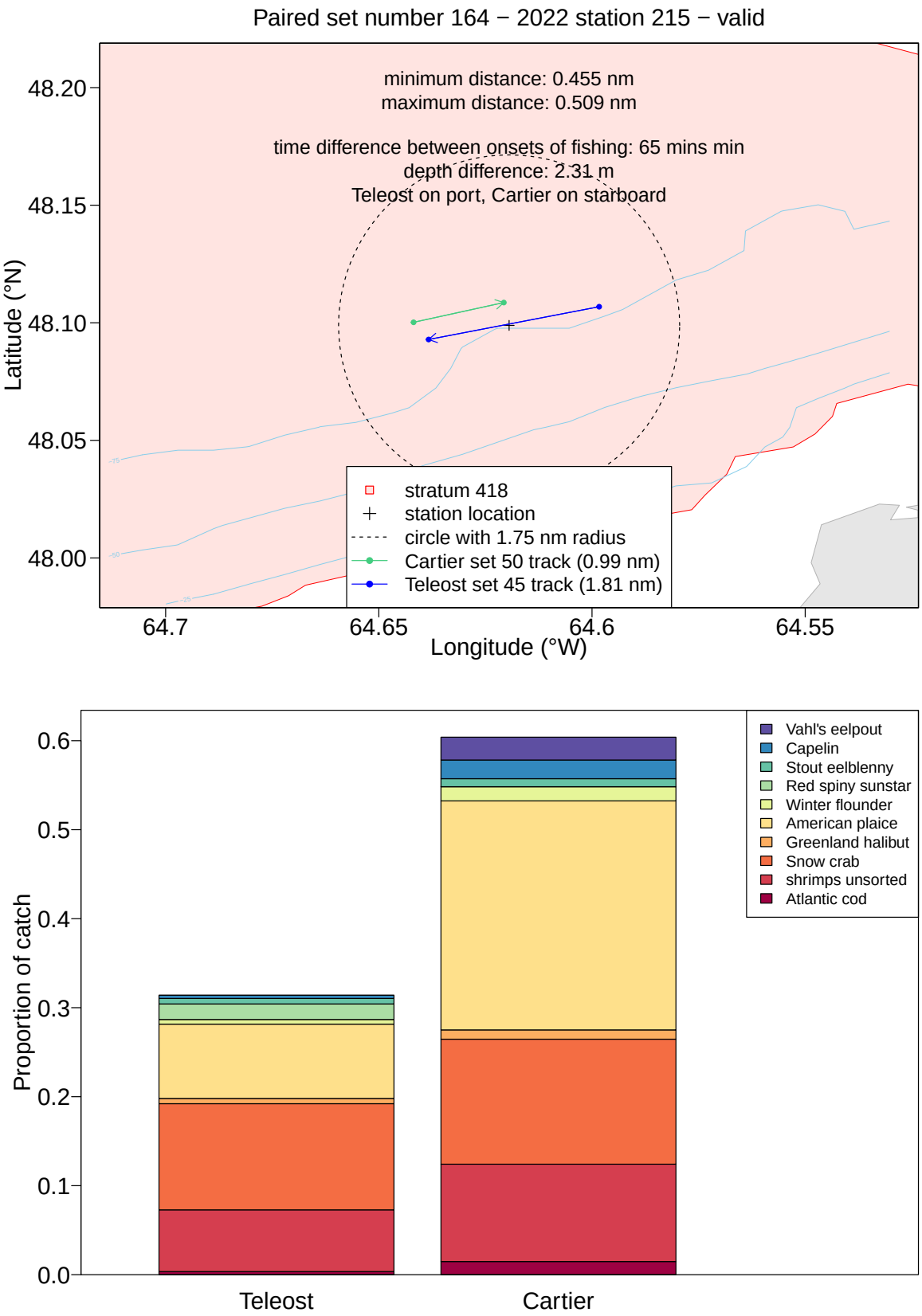

Figure 171. Tow tracks and major species composition for station 215 in 2022.

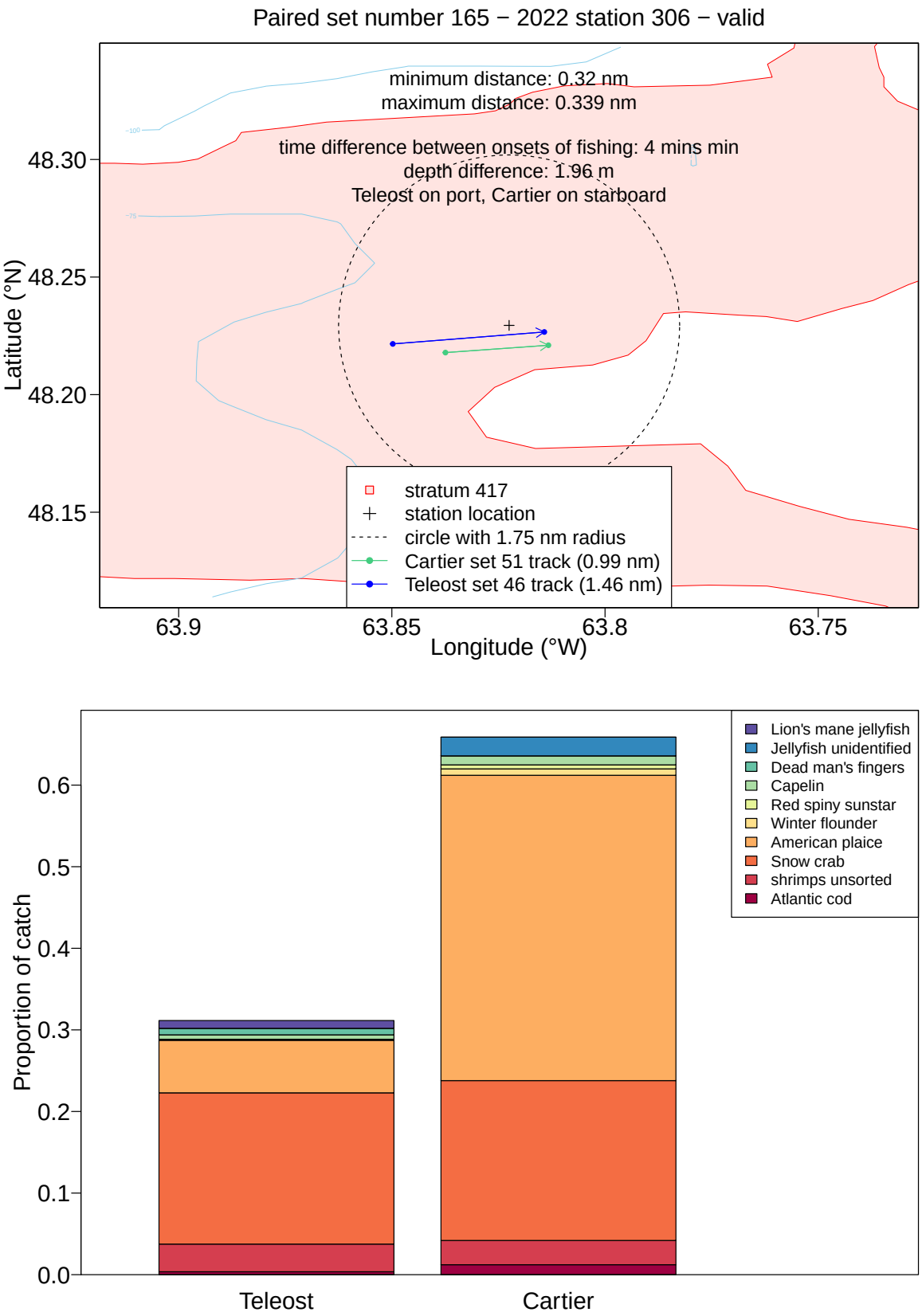

Figure 172. Tow tracks and major species composition for station 306 in 2022.

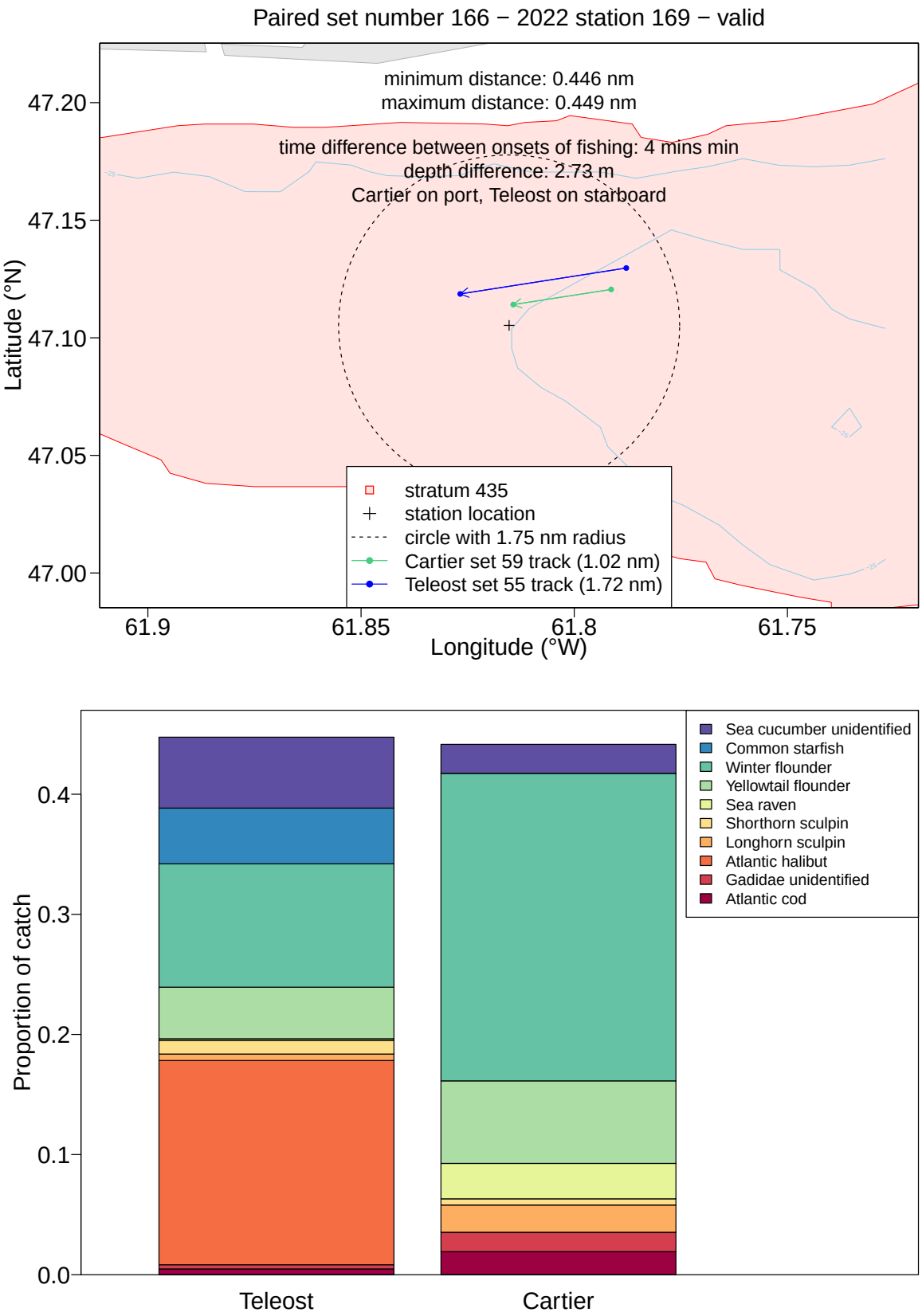

Figure 173. Tow tracks and major species composition for station 169 in 2022.

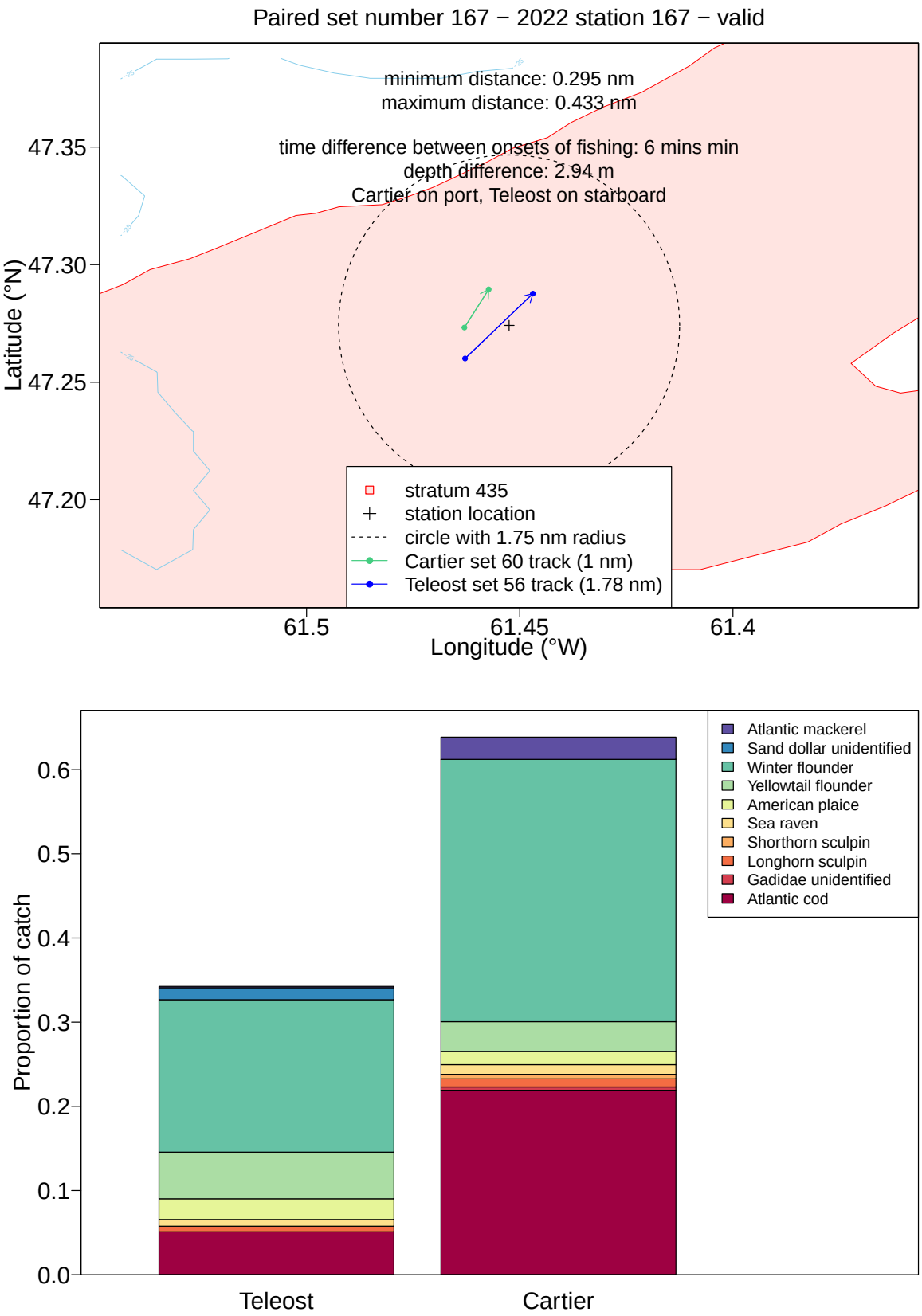

Figure 174. Tow tracks and major species composition for station 167 in 2022.

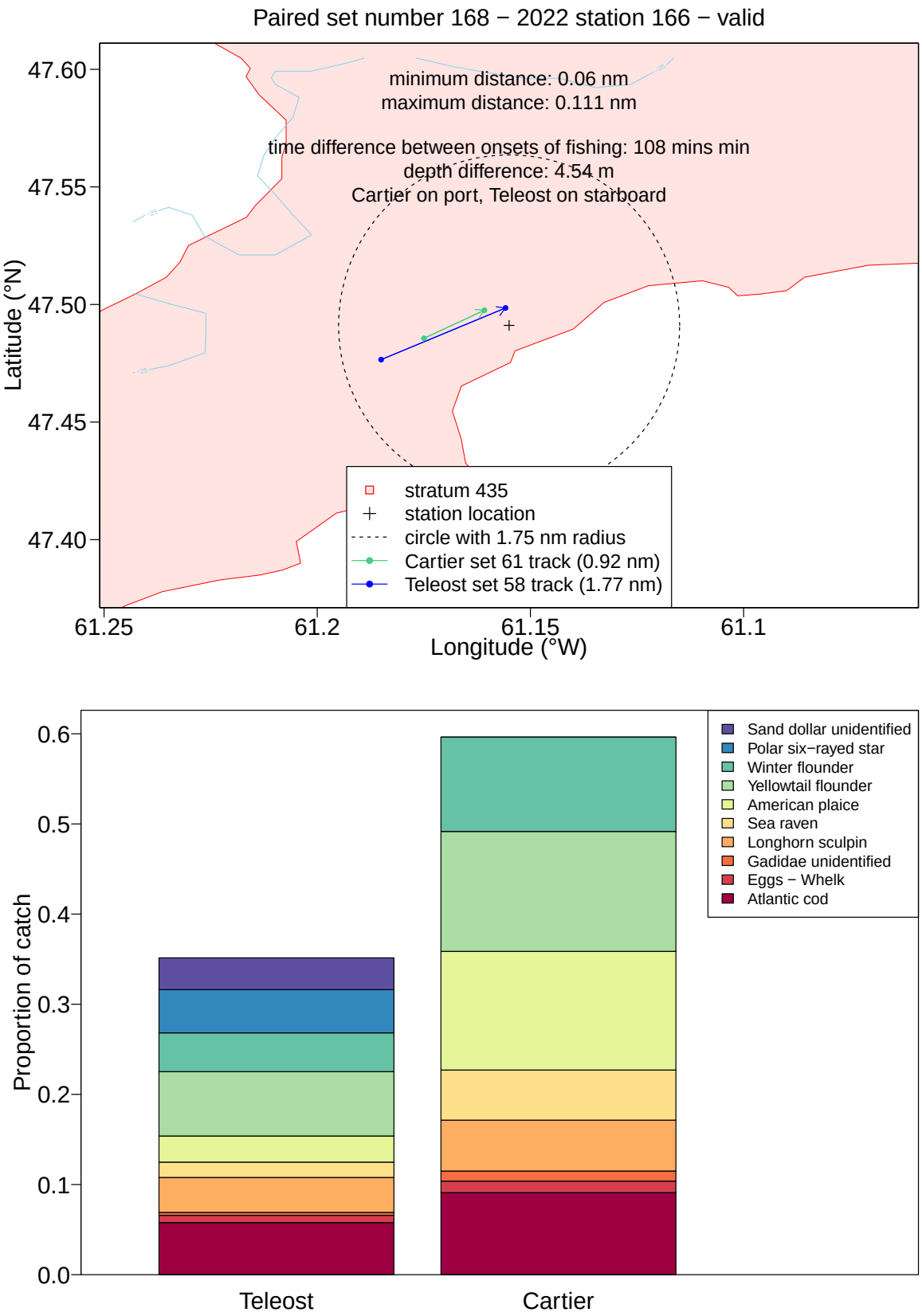

Figure 175. Tow tracks and major species composition for station 166 in 2022.

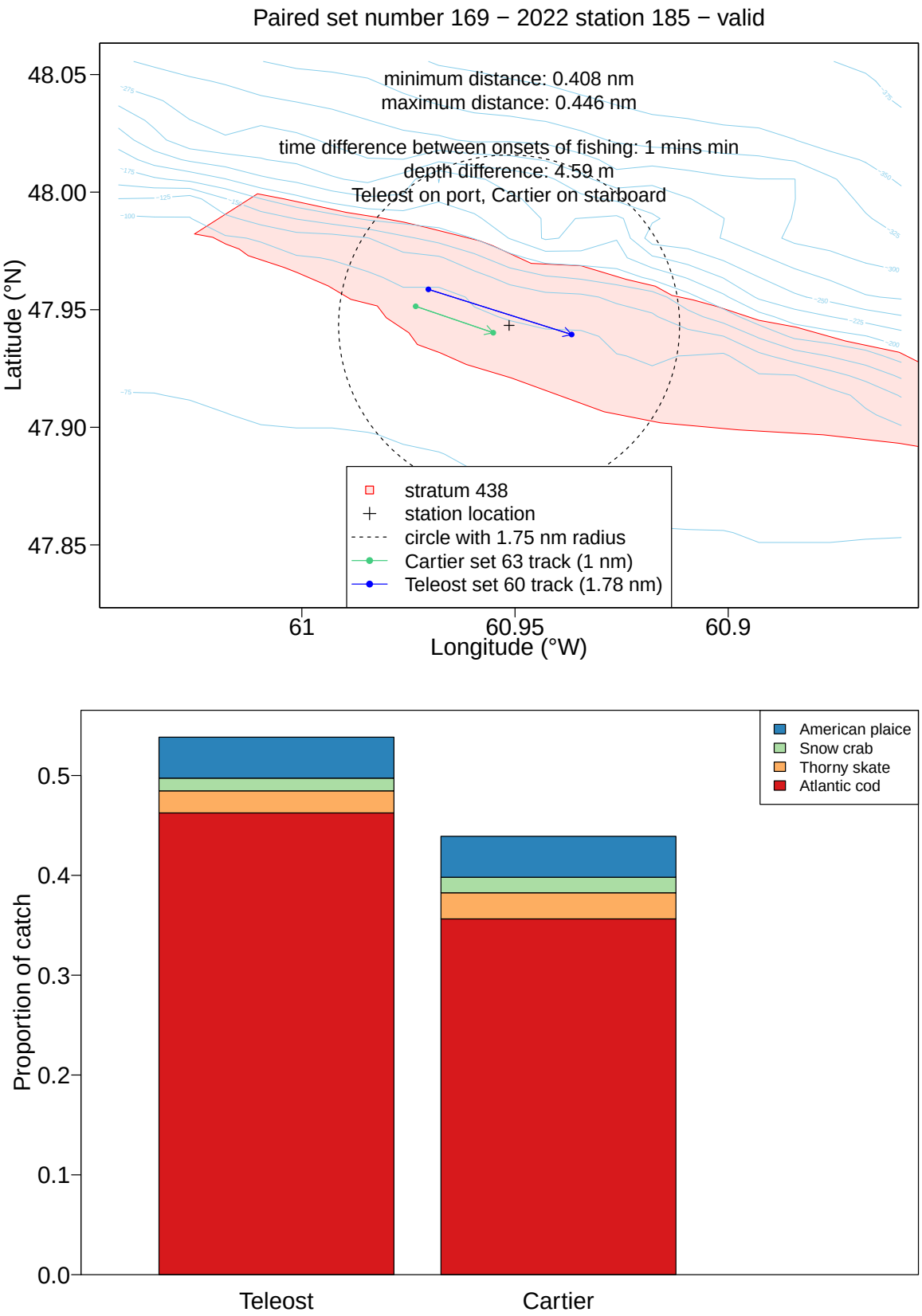

Figure 176. Tow tracks and major species composition for station 185 in 2022.

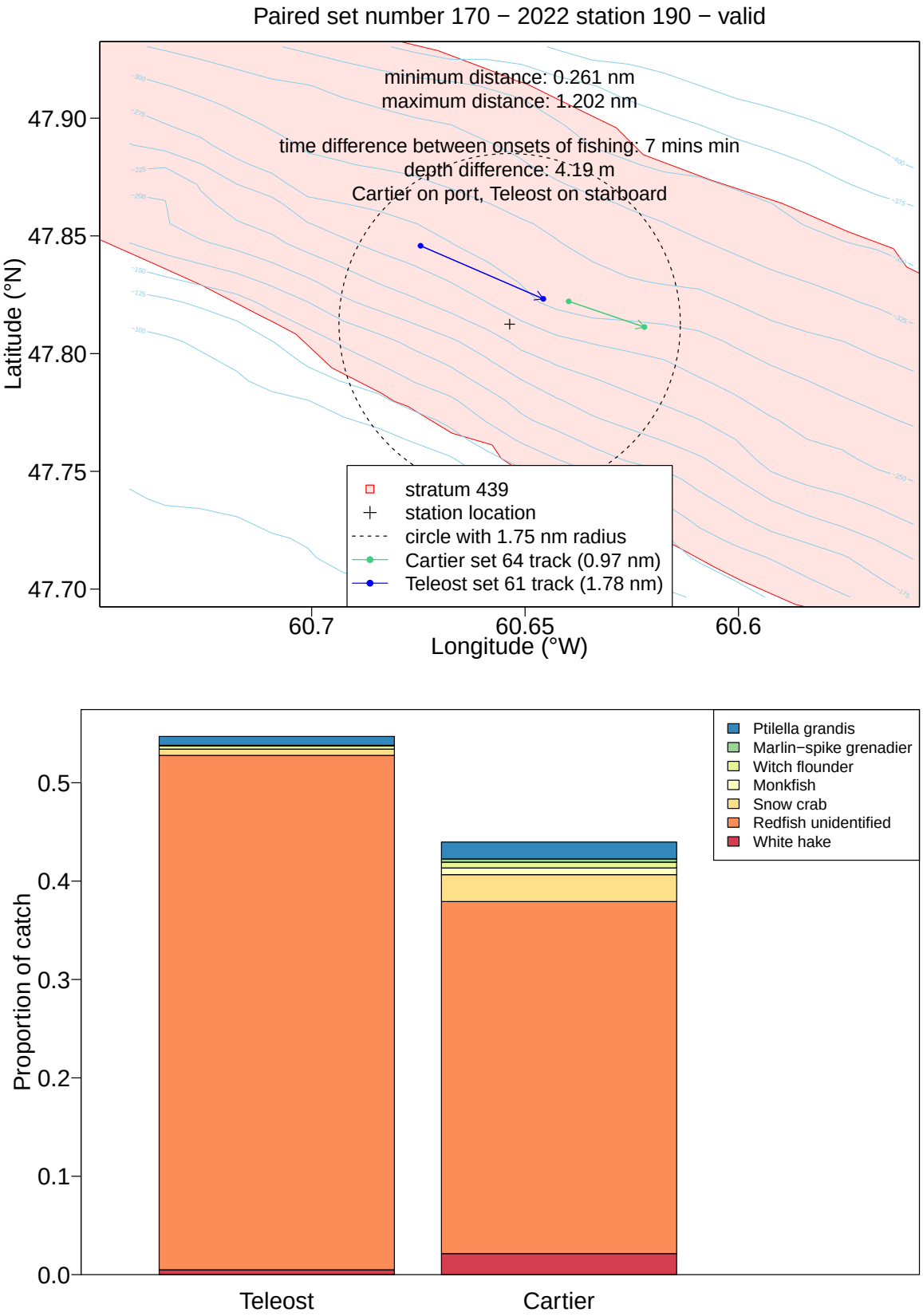

Figure 177. Tow tracks and major species composition for station 190 in 2022.

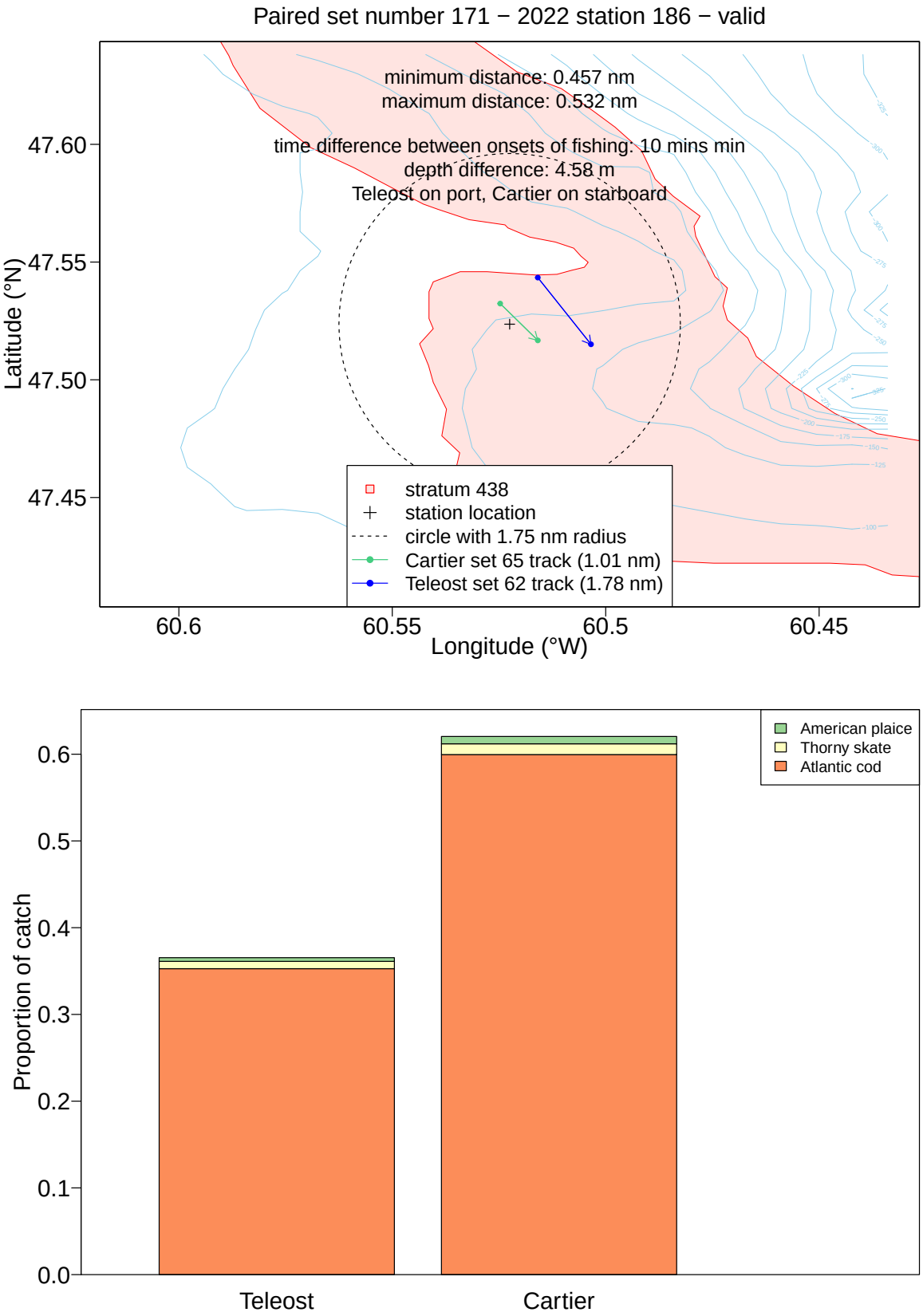

Figure 178. Tow tracks and major species composition for station 186 in 2022.

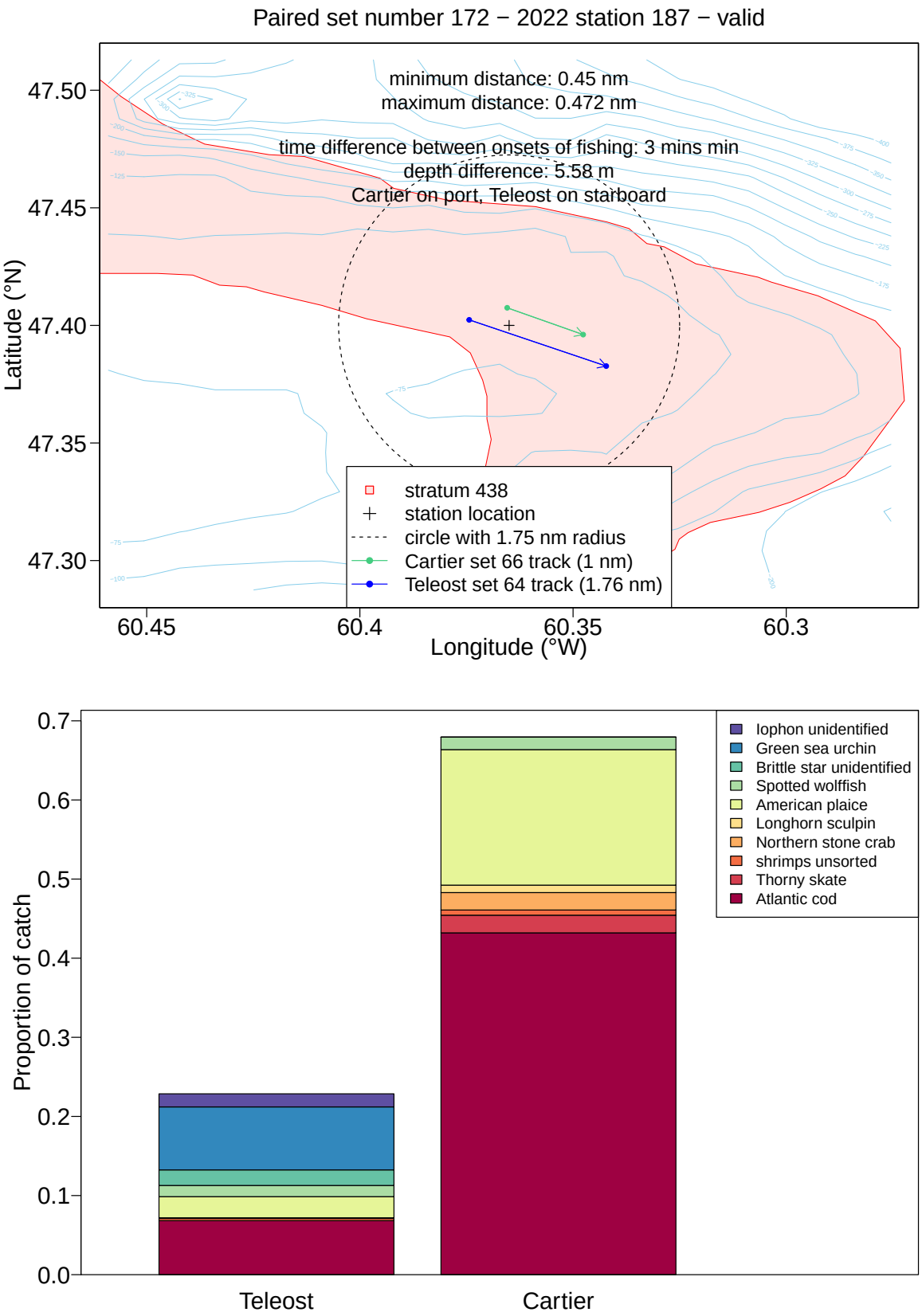

Figure 179. Tow tracks and major species composition for station 187 in 2022.

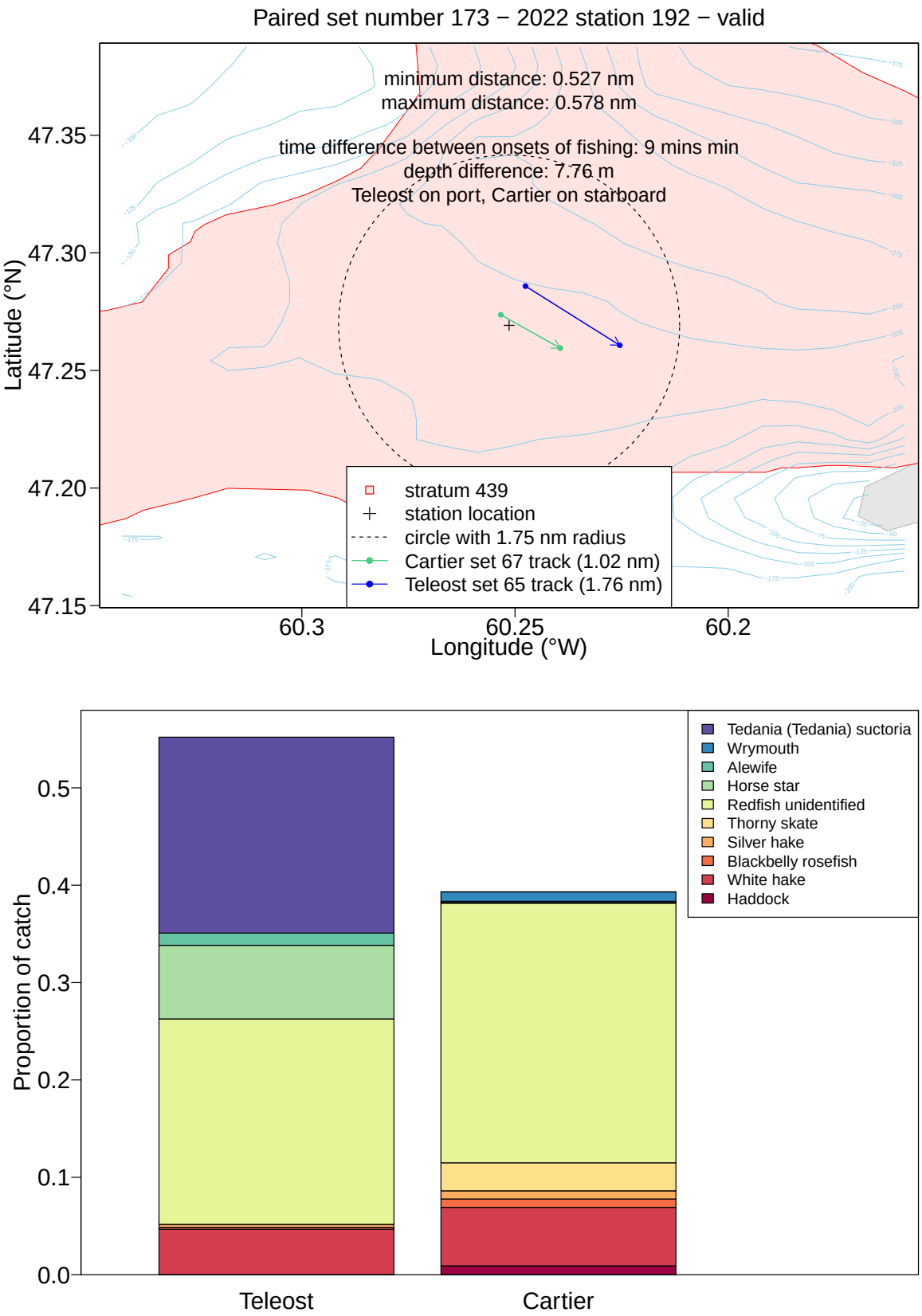

Figure 180. Tow tracks and major species composition for station 192 in 2022.

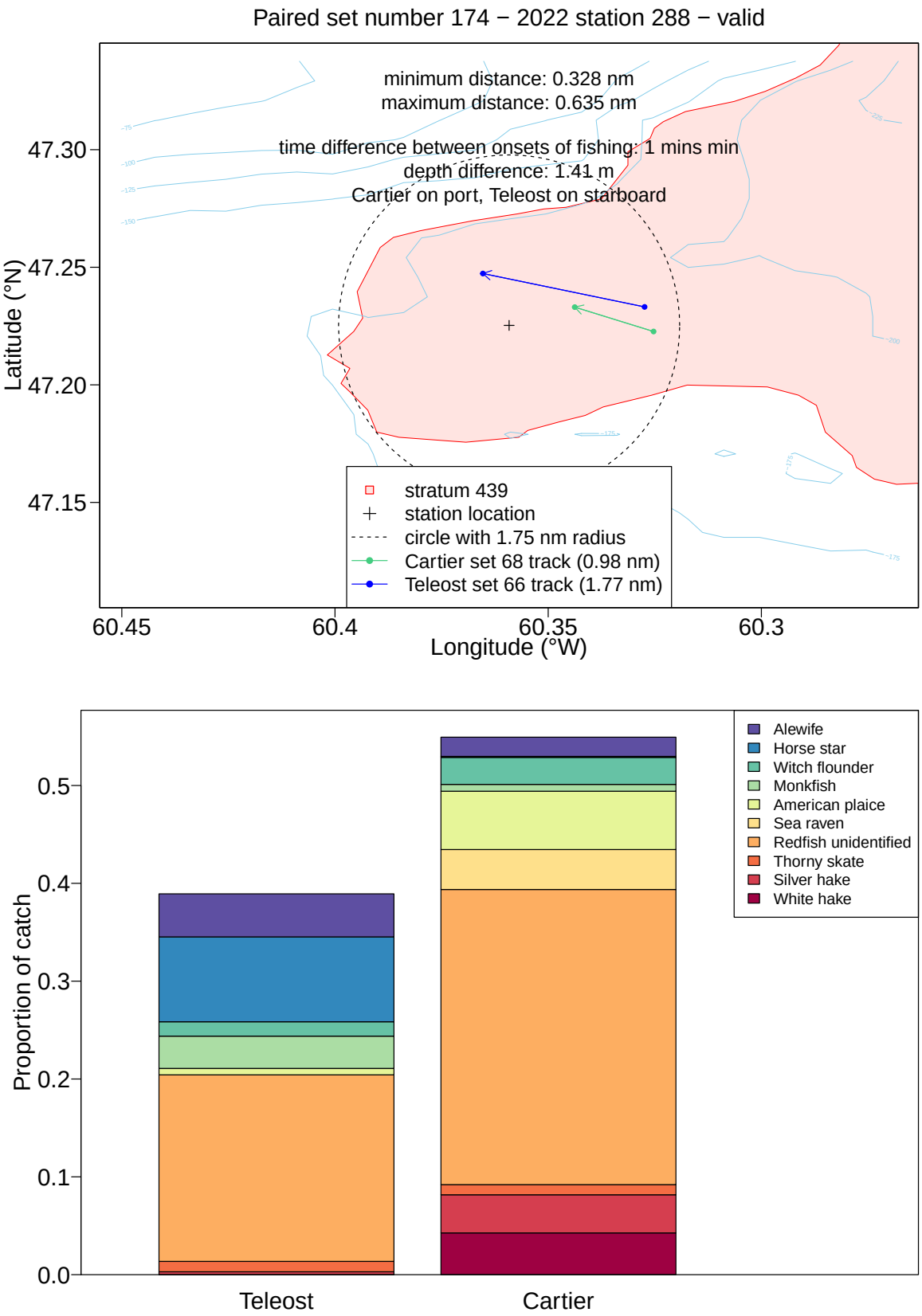

Figure 181. Tow tracks and major species composition for station 288 in 2022.

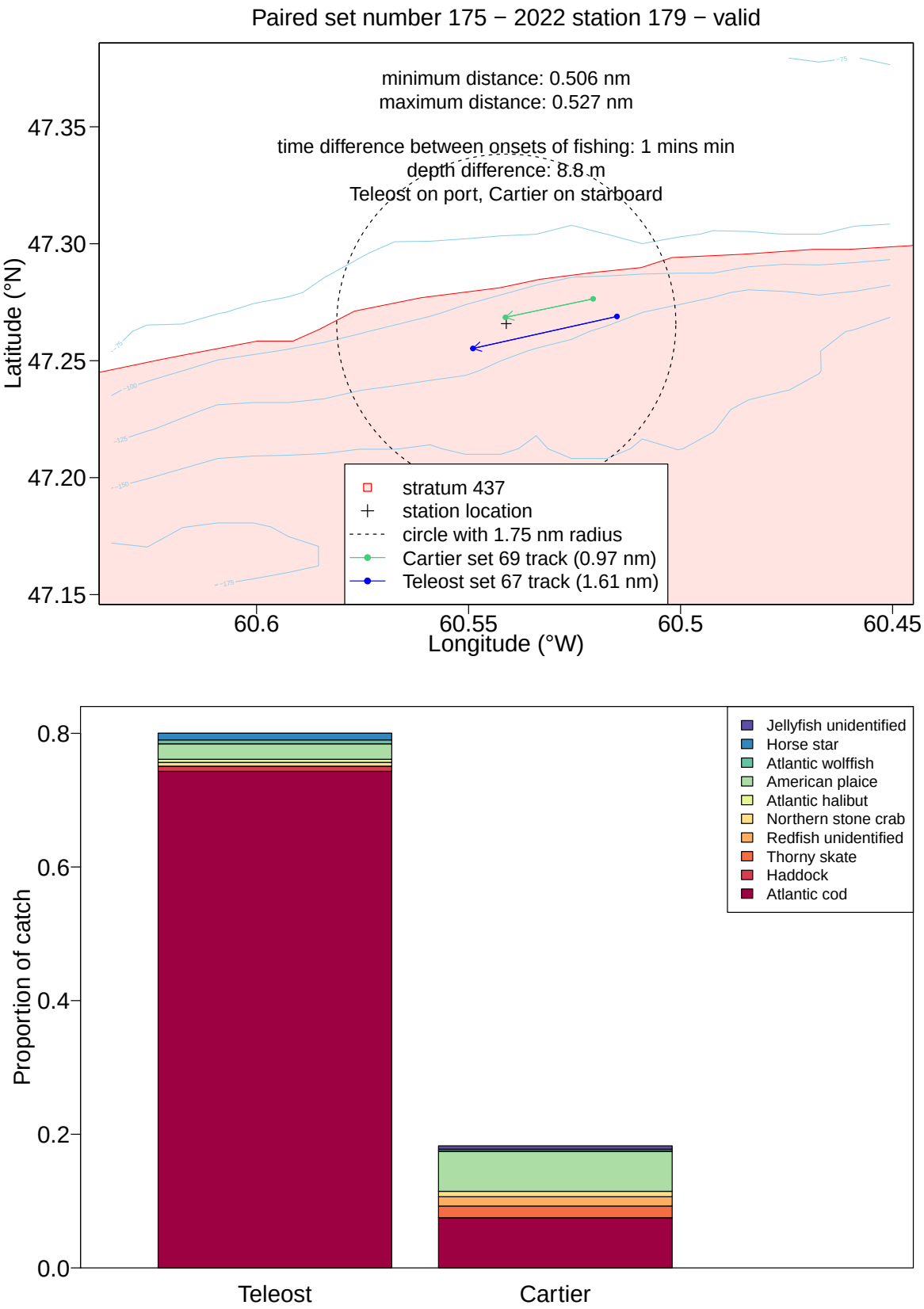

Figure 182. Tow tracks and major species composition for station 179 in 2022.

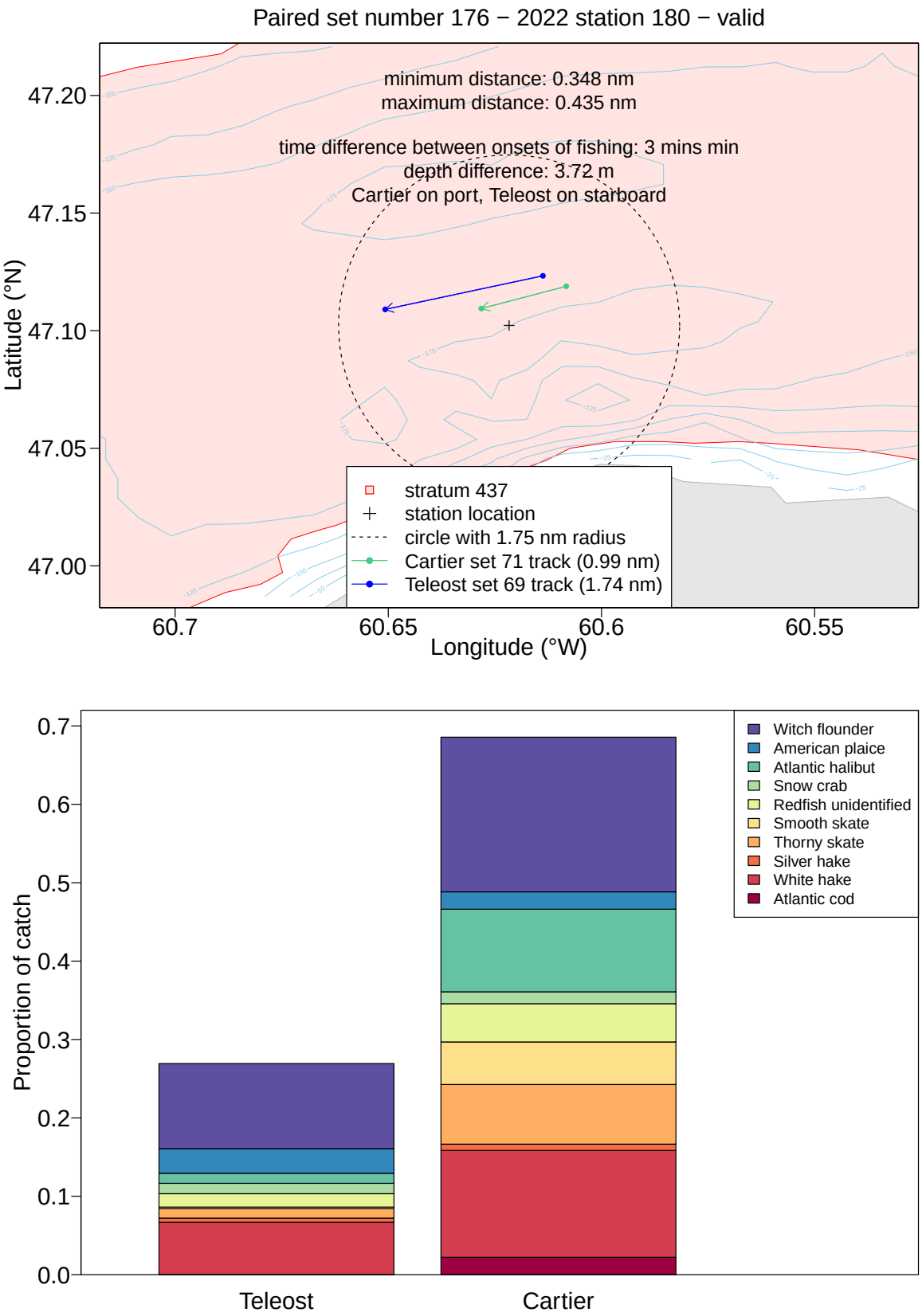

Figure 183. Tow tracks and major species composition for station 180 in 2022.

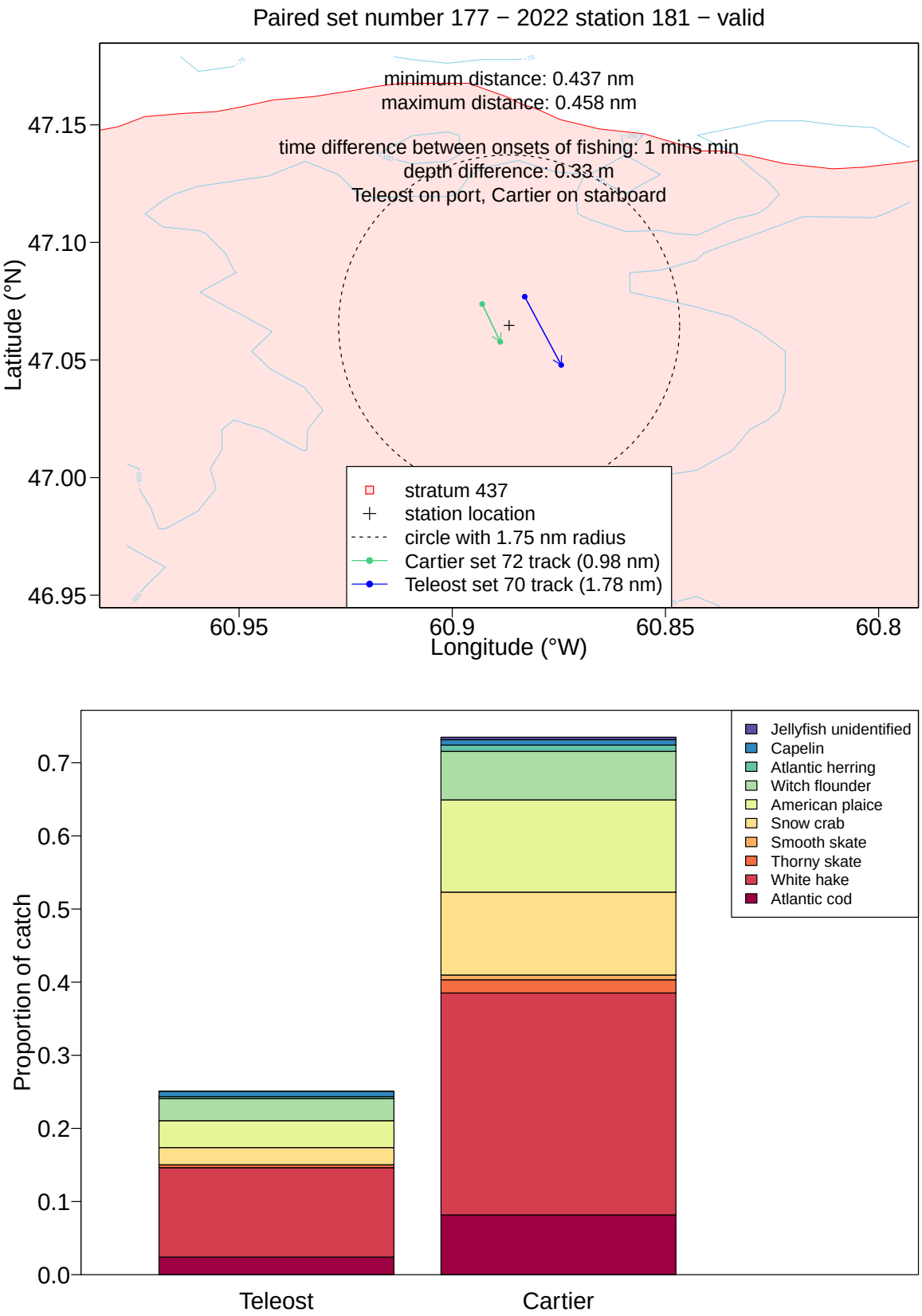

Figure 184. Tow tracks and major species composition for station 181 in 2022.

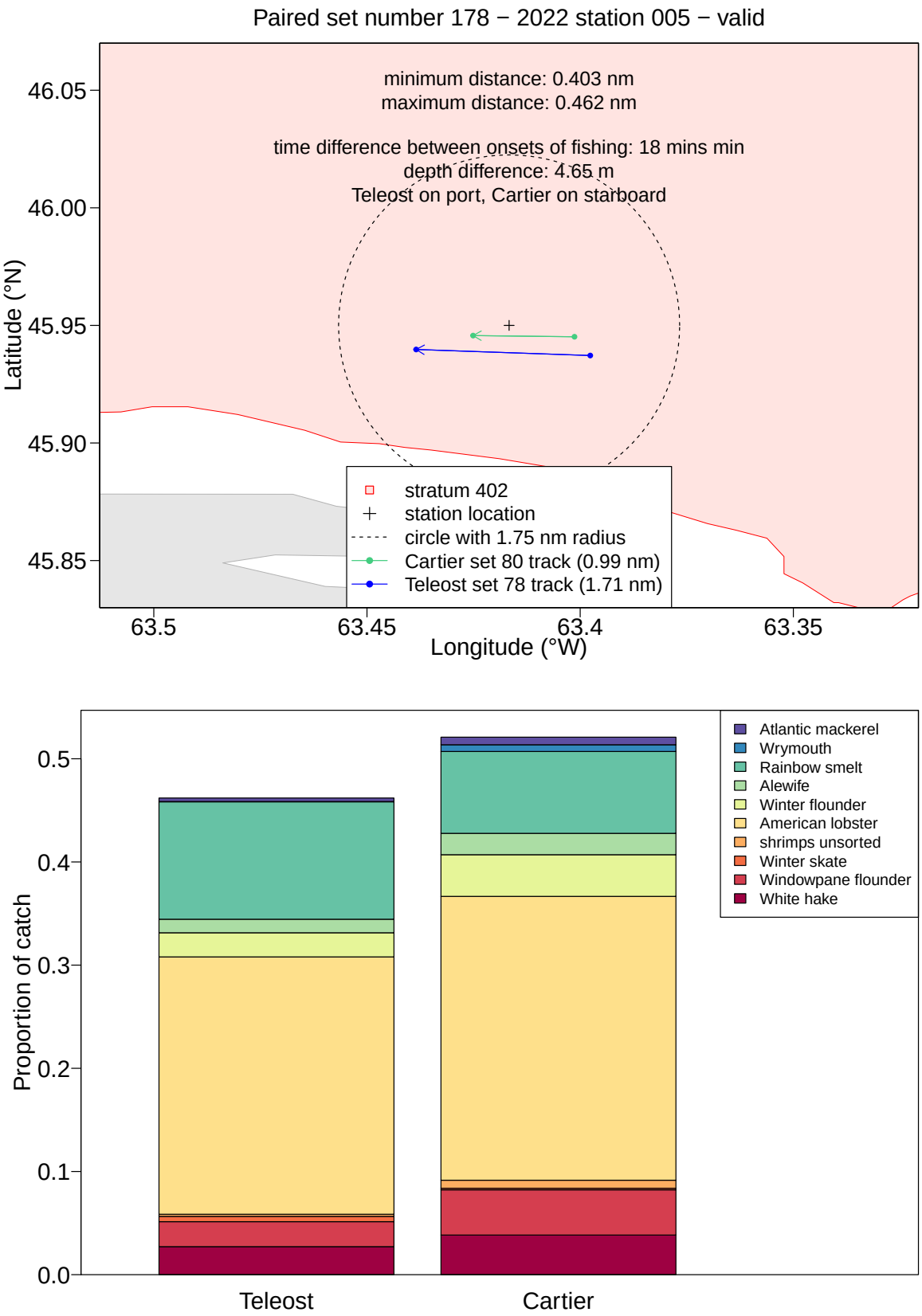

Figure 185. Tow tracks and major species composition for station 005 in 2022.

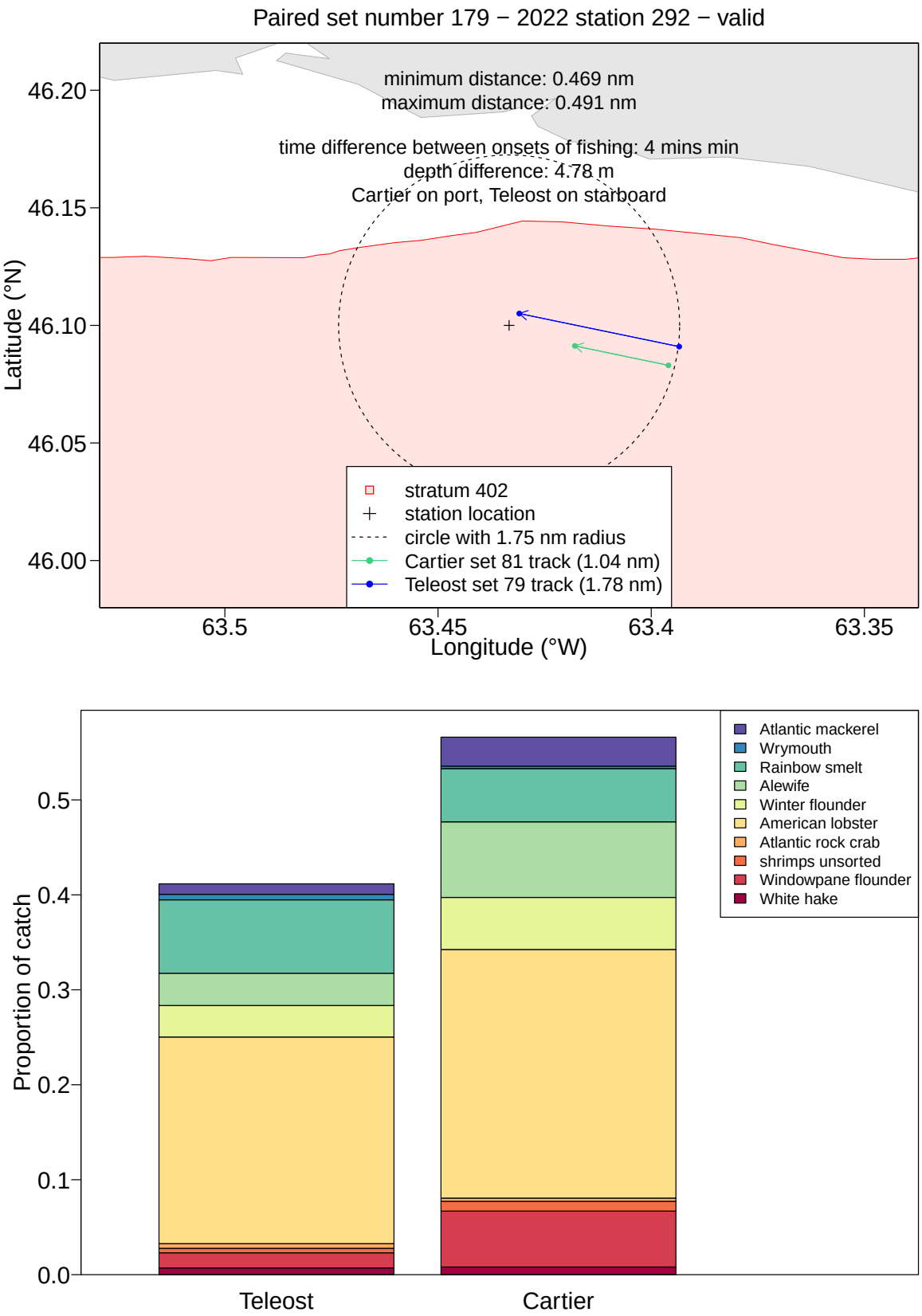

Figure 186. Tow tracks and major species composition for station 292 in 2022.

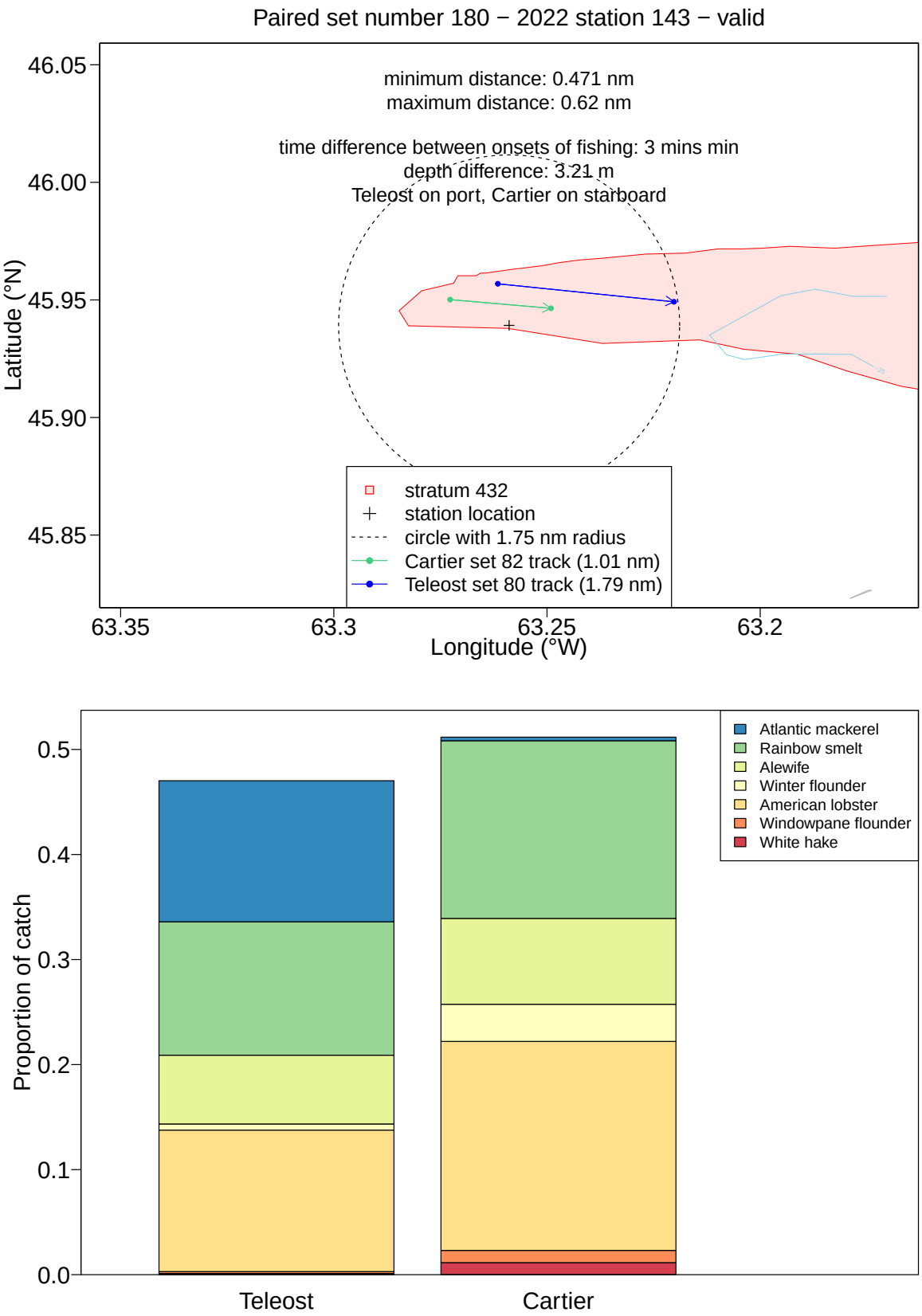

Figure 187. Tow tracks and major species composition for station 143 in 2022.

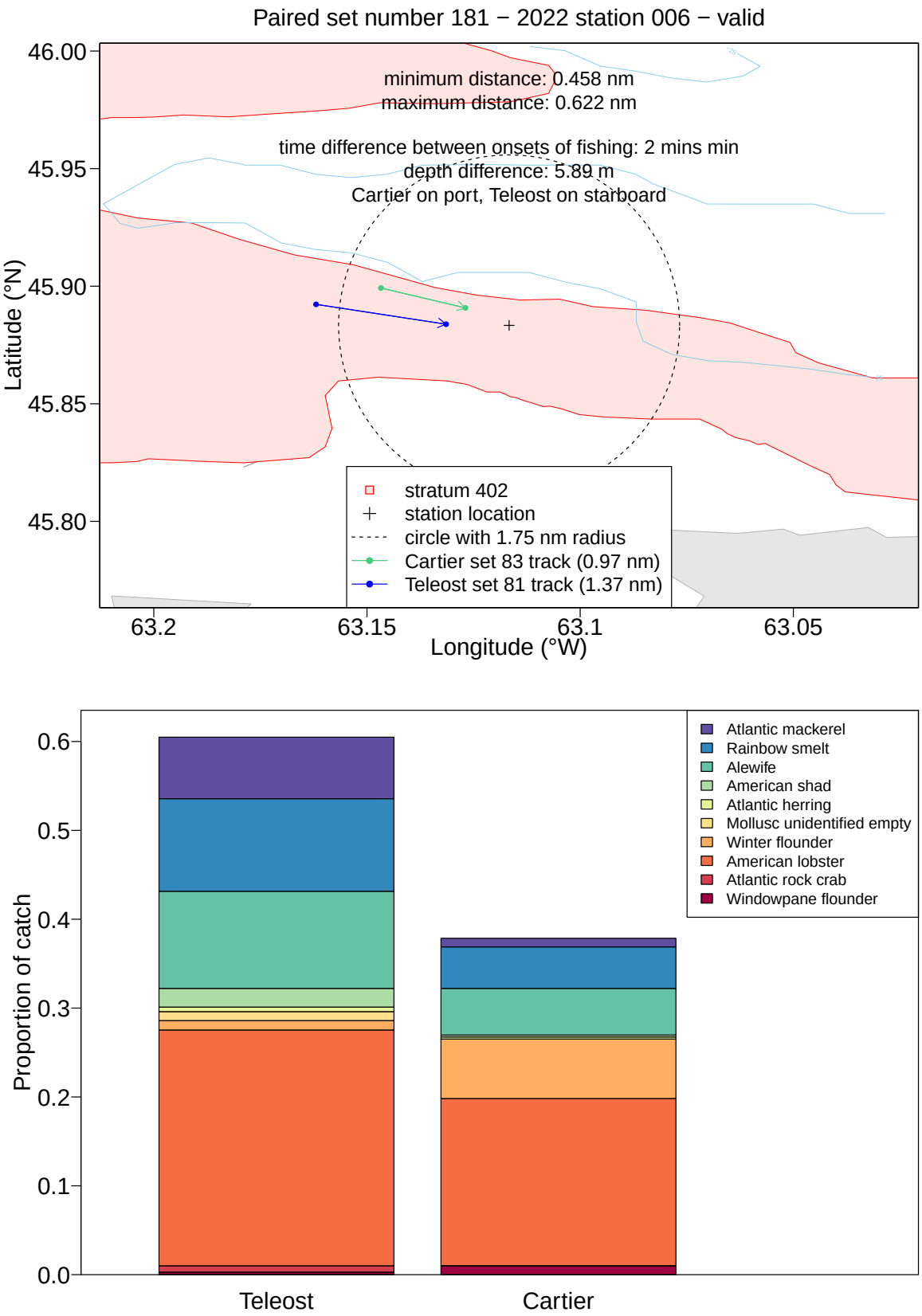

Figure 188. Tow tracks and major species composition for station 006 in 2022.

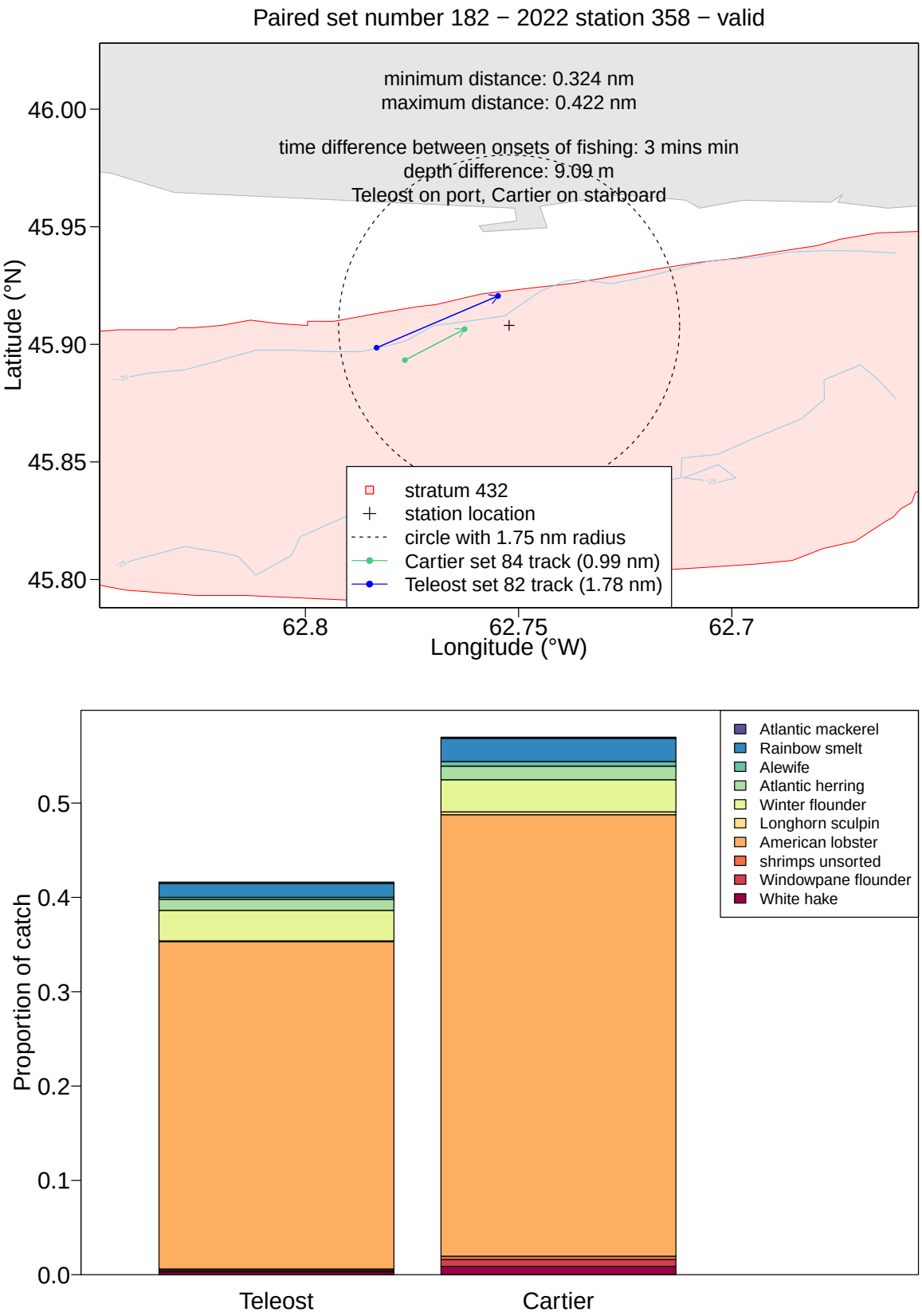

Figure 189. Tow tracks and major species composition for station 358 in 2022.

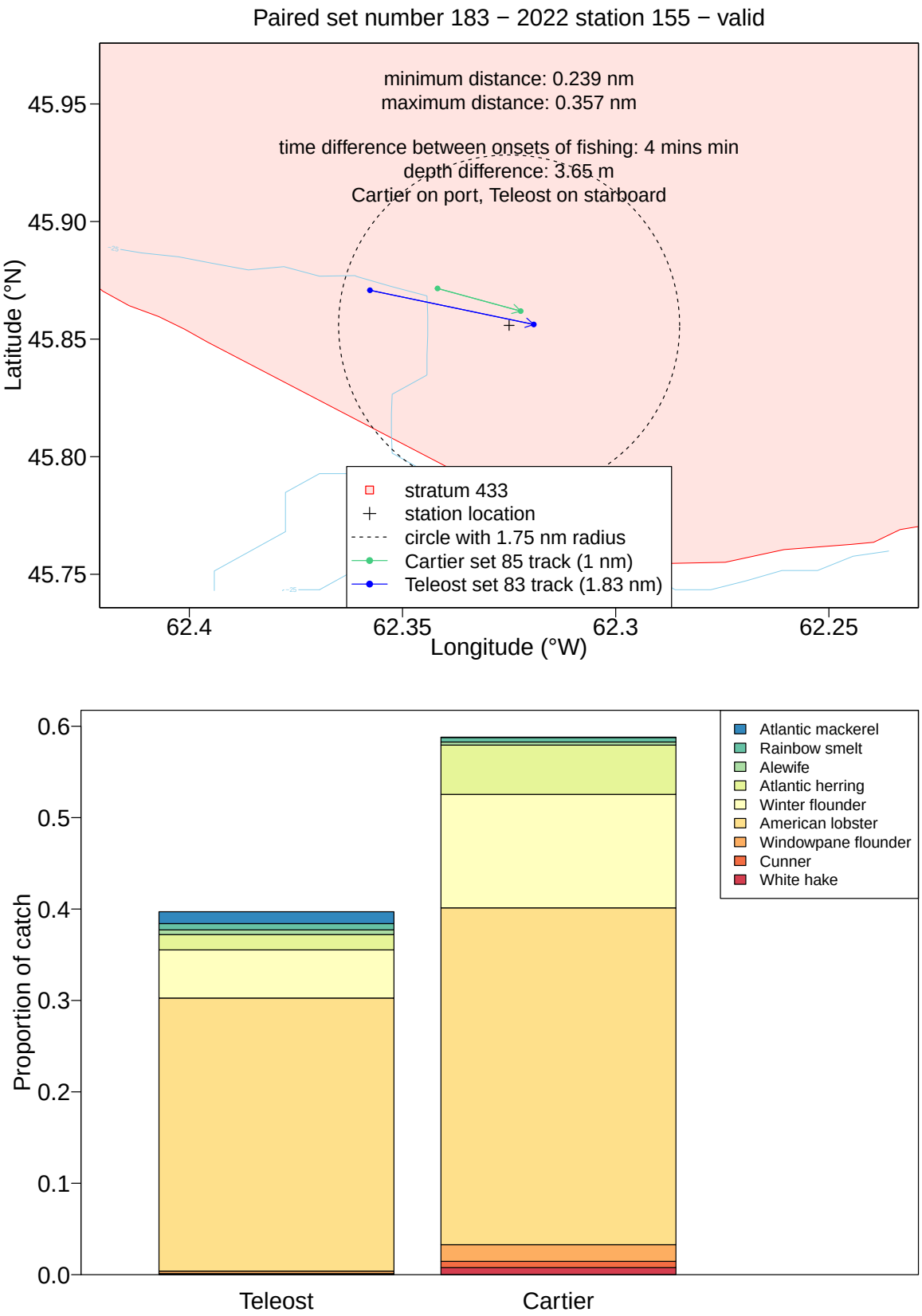

Figure 190. Tow tracks and major species composition for station 155 in 2022.

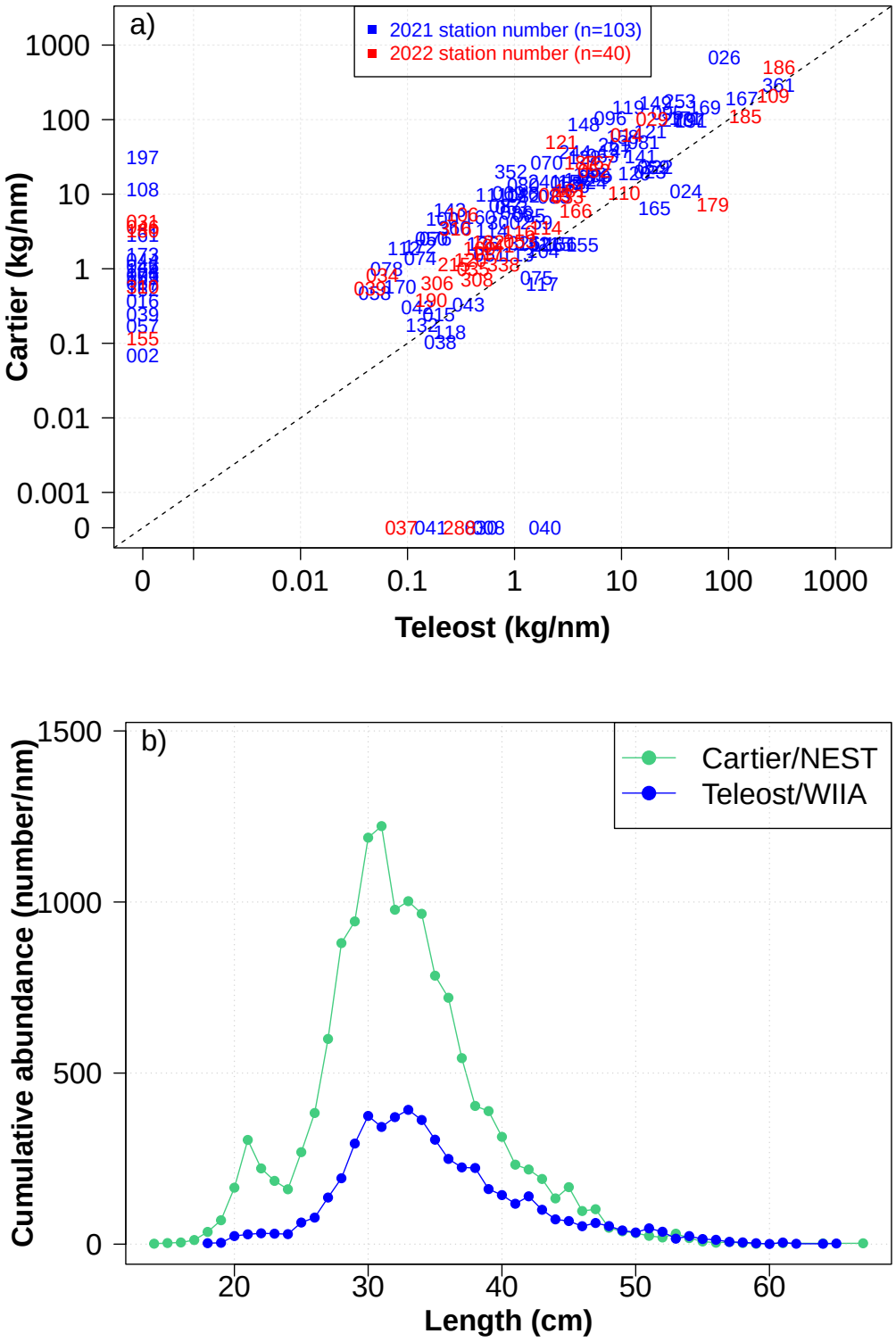

Figure 191. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Atlantic cod (species code 10, *Gadus morhua*).

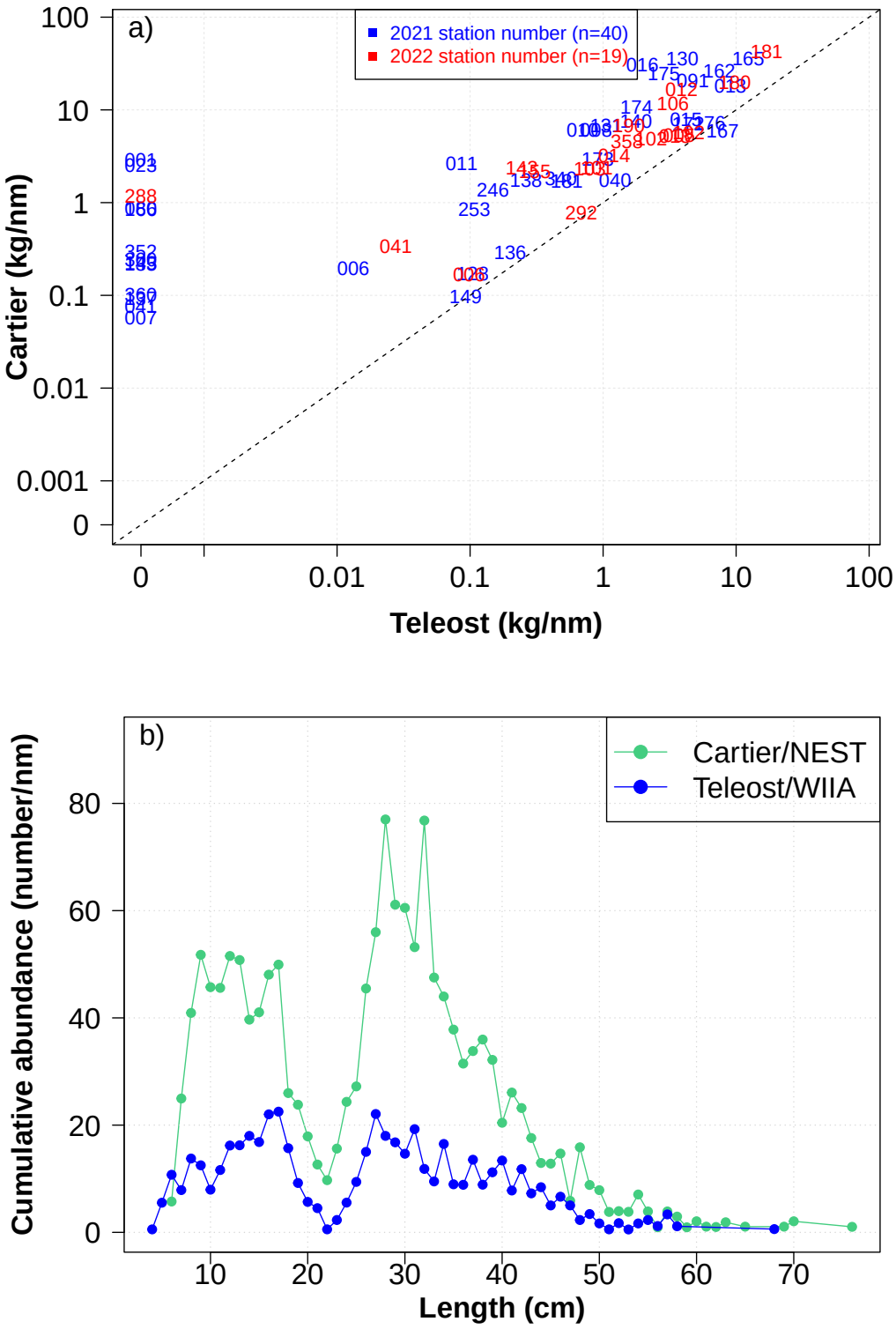

Figure 192. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for White hake (species code 12, *Urophycis tenuis*).

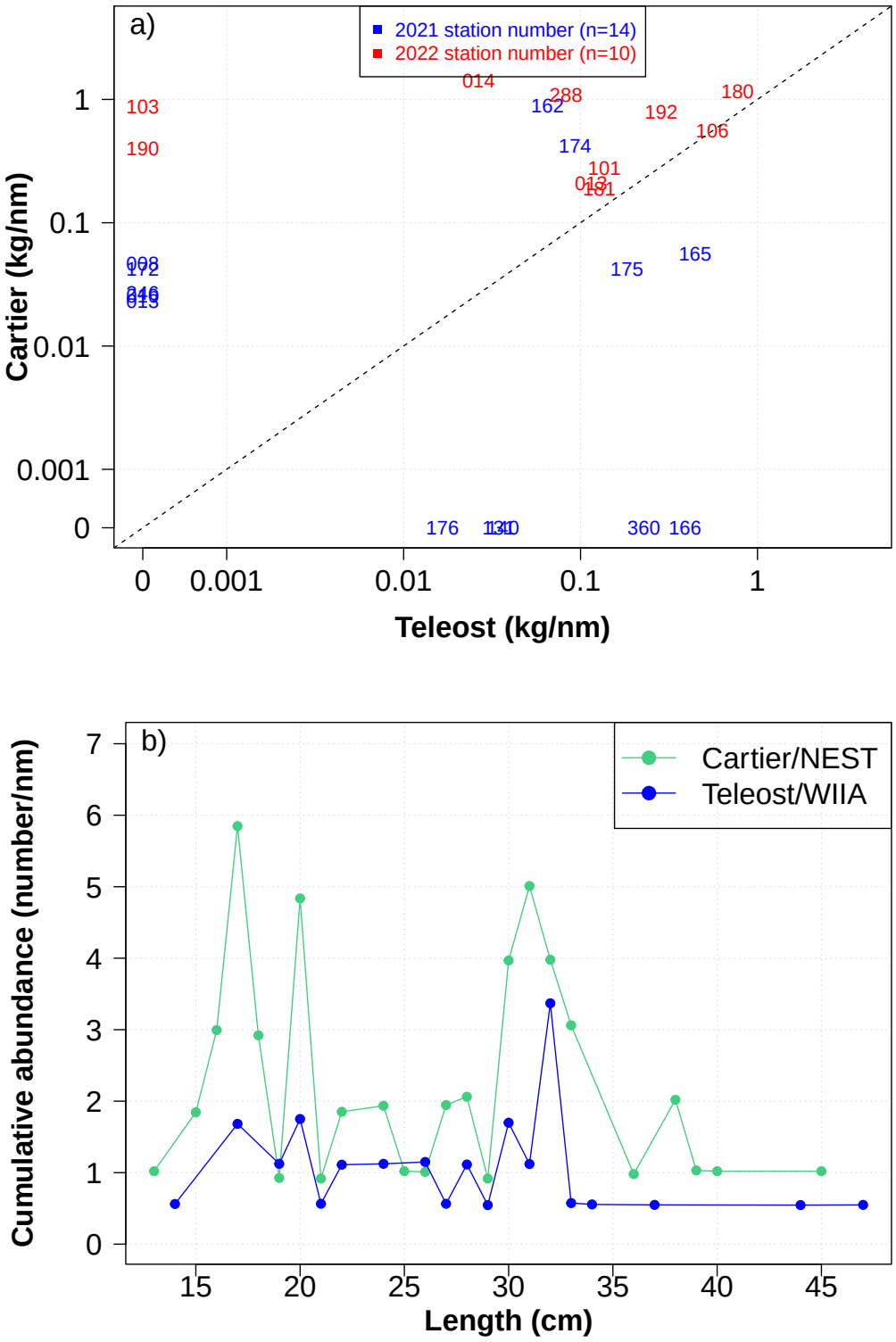

Figure 193. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Silver hake (species code 14, *Merluccius bilinearis*).

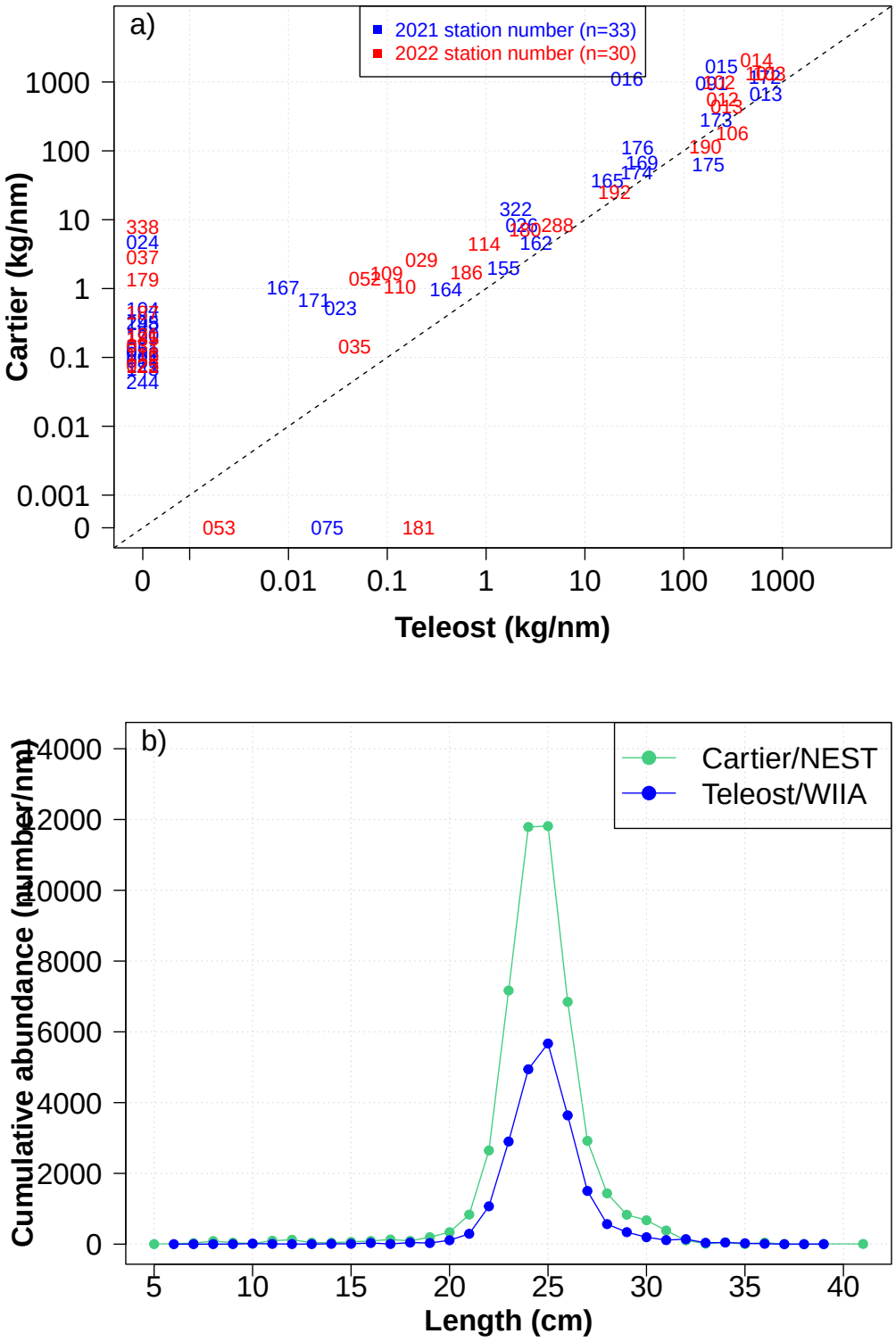

Figure 194. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Redfish unidentified (species code 23, *Sebastes sp.*).

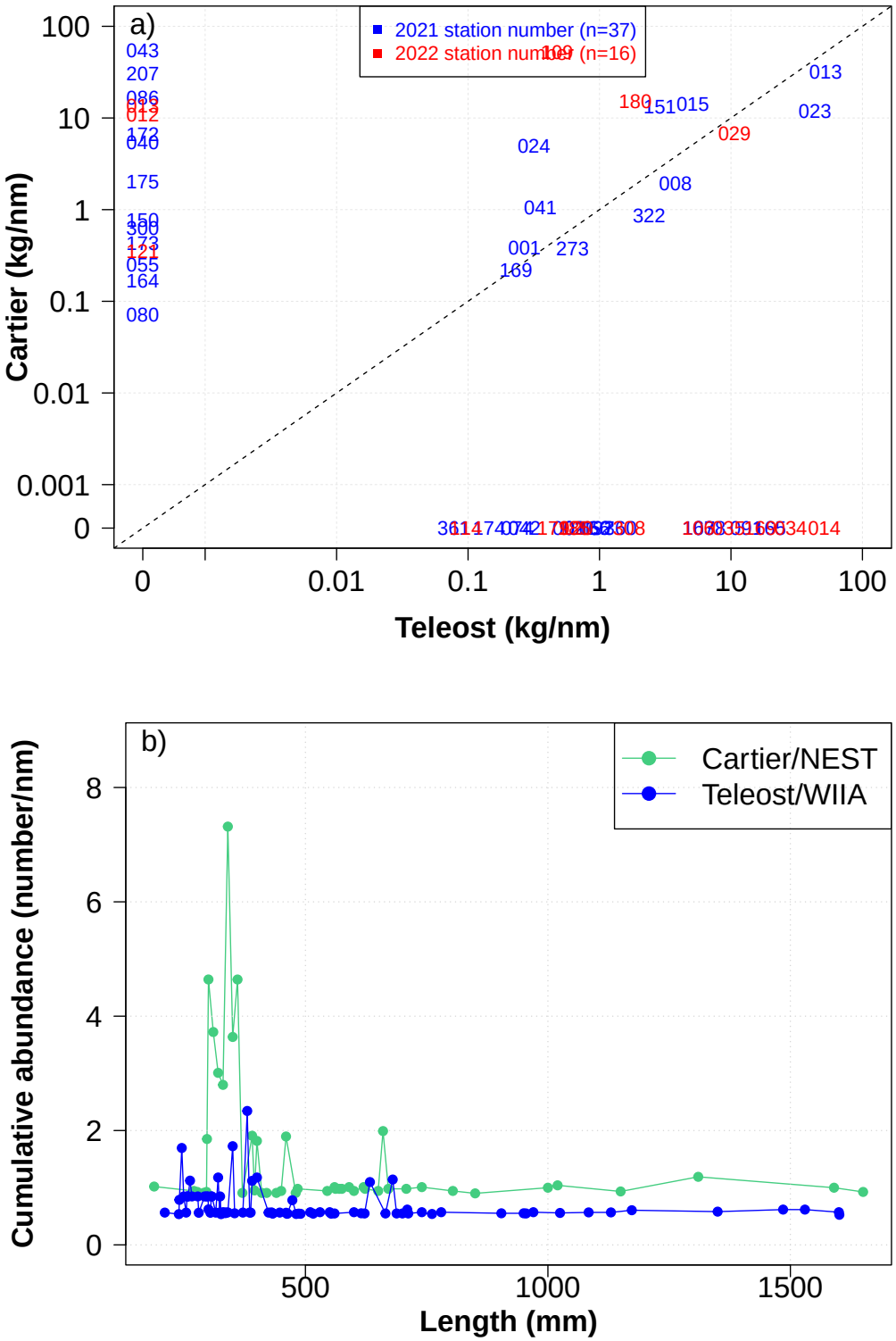

Figure 195. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Atlantic halibut (species code 30, *Hippoglossus hippoglossus*).

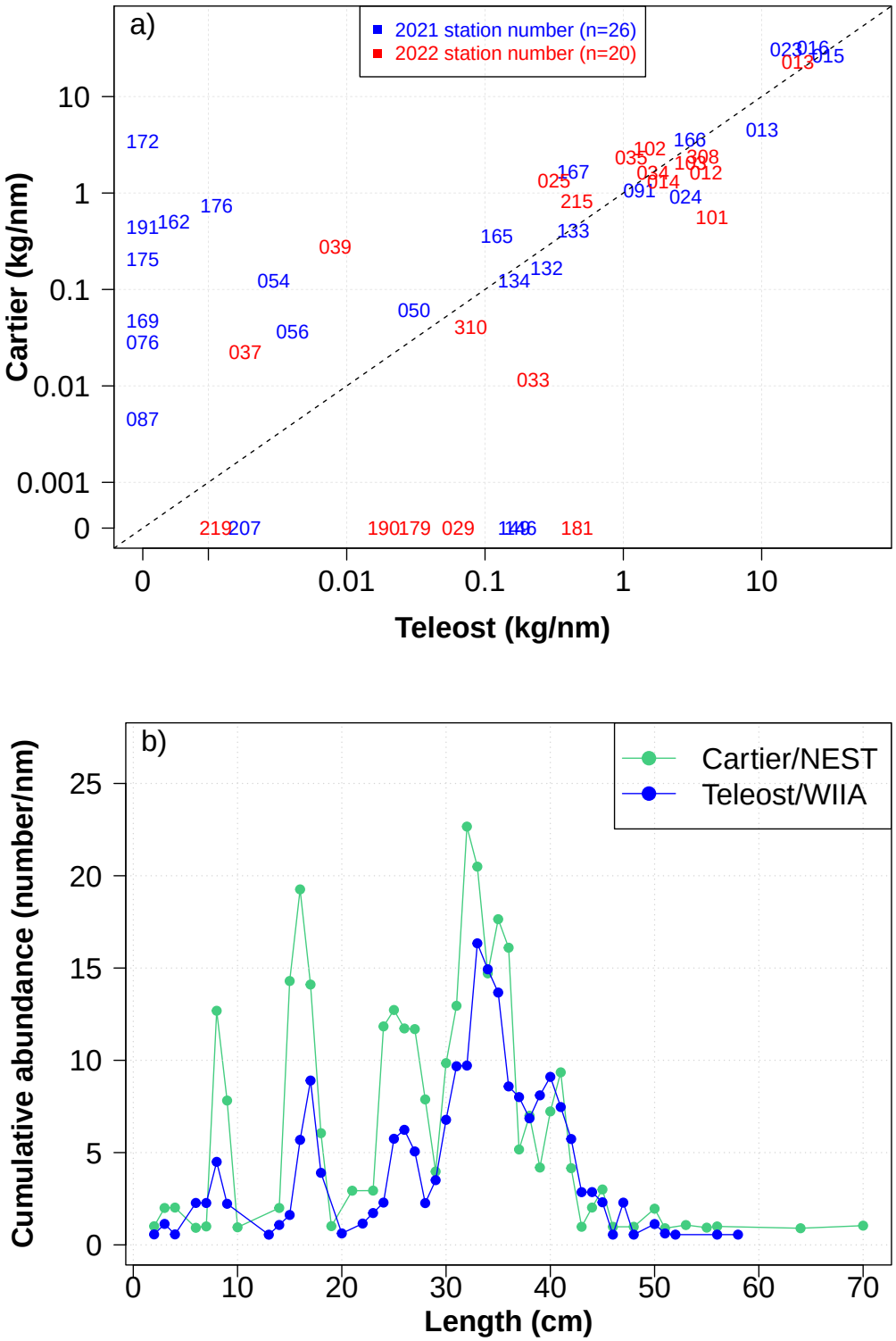

Figure 196. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Greenland halibut (species code 31, *Reinhardtius hippoglossoides*).

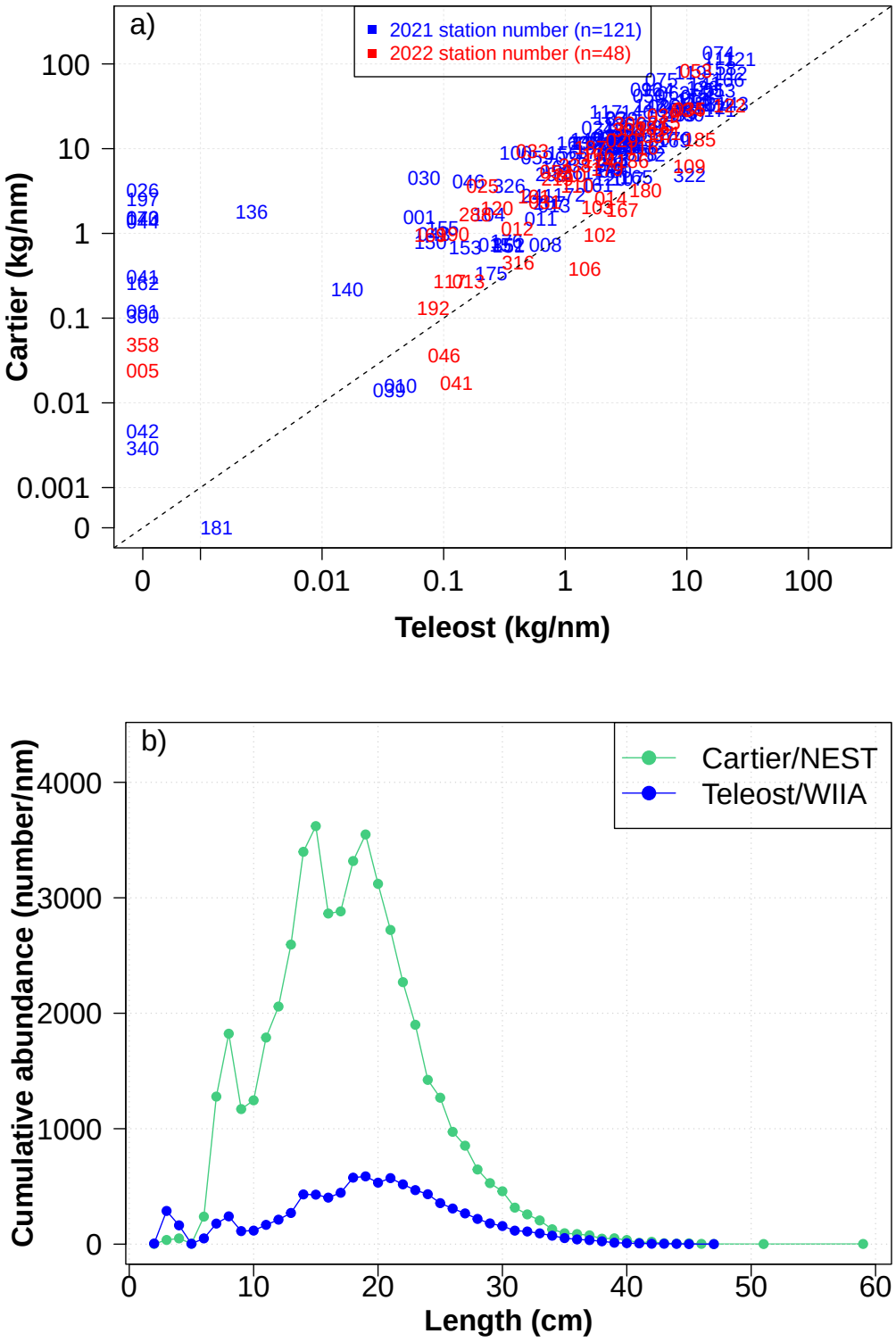

Figure 197. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for American plaice (species code 40, *Hippoglossoides platessoides*).

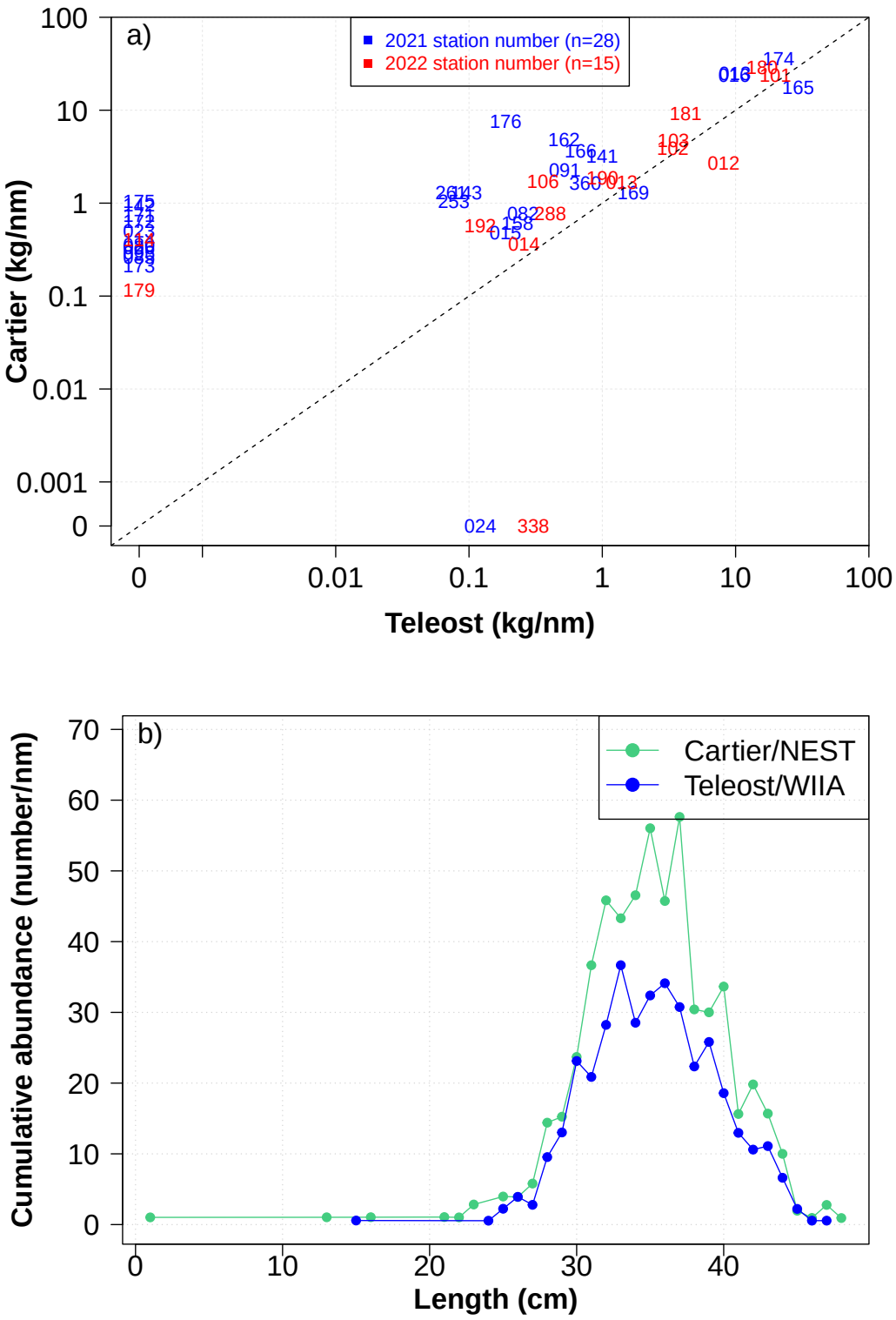

Figure 198. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Witch flounder (species code 41, *Glyptocephalus cynoglossus*).

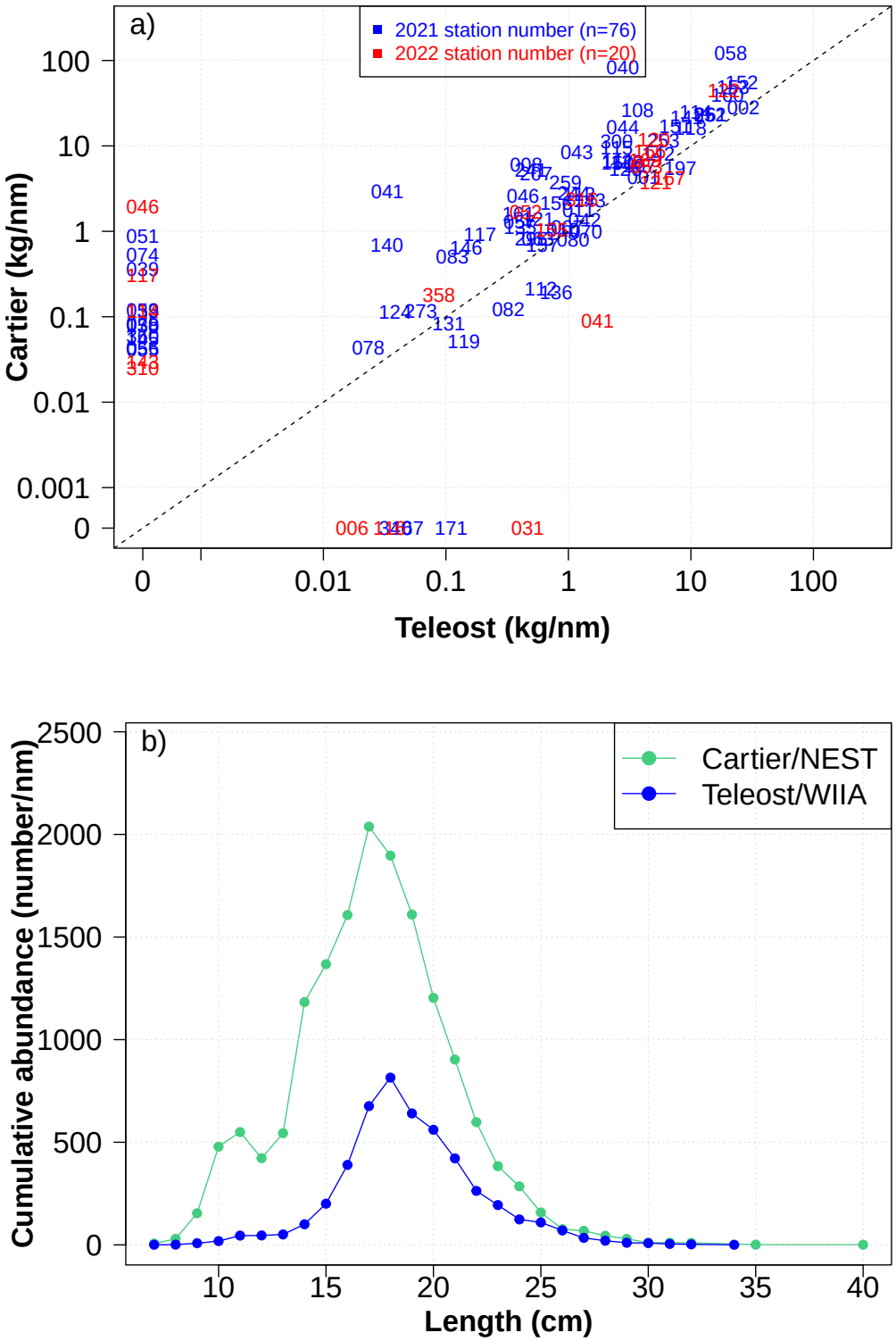

Figure 199. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Yellowtail flounder (species code 42, *Limanda ferruginea*).

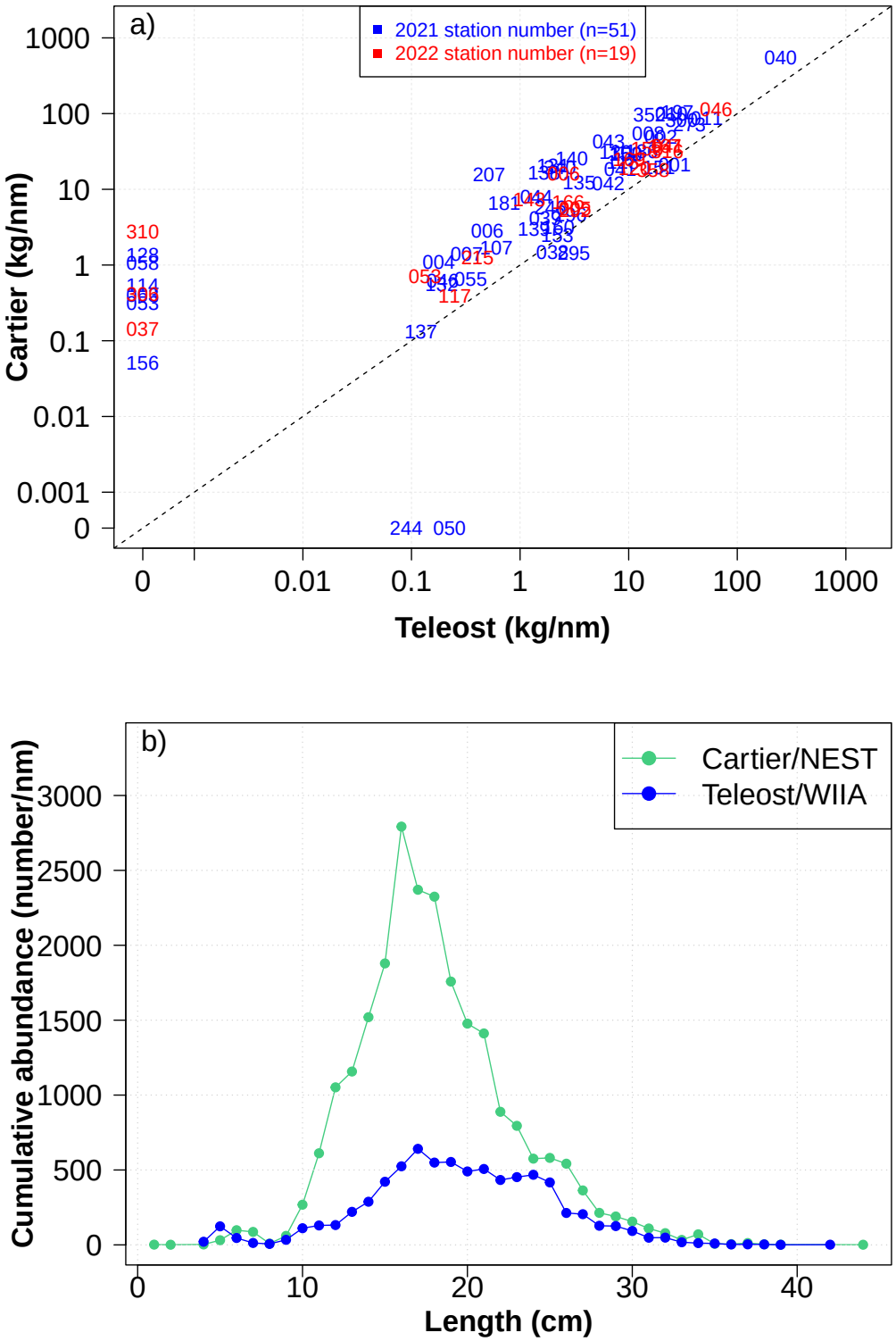

Figure 200. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Winter flounder (species code 43, *Pseudopleuronectes americanus*).

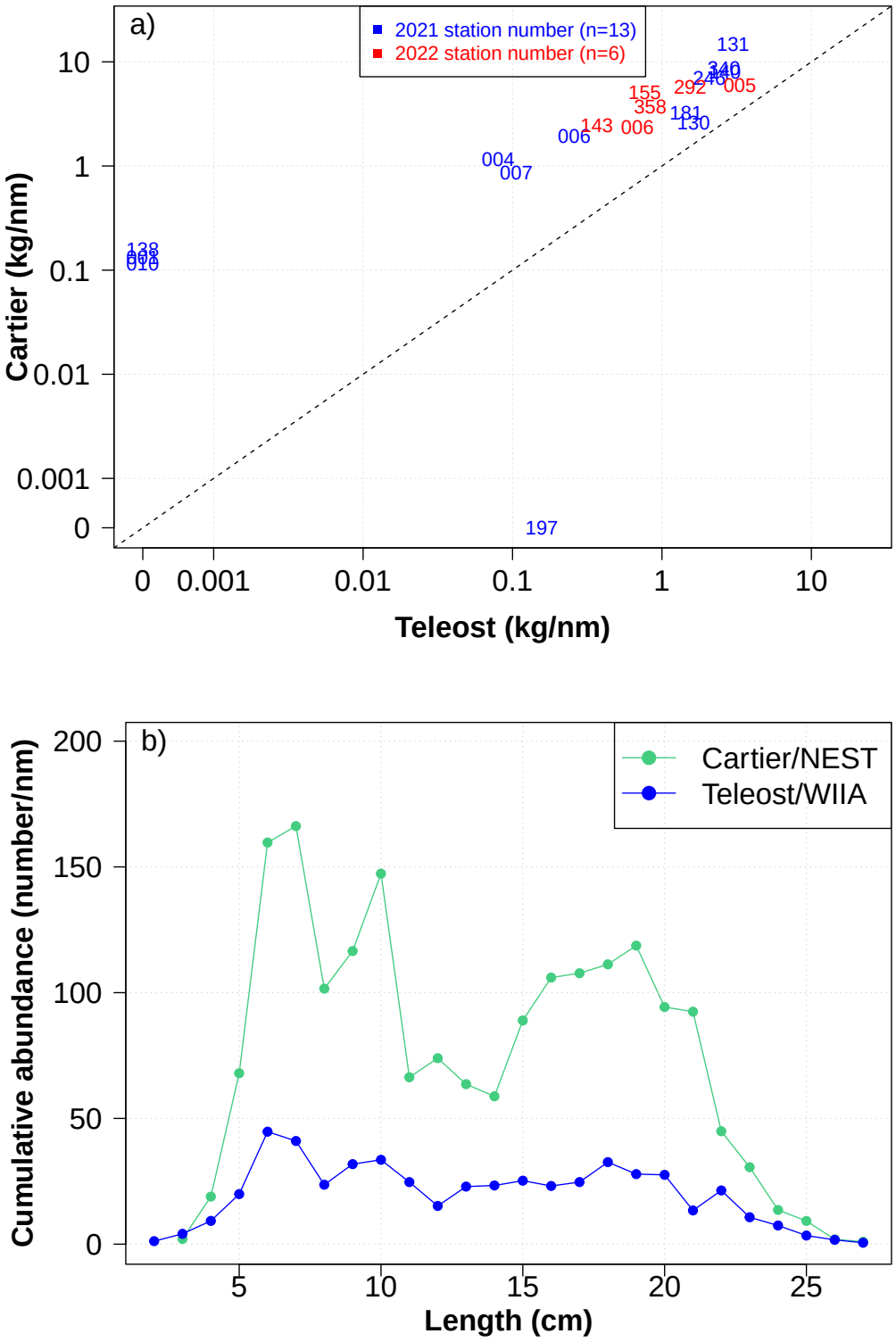

Figure 201. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Windowpane flounder (species code 143, *Scophthalmus aquosus*).

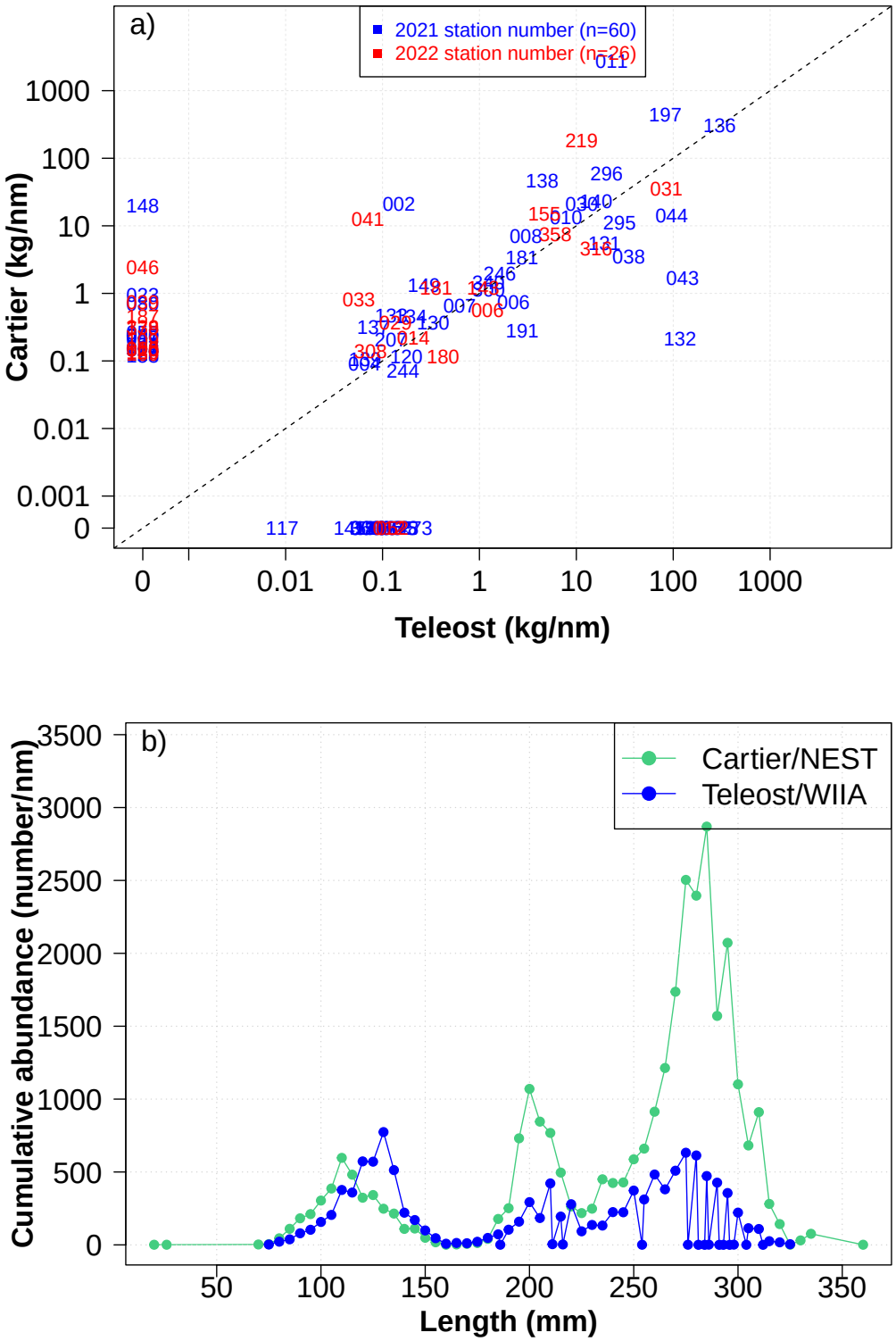

Figure 202. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Atlantic herring (species code 60, *Clupea harengus*).

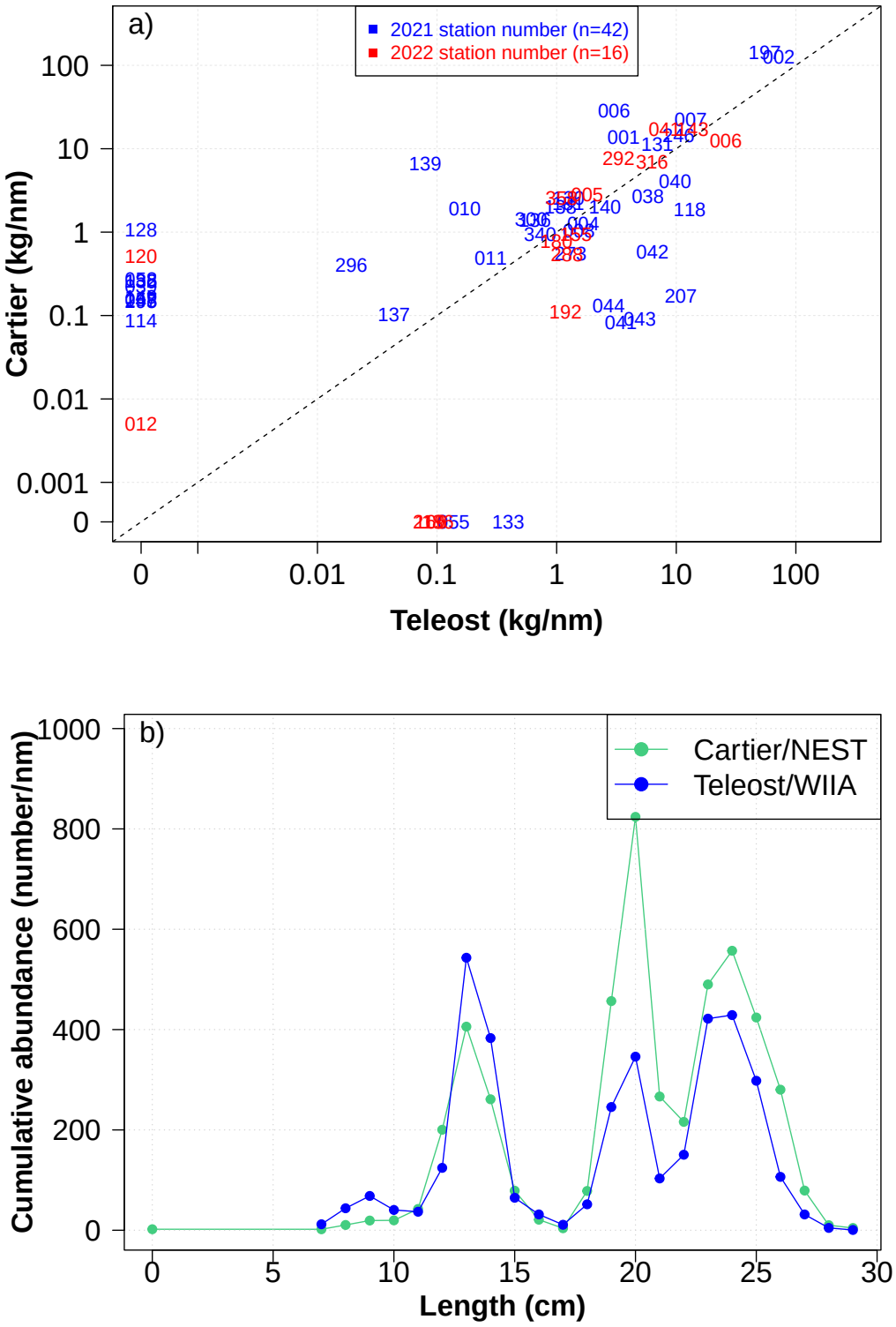

Figure 203. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Alewife (species code 62, *Alosa pseudoharengus*).

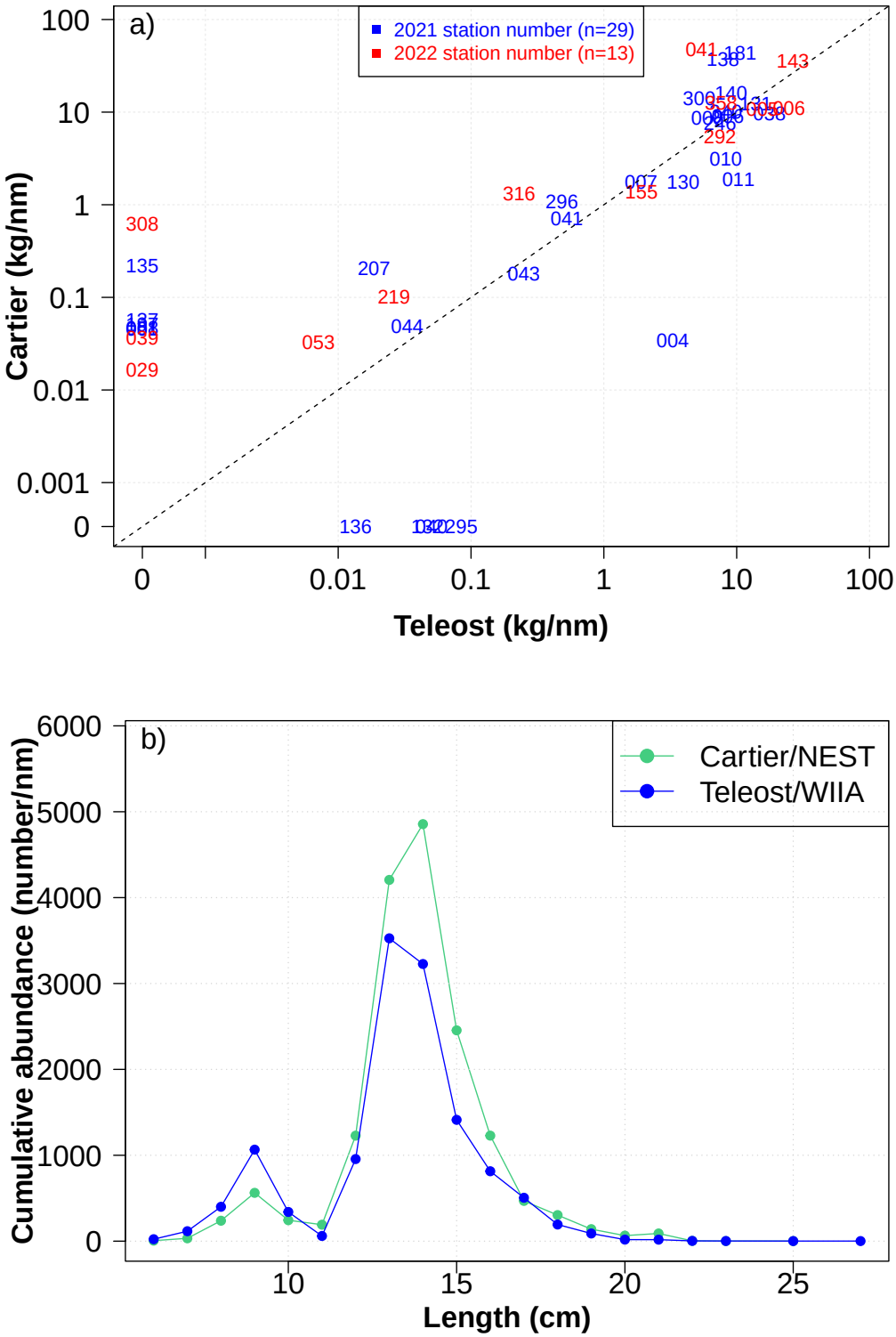

Figure 204. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Rainbow smelt (species code 63, *Osmerus mordax*).

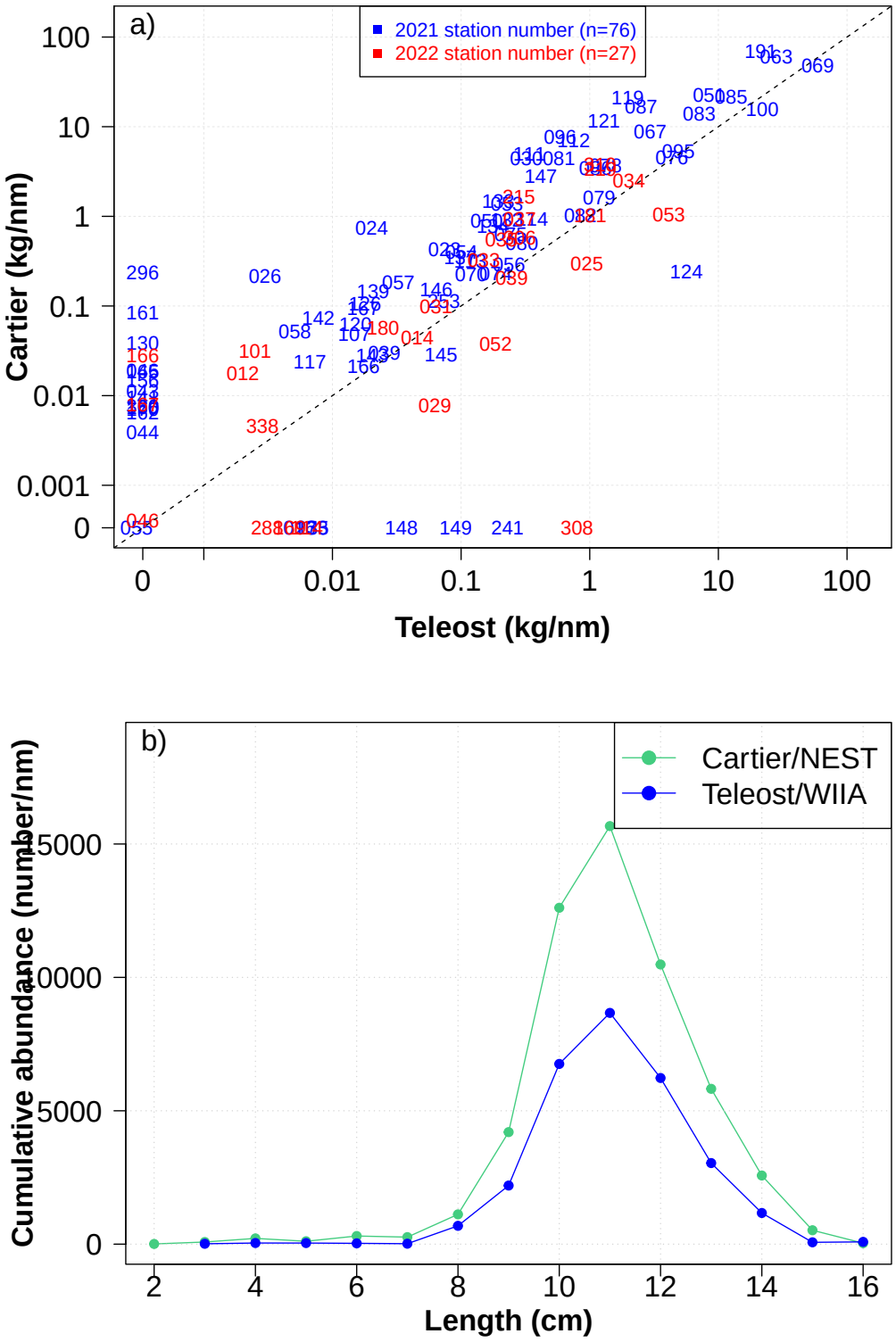

Figure 205. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Capelin (species code 64, *Mallotus villosus*).

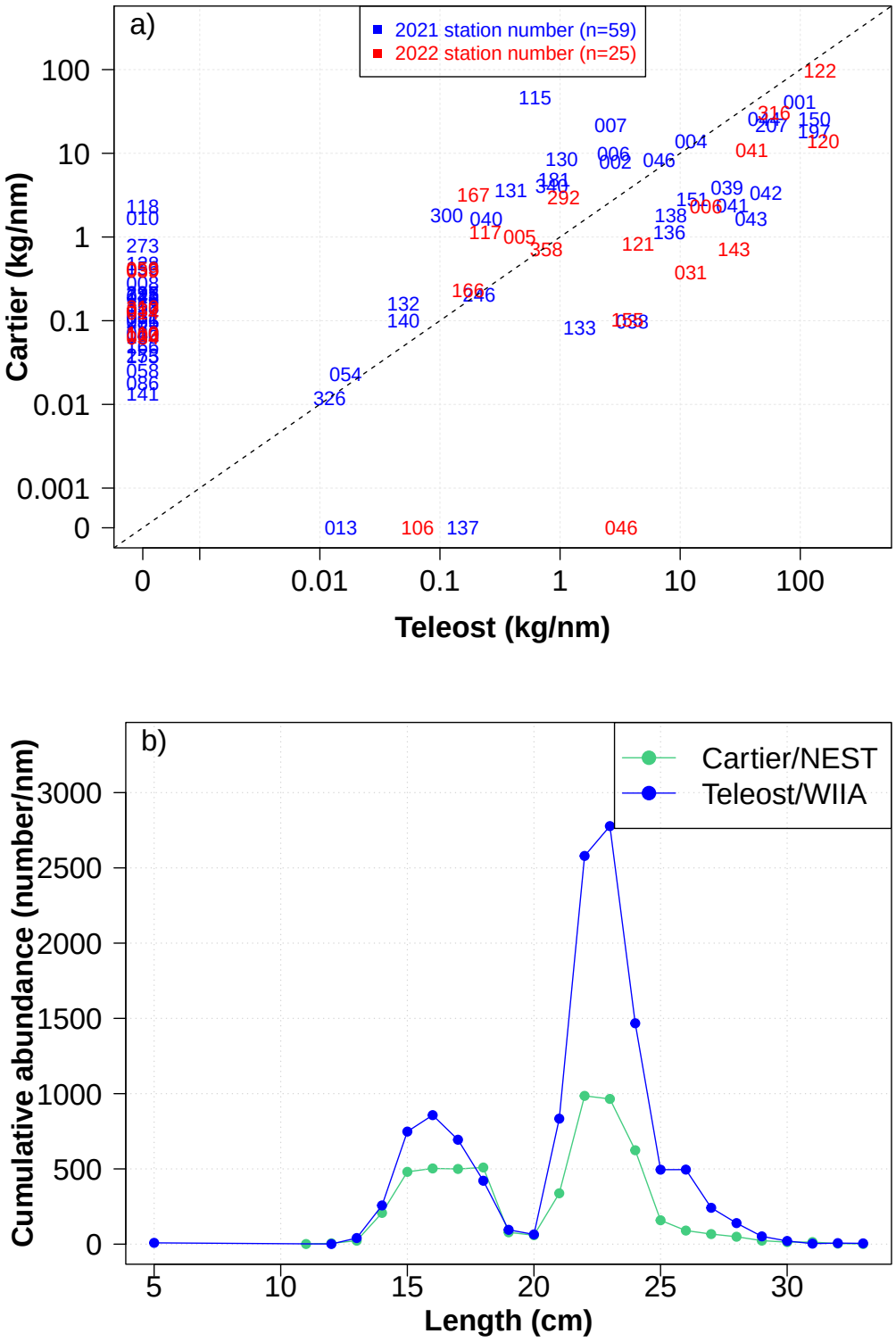

Figure 206. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Atlantic mackerel (species code 70, *Scomber scombrus*).

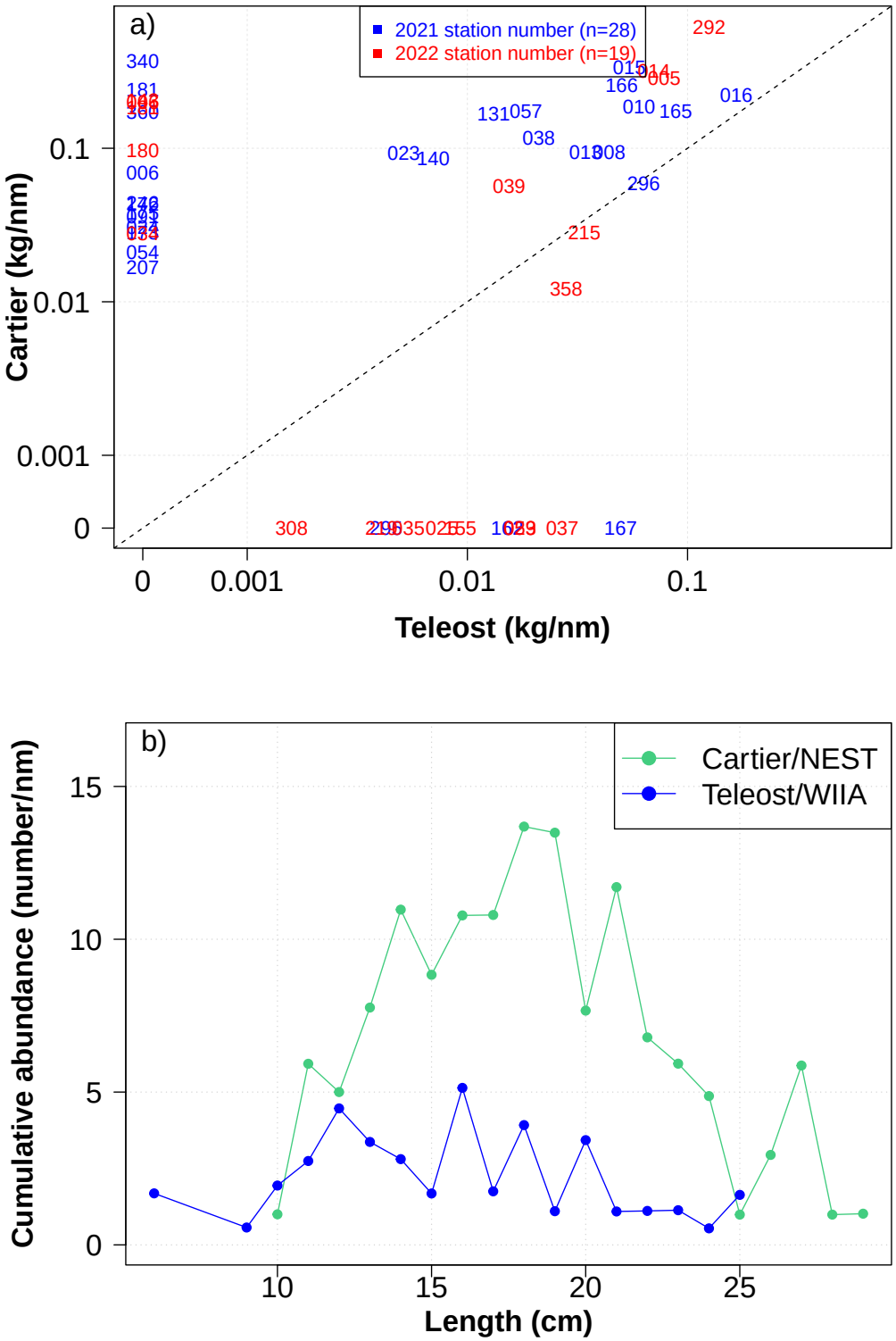

Figure 207. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Fourbeard rockling (species code 114, *Enchelyopus cimbrius*).

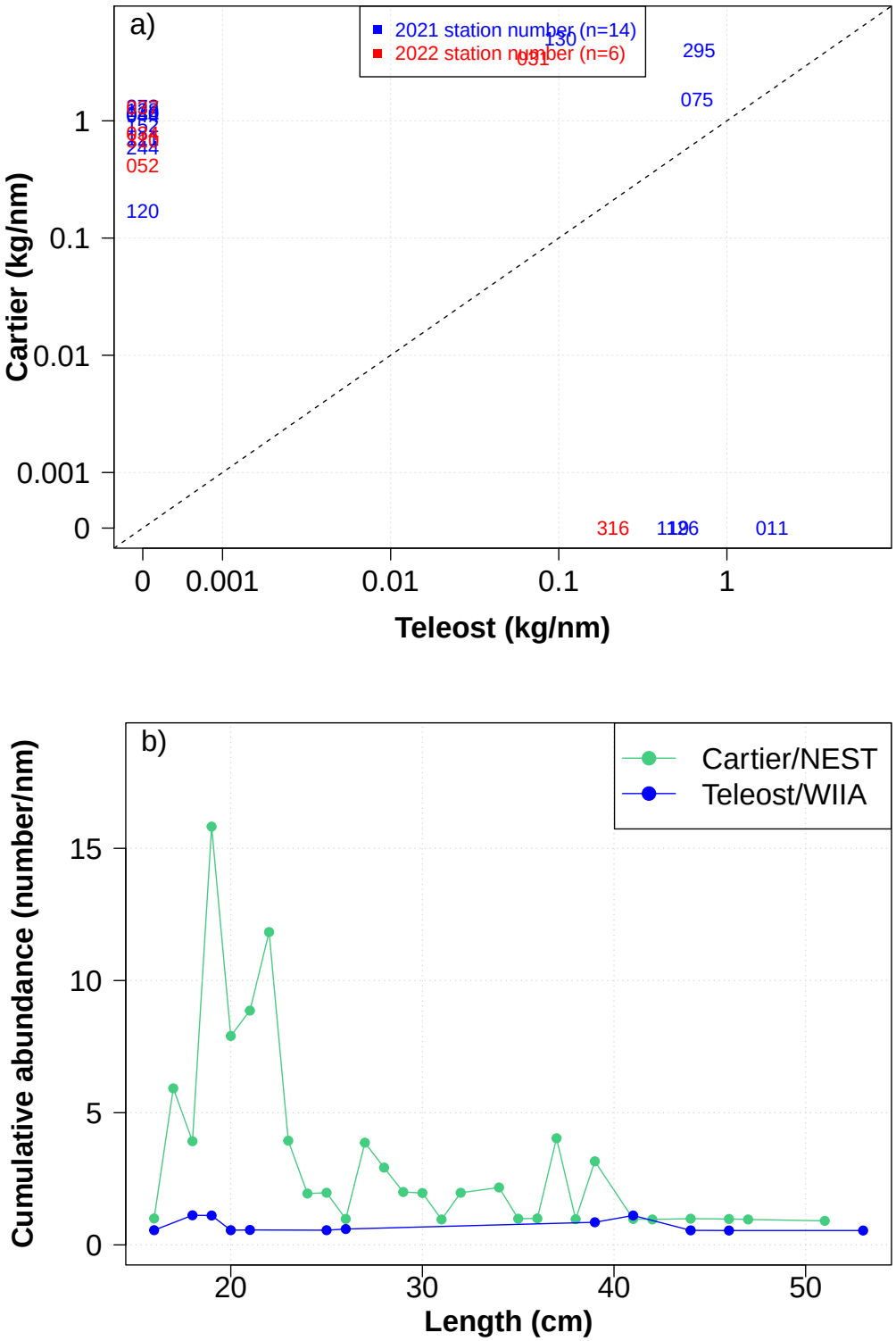

Figure 208. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Greenland cod (species code 118, *Gadus macrocephalus*).

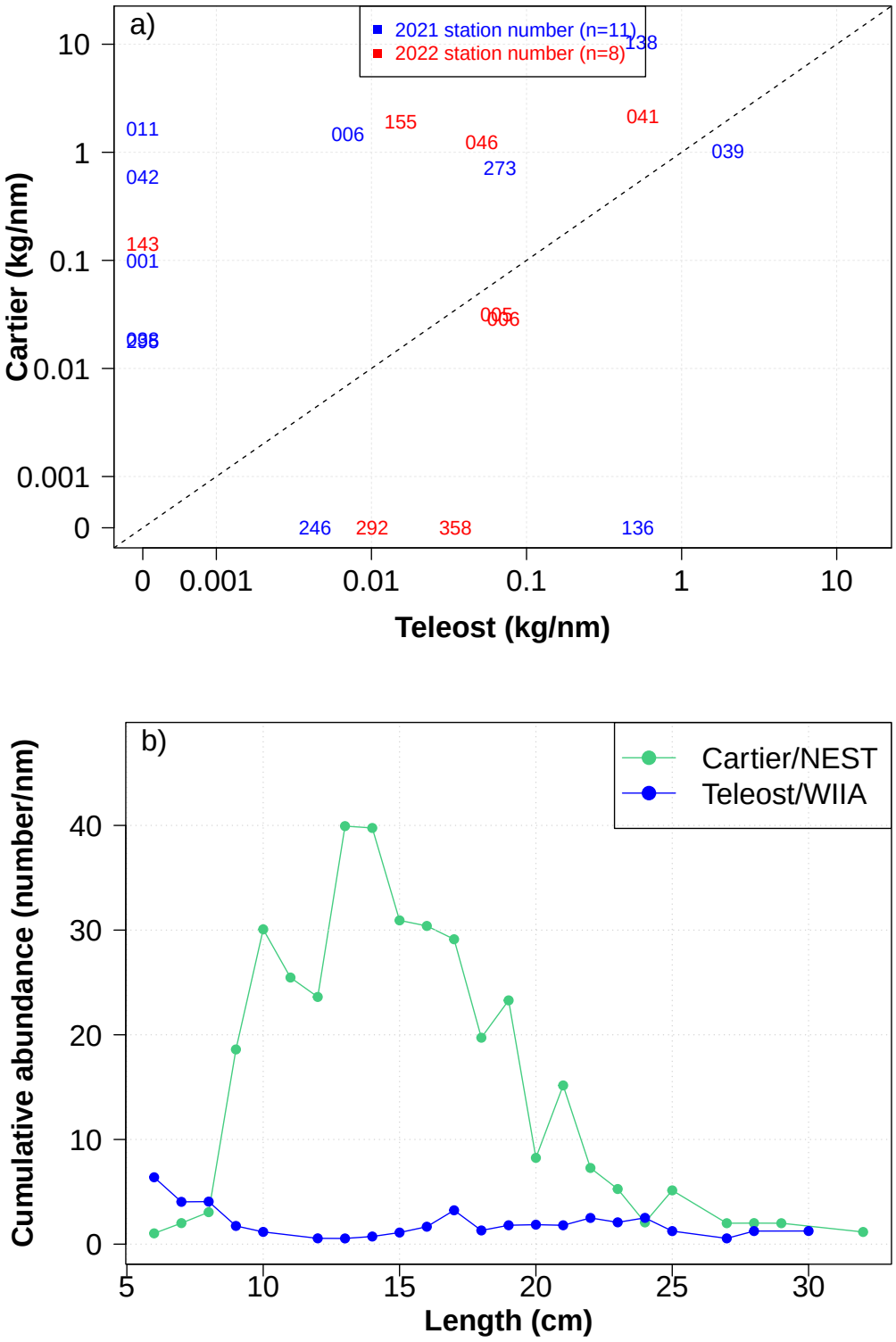

Figure 209. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Cunner (species code 122, *Tautogolabrus adspersus*).

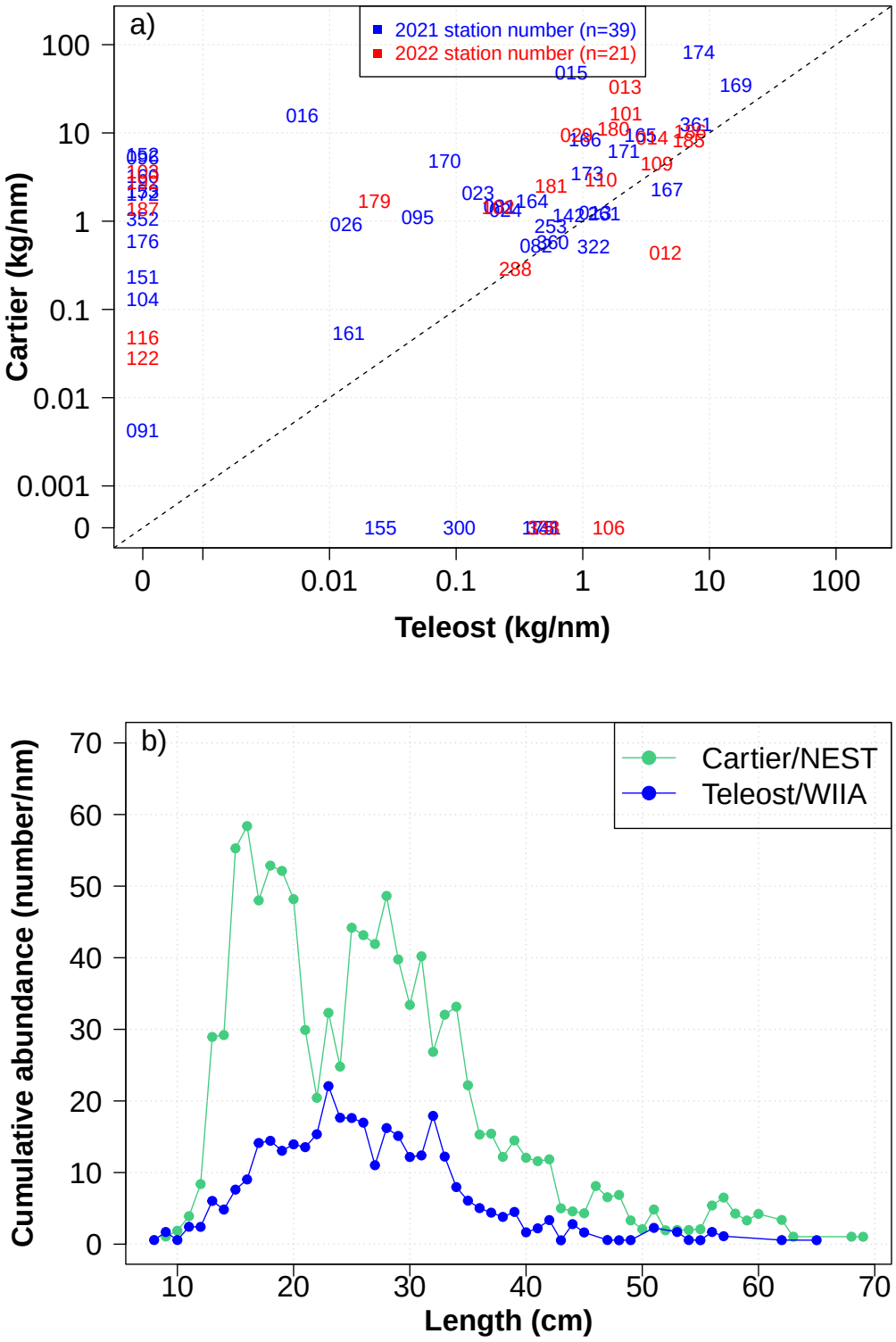

Figure 210. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Thorny skate (species code 201, *Amblyraja radiata*).

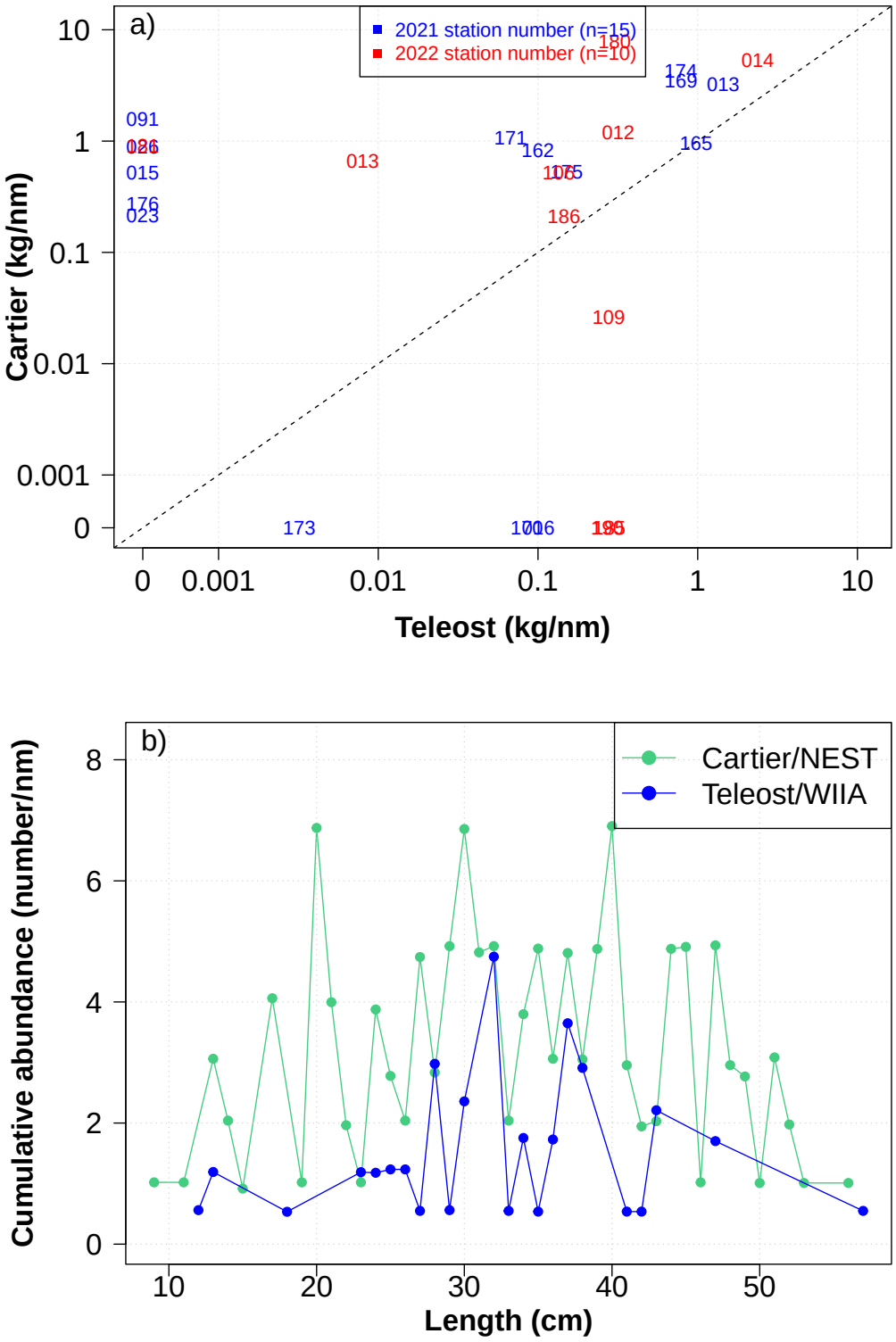

Figure 211. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Smooth skate (species code 202, *Malacoraja senta*).

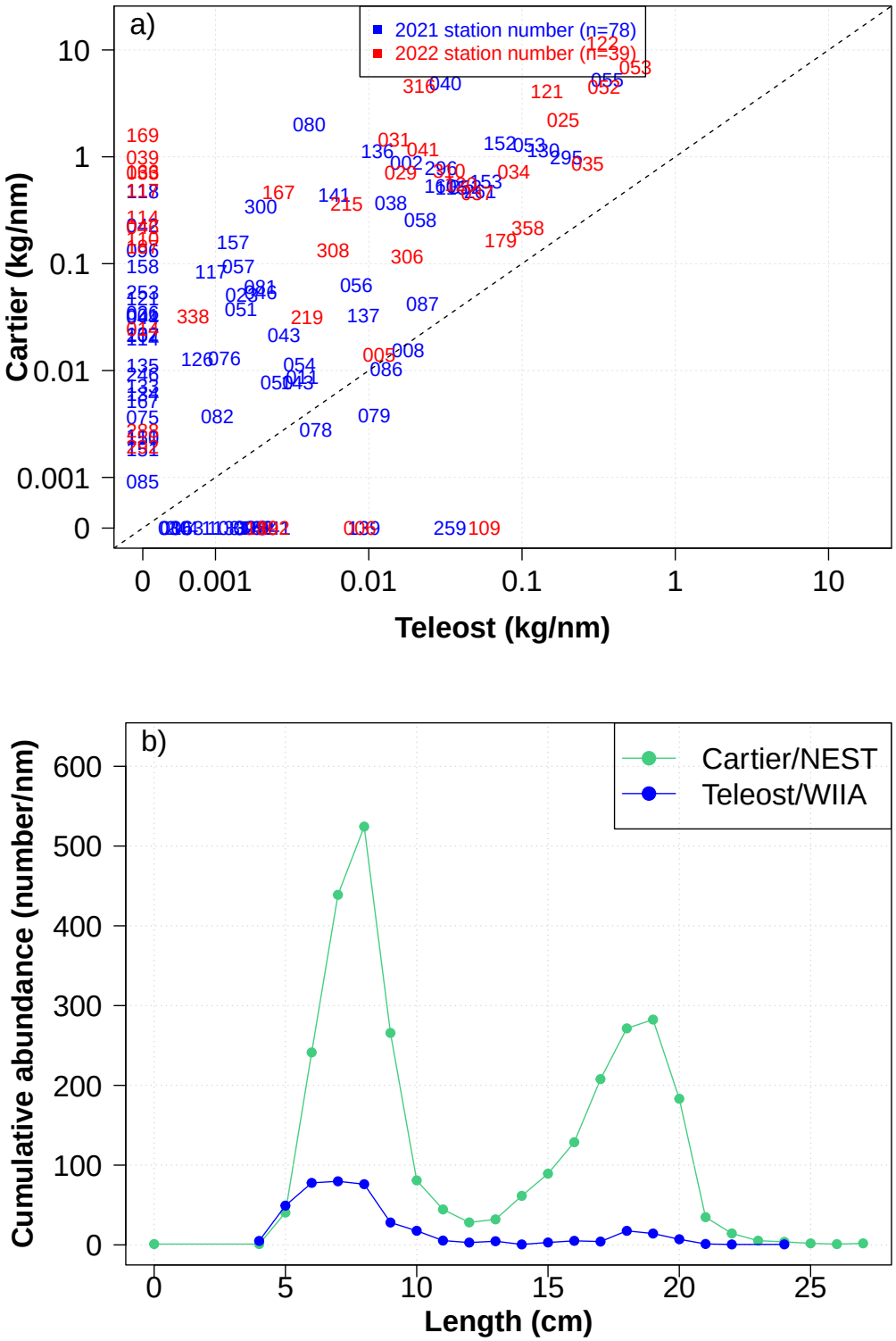

Figure 212. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Gadidae unidentified (species code 251, *Gadidae (f.)*).

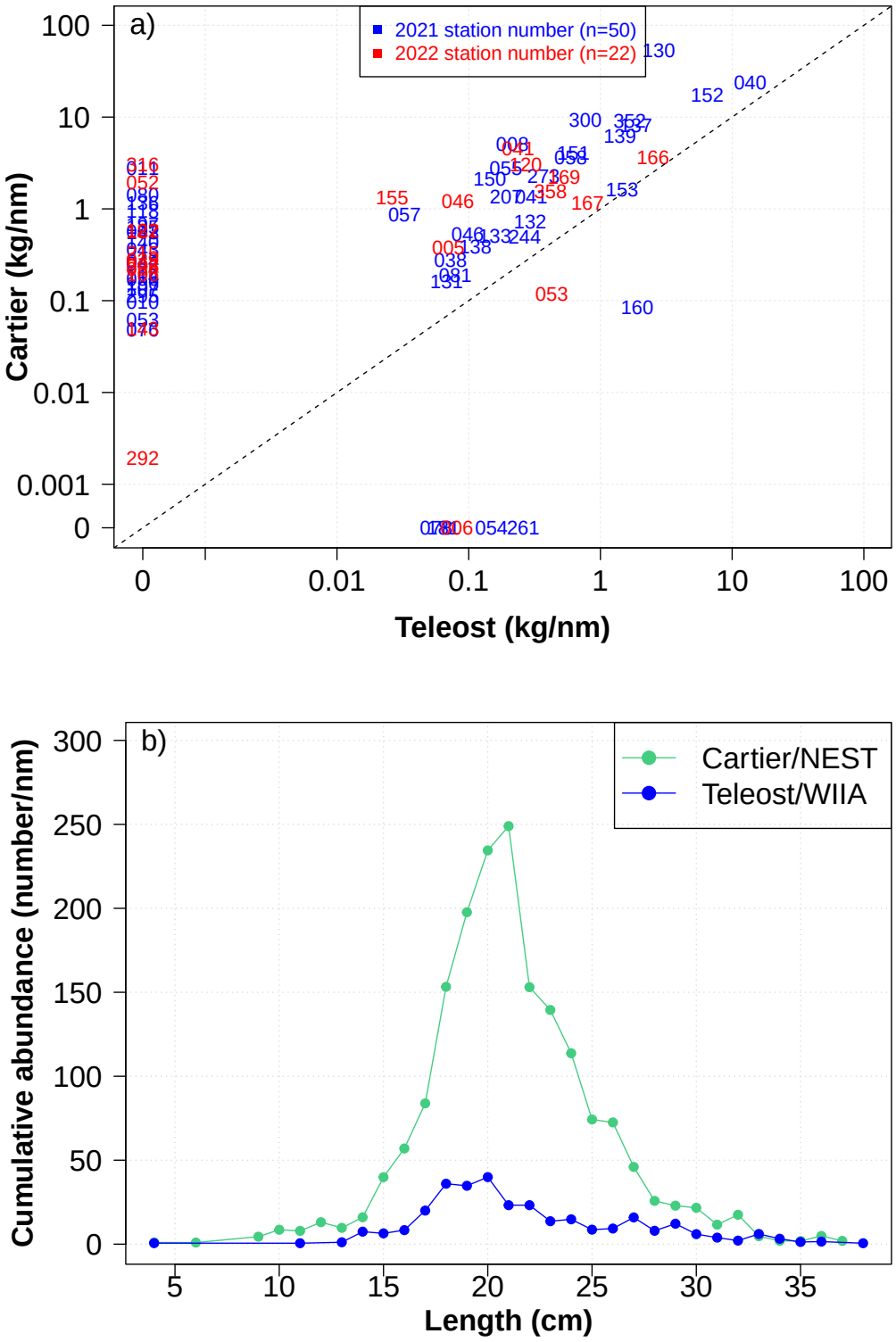

Figure 213. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Longhorn sculpin (species code 300, *Myoxocephalus octodecemspinosus*).

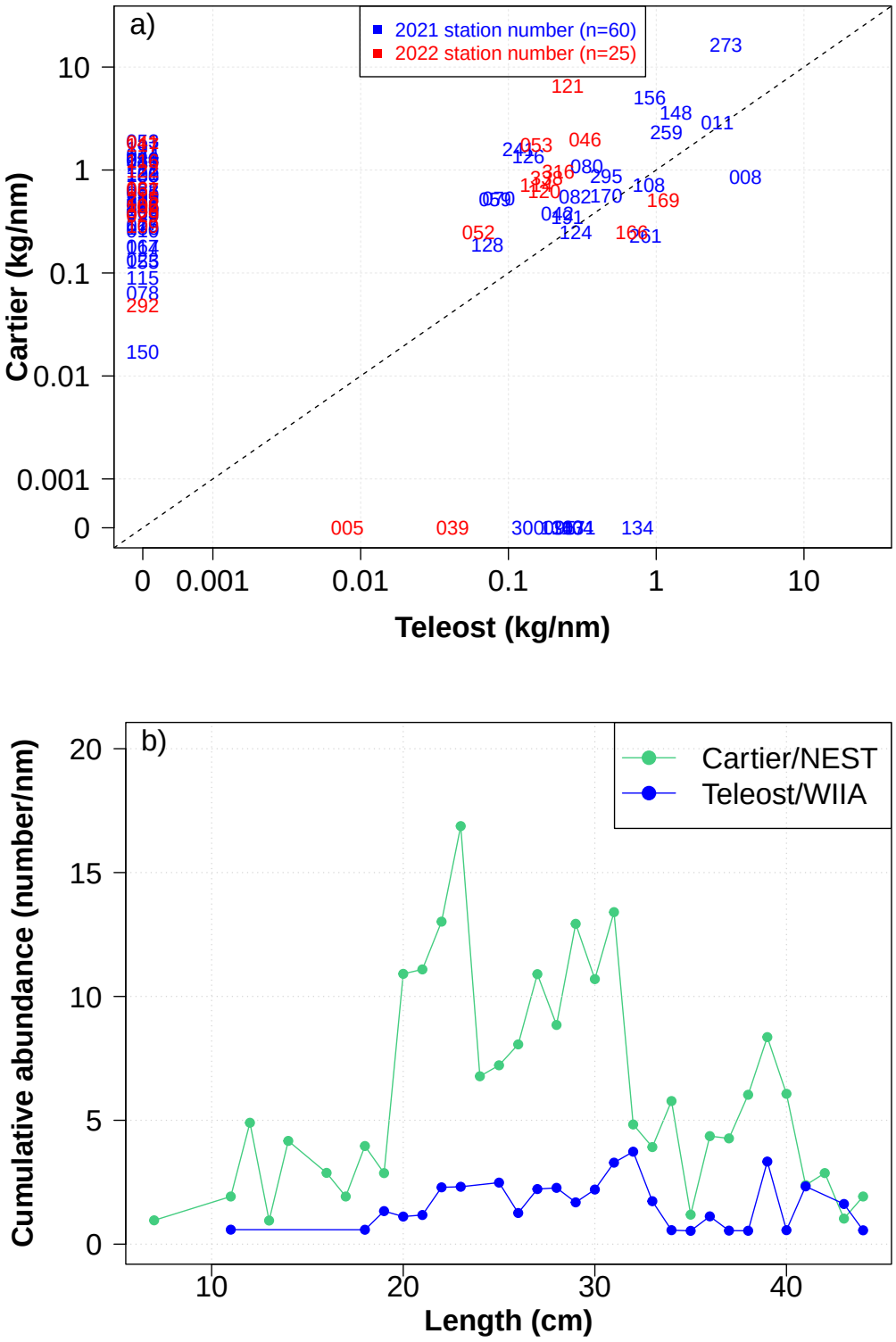

Figure 214. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Shorthorn sculpin (species code 301, *Myoxocephalus scorpius*).

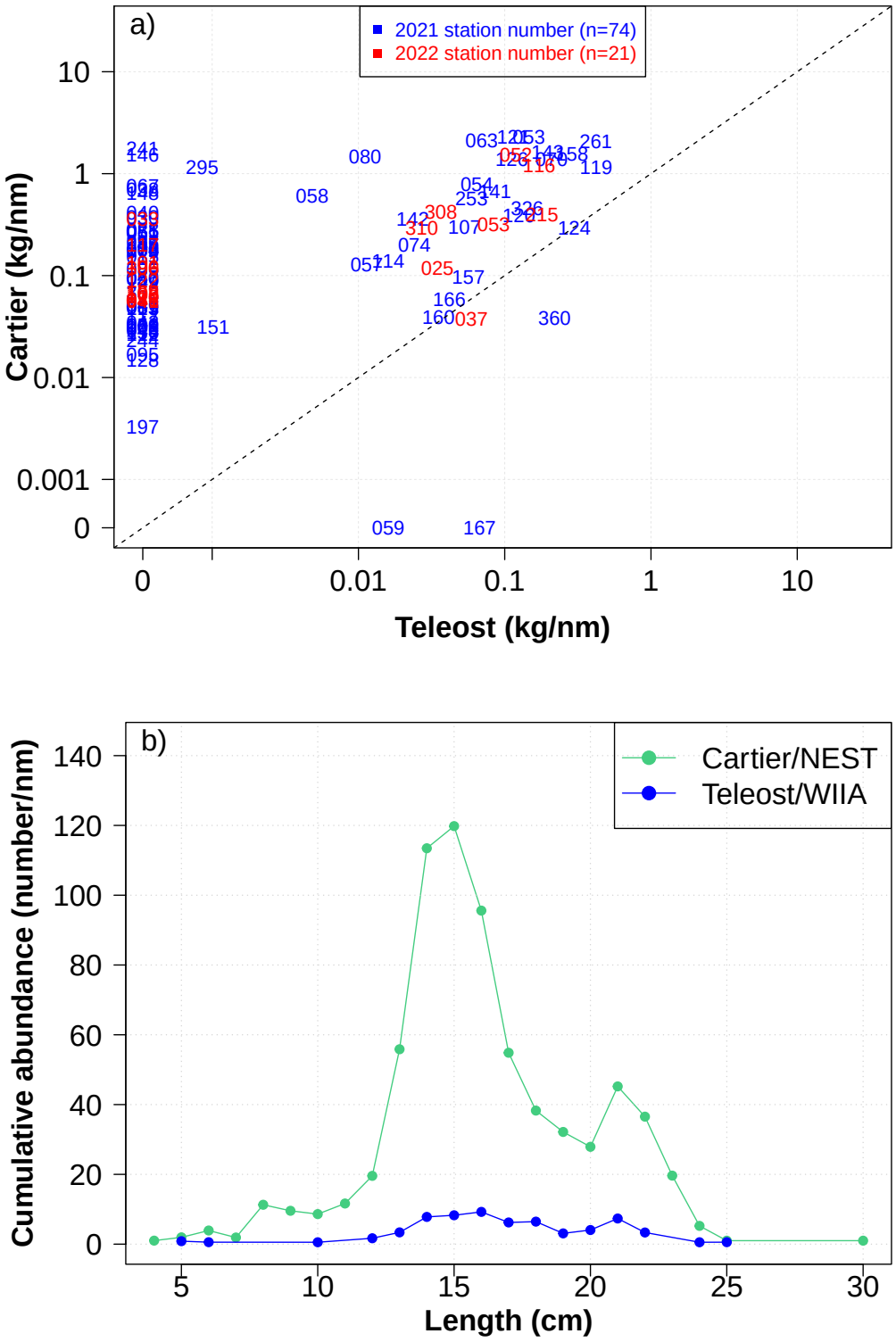

Figure 215. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Arctic staghorn sculpin (species code 302, *Gymnocanthus tricuspis*).

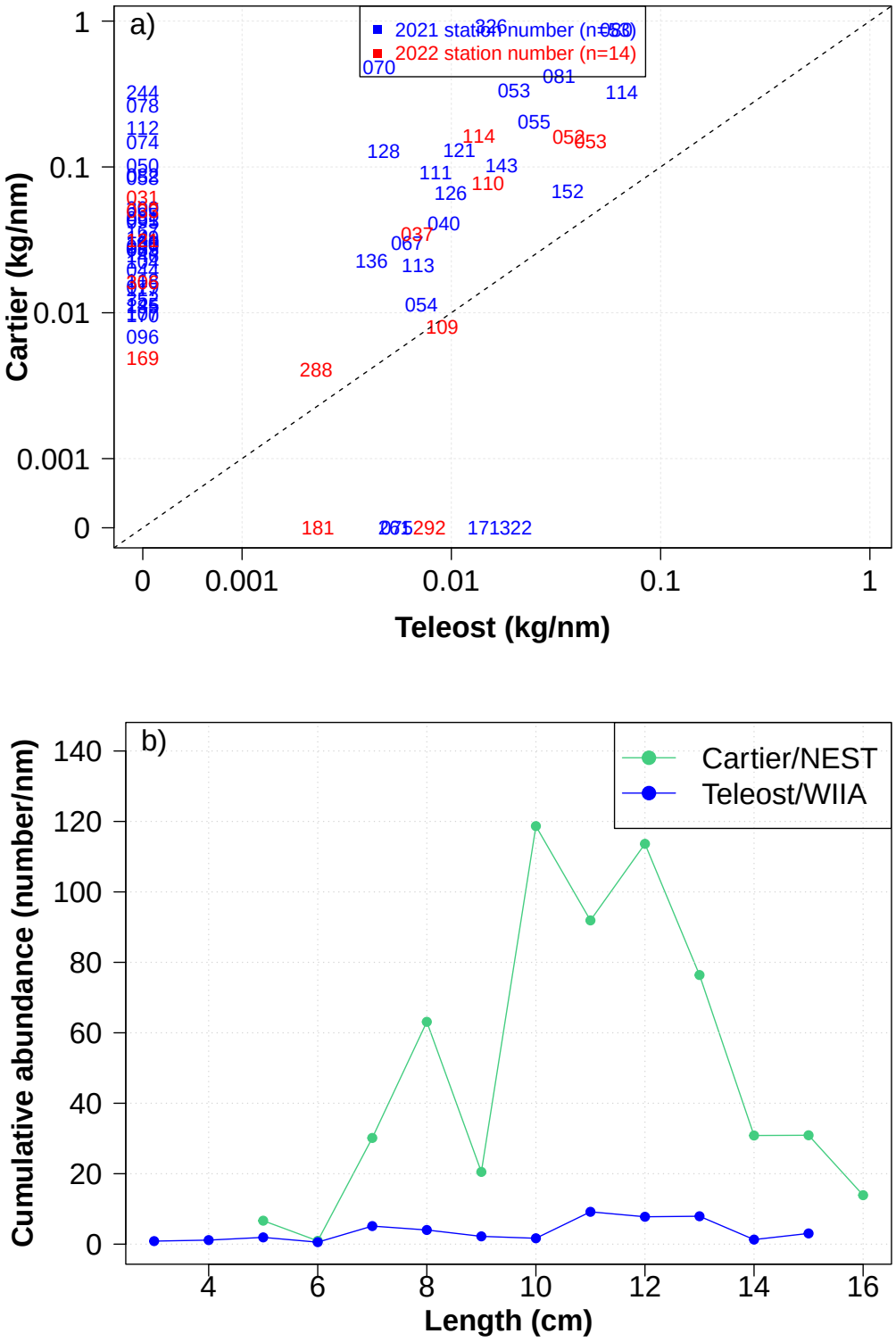

Figure 216. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Moustache sculpin (species code 304, *Triglops murrayi*).

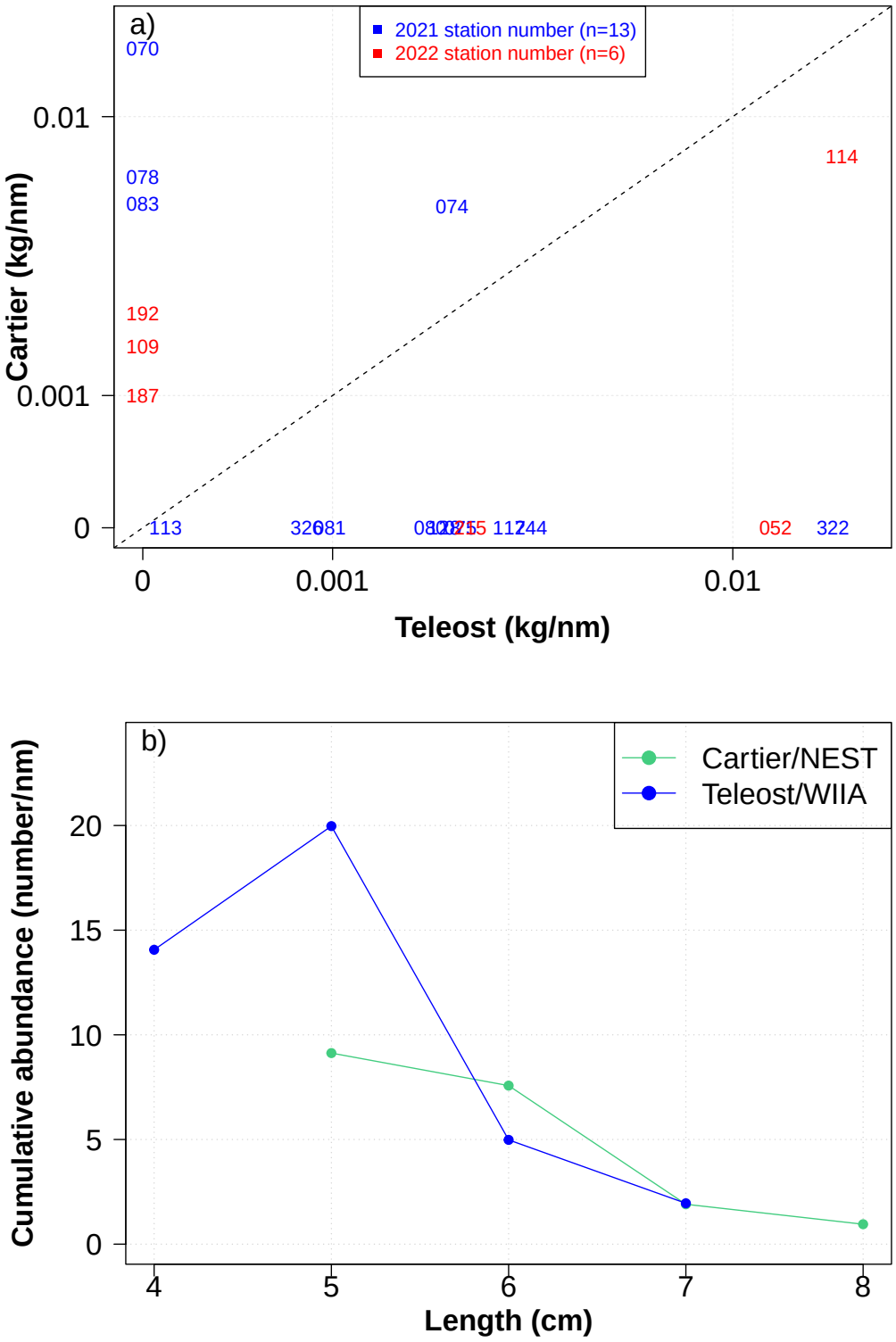

Figure 217. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Arctic hookear sculpin (species code 306, *Artediellus uncinatus*).

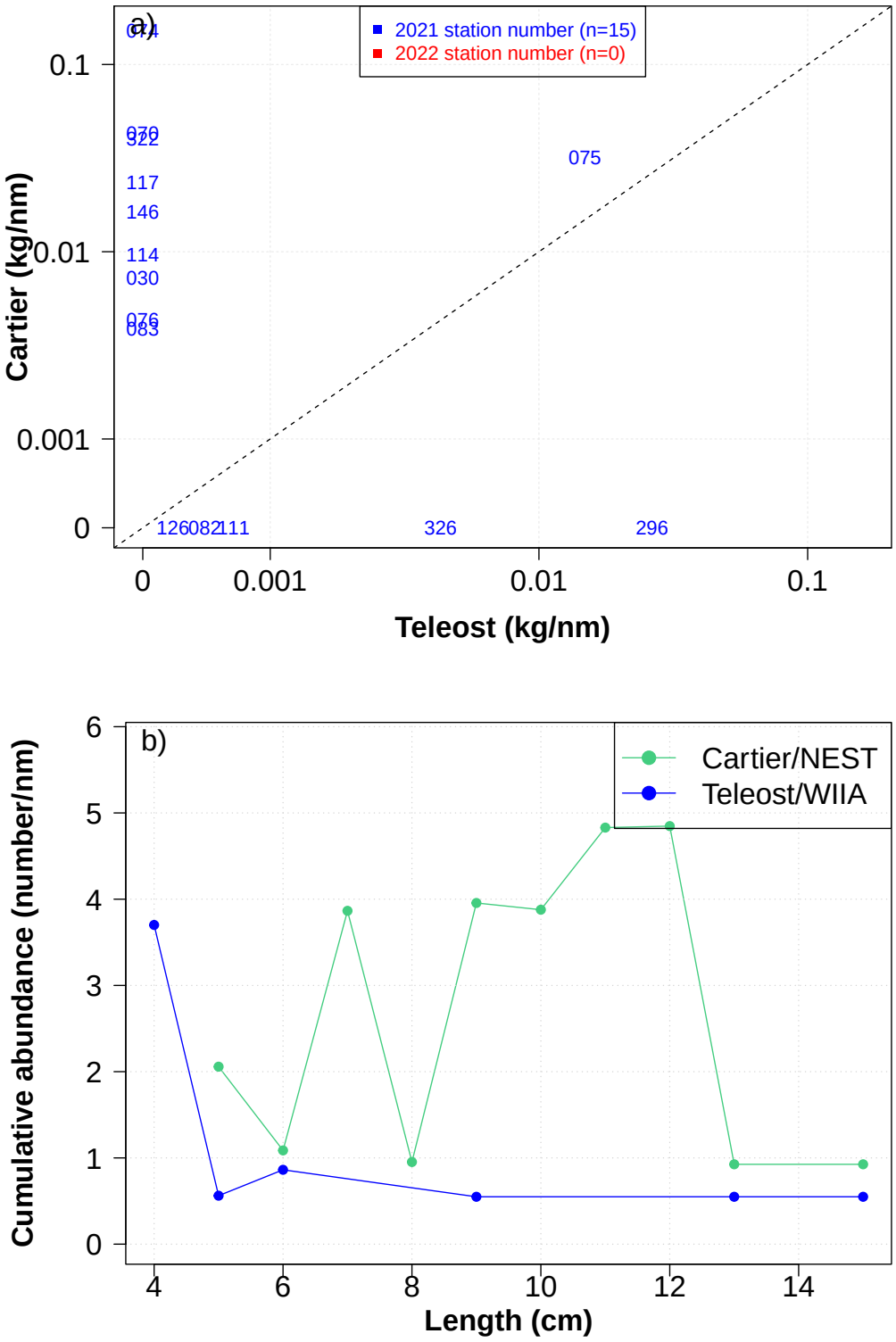

Figure 218. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Spatulate sculpin (species code 314, *Icelus spatula*).

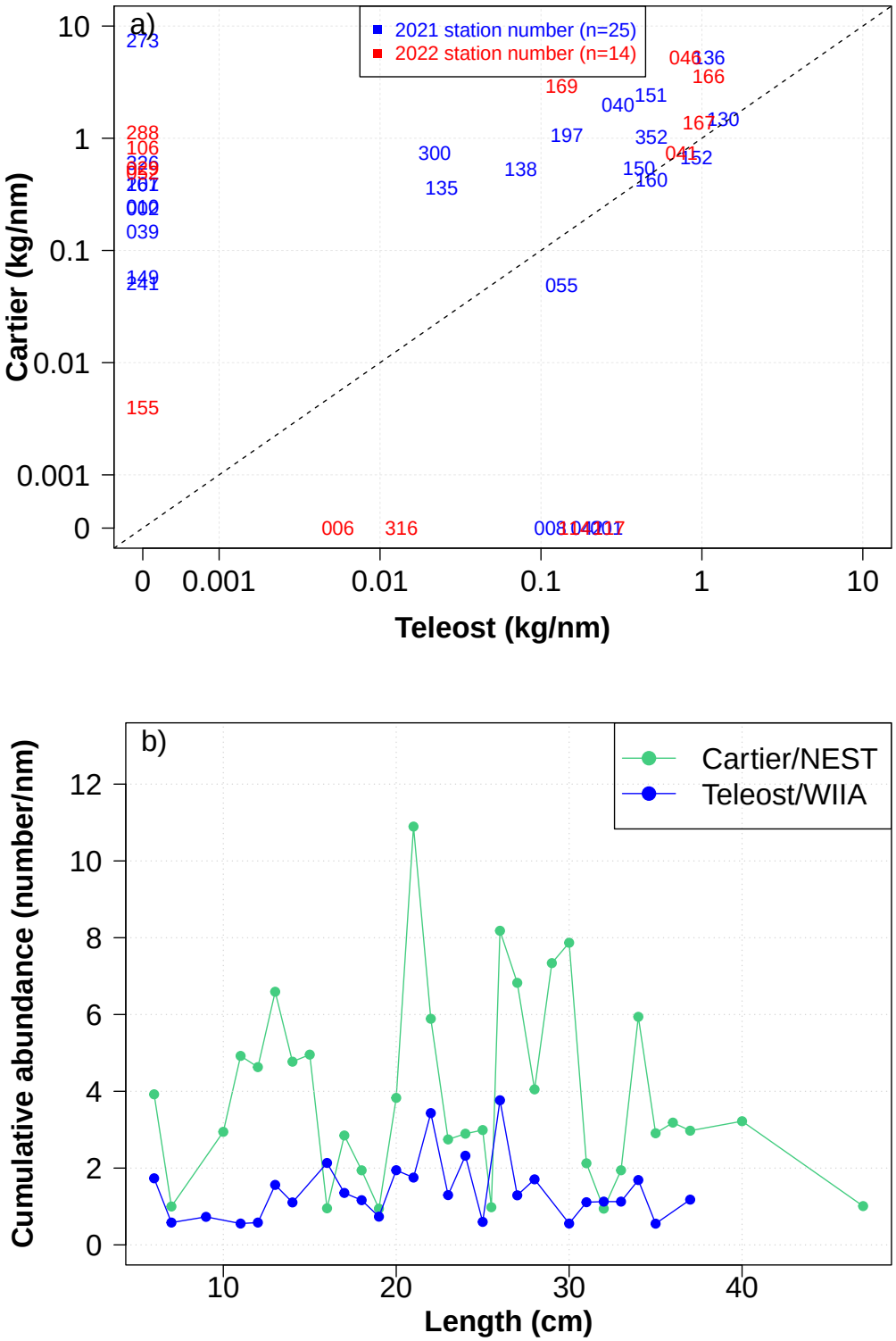

Figure 219. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Sea raven (species code 320, *Hemitripterus americanus*).

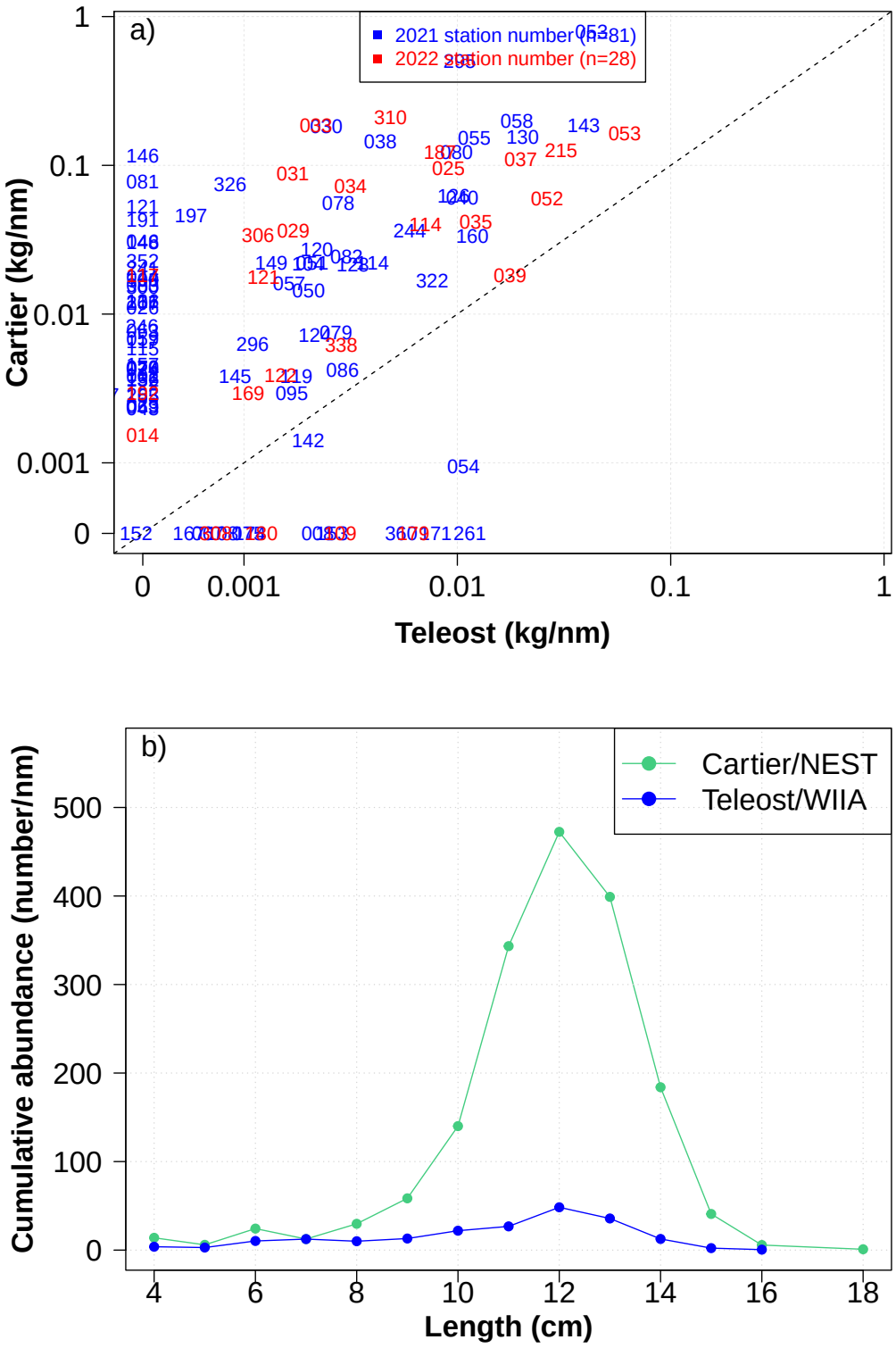

Figure 220. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Alligatorfish (species code 340, *Aspidophoroides monopterygius*).

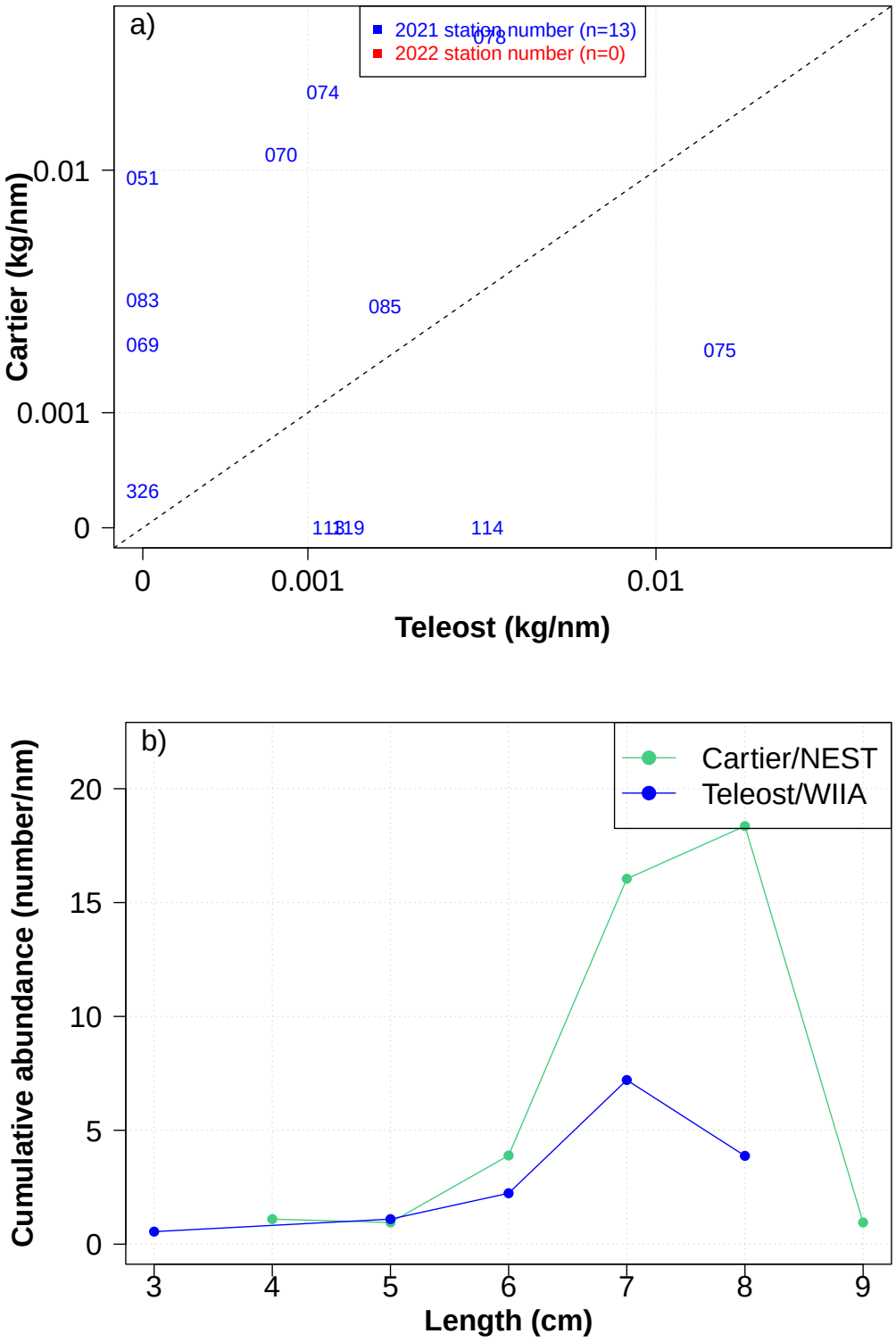

Figure 221. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Arctic alligatorfish (species code 341, *Aspidophoroides olrikii*).

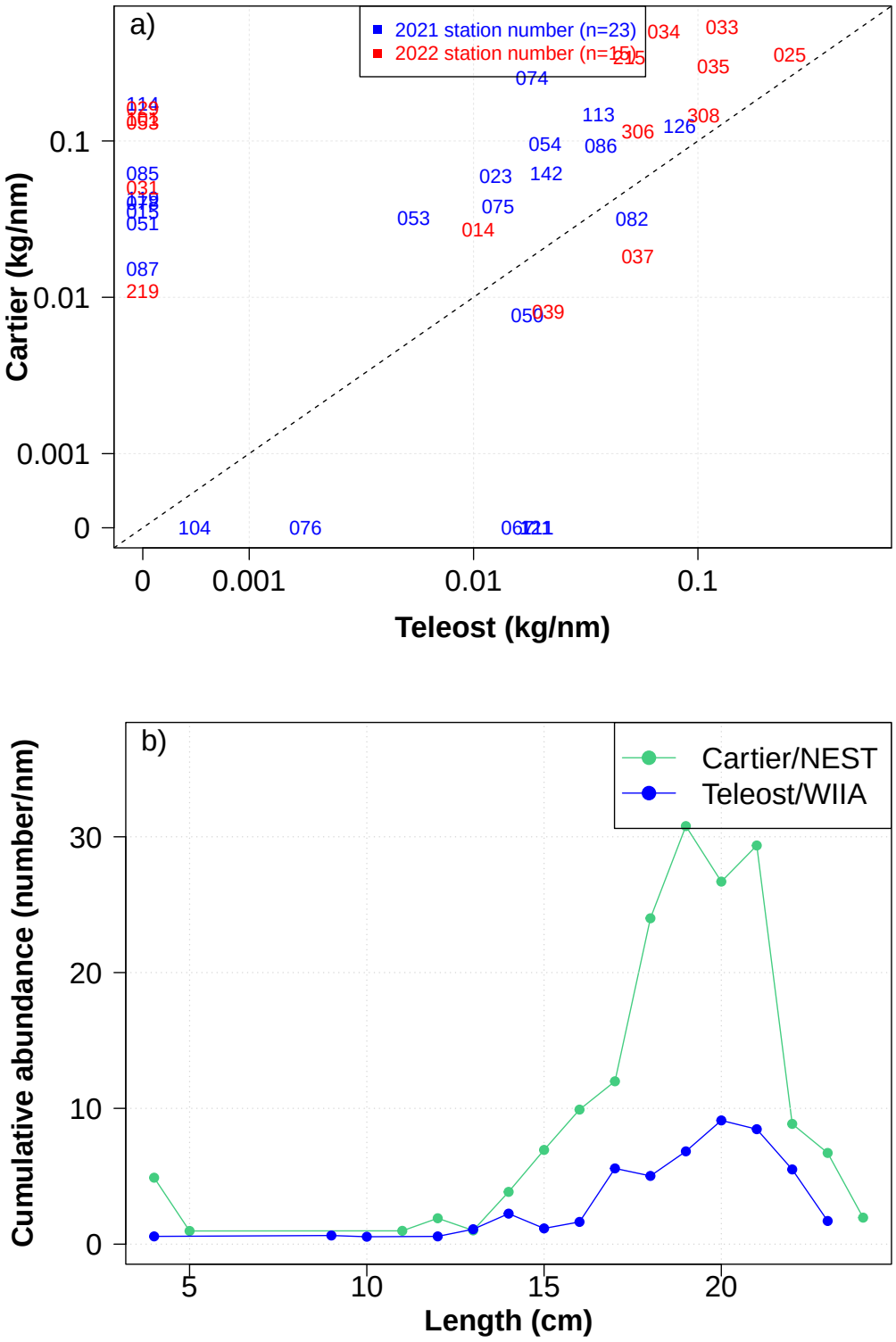

Figure 222. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Atlantic poacher (species code 350, *Leptagonus decagonus*).

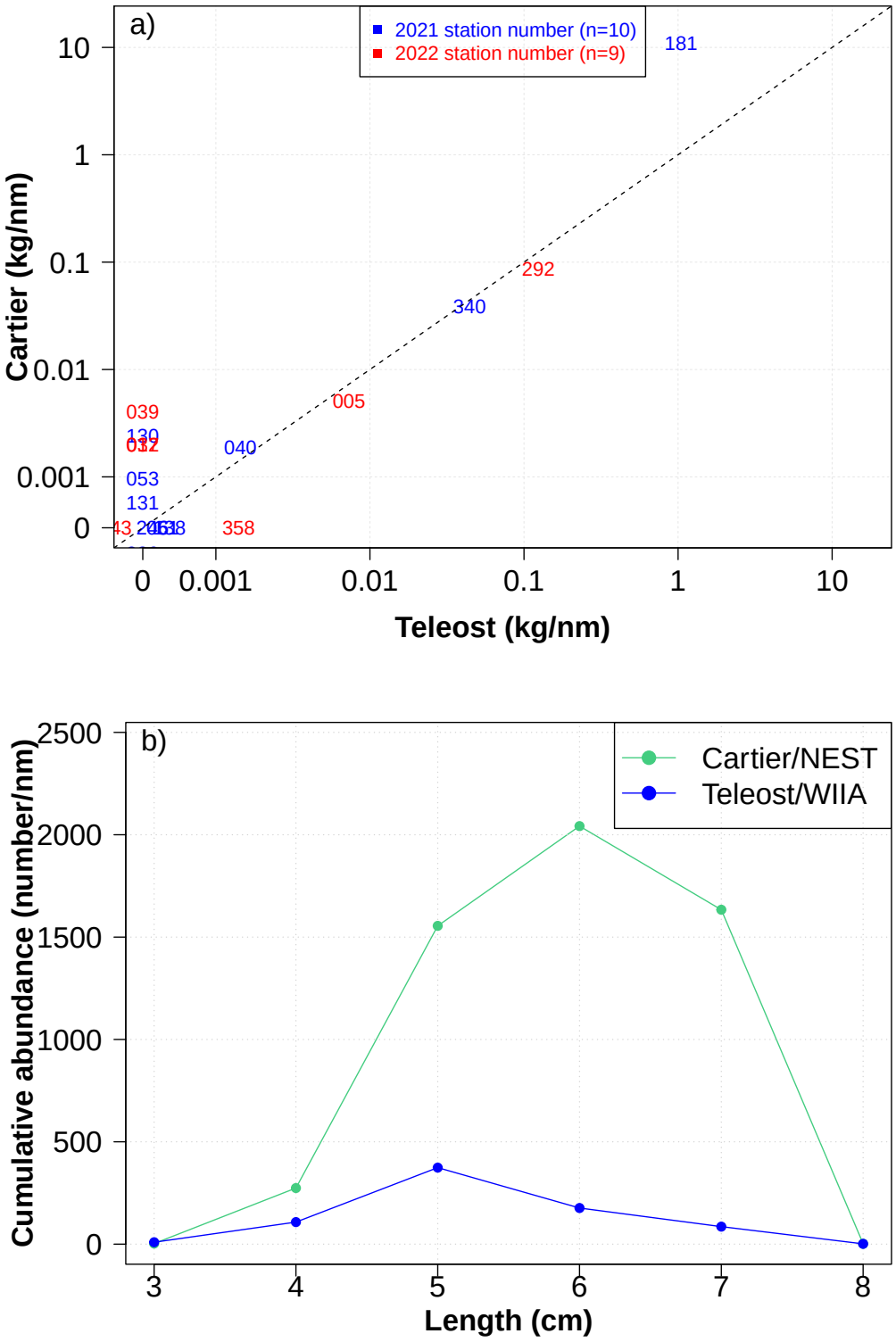

Figure 223. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Three-spined stickleback (species code 361, *Gasterosteus aculeatus*).

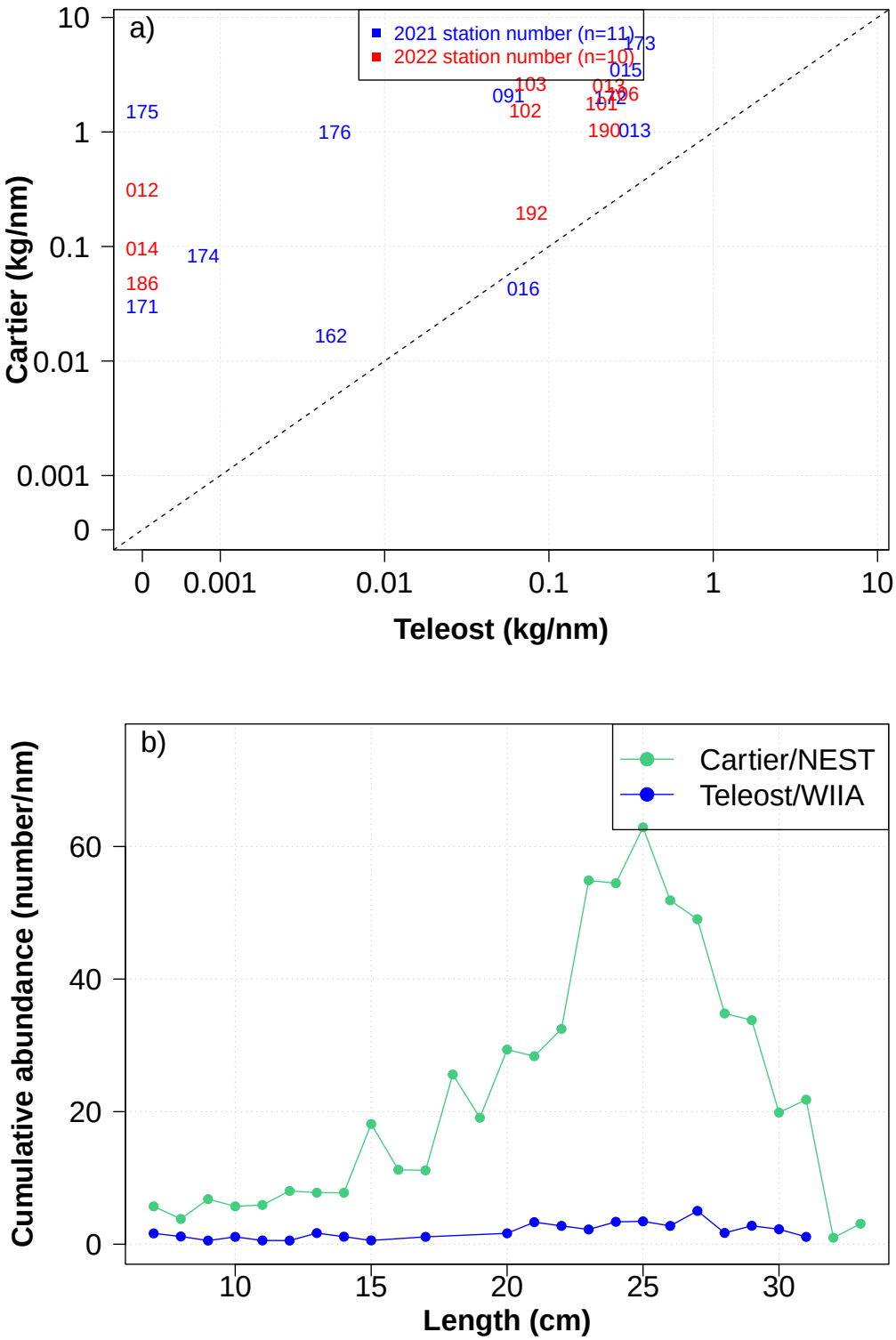

Figure 224. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Marlin-spike grenadier (species code 410, *Nezumia bairdii*).

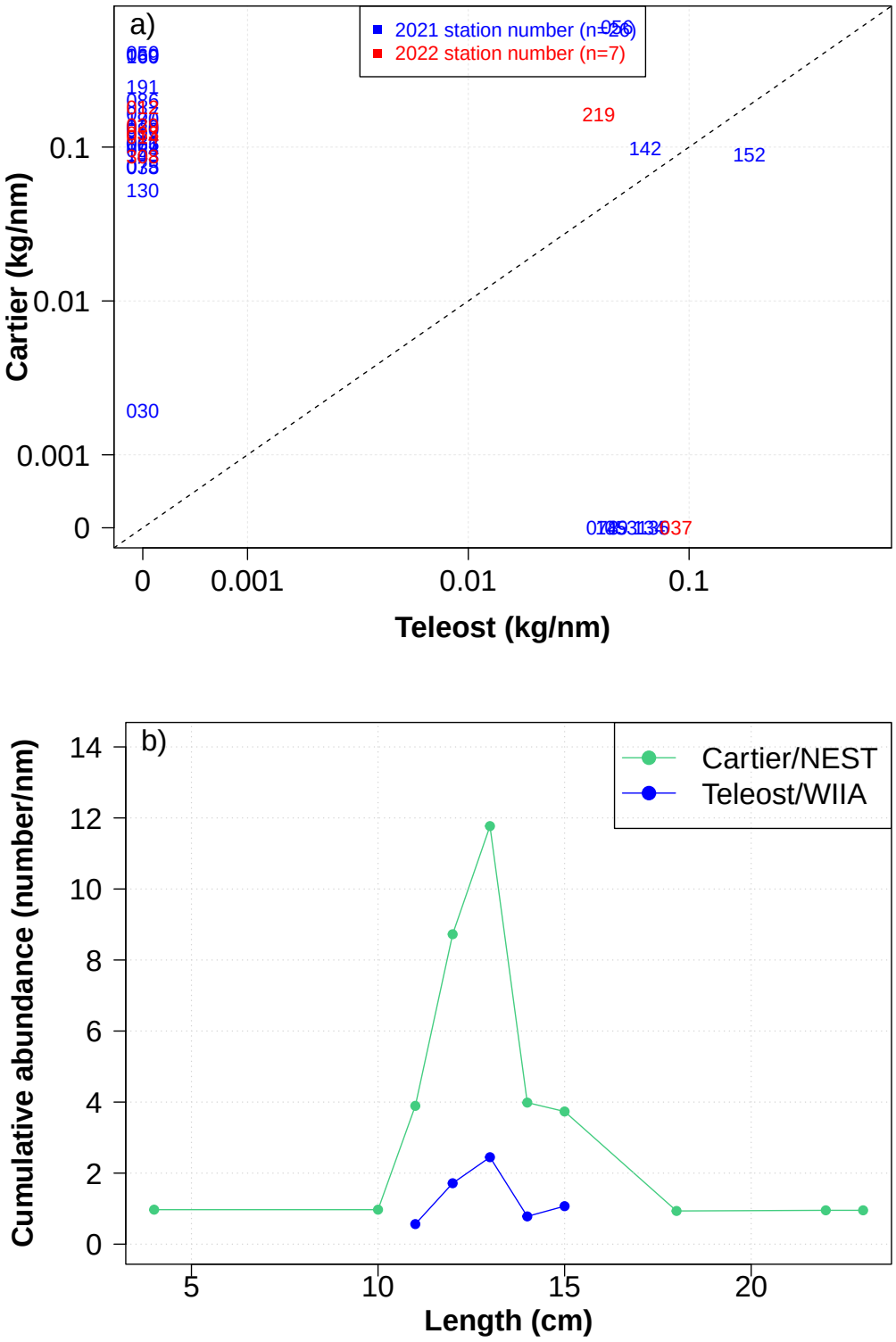

Figure 225. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Lumpfish (species code 501, *Cyclopterus lumpus*).

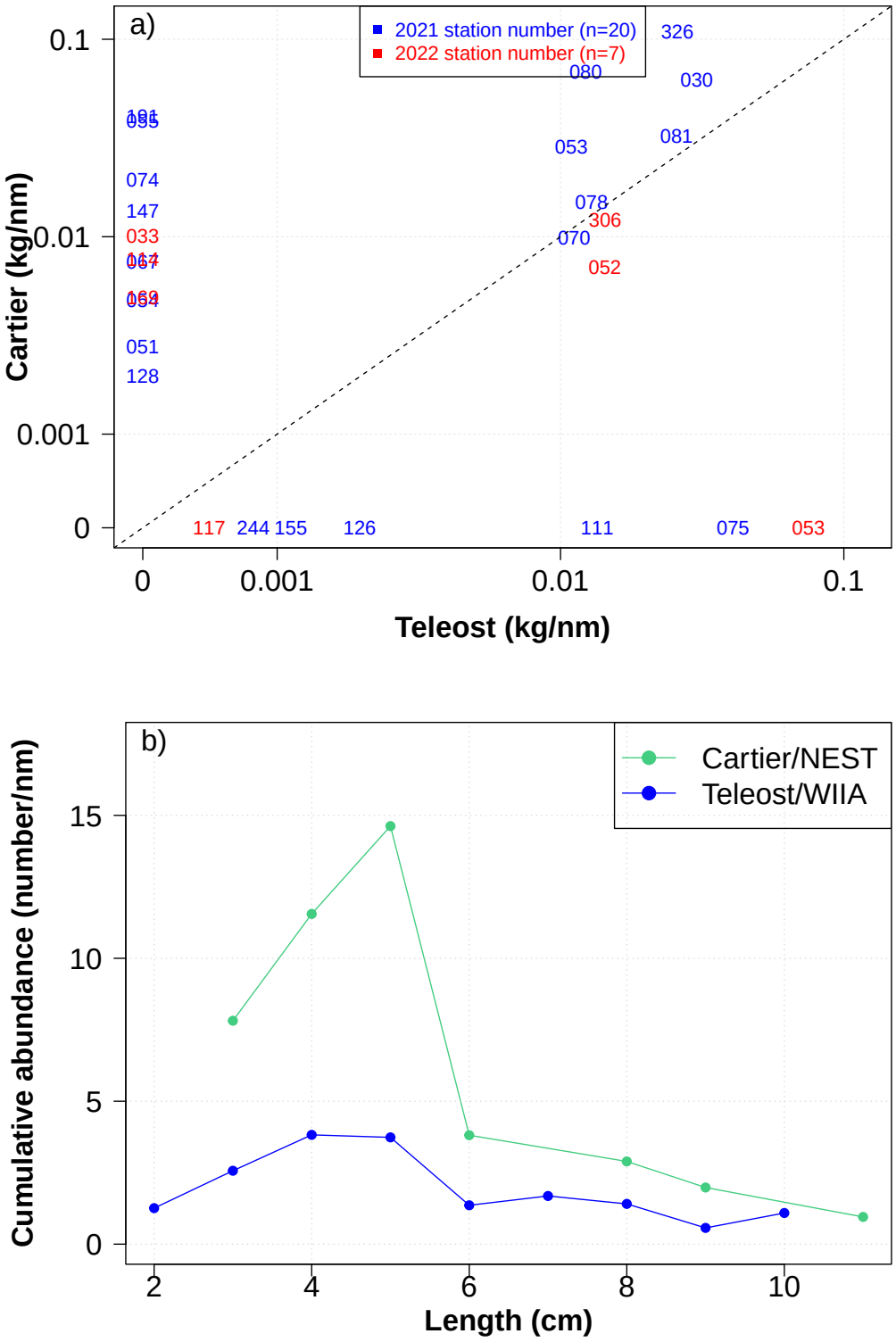

Figure 226. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Atlantic spiny lumpsucker (species code 502, *Eumicrotremus spinosus*).

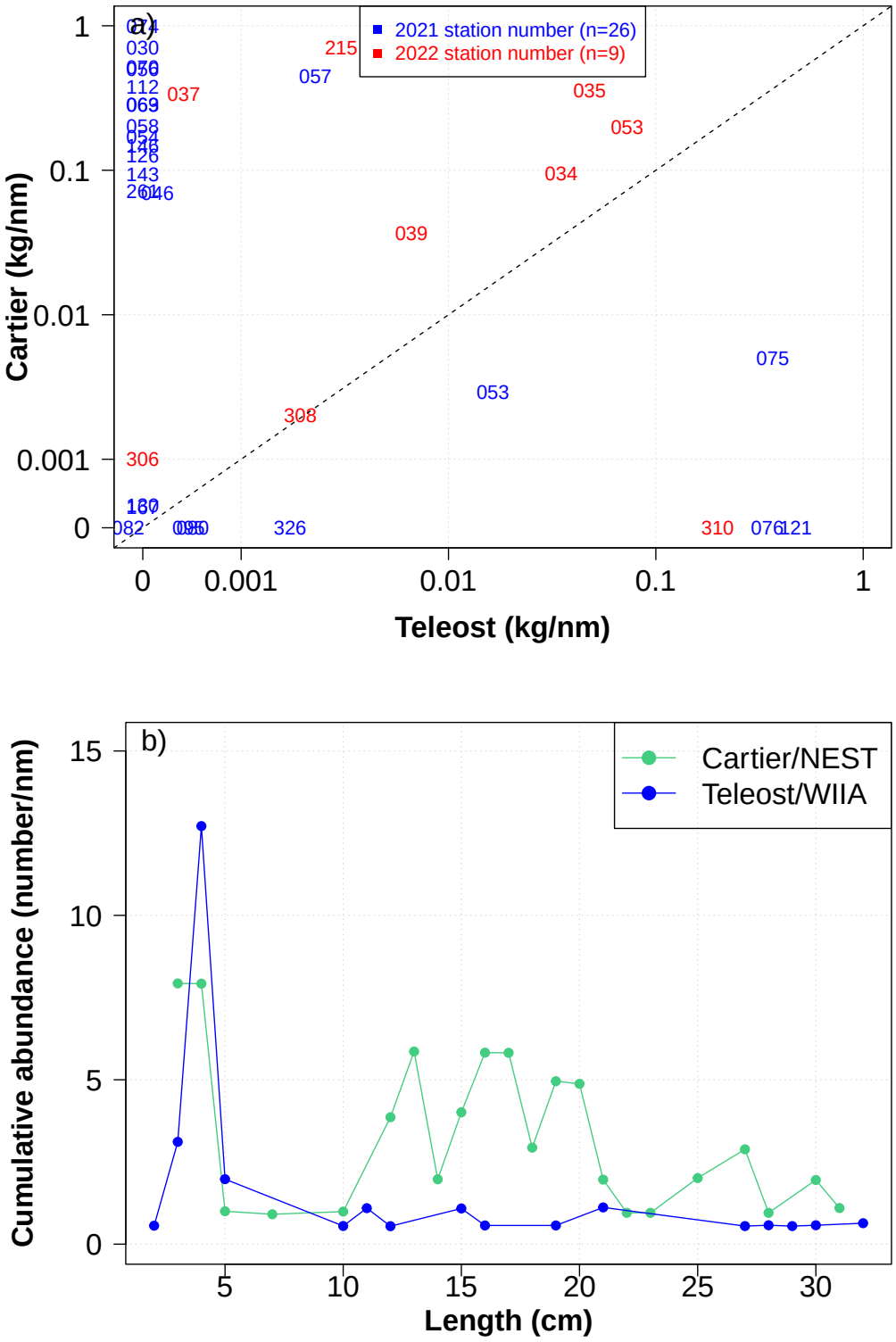

Figure 227. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Dusky snailfish (species code 512, *Liparis gibbus*).

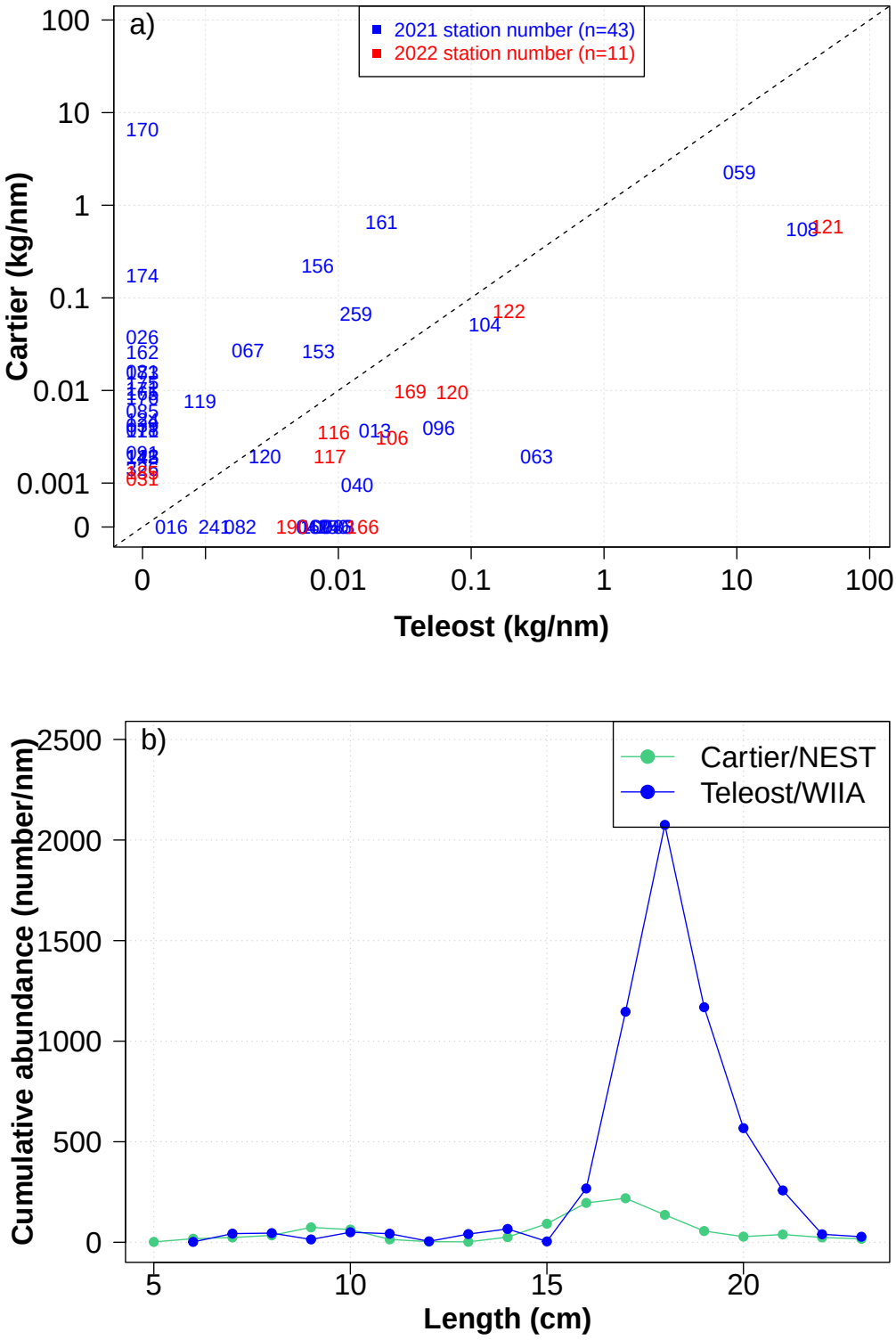

Figure 228. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Northern sand lance (species code 610, *Ammodytes dubius*).

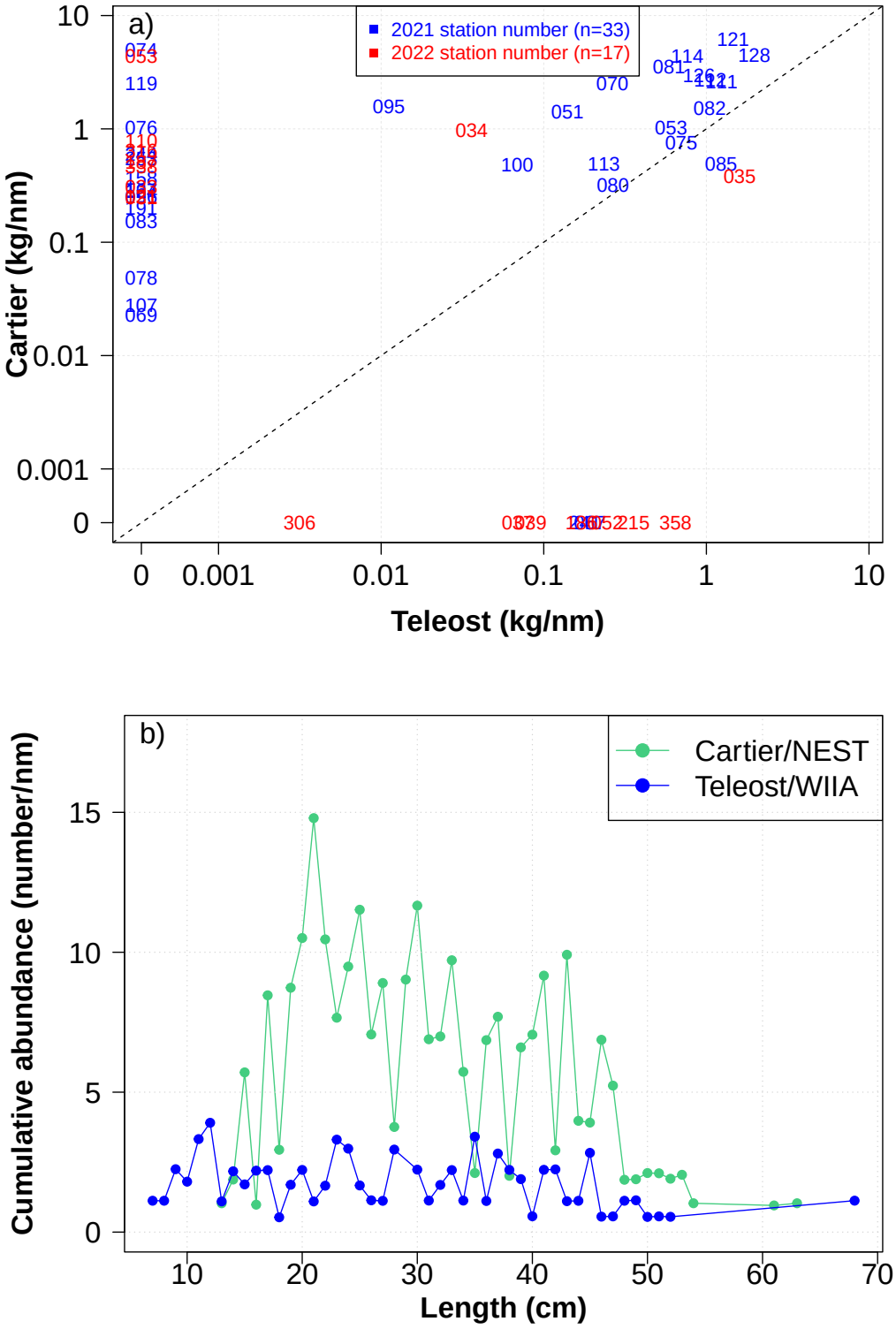

Figure 229. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Laval's eelpout (species code 620, *Lycodes lavalaei*).

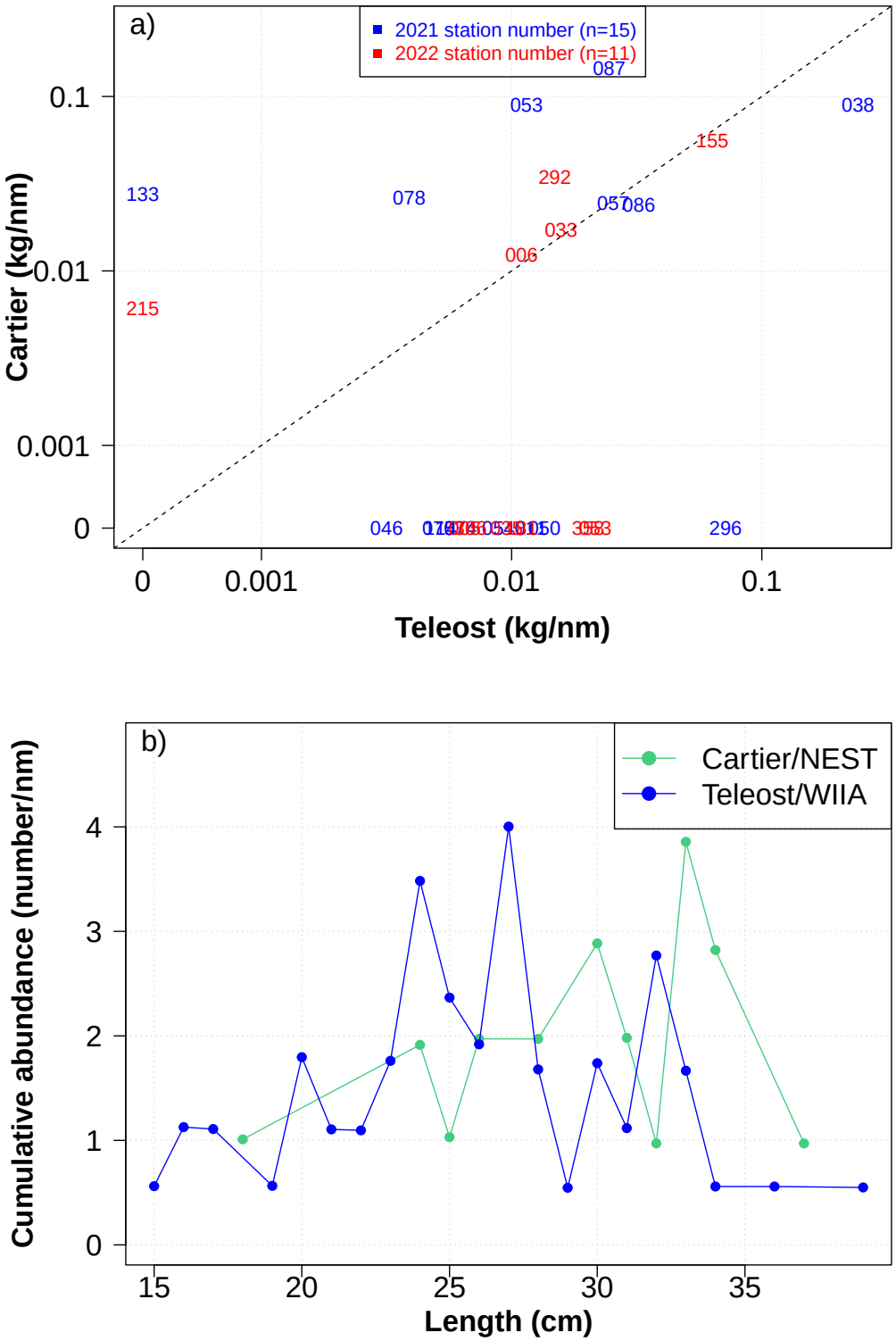

Figure 230. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Snakeblenny (species code 622, *Lumpenus lampretaeformis*).

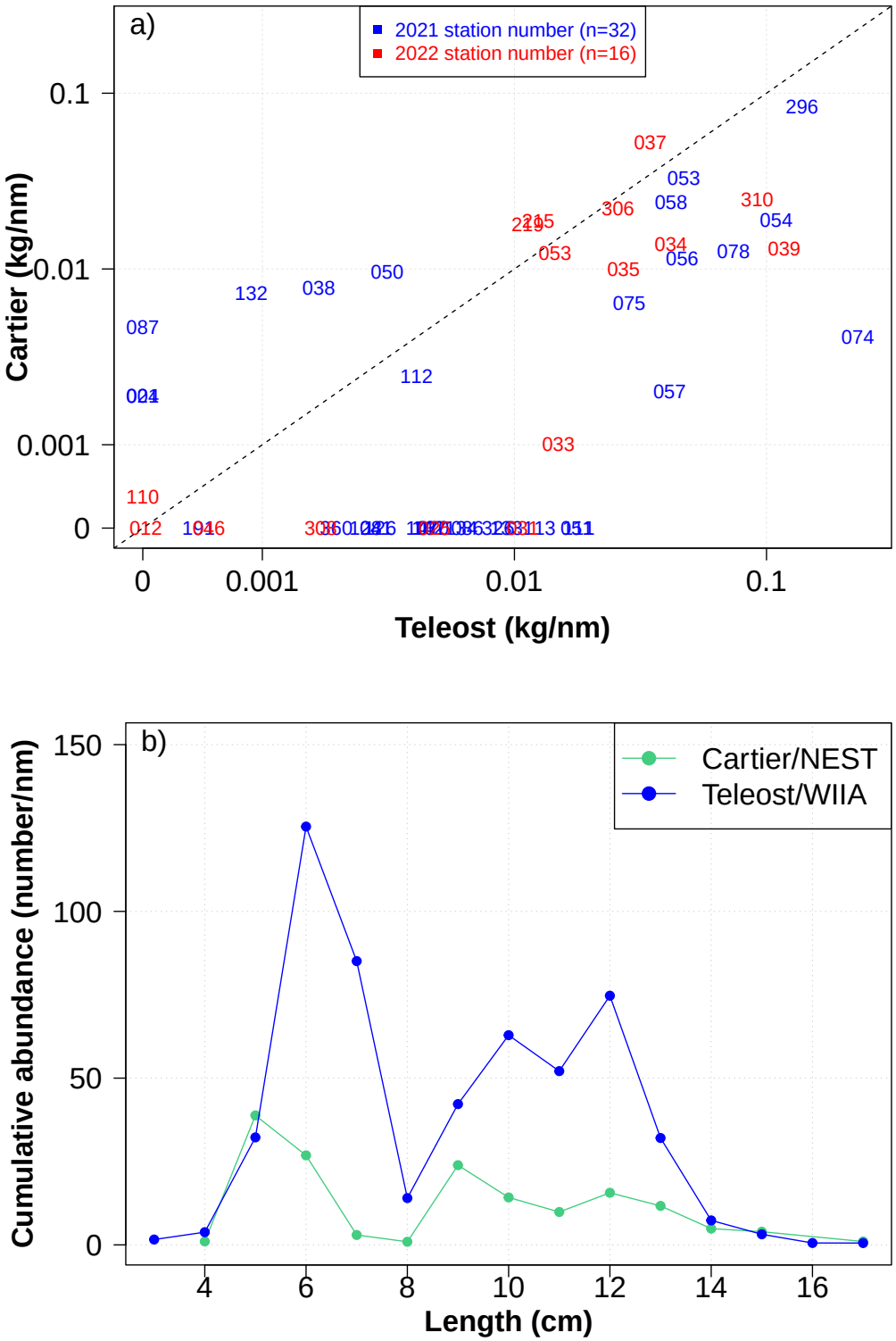

Figure 231. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Daubed shanny (species code 623, *Leptoclinus maculatus*).

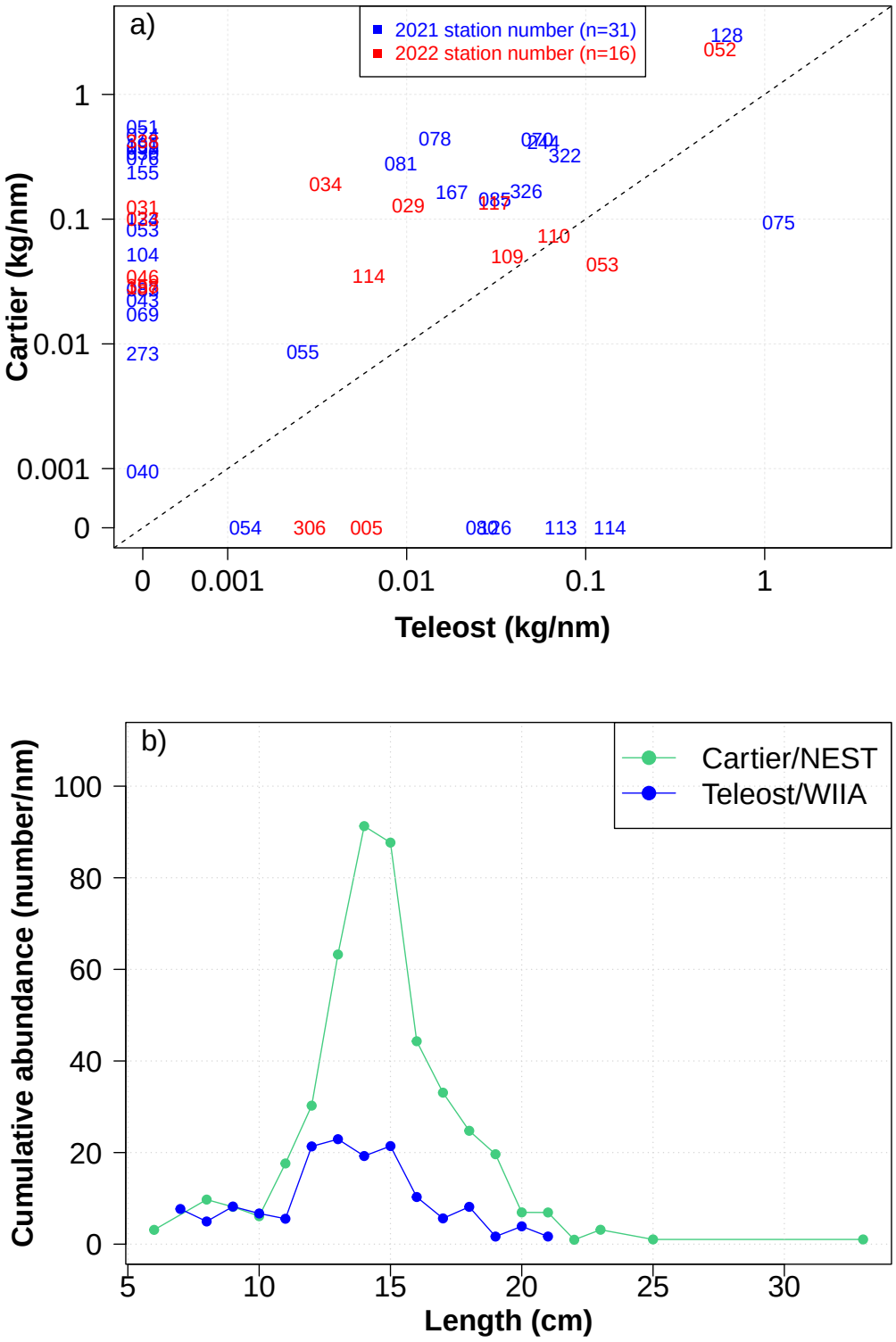

Figure 232. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Fourline snakeblenny (species code 626, *Eumesogrammus praecisus*).

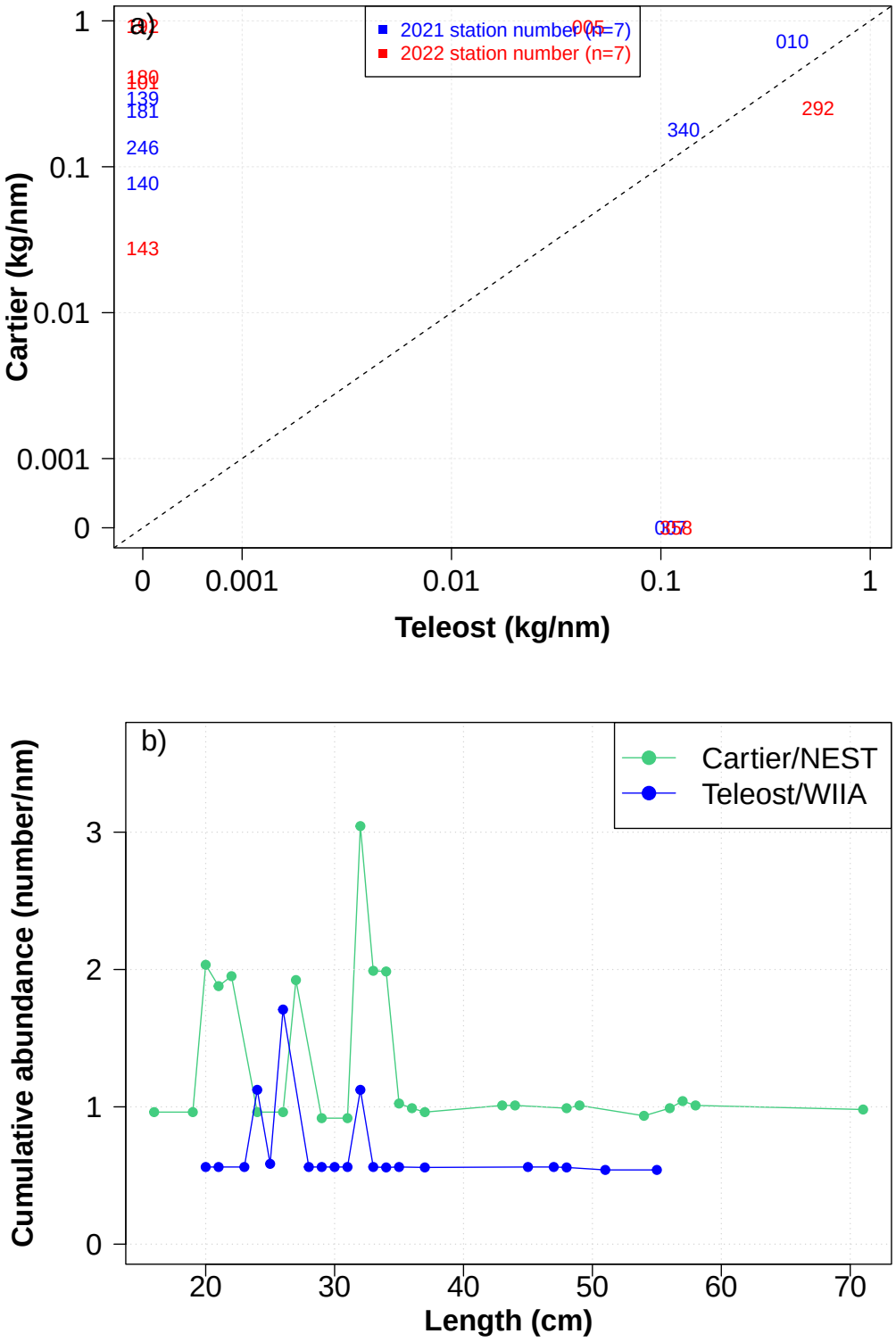

Figure 233. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Wrymouth (species code 630, *Cryptacanthodes maculatus*).

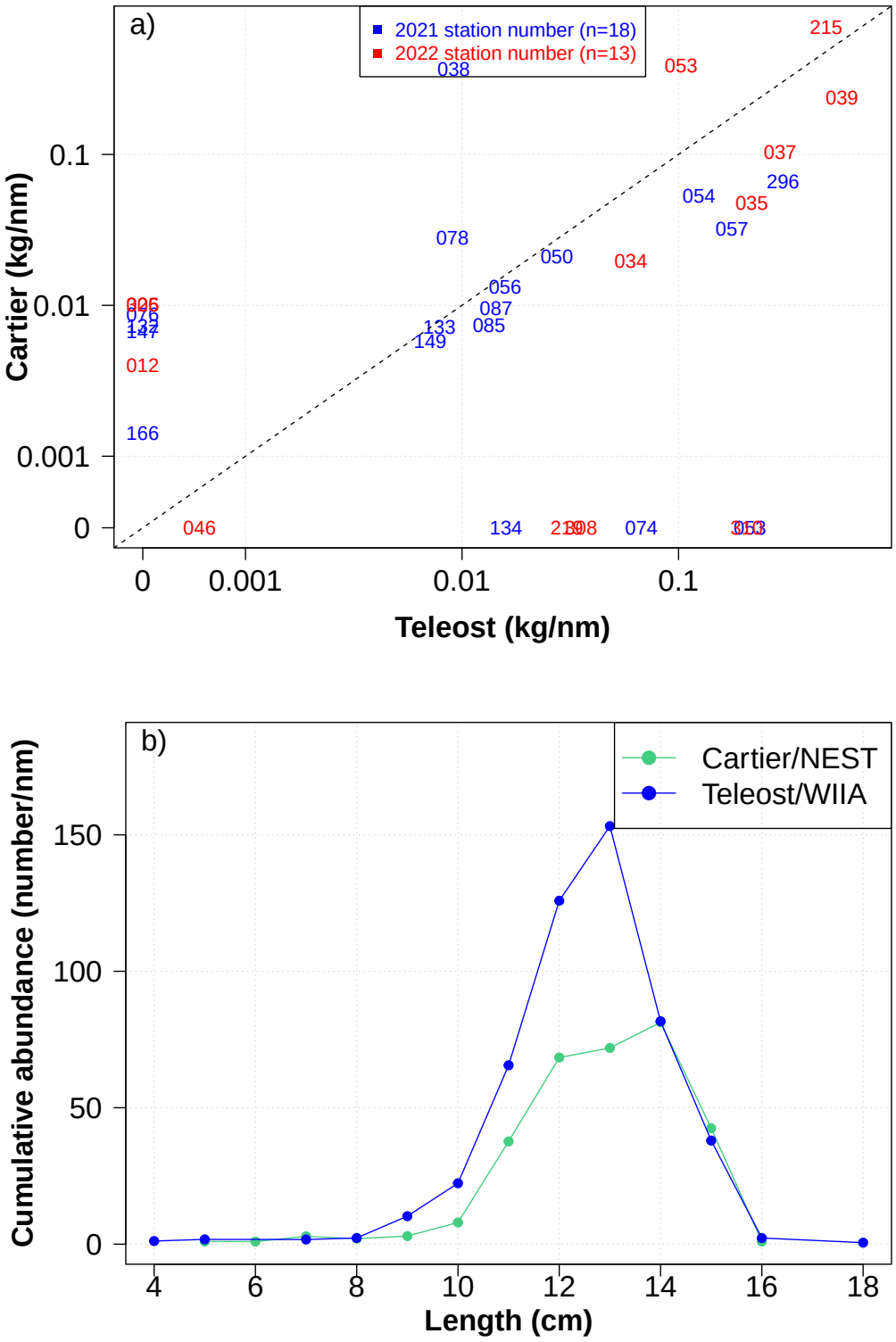

Figure 234. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Stout eelblenny (species code 632, *Anisarchus medius*).

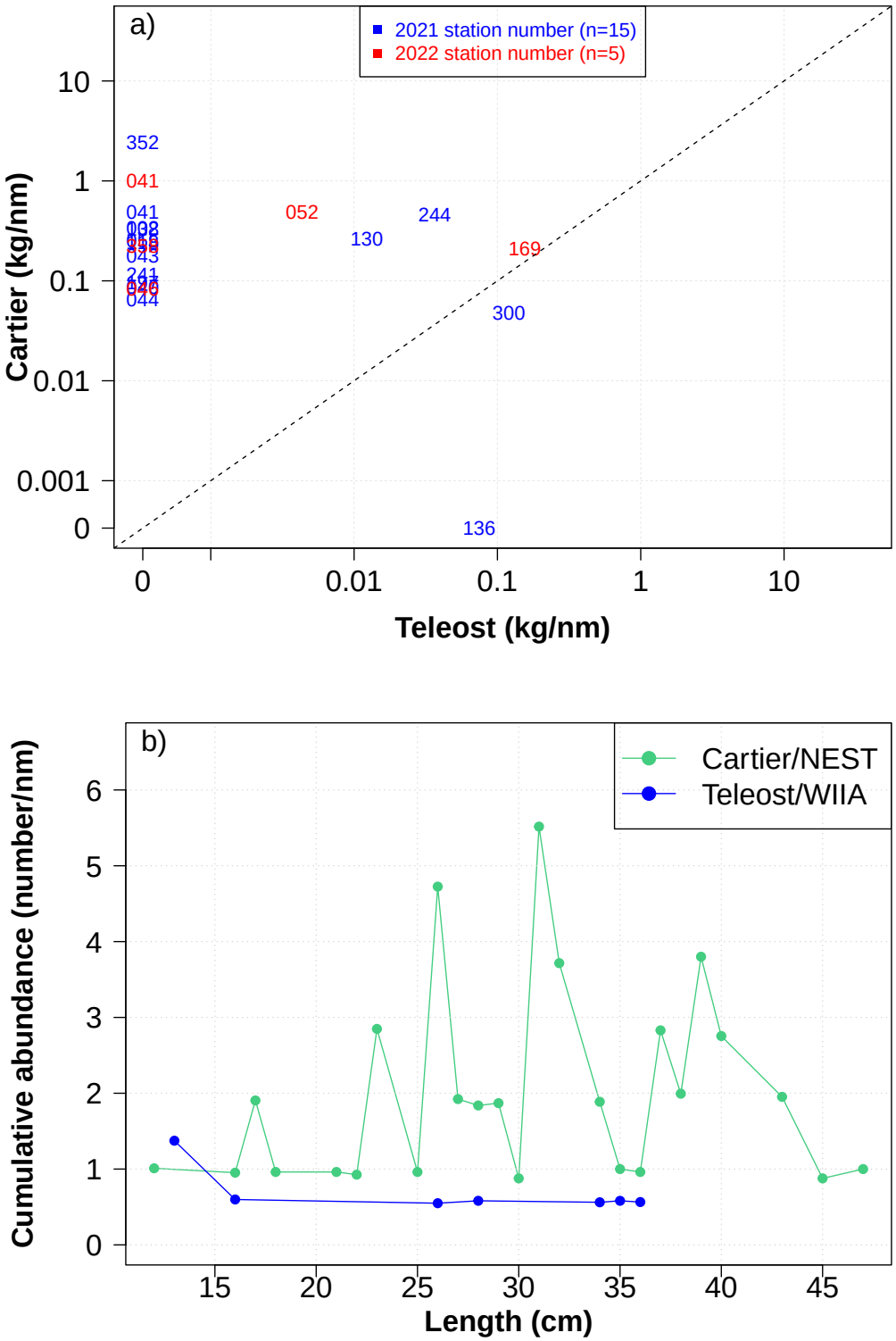

Figure 235. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Ocean pout (species code 640, *Zoarces americanus*).

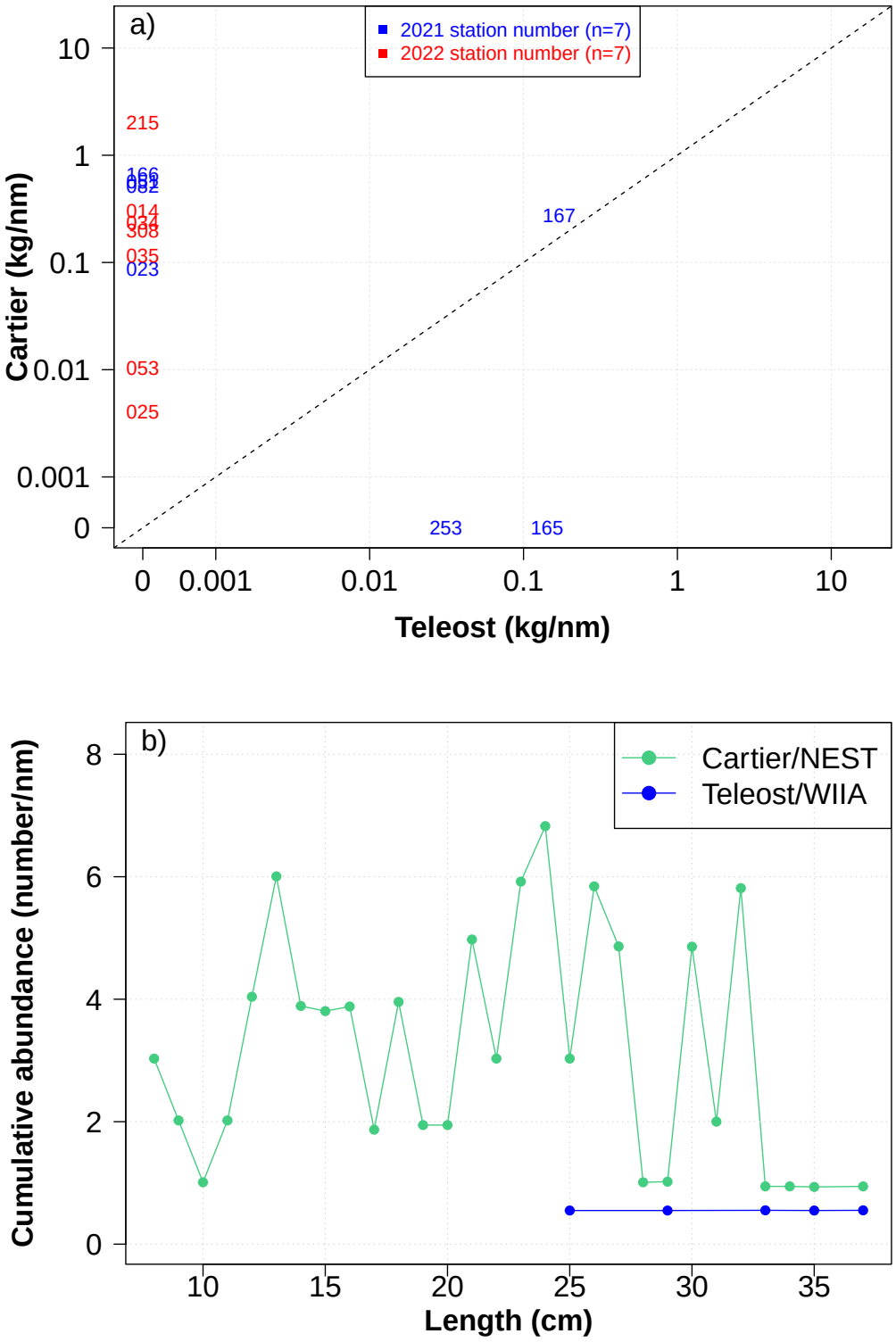

Figure 236. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Vahl's eelpout (species code 647, *Lycodes vahlii*).

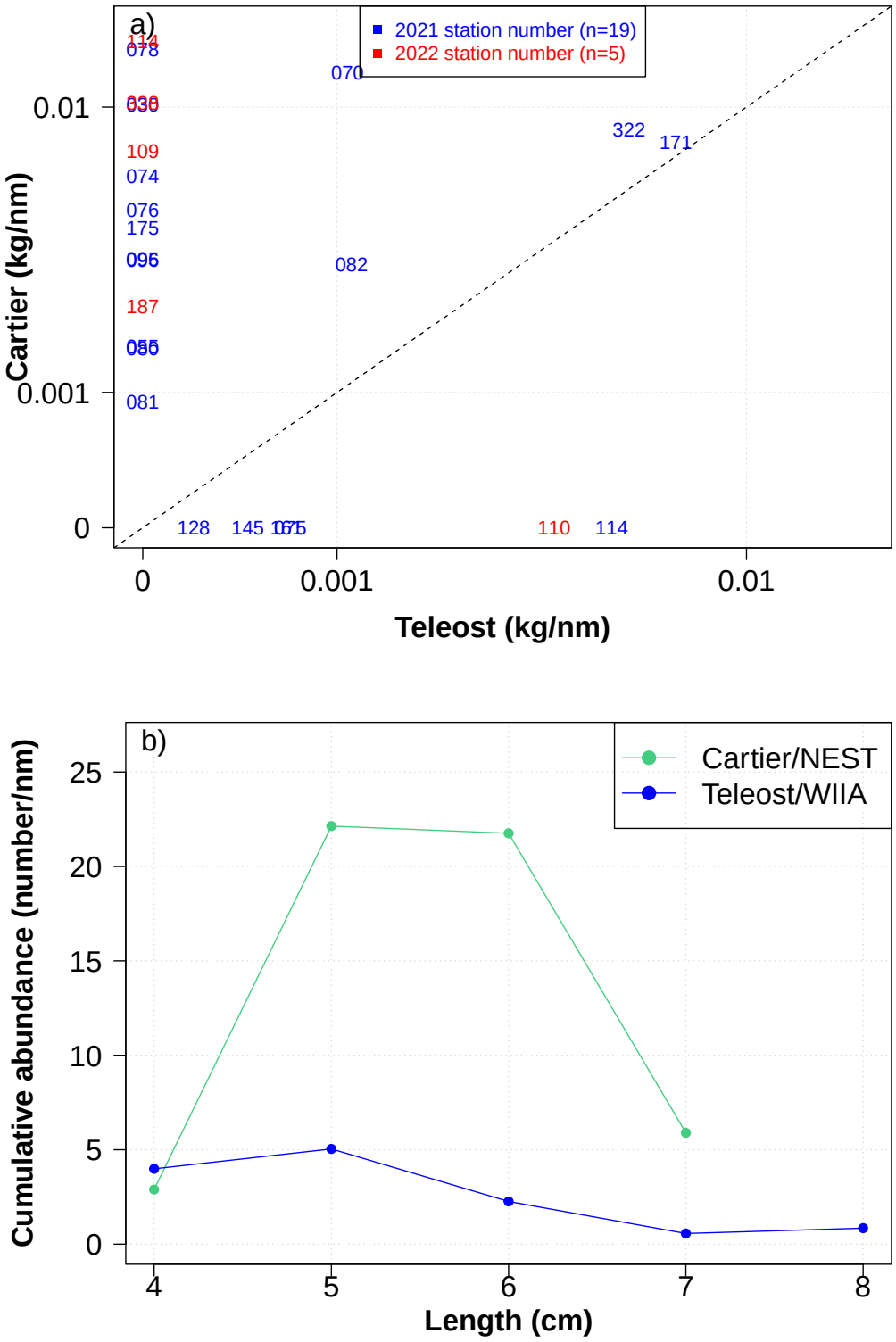

Figure 237. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Atlantic hookear sculpin (species code 880, *Artediellus atlanticus*).

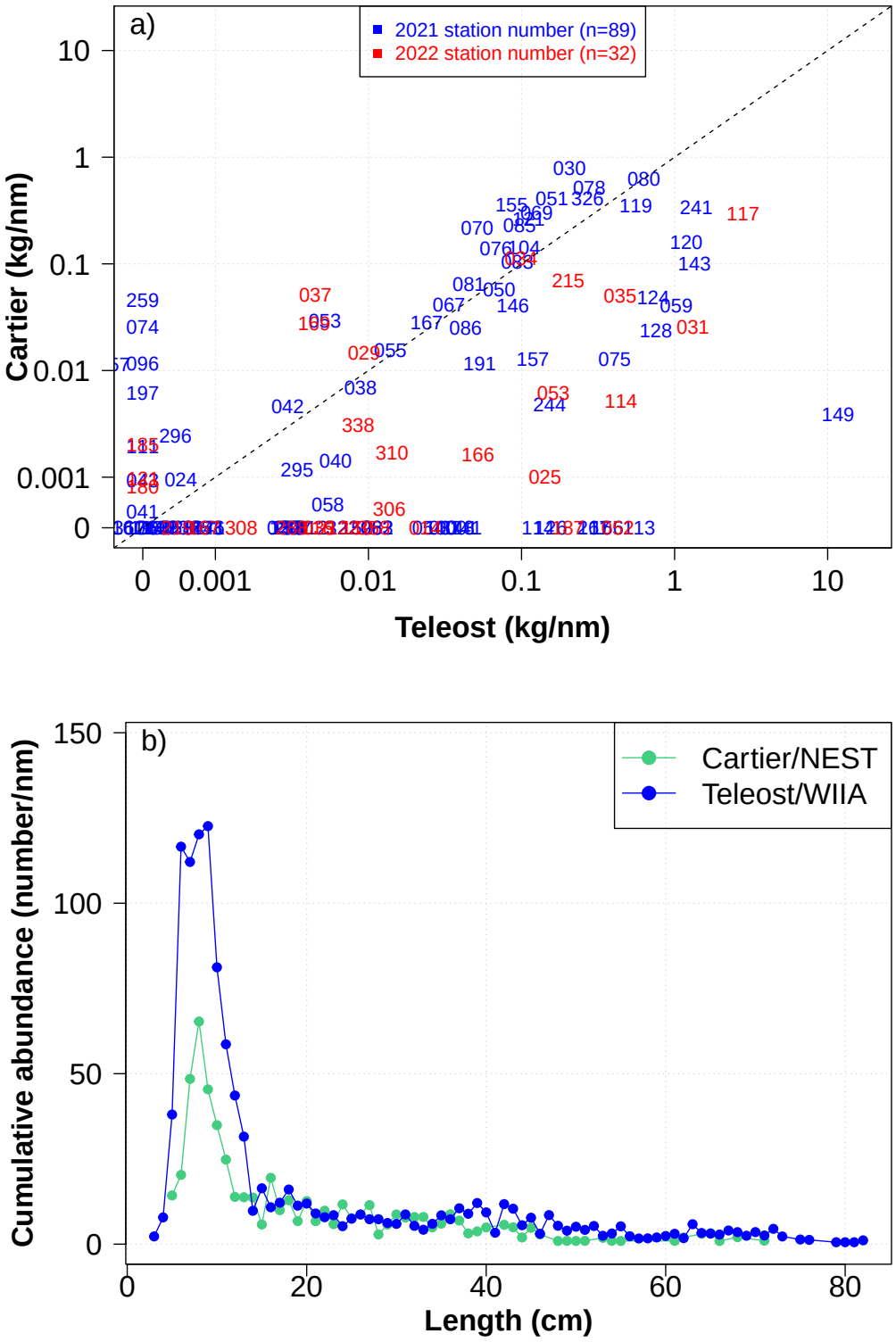

Figure 238. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Arctic Lyre Crab/Lesser toad crab (species code 2521, *Hyas coarctatus*).

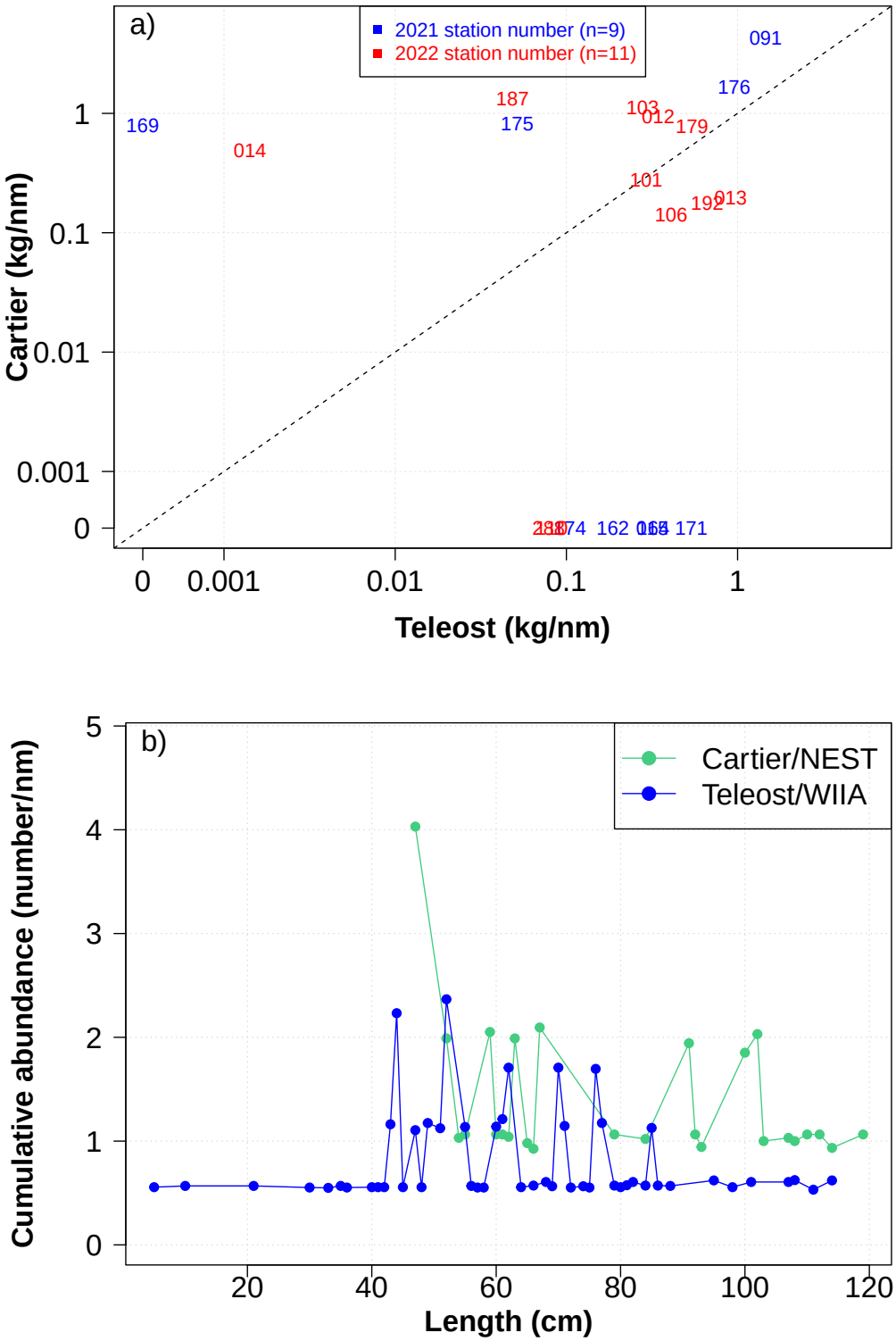

Figure 239. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Northern stone crab (species code 2523, *Lithodes maja*).

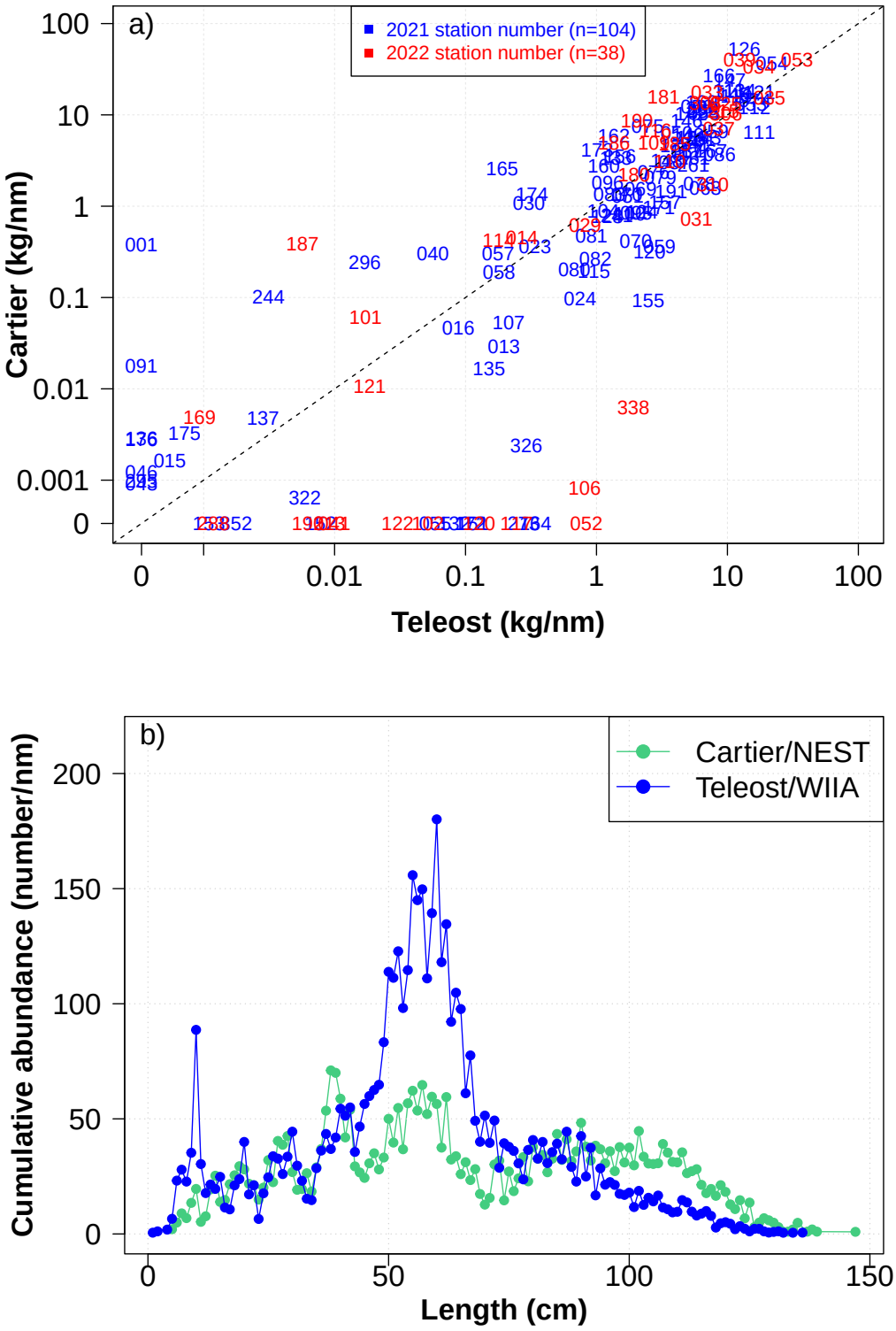

Figure 240. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Snow crab (species code 2526, *Chionoecetes opilio*).

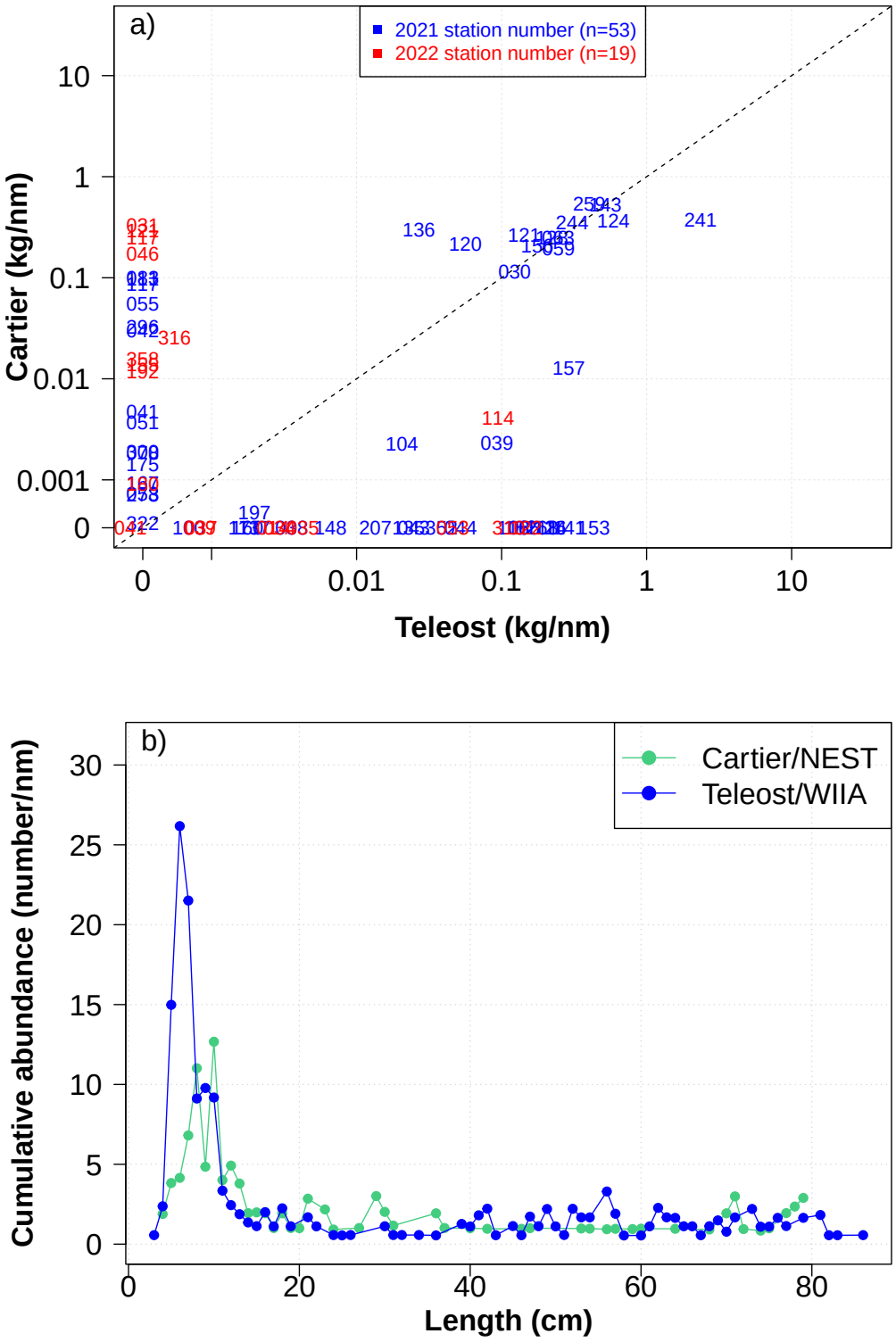

Figure 241. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for Atlantic lyre crab/Greater toad crab (species code 2527, *Hyas araneus*).

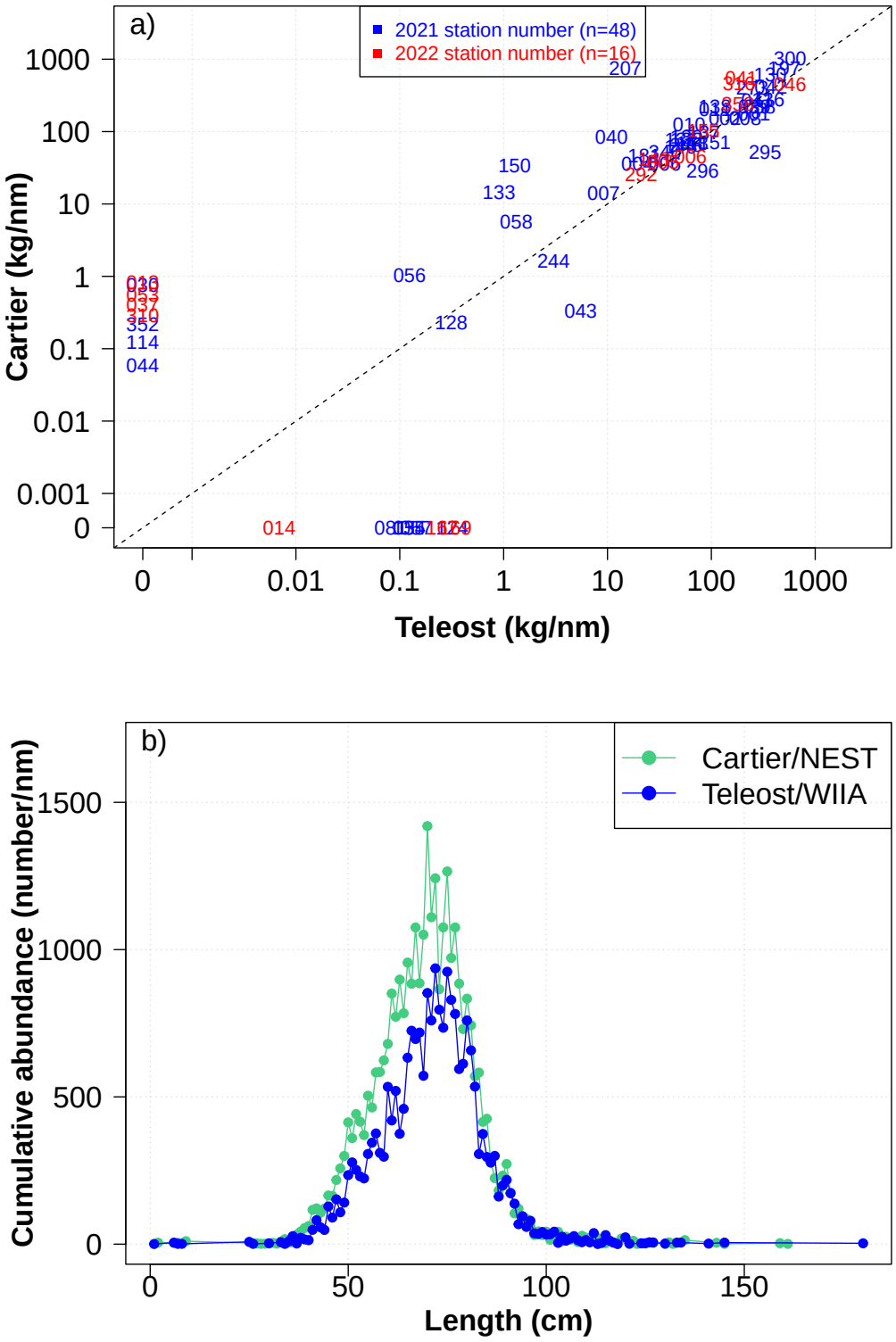

Figure 242. Biplot of Cartier catch versus Teleost catch (upper panel a), and cumulative length frequency distributions (lower panel b) for American lobster (species code 2550, *Homarus americanus*).