



Sea Watch International, Ltd.

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November 29, 2022

VIA ELECTRONIC MAIL

Chris Moore, Executive Director
Mid-Atlantic Fishery Management Council
800 North State Street, Suite 201
Dover, DE 19901

Re: SCOQ Species Separation

Dear Mr. Moore:

On behalf of Sea Watch International, Ltd. I am submitting the following comments regarding the pending FMP amendment addressing the harvesting of mixed clam species. Sea Watch is the largest processor of federal surfclam and ocean quahog shellstock in the US, and its operations would be affected directly, in a negative fashion, by the pending regulatory alternatives that we believe need further investigation and refinement.

The incidental harvesting of quahogs on surfclam trips, or of surfs on quahog trips, does not in any manner threaten the long term sustainability of either resource. The F for both species is so low per NEFSC (1.5% for surfs; less than 1% for quahogs) that mixed harvests do not and will not affect peer reviewed long term stock projections.

The incidental harvesting of quahogs on surfclam trips, or of surfs on quahog trips, does not pose any risk that the quotas for either species will be exceeded. Overall harvesting levels remain at less than 50% of both quotas, and there is no reason to suspect this will change appreciably in the foreseeable future.¹

If it is nevertheless deemed necessary to “account” for the full extent of respective harvests, this can be done responsibly through reasonable estimates, just as reasonable estimates

¹ Moreover, to the extent “uncounted” surfclams are harvested on quahog trips, these effectively offset the “over counted” surfclams on surfclam trips, where a small portion of those “surfclam” harvests actually are mixed in quahogs. The reverse is true with accounting for the overall harvests of quahogs.

this can be done responsibly through reasonable estimates, just as reasonable estimates are employed in our peer reviewed stock assessments and projections. For example, stock assessors cannot actually “count” every clam that is lost each year to natural mortality, so an accepted estimate is employed. Stock assessors cannot count every clam that is lost to discard mortality, so again a standard estimate is employed. These estimates, and others, have never prevented peer reviewed approval of our stock assessments and projections.

Similarly, a simple approach to “accounting for” mixed harvests would be to rely upon a reasonable estimate of the volume of “miscounted” clams of each species resulting from mixed harvesting. There are multiple ways to do this; here are just two:

1. Employ the reported bycatch calculations of independent observers from federal observed trips at sea. The most recent independent bycatch findings are reported at pages 26-30 of the hearing document. Federal observers have found that about 1.5% of the harvest on surfclam trips actually are quahogs, and under 1% of harvests of quahogs actually are surfclams. To be conservative, and since mixing may have increased since those observed trips occurred, double or even triple those percentages and estimate that 4% of surfclam harvests actually are quahogs, and 3% of quahog harvests actually are surfclams. The actual “counting” of the catch of each species then can include those calculations.

2. Establish estimates based upon empirical sampling at sea. This can be accomplished without the proposed burdensome procedure of sorting the entire catch. Instead, it could be required that the harvesting vessel stop the belt at reasonable intervals (perhaps once every four hours), take a picture, and count the respective surfs and quahogs that are present, yielding the respective percentages of the non-target clam species on the belt. With repetition, this will produce a reasonable estimate of the percentage of the non-target species, whether surfs or quahogs, being harvested on any given trip.

Other bases for reasonable estimates of bycatch, i.e., percentages of mixing, certainly come to mind but will not be addressed further here. The salient point is that the intrusive and undoubtedly crushingly expensive procedures for counting every clam, proposed in pending Alternatives 2 and 3 under the proposed amendment, are entirely unnecessary.

The draft amendment, and its supporting narrative, should not have gone out to public hearing. The purported explanations of proposed alternatives, particularly Alternatives 2 and 3, apparently have been cobbled together from FMAT discussions, but without any supporting factual evidence/information, and without any actual investigations of the practicality of those alternatives having occurred. The result is simply unsupported speculation about how Alternatives 2 and 3 might be implemented, but without any basis for predicting what the actual impact and cost of either alternative might be. We are left to “fill in the blanks” in the analysis offered in the hearing document.

Despite this plain deficiency in the prematurely released hearing document, we can attempt

at least the following conclusions about each Alternative as proposed:

Alternative 1

Maintenance of the status quo is not acceptable, unless a moratorium on enforcement of the status quo is put into place. The status quo allows “zero tolerance” for the presence of one or more quahogs in a surfclam cage, or the presence of one or more surfclams in a quahog cage. Given the widespread abundance of both species now reposing together, it is not humanly possible to ensure that a quahog will not end up in a surfclam cage, or a surfclam in a quahog cage. And this is so even if either of the “species separation” procedures described in Alternatives 2 or 3 is put into place.

Given the clearly inconsequential magnitude of quahogs in surf cages, or surfs in quahog cages – as described above – there is no biological or environmental rationale for imposing punitive penalties for the mixing of species in a cage. And if it really is deemed necessary to account for such mixed harvests, there are entirely reasonable procedures available for estimating the abundance of non-target species harvested, as also described above.

Suspension of the status quo sanctions on mixed species in clam cages *will not* lead to increased harvesting of mixed cages of clams. This is primarily because no processor wants to receive, and all vigorously resist, the delivery of mixed harvests to their plants. Two processors deal only in surfclams; plainly, quahogs delivered to them in mixed cages are a nuisance and a waste. Similarly, another processor deals only in quahogs, and the delivery of mixed in surfs causes only operational headaches.

Even the processors who process both species do not want to receive mixed landings. It is expensive to pay surfclam shellstock prices for a cage that is comprised in part of much less valuable quahog shellstock. The two species cannot be processed together, and the waste of time separating out the unwanted species from any particular delivery imposes a cost for which there is no benefit.

Harvesters are well aware that mixed landings are undesirable for all processors, and do their best – sanctions or not – to avoid the most highly concentrated beds of mixed clam species. If this harvester behavior were to change, with the suspension of mixed landing prohibitions, processors would impose their own sanctions, just as they have done in the past when excessive percentages of undersized clams, or rocks instead of clams, were delivered to the plants. Specifically, the processor will “cut” market price payment for the load, knowing that too much of the load is waste. This process effectively disincentivized harvesters from targeting small clams (or rocks) and the same would be true, even if there were no government sanctions for the harvesting of mixed species.

In short, again, the magnitude of the “mixed species” landings is inconsequential and does not endanger the resource. And to the extent mixed landings were to increase following a suspension of sanctions, that would be controlled by the market – a far more effective and ever present guardrail. The market, more efficiently than regulation, will prohibit/ disincentivize mixed landings, even if sanctions are shut down.

Alternative 2

Alternative 2 proposes a procedure for the separation of mixed species harvests which would not work in the real world. Further, this alternative has not been investigated in any fashion in terms of its actual expense and cumbersome impact on fishing operations, and therefore is not possible to evaluate.

Under Alternative 2 “onboard sorting will be required to ensure tagged cages contain [only] the clam species on the tag.” Staff has explained that this procedure will impose “zero tolerance” for the presence of even one non-target species clam in a cage tagged for the target species. This is wholly unrealistic; no matter how diligently efforts are made to separate out *all* of the non-target species, some will inevitably sneak through – exposing the harvester to fines and penalties.

We know this because efforts at onboard sorting are occurring now, precisely because harvesters do not want and processors do not want to accept mixed cages including the non-target species, for the reasons explained above.

More critical, however, is that Alternative 2 simply assumes – with no investigation or data to support the assumptions – that in order to effectuate 100% onboard sorting “onboard operations may need to slow down ... to allow better sorting of the clam species prior to placement in cages.” This pronouncement is certainly true, but begs the question of “slow down” how much and for how long? There may be 100 cages (or more) of clams on a harvesting vessel, with 32 bushels to the cage (i.e., 3,200 bushels). The time required to hand sort the entirety of that catch – on pain of a permit sanction if a non-target clam is missed – certainly would mean that “onboard operations may need to slow down” and indeed may need to slow down so much that the cost of compliance would exceed the value of the trip. Exactly what that cost would be is entirely speculative, and speculation should not be the basis for acceptance of an amendment to the SCOQ FMP.

Indeed, the Alternative 2 narrative concedes that a requirement to hand sort 100% of the catch, with zero tolerance, “may result in increased operating costs for some trips.” Surely, this is correct, but the Council before adopting an alternative that admittedly would result in such increased costs should know with some certainty what those costs might be, and whether those costs would make harvesting financially unfeasible for survival.

Alternative 2 should not have been put out for public hearing until further investigation would allow it to be considered in terms of its financial impact on the harvesters and all of the industry, and until this financial impact could be reasonably ascertained without complete reliance upon nothing but speculation.

Alternative 3

Like Alternative 2, Alternative 3 is premised entirely upon unsupported speculation about its financial impact and operational practicality. Alternative 3 therefore should be removed from

consideration by the Council, at least until necessary investigation cures its speculative assumptions.

Alternative 3 proposes to allow mixed landings but only with a “port sampling program” to be administered at the dock. The draft admits this “would be a costly endeavor.” And indeed it would, as it would require the interception of an arriving vessel (at all hours) and the “dumping and refilling of all or some of the cages.” The “dumping” would be for the purpose of an accurate count of each species landed, for ITQ tracking.

Dumping and refilling “all or some of the cages” at the dock is a wholly unrealistic and impractical proposal. There may be 100 or more cages (3,200 bushels) on any given trip. Who is to do the “dumping” at the dock, and how? Where are the clams to be dumped? How are health standards to be observed while “dumped” clams sit on a dock likely for hours while meticulously “counted” by a field agent?

Who pays for the dock space for the “dumping” and counting? How will the clams then be reloaded into cages, which is necessary for transport into the processing facility? Who does the reloading and how will it be paid for?

The hearing draft purports to respond to these financial inquiries by stating that “this type of program” may cost “more than \$200,000.00 annually.” Where does this figure come from and how is it supported? Is it just a guess? How do we know that the actual figure will not be \$2,000,000.00? There is nothing in the record to justify this “\$200,000.00” cost estimate for this wholly impractical program, a cost that will be borne of course by industry in some fashion.

Alternative 3 should not be considered in its present form by the Council, with utterly no basis for establishing its costs/expense and its operational feasibility.

Alternative 4

Alternative 4 is premised upon development of new technology, apparently already in start up, that would electronically monitor mixed catches as they come aboard. This could be a positive solution, although we have no information on the economic impact of actually installing the technology on a vessel and keeping it operational as a trip progresses. That aside, the primary obstacle here is that it will still take several years for this technology to be operational, according to the hearing draft.

From our perspective it would be fine to continue to pursue this alternative – provided, importantly, that there is enforcement relief for mixed landings while development of this new technology is underway. Otherwise, the industry will continue to be subject to potentially punishing fines and/or permit sanctions for the next several years.


We have already explained above that there would be no effect on the resource or on the harvesting of the quota if the current sanctions for mixed landings were placed in moratorium. So

if the Council would be willing to recommend that penalties/permit sanctions be deferred while this proposed new technology is developed, there really is no reason why industry should be opposed to this Alternative 4. But this moratorium caveat is critical and Alternative 4 should not be adopted unless such a moratorium on enforcement of the prohibition on mixed landings is put into place.

We thank you in advance for consideration of these comments and concerns as this regulatory review moves forward.

Very truly yours,

SEA WATCH INTERNATIONAL, LTD.

By: 
Thomas T. Alspach, General Counsel

TTA/tsd

cc: Michael Pentony, Regional Administrator
Michael Luisi, Chair, MAFMC
Peter Hughes, Chair, MAFMC Surf Clam Committee
Jessica Coakley, MAFMC

Coakley, Jessica

Subject: FW: Mixed Clam Comments

From: David H. Wallace

Sent: Monday, November 28, 2022 2:34 PM

To: Coakley, Jessica <jcoakley@mafmc.org>; Montanez, Jose <jmontanez@mafmc.org>

Subject: Mixed Clam Comments

| Surfclam and Ocean Quahogs Mixed Species Amendment Comments

November 26 2022

Mid Atlantic Fishery Management Council
Dover Delaware

Re, Comments on Mixed Clam Amendment

It is suggested that this amendment be sent back to the clam committee, the clam advisors and NMFS to find a workable solution that protects the clam stocks, and allows industry the ability to stay in business by having an allowance of the non targeted species on the vessel and in mixed cages. The world has changes in the last 32 years and the SCOQ FMP must also change.

Short History,

When the SCOQ FMP went into effect in 1977 the mixing of surfclams and ocean quahog had never been seen and they were separated by surfclams found from the beach to about 100 feet and ocean quahogs in the Mid Atlantic were found starting at 120 feet. Since in most areas the difference between 100 and 120 feet is divided by miles where there was little to no overlap of the two species. Because of the separation there was no known problem of catch ocean quahogs on a surfclam trip and no chance of catching surfclam on an ocean quahog trip.

When amendment 8 was implemented and surfclam and ocean quahogs tags were, and still are different colors for enforcement reasons. This rule was included to prevent vessel operators from catch surfclams, and placing ocean quahogs tags on the surfclam cages. Quahog quotas were higher than demand so those tags were plentiful . The enforcement officers consider placing the wrong tags on the other species a very real possible problem. Therefore, they required a rule that allowed only clams of the same species on a declared surfclam or ocean quahog trip. The rules not to allow even one clam of the other species on a vessel's selected trip was designed to stop possible cheating by landing surfclams with quahog tags. At the time no one in the clam industry or the council objected to the rule because it most vessel and processors were in favor of good enforcement.

Industry understood the rule and no one was opposed. About 20 years ago the industry noticed that the near shore of surfclams started disappearing. There were a few industry members who though there was wide spread cheating, but if that were the case the surfclam shucking plants would be working much harder than than they were. No one wanted to admit that the clams were dying in New Jersey and New York inshore surfclam stocks.

The vessel operators were also noticing that the normal federal surfclam grounds were not productive as they had been in the past. A few years later the ocean quahog vessels started seeing small surfclams on their quahog grounds. At first that was not much of a problem because they were being separated from the quahogs with the deck gear that was used to take out the trash. However, a few years later the surfclams has grown to the size of quahogs and therefore were not being graded out.

About 6 years ago, the industry addressed the problem to the council. The NMFS already knew of the problem and were not doing anything about it. The industry's requested an amendment to fix the mixed clam situation. NMFS rejected the mix clam amendment because there were some in the government that thought some clam industry members may have excessive shares and that had to be addressed before any other clam amendment could move forward.

Therefore, the excessive share amendment when forward and the mix clams was not taken up by the MAFMC. However, at some point NMFS suggested that the mixed clam problem could be resolved with an administrative amendment which it appears to be this proposed amendment.

As time went on, the ocean in the Mid Atlantic bight got warmer, the more surfclams were setting on the quahog grounds and at that point the deck sorting gear was unable to separate the surfclams from the quahogs. Later, the surfclam far outnumbered the quahog population, and the fisheries switched. Now the clam crews cannot pick out the quahogs from the directed surfclam fishery. The warming of the ocean has created this situation and the SCOQ FMP never considered such a thing would happen. The current FMP is not designed to deal with this problem.

It is assumed that the current proposed amendment is the NMFS document because the clam committee and the advisors were not involved and only allowed to see the proposal amendment a few weeks ago.

In the past, the council staff, the SCOQ committee and the clam advisor worked out how amendments are developed so the fisheries are managed in such a way that the industry can comply with no problems. That was the case in the excessive share amendment. The industry worked out a solution and the council, the SCOQ committee, NMFS agreed and the amendment moved forward.

This amendment was not done in the same way, the industry was not involved. The proposed amendment was developed by the FMAT that for the most part have never seen a modern clam boat and have not been on a 48-hour clam trip in the winter. It is easy to justify a proposal if the group has little what it takes to operate a clam boat in the past the people who operate these vessels are consulted. But in this situation the industry was not involved, the alternatives either do not address the problems or are so premature or unclear as to not be possible. That is what the SCOQ AP and the clam committee are to do from the beginning, not at the last minute.

The proposed amendment with four alternatives is unworkable and if 1 through 3 are one that is implemented and enforced, most of the Mid Atlantic bight vessels will go out of business. The simple fact is that there is no way that any cage on the ship that has even one of the other species in a cage is a violation. This means that the entire load is in violation. Zero tolerance is unacceptable and not doable. The industry was not asked if this is possible, it is not and therefore, most of the industry strongly oppose alternatives 1 - 3. As for alternative 4, it would all depend on a number of unknowns and could not have a zero tolerance requirement. An ocean quahog vessel can have as many as 400 thousand quahogs on a single trip, and a zero tolerance for surfclam is unreasonable.

Conclusion

As pointed out, the non mixing of surfclams and ocean quahogs was implemented decades ago for good reason at the time. However, the world has changed though no fault of the industry, the council or the NMFS. But the concept of no mixing of the species is being reaffirmed without consideration of reality and with no input from the council or the industry. The problem is in the details, and the obvious problem has been overlooked, because it is a difficult problem for the agency. The fact is that implementing alternatives 2 and 3 as written will lead to an increase in cost that the vessel owners must demand from the processors which is behind their ability to increase their selling price. The processors do not want mixed clam in the cages that they buy. But zero tolerance is not the solution. There must be a tolerance in the regulation, which the NMFS obviously does not like. The observers report on bycatch for surfclams and ocean quahogs which is in the amendment says that the mixing is low and just a few percent.

In all of the plants, the non targeted species is removed because the customer will not tolerate the other species in their product because the two clams are much different in taste, color and texture. NMFS folks are concerned with reporting of the catch, on a surfclam trip, for the most part, is over reported the catch by a few percent and the same goes for some ocean quahog trips. But the percentages are very small and can be accounted for and will have no effect on either species quota or biomass, since both species are fished below 50 percent of the TAC.

Therefore, it is suggested that this amendment be sent back to the clam committee, the advisors and NMFS to find a workable solution that protects the clam stocks, and allows the clam industry ability to stay in business by having non targeted species on the vessel and in mixed cages.

Thank you for considering my comments.

David H. Wallace

A surfclam and ocean quahog advisor .



Sea Watch International, Ltd.

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November 29, 2022

Dr. Christopher Moore, Executive Director
Mid-Atlantic Fishery Management Council
800 North State Street, Suite 201,
Dover, Delaware 19901

Dear Dr. Moore,

Please accept these comments on behalf of myself and Sea Watch International, Ltd. regarding the proposed Atlantic Surfclam and Ocean Quahog (SCOQ) Species Separation Requirements Amendment.

Even if the proposed amendment contained an ideal amendment with unanimous support of all stakeholders, legal counsel to Sea Watch has indicated Amendment alone may not fully address the overall regulatory issue of mixed landings¹. We have located two separate references that each contain multiple citations toward a prohibition of mixed landings:

- 50 CFR Part 652, provided in Federal Register / Vol. 58, No. 50 / Wednesday, March 17, 1993 / Rules and Regulations p. 14340 contains the following language:
 - *“(3) make it illegal to fish for, retain, or land surf clams and ocean quahogs on the same trip;*
 - *“(4) make it illegal to fish for, retain, or land surfclams on a trip designated by a vessel operator as being an ocean quahog fishing trip or ocean quahogs on a designated surf clam fishing trip;”*
 - *“Existing § 652.9(a) allows the Regional Director, by publication of a notice in the Federal Register, to specify notification requirements that vessel owners or operators would have to comply with prior to departure from port or return from a fishing trip for surf clams or ocean quahogs.”*

- The following language is present in three instances in Amendment 8 to the Fishery Management Plan for Atlantic Surfclam and Ocean Quahog Fishery”
 - *“Surf clam tags may not be used on cages containing ocean quahogs and ocean quahog tags may not be used on cages containing surf clams.”*
 - 2.3.2.3.2. Issuance of allocation permits, p. 5;
 - 9.1.2.4.2. Issuance of allocation permits, page 55;
 - 2.2.2. Issuance of allocation permits, p. App 5 39:

While the proposed amendment addresses those portions of Amendment 8, the question remains as to whether any accepted amendment to the SCOQ FMP alone would supersede the language contained within 50 CFR Part 652.

A stronger distinction is needed between two key terms that underpin both the title of the proposed amendment and the proposed alternatives. The two terms “identification” and “separation” seem to have been conflated in the generation of the proposed amendment, but in practice have very different functions. Identification is the core function required to account for and properly debit each species from the respective quota for that species in the mixed landings scenario that we currently encounter in varying degrees across the geographic range of our fishery. Because of how processors like Sea Watch market each species, separation is an issue that the industry will be forced to tackle, regardless of how this proposed amendment moves forward toward resolution. The mixing of clams in fishable areas is a dynamic driven by global warmingⁱⁱ. Therefore, we need the flexibility to separate as our respective businesses see fit. While identification may be a technical precursor to future separation technologies, we certainly do not believe that separation is a precursor to identification.

The proposed amendments as written do not provide a viable path forward for the industry to cost-effectively address the mixed landings issue, nor do any of the proposed amendments result in a marginal sustainability gain.

Sea Watch does not view mixed landings as an overall threat to the sustainability of the fishery under past, current, or conditions for the foreseeable future. Quota utilization is far below Total Allowable Catch for both SC and OQ. Secondly, boats generally avoid areas of high degree of mixing to both mitigate risks from enforcement and to minimize operational costs of sorting. Therefore, the degree of mixing on the boat is actively minimized.

We believe a Management Strategy Evaluation (MSE) that models different mixed landings percentages along with different levels of quota utilization can help quantify the risks to the fishery associated with our current characteristics of effort. We believe that a combination of high degree of mixing and high quota utilization would be needed before sustainability problems could emerge, but we prefer to allow science to set the upper limit guiderails for sustainability. We believe the Northeast Fishery Science Center is the entity best equipped to conduct this MSE.

Our assumptions that low mixing and low quota utilization do not pose a risk to the fishery are rooted in the bycatch reports for each fishery. Note that our fishery is among the lowest in bycatch metricsⁱⁱⁱ, where the highest bycatch for SC is OQ trips, and is OQ for SC targeted trips. The highest degree of bycatch is OQ caught in SC targeted trips in the mid-Atlantic. While there is a degree of under-reporting of OQ catch, this is done at a concomitant volume-to-volume degree of over-reporting of SC landings. During my opportunity to share public comments at the Council October 2022 meeting, I provided a sketch of relative bycatch figures for this scenario. Below are data that provide a more thorough understanding of the magnitude of the most prominent bycatch scenario:

- National Bycatch Report Update 3, 2019^{iv} indicates that the OQ bycatch among SC directed trips in the Mid-Atlantic is 2.59% of the SC harvest, by weight.
- As supported in page 17 of the public comment document^v, the quota utilization percentage of OQ somewhere in the low 40s over the last three years, with 2020 ending slightly lower.
- Expressed as a percentage of OQ quota, the OQ bycatch amounts to an additional 1.65% of the OQ quota, not accounting for any bushel density differential. Therefore, this percentage PLUS OQ quota utilization over recent years still results in a historical low quota utilization. Based on 2021 landings, total ocean quota utilization would have been 44.0%.

We agree that we can improve how we quantify landings by employing best practices already employed across US fisheries, including the SCOQ fishery. VTR estimates are already employed on every clam fishing trip where captains provide an estimate of bycatch for the other species landed. The bycatch clam species could be listed separately from the other bycatch species. Our view is that this is an incremental improvement over the current under/over reporting tradeoff currently underway. We believe reliance on the VTR would eliminate the need for a mixed landings declared trip, which is part of proposed Alternatives 2, 3, and 4.

Until we can quantify the implementation costs and risks of amendment implementation given the current fishing behavior, we ask for a suspension of enforcement action associated with mixed landings. As mentioned before, even with suspension enforcement, fishing vessels would still seek to minimize the degree of mixed landings due to market requirements that the two species are shucked and processed separately.

With the combination of enforcement suspension and VTR implementation, we have the time to develop a proper risk assessment based on science. We have proposed the MSE framework and by whom this should be conducted. SCMFIS has a completed^{vi} and has an ongoing^{vii} project that is allowing us to begin to understand the scope of the mixed clam grounds. SCMFIS industry members recently funded a new proposal to develop GIS layers to better visualize the degree of mixing in the fishery over time-series from existing datasets.

With enforcement suspension and VTR implementation, we will have the time to investigate and understand the costs of implementation of both identification and separation. The public comment document does not provide cost estimates that are at this point specific and reliable enough to be used as a basis to understand costs of Electronic Monitoring (EM) implementation. This is assumed to be an outcome of the Coakley and Hennen proposal on EM that was funded by NOAA. Through SCMFIS, we are working with experts in agricultural engineering to bring forth a proposal to understand the costs and capabilities of sorting technologies that work for the various needs across the industry.

Our view of a viable alternative removes any mandate on sorting or separation. This will give the industry flexibility to implement separation either on-vessels or at the processing plant, depending on which technique best suits each individual business enterprise.

A summary of points in these comments for consideration are as follows:

- Suspend enforcement of the zero-tolerance for mixed landings.
 - o Incentives to minimize mixed landings will remain to minimize costs to separate clams and maximize processing efficiency.
- Implement non-target clam reporting on VTRs.
 - o This recommendation is consistent with both National Standard 6 (Variations and Contingencies) and 9 (Bycatch).
- Abandon the concept of the proposed mixed landings trip declaration.
- To be assured risks tolerances are based on the best available scientific information consistent with National Standard 2 (Scientific Information):
 - o Commission the NEFMC to conduct an MSE aimed at understanding risks that mixed landings pose to sustainability of the fishery.
 - o The industry has and will continue to support research on comingled landings through SCMFIS.
 - o The NOAA-funded (EM) project will proceed and provide greater understanding of the technical challenges of identification.
 - o The industry will consider the implementation of separation technology studies that suit our various operational needs.
- Provide greater detail on implementation costs of identification technology, as well as a range of scenarios where identification measures are required for the ongoing sustainability of the fishery.

Below is a summary of our opinion on each alternative:

- Alternative 1 is not viable because the status quo cannot continue. We need to address the issue in some way. Sea Watch opposes Alternative 1.
- Alternatives 2 and 3 are not workable as they assume separation as a precedent to the issue of identification. Furthermore, the mandated degree of separation precision goes beyond what is needed for continued sustainable management in the fishery. Implementation costs of sorting associated with each alternative are inadequately characterized. No stakeholders in this process have a full understanding of costs, nor is it known over what timeframe these sorting measures can be implemented. Alternative 2 or 3 as will lead to more problems than we currently have. Sea Watch opposes Alternatives 2 and 3.
- We believe that the long-term solution to address the core issue of identification of catch indicates the need for a new alternative modeled after Alternative 4. The proposal submitted by Coakley and Hennen for funding on EM will require a few years to complete. Implementation of an Alternative 4-type of alternative would only need to be considered when risks to sustainability to the fishery grow beyond an acceptable level. For example, EM technologies could only be required when mixing percentages and/or quota utilization rates reach certain levels that are informed by a well-designed MSE. One note on Alternative 4 is that it is not clear how cost-

Public Comments on Atlantic Surfclam and Ocean Quahog (SCOQ) Species Separation Requirements Amendment, J.J. Myers, Sea Watch International, Ltd.

recovery is relevant if costs are already incurred through EM implementation. The total costs need to be understood as well the mechanism by which costs would be implemented. An Alternative 4-type of solution seems workable with suggested preconditions and changes detailed above in the summary comment points.

Thank you for the opportunity to comment on the proposed Atlantic Surfclam and Ocean Quahog Species Separation Requirements Amendment.

Sincerely:



Joseph J. Myers
Sr. Director, Innovation and Sustainability

These comments were submitted by e-mail.

ⁱ T. Alspach, Personal communication.

ⁱⁱ E. Powell, personal communication, and reference in Footnote vi.

ⁱⁱⁱ NOAA Fisheries. 2022. National Bycatch Report <https://www.fisheries.noaa.gov/resource/document/national-bycatch-report>. Published 14 February 2018. National Bycatch Report Update 3, 2019. https://media.fisheries.noaa.gov/dam-migration/nbr_update_3.pdf, p.13.

^{iv} NOAA Fisheries. 2022. National Bycatch Report <https://www.fisheries.noaa.gov/resource/document/national-bycatch-report>. Published 14 February 2018. Update 3 Tables, Greater Atlantic Region, Table 3.4.2a https://media.fisheries.noaa.gov/dam-migration/table_342a.pdf. Updated 8 Jun 2022.

^v Mid-Atlantic Fishery Management Council, National Marine Fisheries Service. 2022. Species Separation Requirements Amendment. Amendment XX to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan (NMFS). https://static1.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/633df2ef89cdc26dfcb7b390/1665004417479/SCOQ_SpeciesSeparationRqmt_PHD.pdf. published October 2022.

^{vi} SCMFIS. 2022. How climate change is pushing surfclams and ocean quahogs into conflict. <https://www.youtube.com/watch?v=ZPID2Uiig7g>.

^{vii} Stromp, S. 2022. Evaluation of the degree of co-occurrence of surfclams and ocean quahogs at fishable concentrations. SCMFIS Fall 2022 Meeting. <https://www.youtube.com/watch?v=0efDrcg6h2s>.



Chris Moore, Ph.D., Executive Director
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RE: SCOQ Species Separation

Dear Dr. Moore,

I appreciate the opportunity to comment on the Draft Species Separation Requirements Amendment, Amendment XX to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan (Amendment). While recognizing that the degree of co-mingling of the two clam species varies by location, Company, and by individual harvesting vessel when targeting either surfclams or ocean quahogs, and is likely to increase in the future, I cannot support any of the four alternatives presented in the Draft Amendment because they offer solutions that are either impracticable or are presently poorly described with no clearly defined socio-economic impacts to the clam industry.

LFF is a vertically integrated seafood company that harvests and processes surfclams in NJ, employing over 200 personnel. The company is well respected in the seafood industry and surfclams are certified by the Marine Stewardship Council, a globally recognized assessment body that evaluates sustainability, excellent management, and is a fishery that has minimal negative impacts on any other species or habitats.

Clam vessels operating bottom-tending hydraulic dredges declare, at the start of their trips, whether they are targeting surfclams or ocean quahogs and will tag the cages of either species with the tag identified for one species or the other. These vessels catching surfclams and ocean quahogs (hereafter referred to as the clam industry) sometime encounter both species of clams on a single trip to varying degrees in what is referred to as co-mingling of the two clam species. This co-mingling will vary by depth, distance from shore, latitude, or some other benthic characteristic where both species are developing. Co-mingling has been increasing within recent years as bottom ocean waters have been warming due to climate change and the less tolerant of increasing temperatures, the surfclam species, is moving in a Northerly and/or Easterly direction in the Exclusive Economic Zone (EEZ) where bottom temperatures are more favorable for settlement and growth. Under the current management regime for the clam industry where vessels must declare for one species and land only that one species, it becomes necessary to develop best management practices to minimize or eliminate by-catch and, at the same time, not waste a resource that is biologically healthy. In fact, both clam species are very robust, as

demonstrated in their most recent benchmark assessments and are fished well below any fishery management target reference point value. The Annual Catch Limits (ACL) for both species are well below target biomass levels and, in fact, the clam industry landings for both species have been below their ACL values that have not changed in at least the last 10 years. Landings and by-catch of either species present no threat to the health of both species.

While the Draft Species Separation Requirements Amendment (Amendment) offers four alternative actions developed by the Fishery Management Action Team (FMAT) comprised of scientists from both Federal agencies within the National Marine Fisheries Service (NMFS) and Mid-Atlantic Fishery Management Council (MAFMC) staff, the document and alternatives would have benefitted tremendously with the input of the clam industry, particularly members of the MAFMC Advisory Panel for Surfclams and Ocean Quahogs.

The clam industry recognizes that Alternative 1, No action/status quo, is unacceptable since it was the clam industry that approached the MAFMC with a growing problem of co-mingling due to climate change that required changed management measures. The clam industry, through a project funded through the Science Center for Marine Fisheries (SCEMFIS) documented a wide band extending throughout the mid-Atlantic region where both species of clams were overlapping at varying degrees.

As LFF cannot support Alternative 1, neither can we support Alternative 2, Allow Combined Trip Declaration and Require Onboard Sorting. While the allowance for a combined trip declaration would allow for both species of clams on a single trip to be landed and reduce any by-catch discards, the sorting of the entire catch aboard the clamming vessel is impracticable in many, or possibly the majority of cases, where the two clam species come aboard at the same time and during the same trip. The sheer volume or numbers of clams in the catch, coming aboard the clam vessel and moving through a rapid conveyor system to placement in cages cannot possibly be sorted 100% by existing crew aboard the vessel. Couple this challenge with the added potential for rough seas and the onboard sorting of clam species by existing crew is impossible. Placing additional crew members aboard a clam vessel and slowing down the conveyor system putting the clams in their respective cages could very well make for a trip that is not only impractical but also not financially feasible.

LFF also cannot support Alternative 3, Allow Combined Trip Declaration, Mixing of Clam Species within cages (on a Declared Combined Trip) and Require Manual Port Monitoring of Declared Combined Trips. Again, allowing for the landing of both species if encountered on a single trip would prevent wasteful discards if the by-catch is substantial and cannot be sorted at sea. However, combining both clam species within a single cage poses problems with species specific cage tags that monitor the catch and may present a Company that targets primarily one species or the other from maximizing their landings value. For example, LFF is referred to as the *Home of the Hand Shucked Clams* and targets and shucks surfclams exclusively. Landing ocean quahogs within a cage with surf clams is not desirable and less profitable for the vessel and the company. The details of the shoreside monitoring of mixed cages is not well defined, in fact, it is poorly defined, and the cost associated with such a new shoreside monitoring of mixed cage clams may be prohibitive to the point that the clam industry not only loses out on its

targeted species but must now bear the non-estimated costs that will come back for the clam industry to pay under the terms of the Cost Recovery Program Amendment for the fisheries.

Alternative 4, Allow Combined Trip Declaration of Clam Species within Cages (on a Declared Combined Trip, and Require Electronic Monitoring of Declared Combined Trips) shows some long-term possibilities with the implementation of a new onboard electronic monitoring (EM) program to assess catch composition but no such EM system exists for the co-mingling of surfclams and ocean quahogs problem. How long will it take to research and develop such an EM monitoring system and how much will it ultimately cost the clam industry? Without any answers to these two very important questions, LFF cannot support Alternative 4. The Amendment identifies Alternative 4 as a long-term solution but what does the clam industry do about co-mingling in the meantime while this new technology is being developed?

Ultimately, the clam industry, not the FMAT, needs to come up with a short-term solution to the co-mingling problem created by climate change that is practicable and affordable. **One thing the clam industry strongly supports at this time, either within an Amendment or some other, more efficient administrative process under NMFS, is the immediate suspension of legal liability that prohibits the landing of even one clam, either surfclam or ocean quahog, from being present in a cage with a tag for the other species.** By removing this legal jeopardy on clam vessels now, the industry can devote sufficient time to come up with a practicable solution to the co-mingling problem. Due to the fact that first, co-mingling is a natural occurrence of clams in the wild, second, there is no damage to the biomass and thirdly there is no benefit to the industry or enforcement to monitor and issue citations for co-mingling, it is in the best interests of all stakeholders to find a solution to this issue.

In summation, since the clam industry, from the LFF point of view, cannot support any of the four Alternatives in the Draft Amendment, it would be advisable for the MAFMC to postpone any action of this Draft Amendment when it meets in December 2022 but allow the clam industry to better participate in developing Alternatives for the short-term and long-term solution to the co-mingling problem.

On behalf of LFF, I appreciate the opportunity to comment on the Draft Species Separation Requirements Amendment and look forward to working with the FMAT to present Alternatives for this Draft Amendment soon.

Sincerely,

A handwritten signature in blue ink that reads "Daniel P. LaVecchia". The signature is written in a cursive style with a large, stylized initial "D".

Daniel P. LaVecchia, President
LaMonica Fine Foods

From: [Jeffrey Pike](#)
To: [Coakley, Jessica](#)
Subject: SCOQ Species Separation
Date: Tuesday, November 29, 2022 4:14:14 PM

Jessica

Bumble Bee Seafoods has reviewed all the alternatives and supports option #3.
Sorting onboard vessels is impossible for many harvesters.
Thank you

Jeffrey R. Pike
Pike Associates, LLC
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The draft Atlantic Surfclam and Ocean Quahog (SCOQ) Species Separation Requirements Amendment (Amendment) alternatives, to modify the species separation requirements in the Atlantic surfclam and ocean quahog fisheries, do not adequately recognize the biological, economic, social, and physical interactions among the components of the relevant ecosystems. Regulatory changes are needed because it has been, and will continue to be, impossible to ensure that 100 percent of the catch on a targeted trip is the targeted clam species in every cage. This was well communicated by industry prior to the development of the proposed alternatives but has not adequately been addressed within the Alternatives.

A management strategy evaluation (MSE) has not been performed to determine the impacts resulting from different levels of non-targeted species in landings. A MSE for the proposed amendment should explicitly evaluate a range of management strategies in response to the mixing of Atlantic surfclam and ocean quahog species being caused by climate change. Until this is done, proposing alternatives for a FMP Amendment is pre-mature. An analysis is necessary to determine the flexibility management has around a reasonably precise estimate of the proportion of mixing in catches to determine the point where the degradation of the precision of landings reports may impact the stock assessment. Various incremental landings of the non-targeted incidentally caught species must be analyzed so that an allowance can be determined that doesn't increase uncertainty to unacceptable levels. The assessment model would be run by the NEFSC to determine the influence of increased uncertainty in the landings data, both for the surfclam model and the ocean quahog model. It is quite possible that some increases in uncertainty will not materially impact the assessment for these two species. Performing this analysis may be as simple as increasing the coefficient of variation (CV) on the landings, yet an analysis hasn't been requested of the NEFSC.

Here I will provide my comments on each of the specific alternatives presented in the proposed Species Separation Requirements Amendment as well as on the new combined trip declaration category:

Combined Trip Declaration (Alternatives 1,2, & 3) – I think of this as the “Know Before You Go” piece of the Amendment. Trip declarations are made before the vessel departs the dock (or crosses the demarcation line, 3nm offshore in most areas). For many, if not most trips it would be impossible to know if there will be incidental catch of the other clam species before making a declaration. A large percentage of the time spent harvesting clams is spent looking, making tows in which the composition of the catch is unknown until it is harvested. Industry has performed two analyses of a surfclam vessels’ trip area. In one analysis of LaMonica Fine Food’s vessels within the Atlantic Shores wind lease area found the median trip area of 10.0 sq. nm for a clam vessel harvesting surfclams. Another analysis of all surfclam industry vessels working within the Ocean Wind I lease area found the median trip area of 8.41 sq nm. These analyses were done using vessel VMS data collected over an eleven-year period.¹ Harvesting over such a large area will inevitably cross areas containing different levels of species mixing.

A change in the tide, the direction of the wind, or a change in the barometric pressure will often change the composition of the catch for any given location and as often as not, results in the vessel moving or changing its tow up. Even vessels targeting areas that are thought to be 100 percent single species may have small amounts of the non-targeted species, making these vessels out of compliance if a single non-targeted clam finds its way into the catch. The proposed amendment hasn’t considered what happens if a vessel declares a Combined Trip but catches only one species or declares a single species trip but ultimately catches and wishes to retain incidental catch of the other species.

Alternative 1 is not a desirable management alternative because vessels will have to operate in violation of the regulations to achieve optimum yield. An increasing number of surfclam sets will be on grounds still occupied by ocean quahogs because (1) ocean quahogs can bury to avoid warmer waters when necessary, and (2) because the ocean quahogs are such long lived creatures, they will continue to occupy the new areas where surfclams are setting for many years to come.

¹ Last Tow, LLC Fishing Route Analytics Reports Prepared by Azavea, 990 Spring Garden Street, 5th Floor Philadelphia, PA 19123 (215) 925-2600 <http://www.azavea.com>

Alternative 2 is not a desirable management alternative because 100 percent onboard sorting would be required, which is impossible. Although vessels would be able to land both species on a trip, they would always be in violation of regulations requiring 100 percent of each cage is a single species.

Alternative 2 was presented as feasible if trips with mixed catch were “slightly” slowed to allow time for onboard sorting. This statement is simply not based on facts. If there is species mixing within the catch, cages aboard the vessel will likely contain some amount of the non-targeted species – period, it is unavoidable. It is not possible to sort 100 percent and still run an economically feasible business. This is the reason that the SC/OQ Advisory Panel and industry members all communicated that an allowance for the non-targeted species was necessary. This alternative does not provide that allowance.

Alternative 3 is not a desirable management alternative because this regulatory framework would unnecessarily increase government and industry costs associated with administering the regulatory requirements and result in an estimate of each species that would likely be much less accurate than a measurement that could easily be made by the crew aboard the vessel during the trip. A NOAA Fisheries sampling program to assess catch composition after clams are offloaded and before they are processed is not necessary nor is it practicable. This Alternative’s measures would increase the regulation burden, impact the way the fishery operates such that offloading and transportation is disrupted, and will negatively impact fishing operations and practices.

For a port sampling program to produce a sufficiently accurate assessment of the catch composition a sufficient sampling of the cages aboard the vessels will be necessary. Because the port sampling agent will not know if the clams were caught over a limited area or a vast area, or the variability of the load, a relatively high number of samples will be necessary for accuracy. Clams will have to be removed from multiple cages (cages weigh several thousand pounds when full) and separated to measure the volume of each species. Then the clams will have to be put back into cages.

Compare this process to one that a vessel operator would have to undertake to accurately report the volume of each species, of a mixed species catch. The vessel operator would need to sample only as necessary to determine catch composition. If the vessel was harvesting the same area during the entire trip and conditions remained such that catch composition didn’t change, limited sampling would be

enough for accurate reporting of the number of cages for each species. If the vessel worked several areas to get the trip or conditions changed such that catch composition changed, the vessel operator would know when new sampling would be necessary, and how to apportion all sampling results to the species being reported, to accurately report catch. Where port sampling would require that clams were removed from cages for sampling, the vessel operator would be sampling catch composition before the clam were put in cages. In summary, accurately report the volume of each species, of a mixed species catch would be very difficult, time consuming and expensive if done by port sampling while accurately report the volume of each species, of a mixed species catch would be easy and straightforward if done by the vessel operator during the trip.

Vessel Trip Reports (VTRs) can provide the quality data necessary to inform fishery science and management. Vessel owners or operators of vessels issued a surfclam or ocean quahog permit, are currently required to maintain and submit, an accurate fishing log report for each fishing trip. VTR reporting of quantities of surfclams, or ocean quahogs incidentally caught and retained would provide the quality data necessary to inform fishery science and management for mixed catches.

Alternative 4 - The feasibility of the implementation of a new onboard electronic monitoring (EM) program to assess catch composition has yet to be determined. This alternative should not be considered until such feasibility is known. Knowing the many hurdles that would need to be addressed for this to be successful, it is likely that an EM alternative turns out to be no more accurate than the owner or operator reporting the number of cages of the non-target species using VTRs. EM, in my opinion, will take much longer to perfect and be much more costly than anticipated.

Because Alternative 4 would not allow the mixing of both clam species within the cages or onboard the vessel until the implementation of a new onboard electronic monitoring (EM) program to assess catch composition is put in place, we are potentially many years away from actual modifications to the regulations if choosing this alternative, therefor this alternative is not currently acceptable.

SUMMARY

Current regulations must be modified to allow landing both Atlantic surfclams and ocean quahogs on the same trip. Alternatives 1 and 2 are not appropriate because they do not permit some level of mixing of both clam species within the cages. In these high-volume fisheries that are overlapping due to climate change, it has become

impossible to ensure that 100 percent of the catch on a targeted trip is the targeted clam species in every cage. The areas of overlapping will likely grow larger while it will be these same areas needed to support the fishery. Even if a vessel chose to separate the different species into separate cages there would always remain some level of mixing. An evaluation is necessary to determine where incremental landings increase of the non-targeted incidentally caught species increase the uncertainty for biomass assessment levels of the targeted and non-targeted species to unacceptable levels.

The implementation of a new NOAA Fisheries sampling program to assess catch composition under Alternative 3 is not practical. Many cages would have to be dumped and sampled to get an accurate count of both species because cages with clams caught from different areas will have a different composition of species mixing; whereas an accurate accounting could be determined easily by the vessel operator during the normal course of the trip.

Alternative 4 isn't practical at this time and it may take many years for an electronic monitoring program would be robust enough to assess catch composition in the SC/OQ fisheries.

A management alternative is needed where - vessels declare the targeted fishery as they currently do; vessels can retain non-targeted surfclam or ocean quahog if all retained catch is reported on the VTR; and vessels have some allowance for non-targeted species within cages. We do not currently have an acceptable management alternative.

Thank you for considering our comments.

Regards,

Thomas Dameron

Thomas Dameron
Government Relations &
Fisheries Science Liaison
Surfside Foods, LLC

QUALITY SEAFOOD PRODUCTS

Last Tow, LLC

Fishing Route Analytics Report

Prepared by



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Overview

Last Tow LLC is working with Oceanside Marine/LaMonica Fine Foods and Atlantic Shores to help plan for wind turbine development that will be minimally disruptive to local fishing operations. Azavea was contracted by Last Tow to perform analytics on past fishing trips by Oceanside Marine vessels within the Atlantic Shores leasing area. The objective was to help give Oceanside Marine/LaMonica Fine Foods a better understanding of the spatio-temporal characteristics of these fishing trips which will help inform Atlantic Shores' placement of wind turbines and inter-array cables. This report outlines the work and findings.

Trip data

Last Tow provided NOAA Vessel Monitoring System (VMS) point data of periodic time stamped locations for each ship. Approximate trip paths were generated by arranging the points in chronological order and then connecting them. In the absence of actual travel path data, the ships were assumed to have traveled in a straight line from each point to the subsequent one. For each segment, estimates were calculated for speed and direction based on the coordinates and timestamps of the starting and ending points.

Classifying fishing and transit segments

For the purpose of the analysis, it was necessary to separate the 'transit' (i.e. travel to and from fishing locations) from the 'towing' (i.e. engaged in active fishing) segments. The raw point data did not include a record of the fishing status of the boat at that time so each segment needed to be classified into these two categories. At the suggestion of Last Tow, all segments in which the boat was traveling at an estimated speed of four knots or less were classified as towing and the rest were labeled as transit.

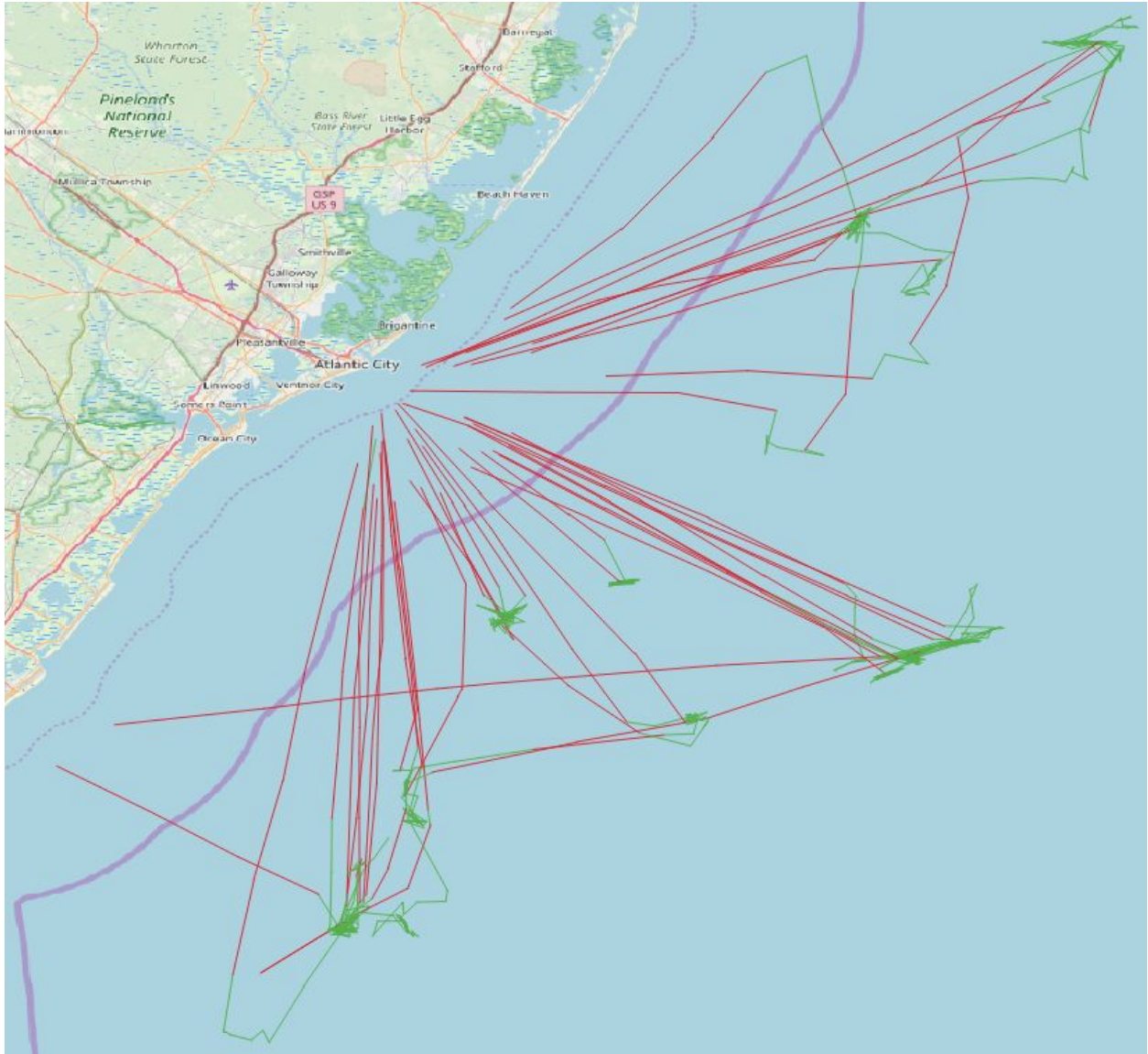


Fig 1. In this and other maps, red and green lines indicate segments that were originally classified as 'transit' and 'towing', respectively. This shows all of the transit and towing segments for a single year of one boat.

While this rule worked to an extent, it was not perfect. For example: in the first-pass analysis, there were cases in which a single fishing segment would be found within an otherwise uninterrupted stretch of transit. It was usually not clear exactly why the boat slowed down for that one segment. However, it was clear from context that the boat had not simply slowed to fish in the middle of its transit.

Fig 2. An example of a misclassified transit segment

On the flip side, there were misclassified towing segments. Continuous fishing periods are easily identifiable because they consist of many consecutive short transit segments that zig and zag back and forth across a bounded space. Occasionally these contextually obvious towing segments would have a speed greater than 4 knots. This was often due to the inconsistency in the time intervals between readings. Generally, points were recorded about an hour apart but there were some cases in which they were as frequent as a few minutes. The abbreviated segments yielded much greater variance in the estimated speeds. It is possible for a boat in the act of fishing to travel faster than 4 knots over the small sample of a few minutes.

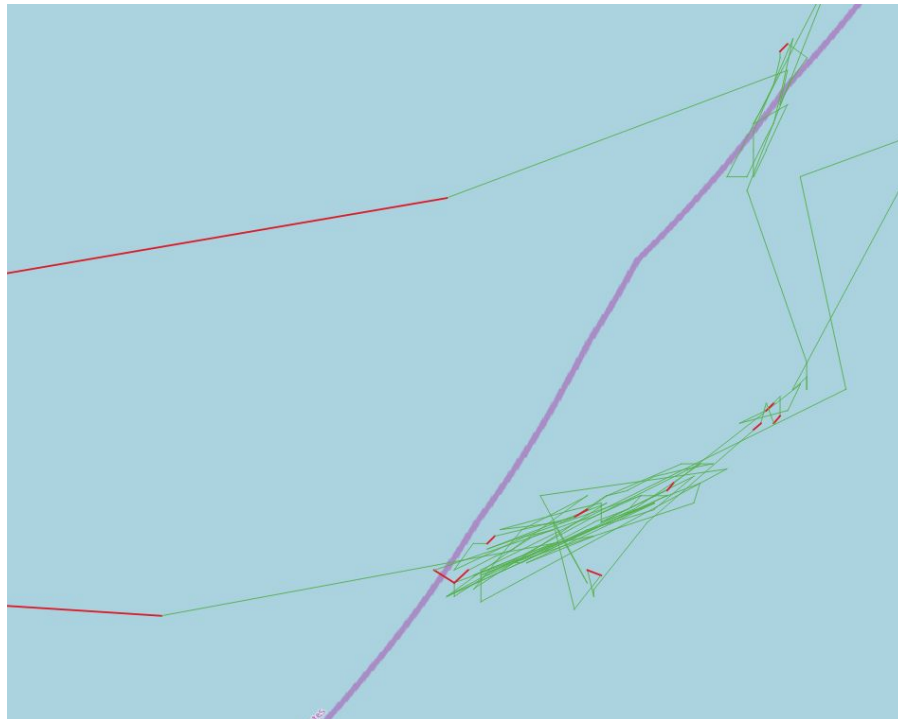


Fig 3. An example of a fishing trip with a series of short segments. Because the readings were so frequent there were many small fishing segments that had speeds greater than 4 knots and were there misclassified as transit.

Several different rules were explored in an effort to try to remove these outliers. Ultimately, an algorithm was implemented to examine all segments that were bounded by two segments of the opposite type. It checked the speed, direction, and distance of the segment in question and compared the values to predefined thresholds. If two out of three criteria were met, the classification of the segment would change.

The three thresholds for reclassifying a travel segment to towing were: a speed of 4.6 knots or less, a duration of less than 36 minutes, and a distance of less than 1.2 nautical miles. These thresholds were determined by iterating over a series of options and finding the combination that yielded a significantly larger change in the number of trip polygons (described in the next section) than others. This suggests that the aforementioned thresholds found a natural break in the data and did a better job of classifying than others.

<i>Outlier threshold options</i>	<i>Decrease in trip polygons from previous set</i>
Duration: < 0.4 hrs; Distance: < 0.8 nm; Speed: < 4.2 knots	--
< 0.5 hr; < 1 nm; < 4.4 knots	8
< 0.6 hr; < 1.2 nm; < 4.6 knots	36
< 0.7 hr; < 1.4 nm; < 4.8 knots	7
< 0.8 hr; < 1.6 nm; < 5.0 knots	15
< 0.9 hr; < 1.8 nm; < 5.2 knots	8
< 1.0 hr; < 2.0 nm; < 5.4 knots	11
< 1.1 hr; < 2.2 nm; < 5.6 knots	12

The decrease in the number of trip polygons for the selected threshold was the only statistical outlier within the group (i.e. the value was more than two standard deviations from the mean).

Fishing trip polygons

After filtering out transit segments, an approach was developed to measure the size and shape of a “fishing trip.” This is distinct from what this report will refer to as an ‘event’ which is the set of collective boat movements between leaving shore and returning. In this context, a fishing trip is defined as the set of continuous towing segments (i.e. the familiar clusters of green lines from fig. 1). Fishing trips do not include the transit portion of an event. There are some cases in which a boat would travel out from shore, fish in an area for a period of time, travel to another area, fish again, and then return to shore. In this case, the event would include multiple trips. Last Tow believed that the shape of a trip would be

more instructive than that of an event because the trip shape is the geographic unit that will actually need to fit into the turbine grid.

The fishing trip polygons were defined as the convex hulls of all points within a fishing trip. A convex hull, in this context, is the smallest convex polygon that contains all of the points within the set. This means that the resulting polygon will have no interior angles greater than 180 degrees and no line between any two vertices will pass outside of the polygon.

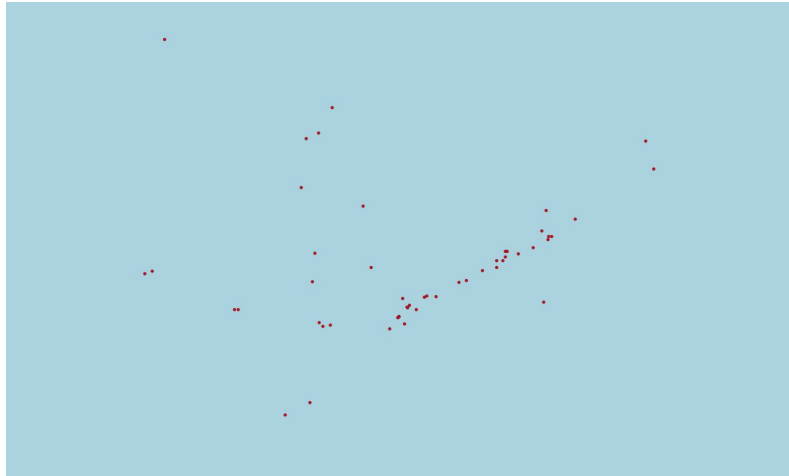


Fig 4. Example creation of a fishing trip polygon: All of the consecutive fishing trip points.



Fig 5. The points after they had been connected to make segments

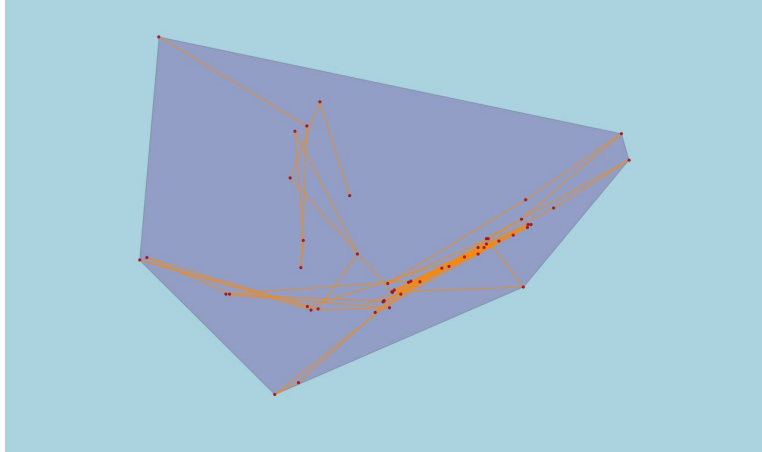


Fig 6. The convex hull of all segments within this fishing trip

It would be possible to draw a smaller polygon that also encompassed all of the points but the convex hull would be more predictive of the actual amount of area needed for a similar future trip: If another boat fished in this same area as shown in figs. 4-6, it would not exactly repeat the pattern. It would be more likely to occupy the same amount of general area (i.e. the polygon) but move to slightly different space.

Analysis

Analysis of the derived datasets (i.e. segments and trip polygons) had three main components:

1. Trip shape analysis
2. Ship travel path density
3. Travel direction
4. Proportion of fishing within EDF Renewable Zone

Trip shape analysis

Last Tow decided to limit fishing trip mapping and analysis to trips with a duration between 20 and 28 hours. This helped to eliminate outlier trips that could have occurred for a number of different reasons. It also removed small polygons that were the result of residual segment misclassification. The analysis was focused on the trips that were most characteristic of normal fishing events. It also only included fishing trips for which at least half of the area overlapped with the EDF Renewable Zone. Between 2008 and 2019 there were 144 qualifying trips.

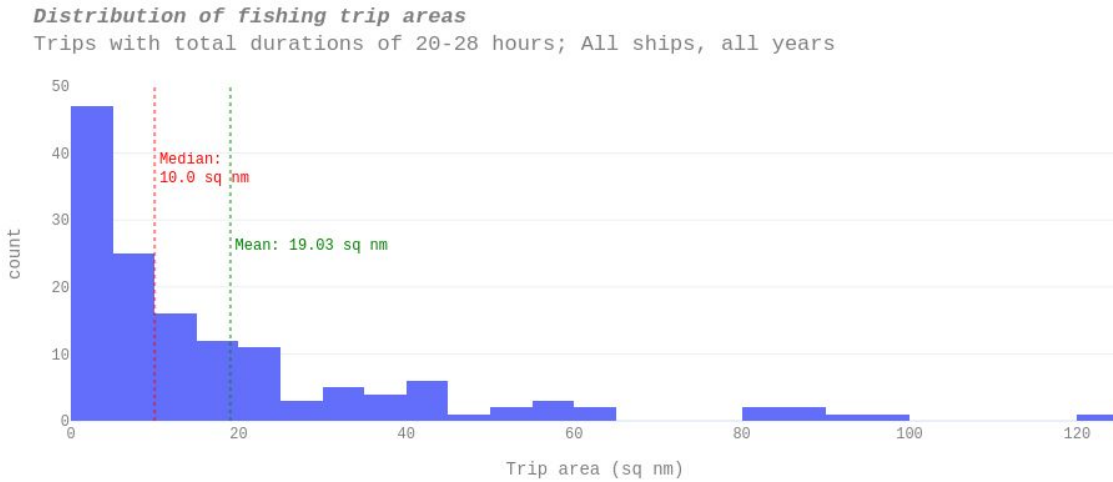


Fig 7. Left-skewed distribution of trip sizes

The average size of fishing trips (19.83 sq nm) was higher than the median (10.6) due to some large outliers. Half of the trips were smaller than 10 sq nm and 47 (32.6%) were smaller than 5.

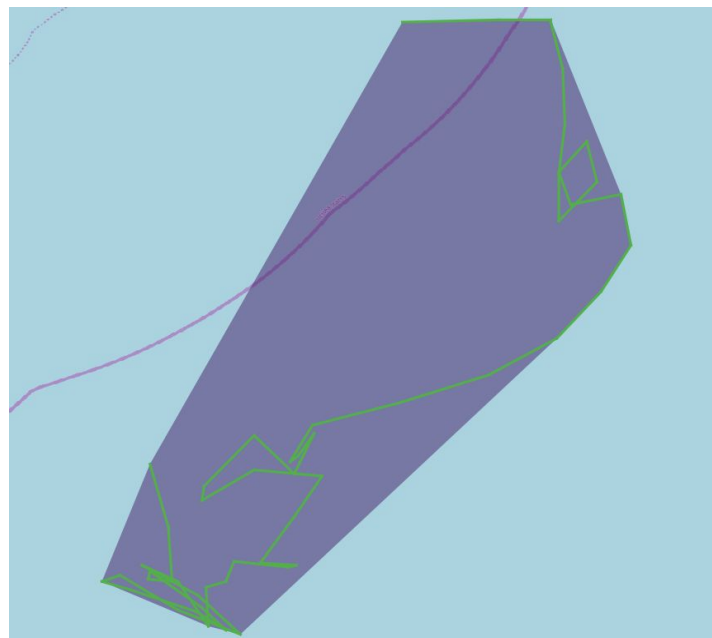


Fig 8. An outlier large fishing trip (120.3 sq nm) with a particularly meandering path

The fishing trip durations were more normally distributed with both median and mean values of about 24 hours.

Distribution of fishing trip durations

Trips with total durations of 20-28 hours; All ships, all years

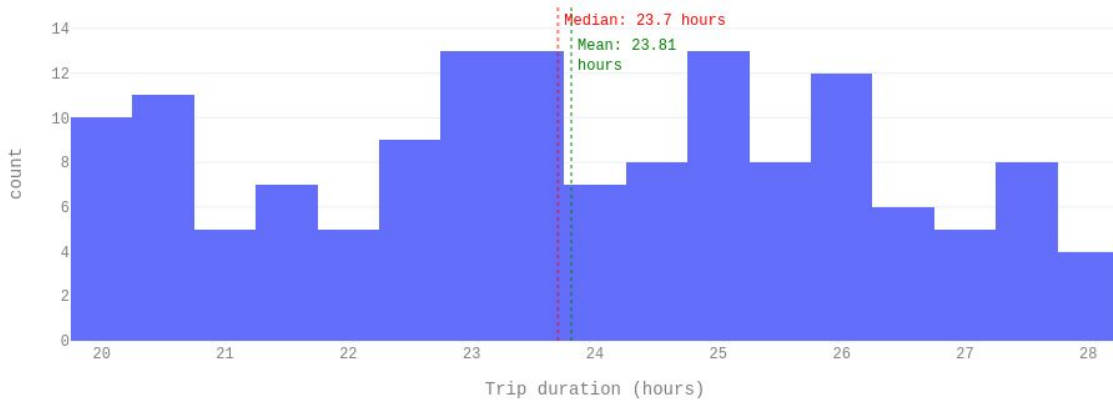


Fig 9. Distribution of trip durations

Surprisingly, there seemed to be little to no correlation between size and duration. Some ships fished in very compact patterns while others covered more ground in the same amount of time.

Relationship between trip duration and area

Trips with total durations of 20-28 hours; All ships, all years

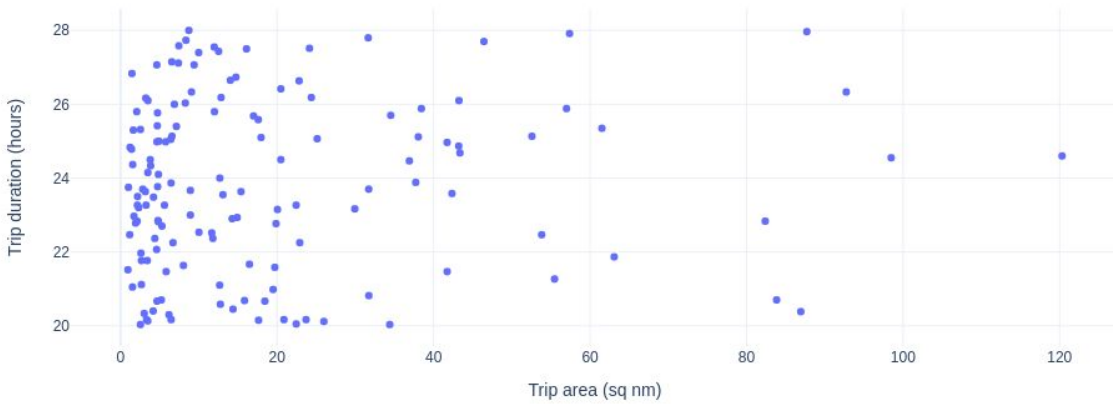


Fig 10. Very little correlation between trip duration and area

Given the large number of polygons within a confined area, it would be difficult to map all of the trip polygons and still get a sense of what they looked like, so representative samples were selected. Fig 11 shows a sample of 10 fishing trip polygons are in the middle of the area distribution, with five each on either side of the median. In other words these are ‘typically sized’ polygons.

Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long

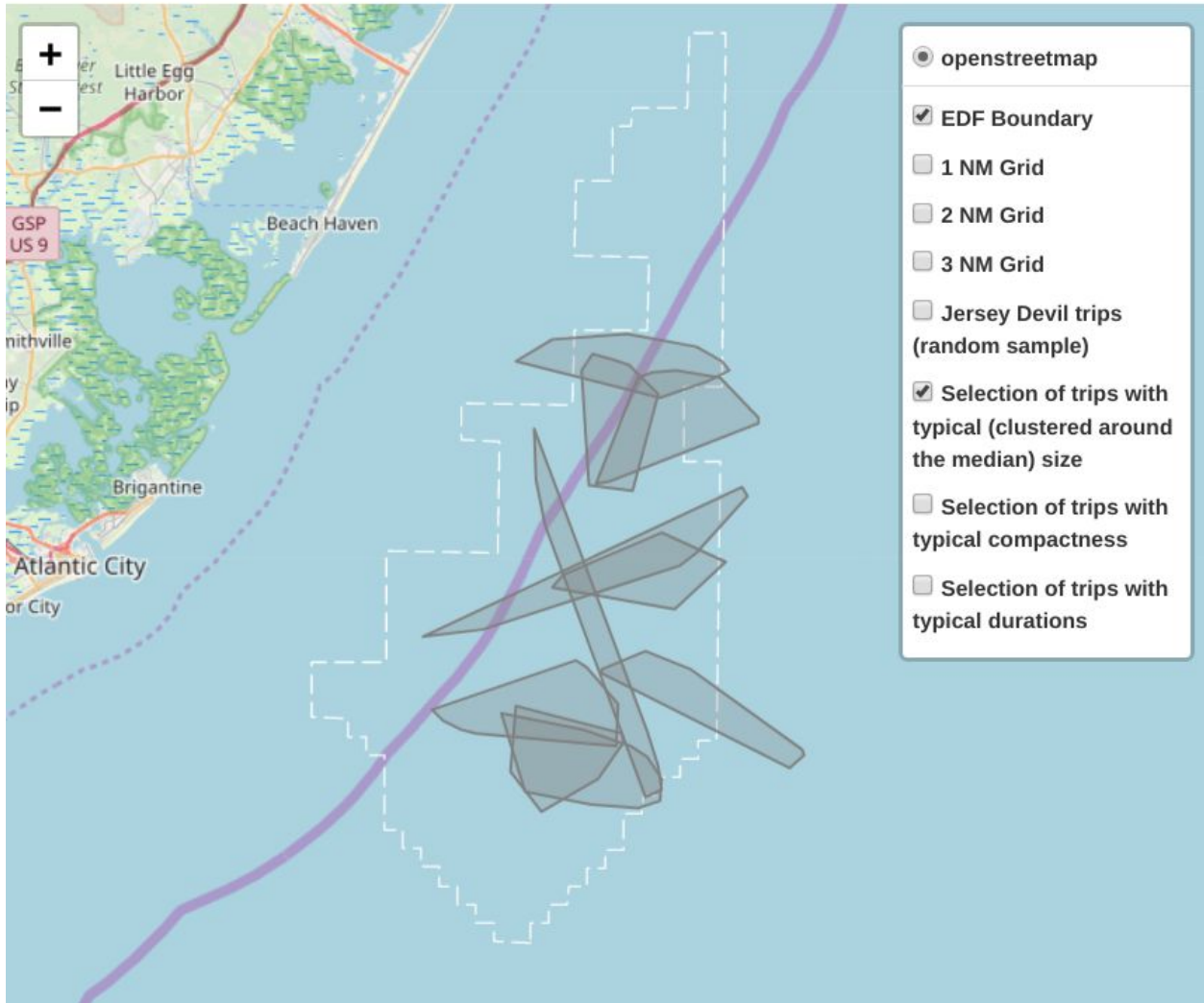


Fig 12. A selection of representatively sized polygons, overlaid with the EDF boundary

The appendix includes maps of additional samples that are selected using the same process but for duration and compactness (perimeter to area ratio). There are also maps showing a random sample of trips from one of the boats *The Jersey Devil*.

A set of points were also generated that could simulate the future grid of wind turbines and give the map viewer a rough sense of how the size and shapes of past trips would fit into it. These grids are not aligned with planned turbines nor are they oriented in the correct direction. They are simply meant to give a visual reference of different grid distances.

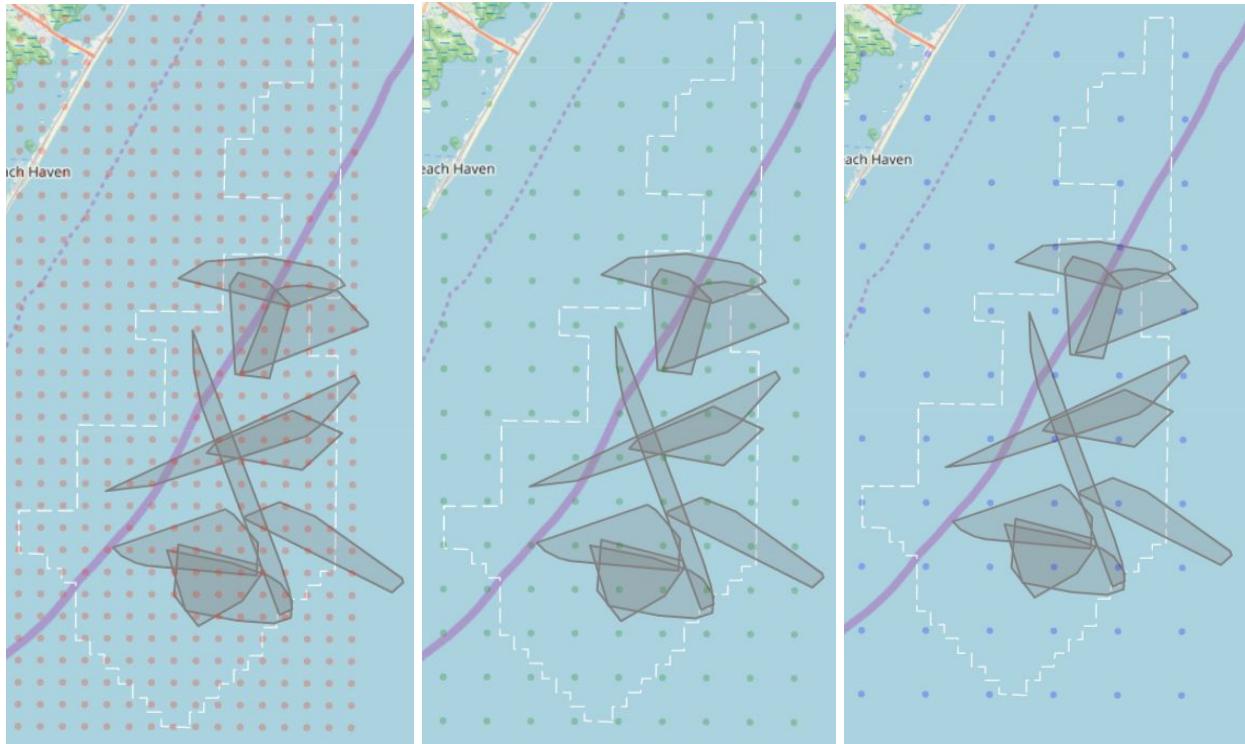


Fig 13. Typically sized fishing trip polygons overlaid with potential turbine grids spaced out at 1nm x 1nm (left), 2nm x 2nm (center), and 3nm x 3nm (right)

Ship travel path density

In addition to the size and shape of each fishing trip, Last Tow was also interested in understanding which parts of the EDF Renewable energy have been highly trafficked by fishing boats in the past. Line density maps were developed to measure and visualize boat traffic.

The segment data that was derived from original point locations was used to determine the paths. The EDF zone is broken up into 0.2nm x 0.2nm grid cells. The value associated with each grid cell corresponds to the number of boats that passed through it (boats in the act of fishing, in the case of fig. 14). There was a much higher concentration of fishing in the northern part of the region.

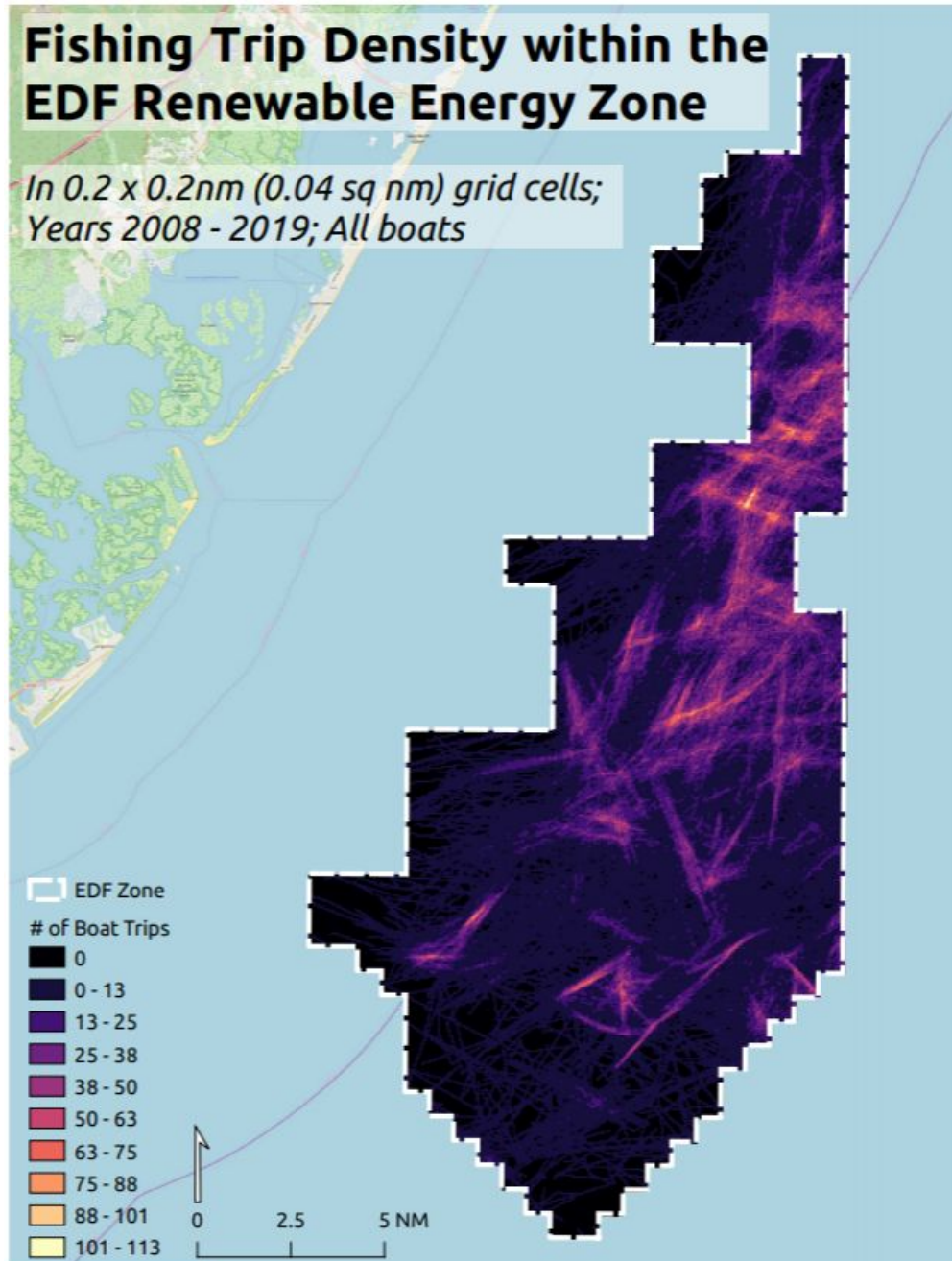


Fig 14. Density of fishing segments, all years

As you can see in fig. 15, boats in transit occupied different parts of the region than those that were fishing.

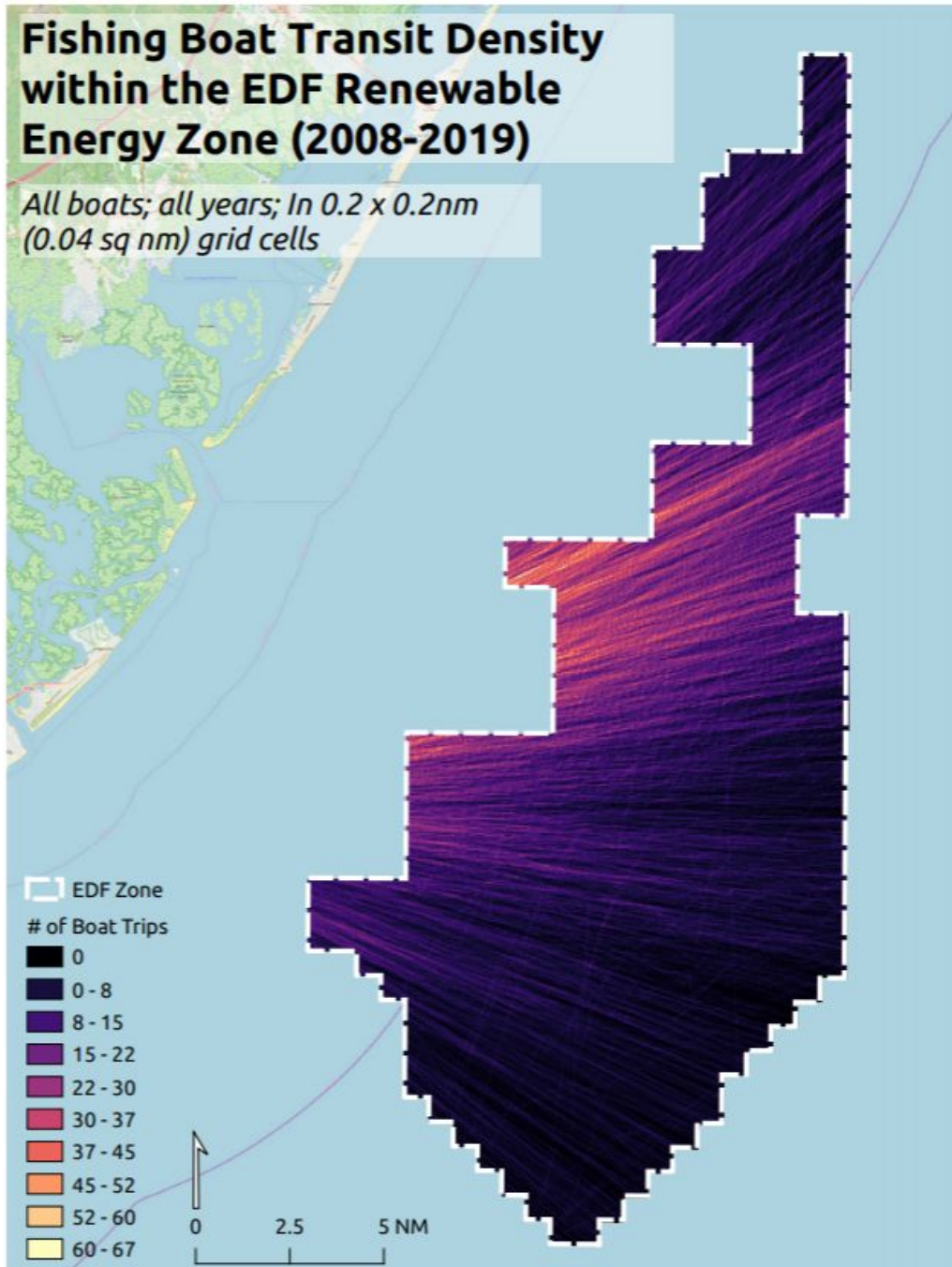


Fig 15. Density of transit trips within the EDF zone

Travel direction

The orientation of the turbine grid could affect the ability of future ships to recreate past fishing routes so the direction of travel of past trips within the EDF zone was quantified. Each segment was sorted into one of 16 different directional buckets (e.g. N, NNE, NE, ENE, etc.).

The polar plot in fig 16 shows which directions fishing boats traveled in most frequently over the extent of the dataset. The radial axis indicates the total mileage of all boats in a specific direction. For example, over the course of all years, all boats traveled roughly East-Northeast for about 6500 nautical miles.

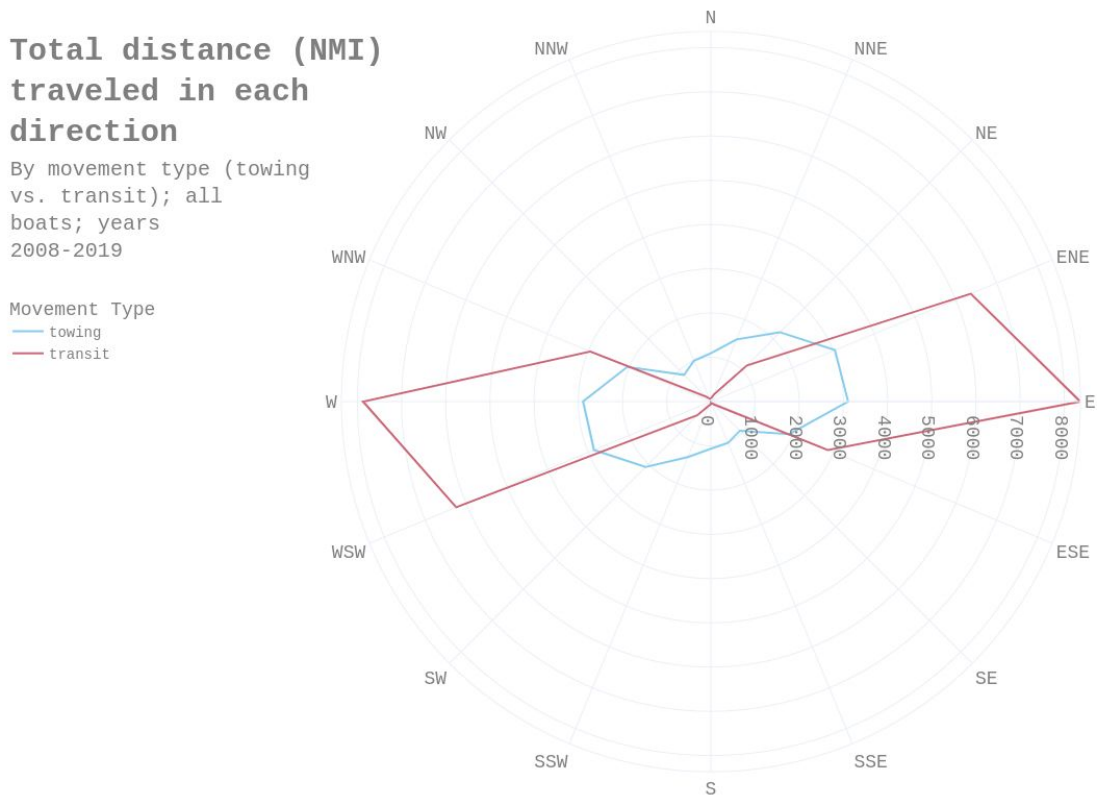


Fig 16. The fishing boats traveled in slightly different directions when towing as compared to when simply in transit

This appendix includes additional polar plots that show total direction of travel broken down by individual boat over all years and by year for only trips by *The Jersey Devil*.

Proportion of Fishing Within EDF Renewable Zone

Last Tow interested in understanding the annual breakdown of total fishing time spent inside and outside of the EDF renewable region. Fig 17 represents those results in table form.

YEAR	% OF FISHING WITHIN EDF
2007	8.2%
2008	1.1%
2009	7.5%
2010	6.8%
2011	1.6%
2012	1.6%
2013	3.2%
2014	3.7%
2015	13.8%
2016	30.0%
2017	26.2%
2018	15.5%

Fig. 17. Percentage of all fishing hours that occurred within the EDF renewable region.

This table shows what percentage of all fishing hours occurred within the EDF zone. As you can see, more than 90% of all fishing took place outside of the zone between 2007 and 2014 before increasing in 2015.

Appendix

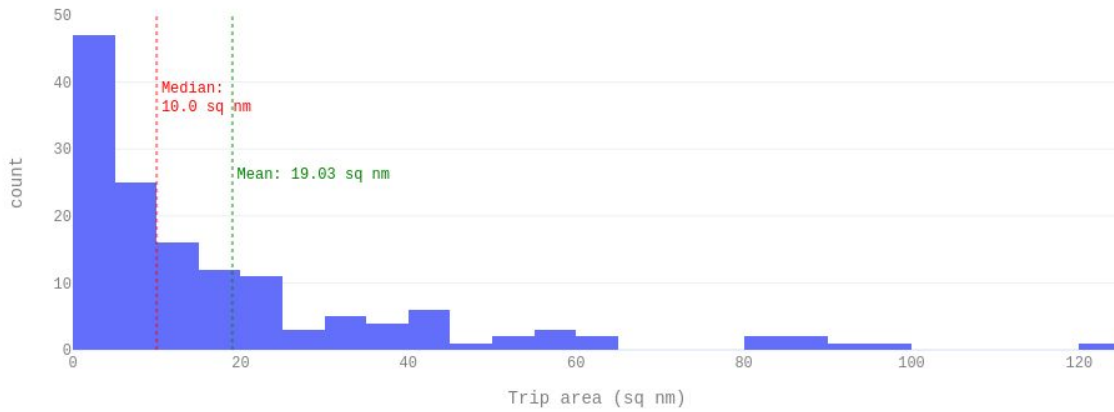
- A. Fishing trip charts
- B. Fishing trip maps
- C. Polar plots
- D. EDF renewable zone fishing
- E. Line density maps

(A) Fishing Trip Charts

Item A.1

Distribution of fishing trip areas

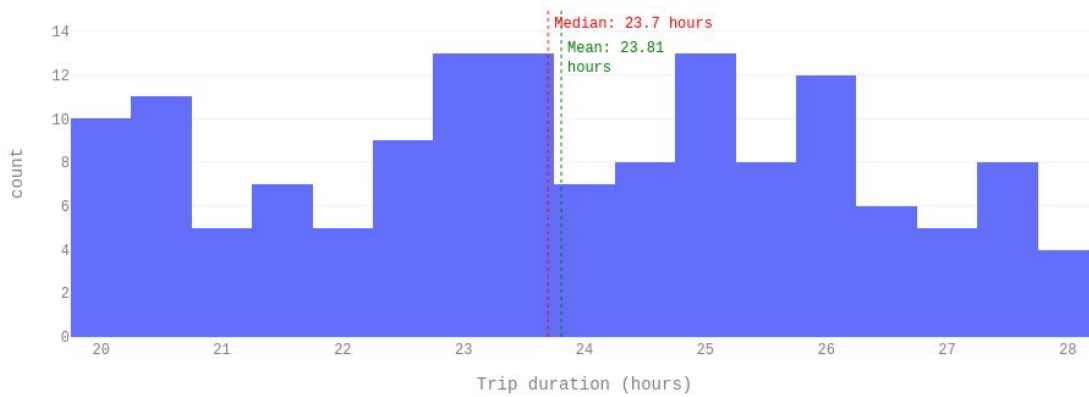
Trips with total durations of 20-28 hours; All ships, all years



Item A.2

Distribution of fishing trip durations

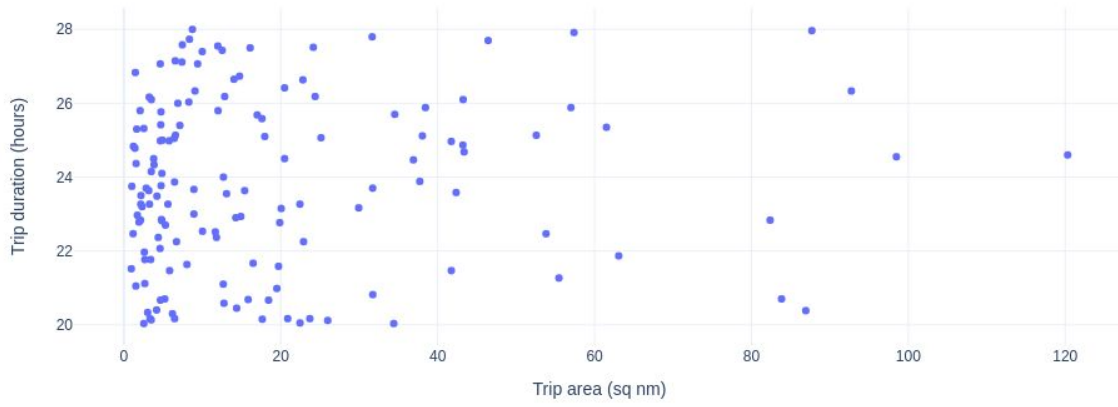
Trips with total durations of 20-28 hours; All ships, all years



Item A.3

Relationship between trip duration and area

Trips with total durations of 20-28 hours; All ships, all years

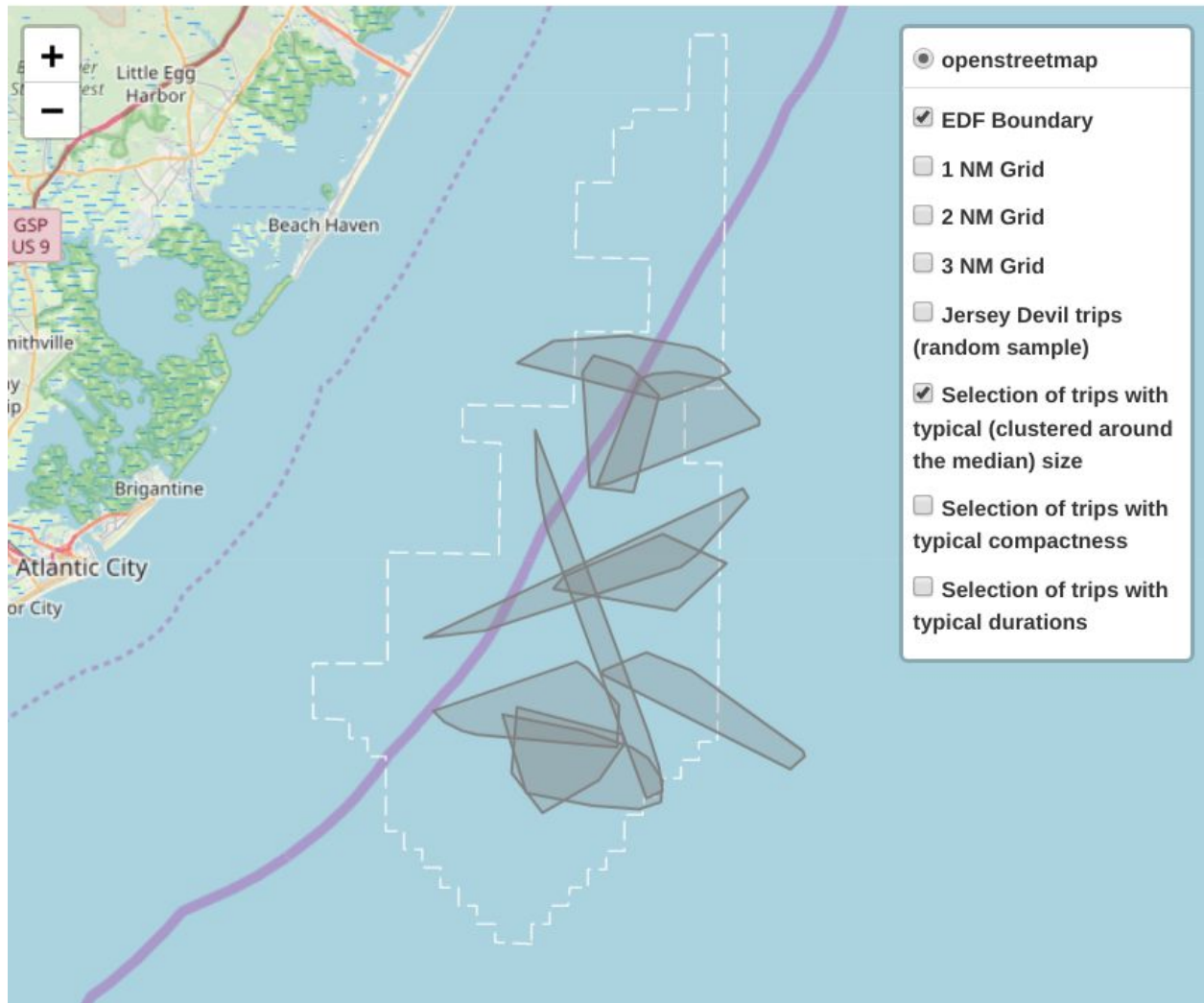


(B) Fishing trip maps

Items B.1 - Size

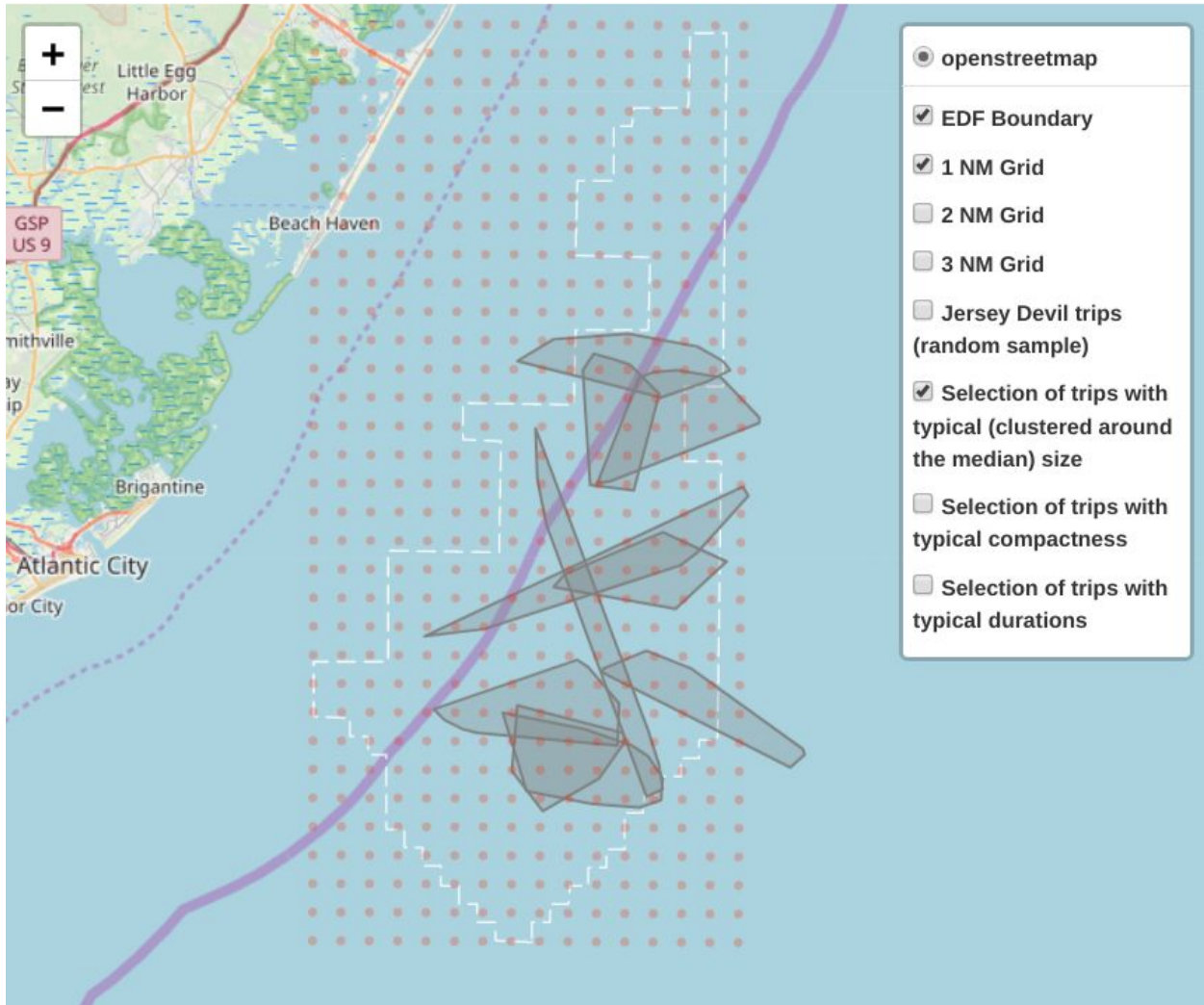
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



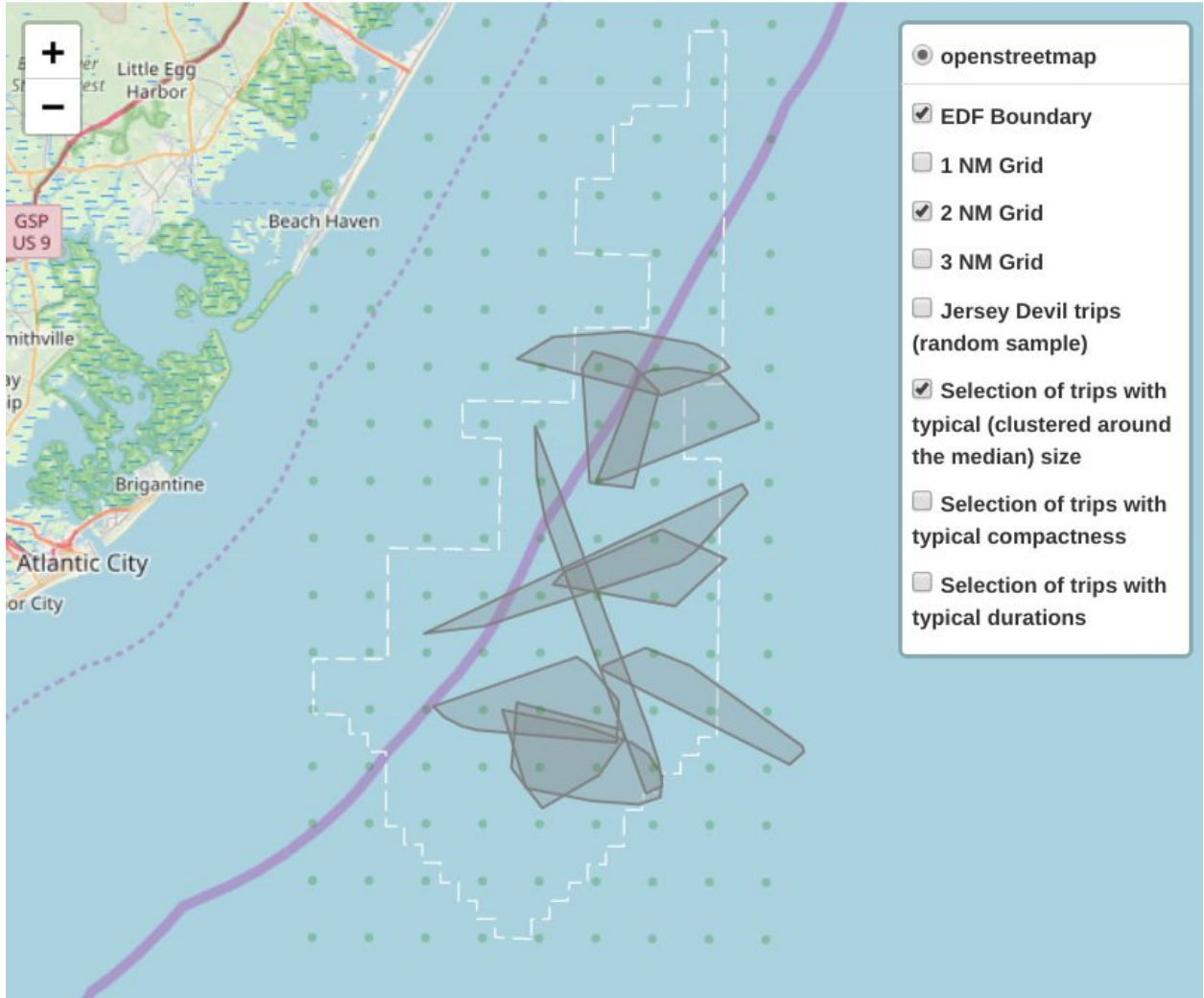
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



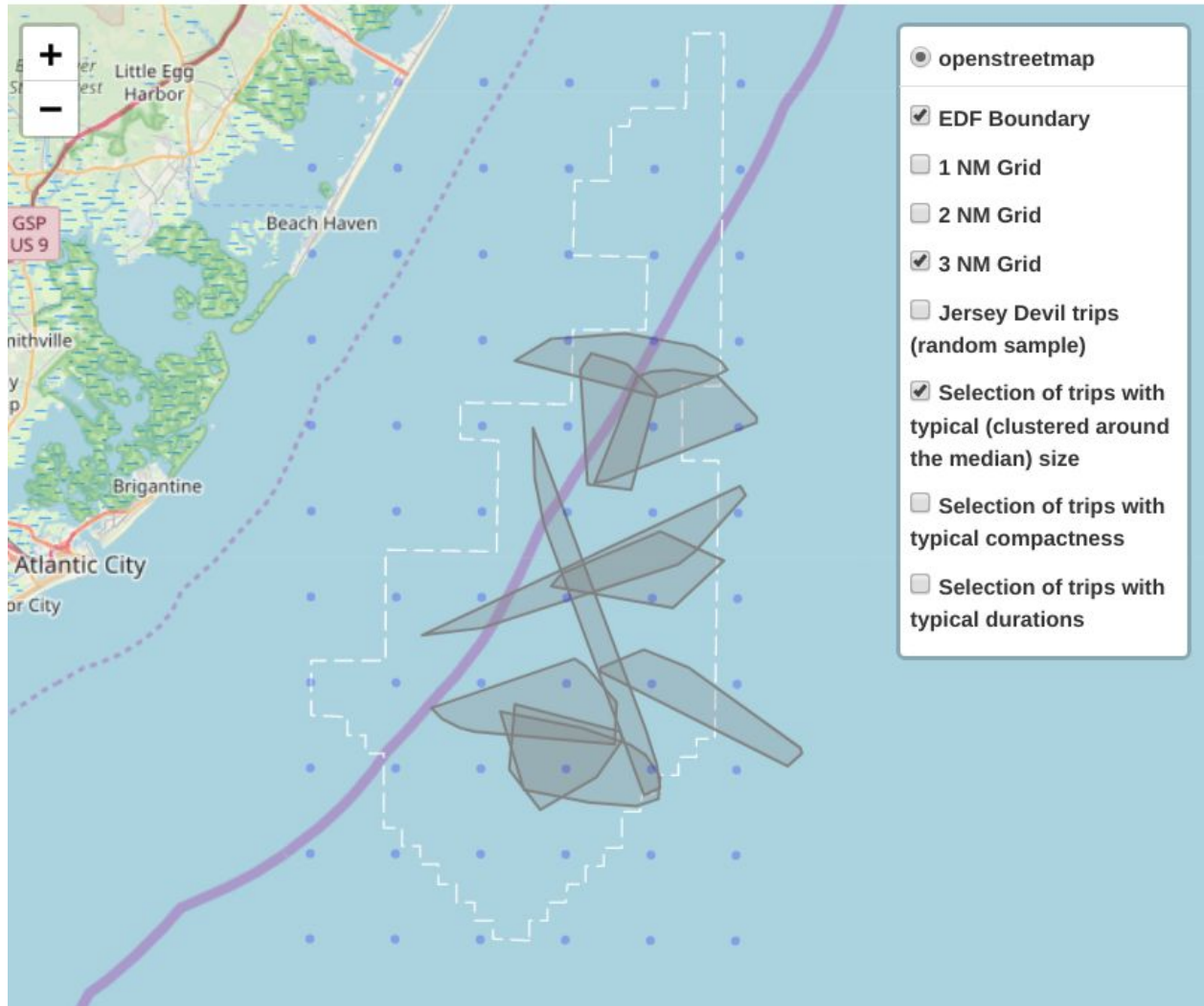
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



Fishing trip shaped within EDF renewable region

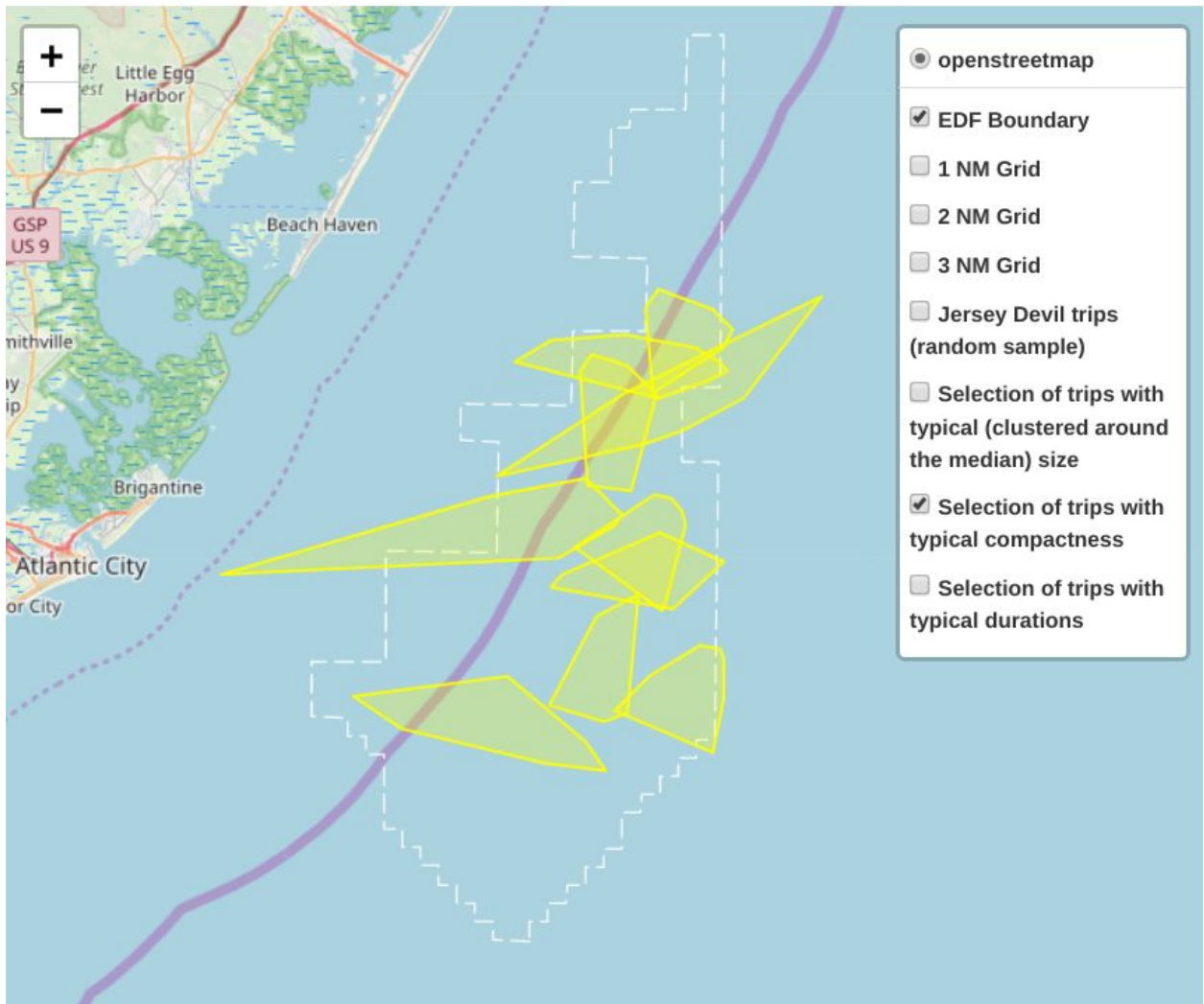
Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



Items B.2 - Compactness

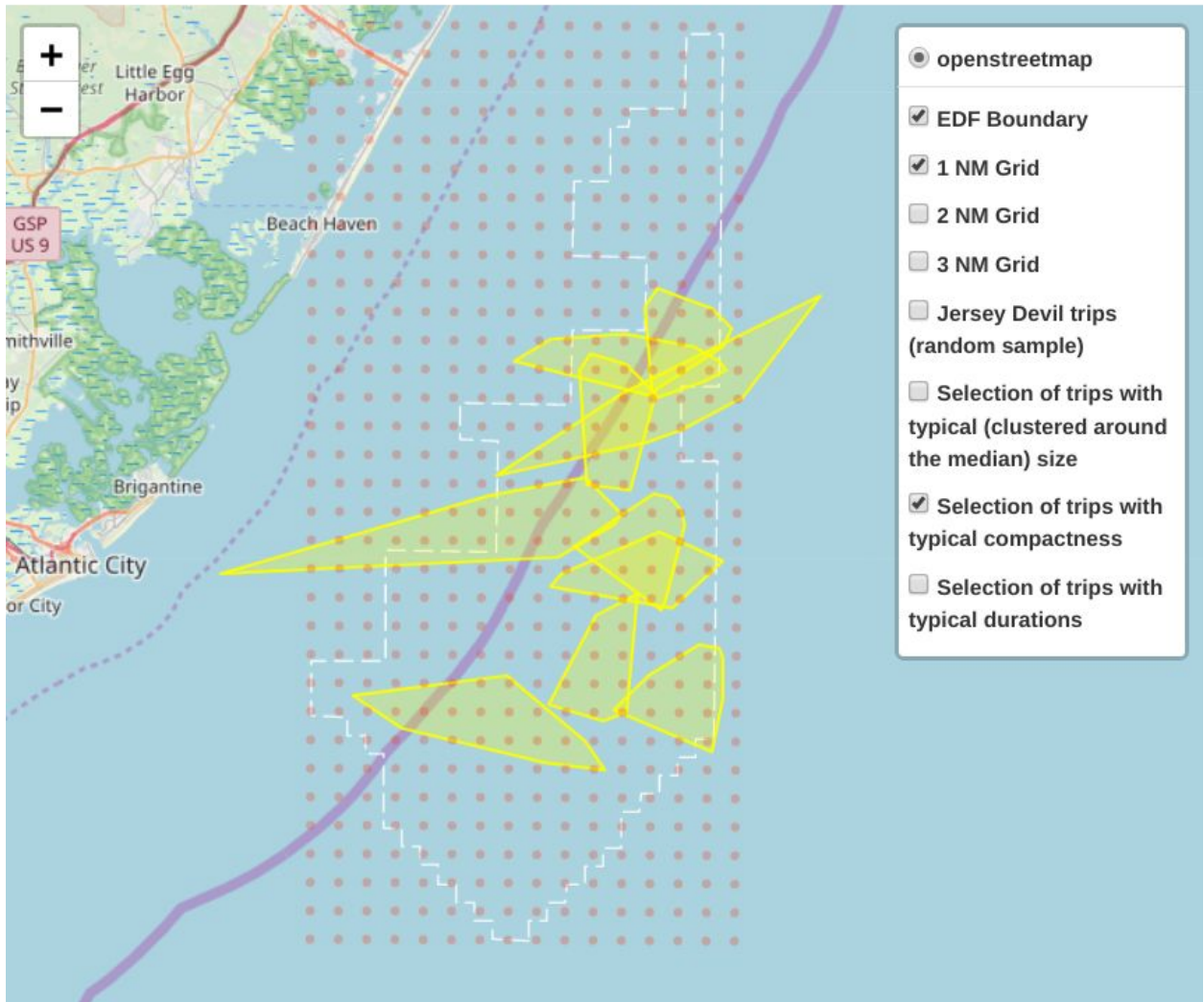
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



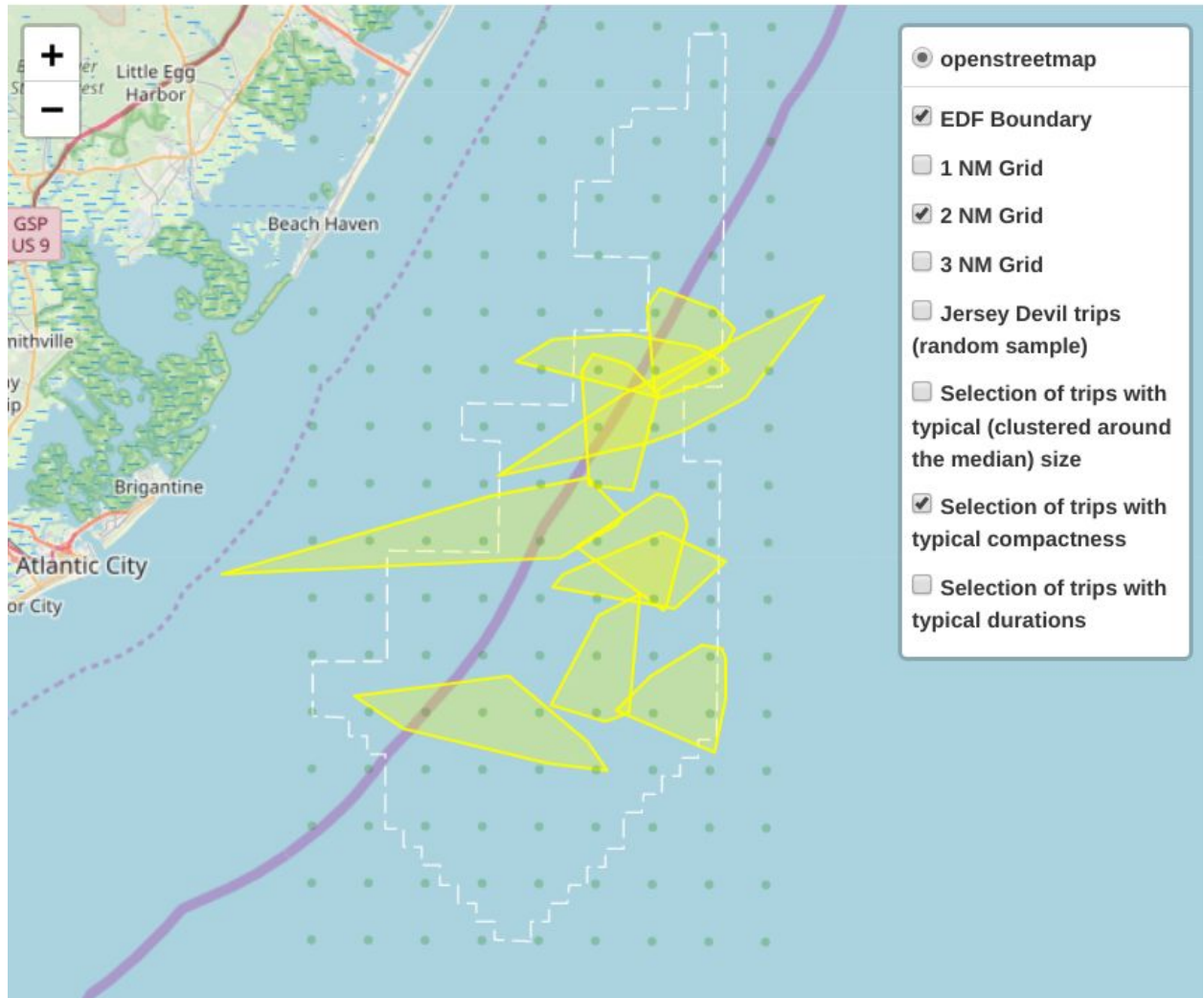
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



Fishing trip shaped within EDF renewable region

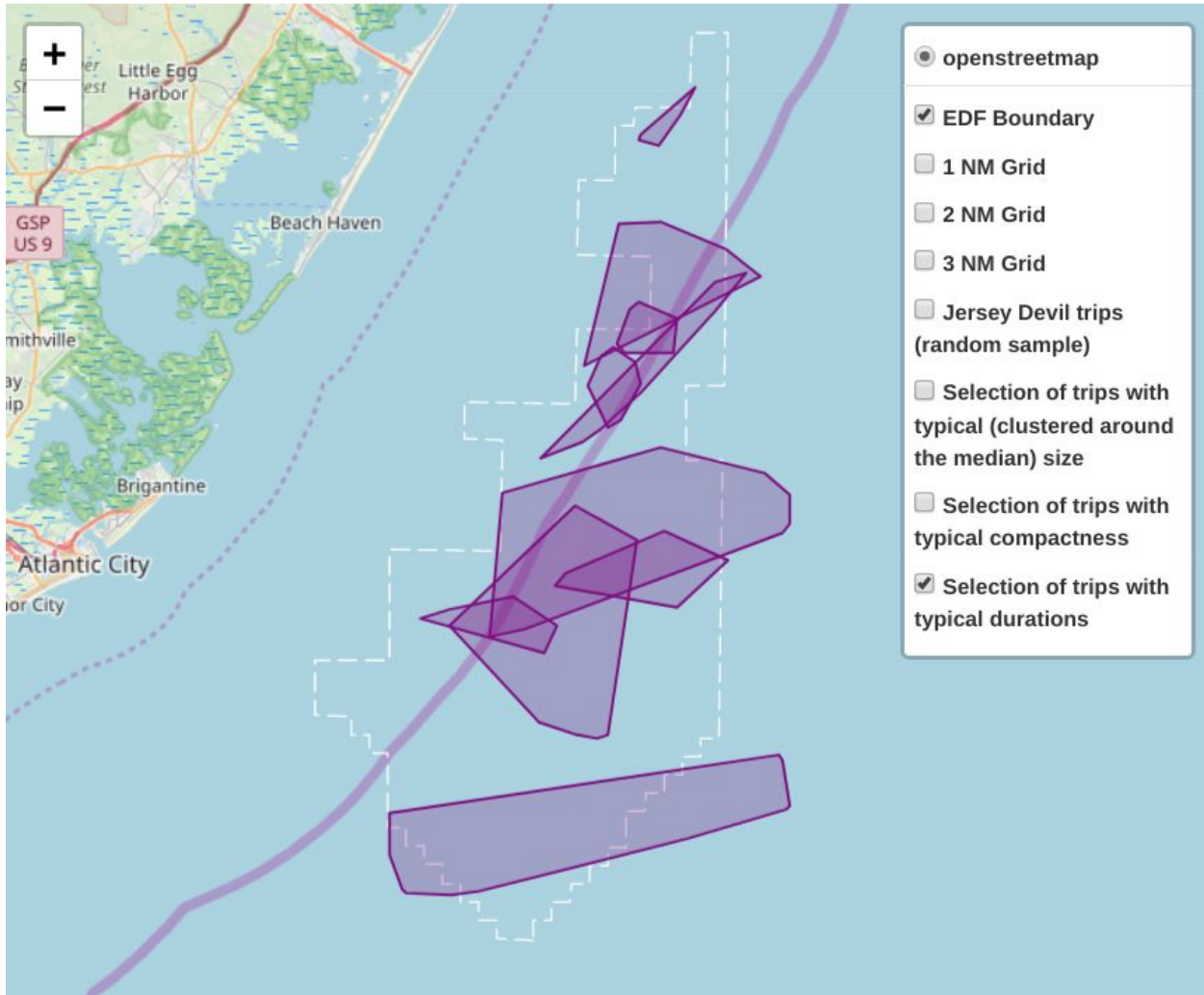
Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



Items B.3 - Duration

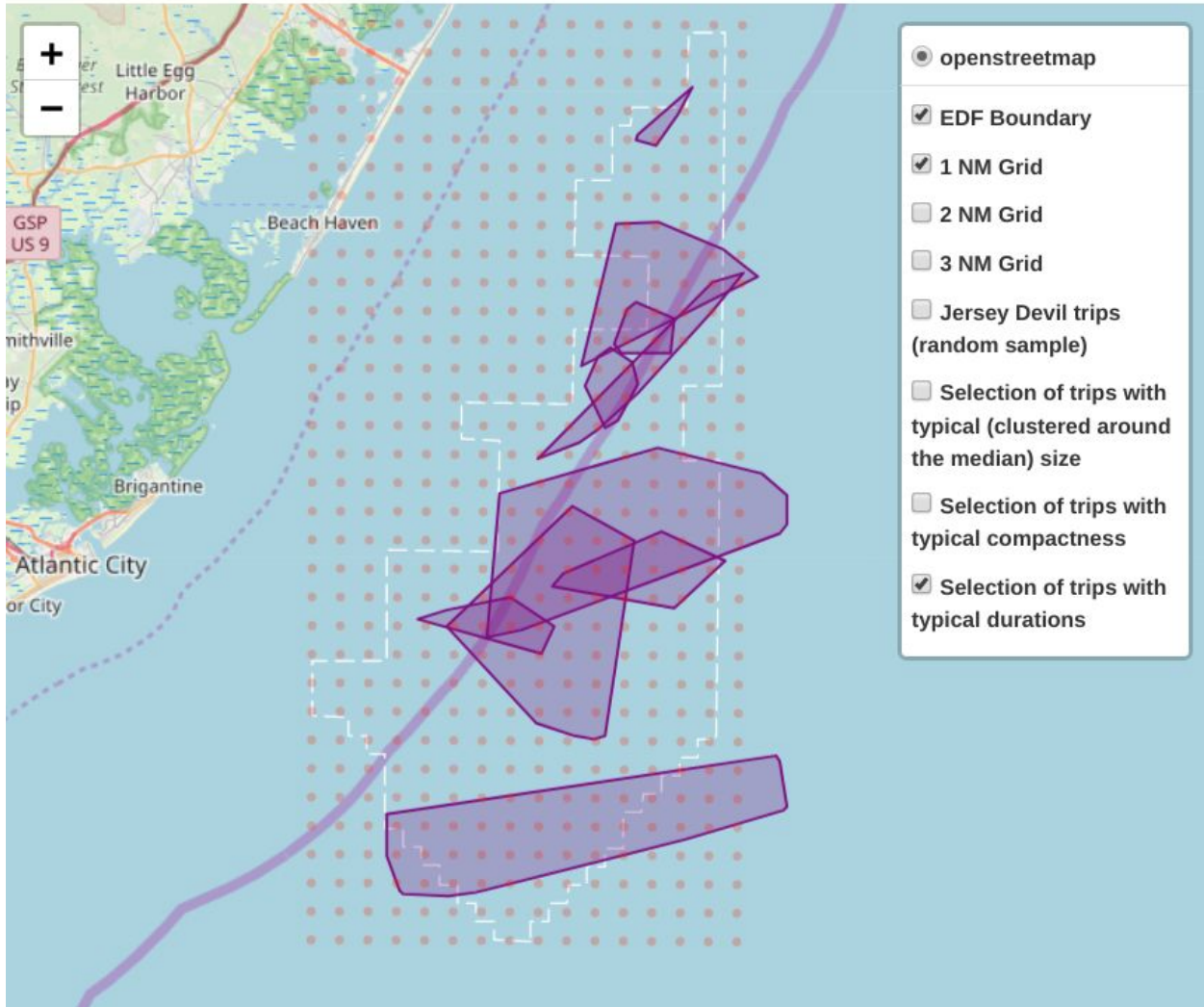
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



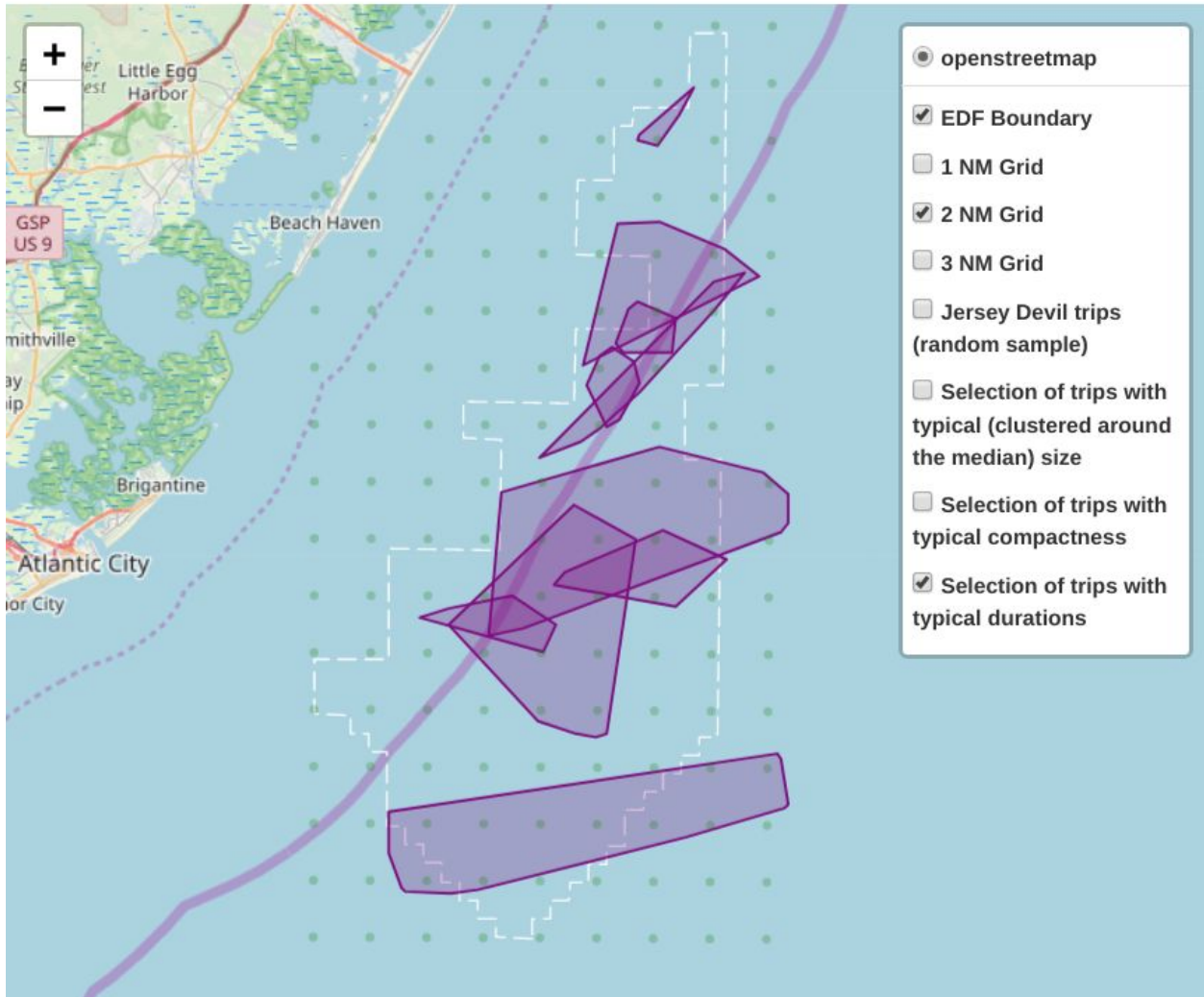
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



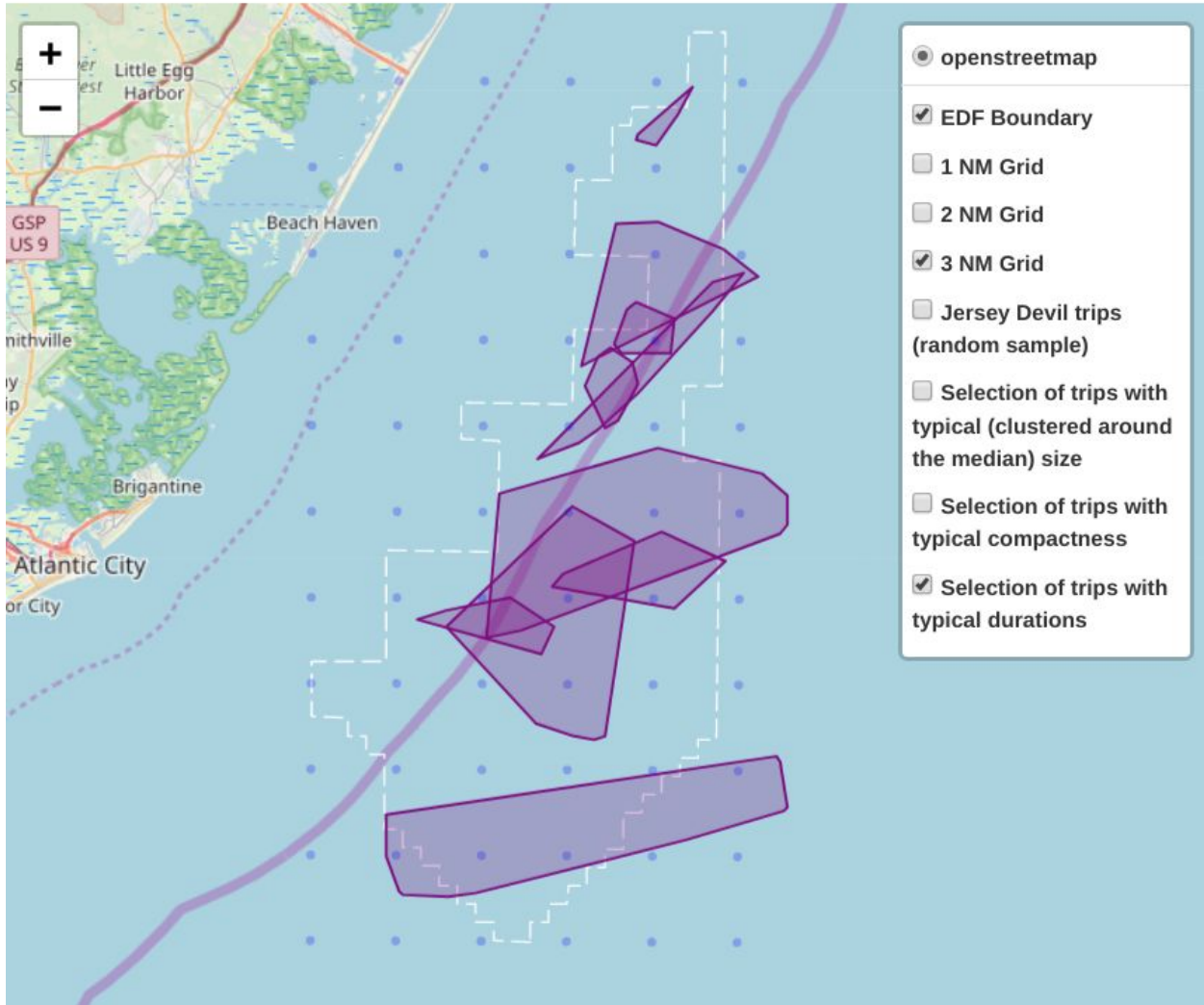
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



Fishing trip shaped within EDF renewable region

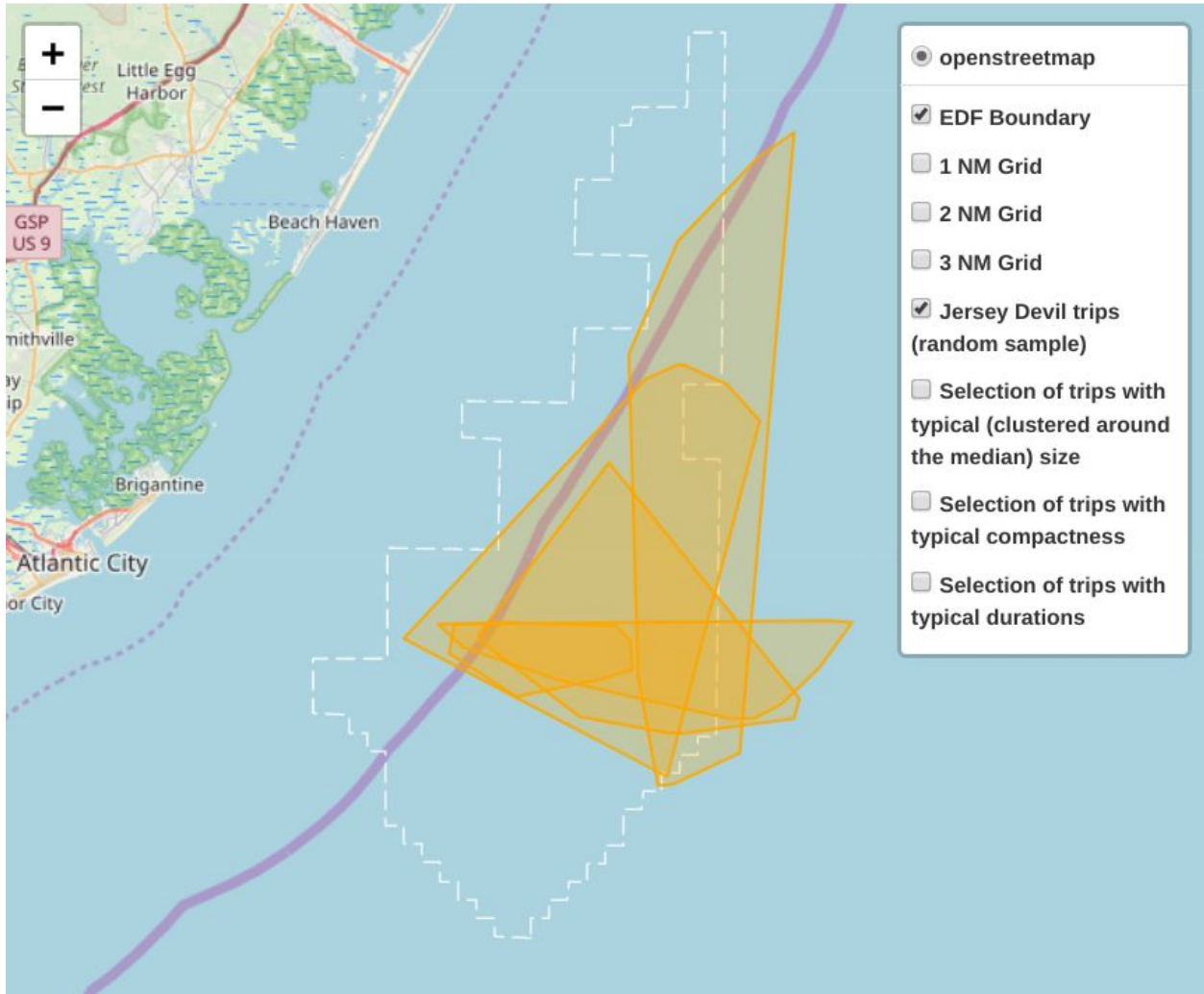
Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



Items B.4 - Jersey Devil

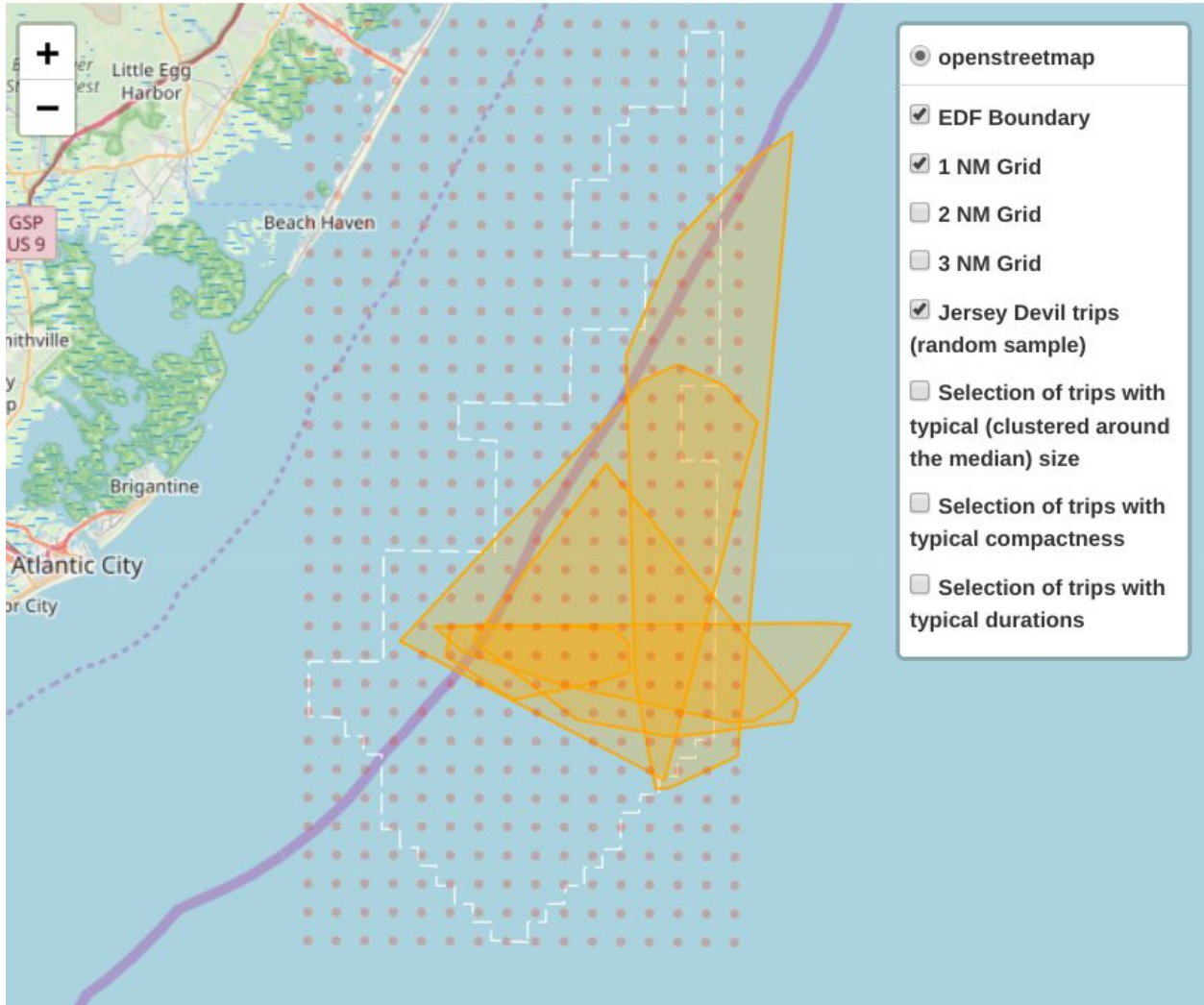
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



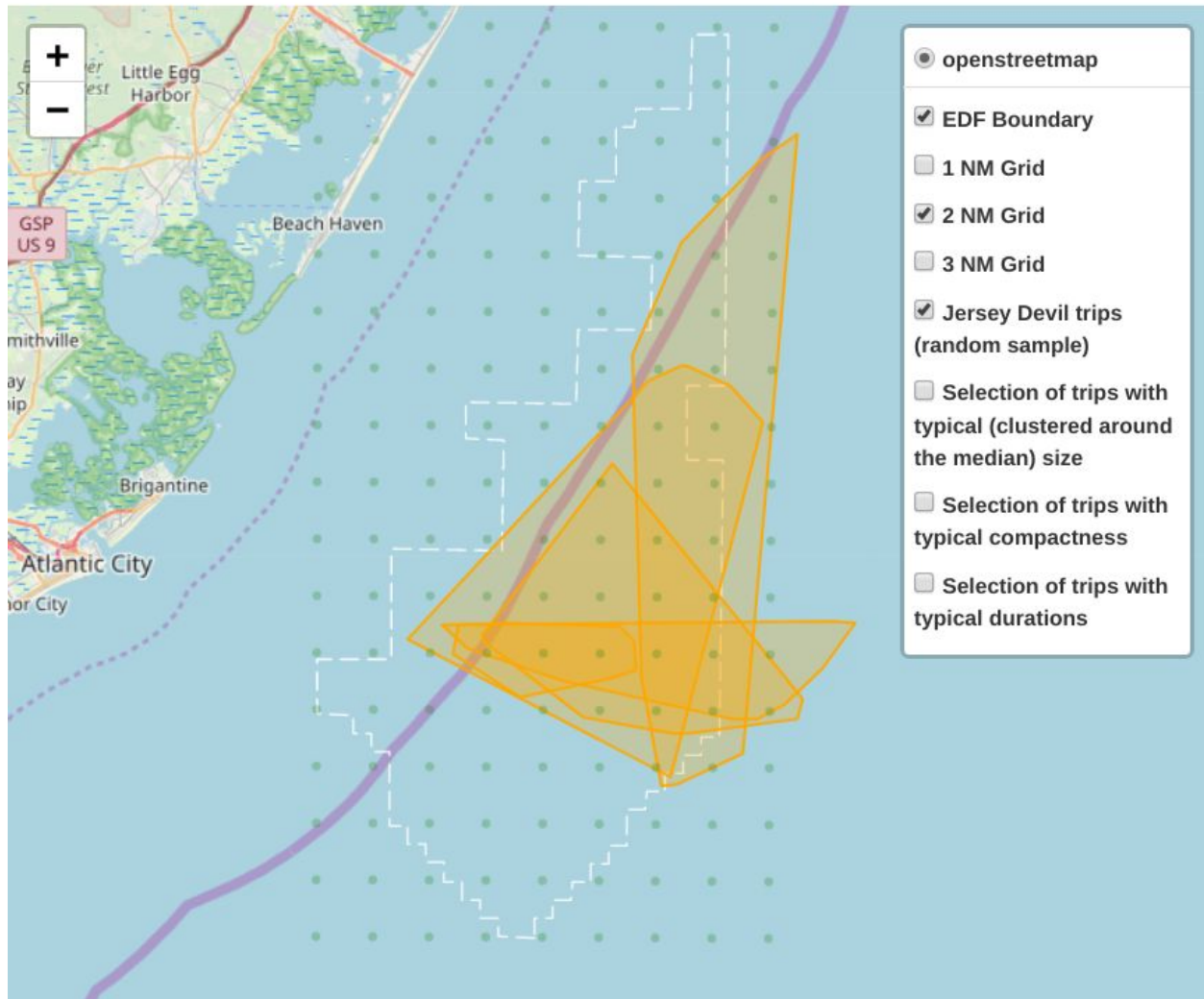
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



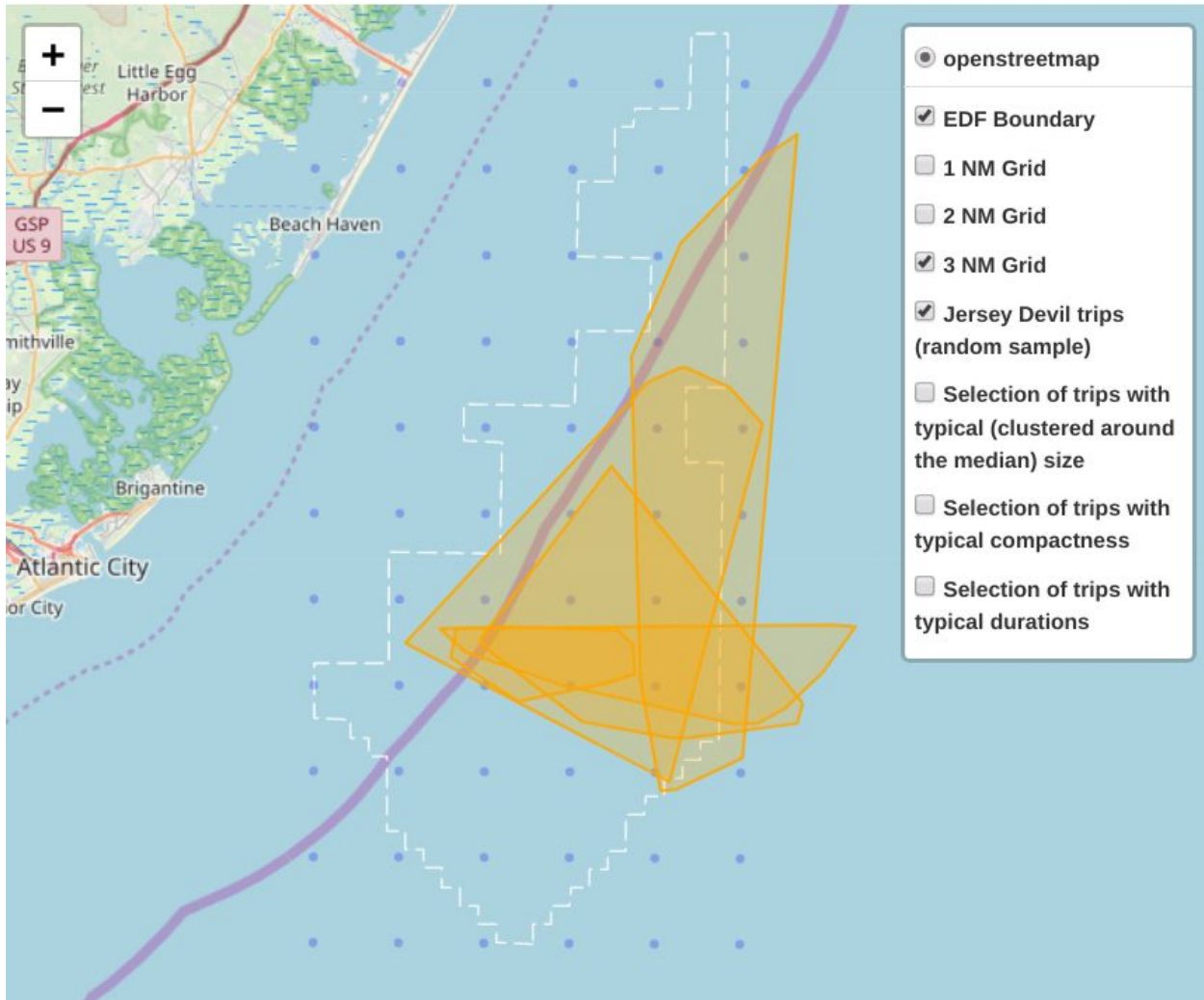
Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



Fishing trip shaped within EDF renewable region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 20-28 hours long



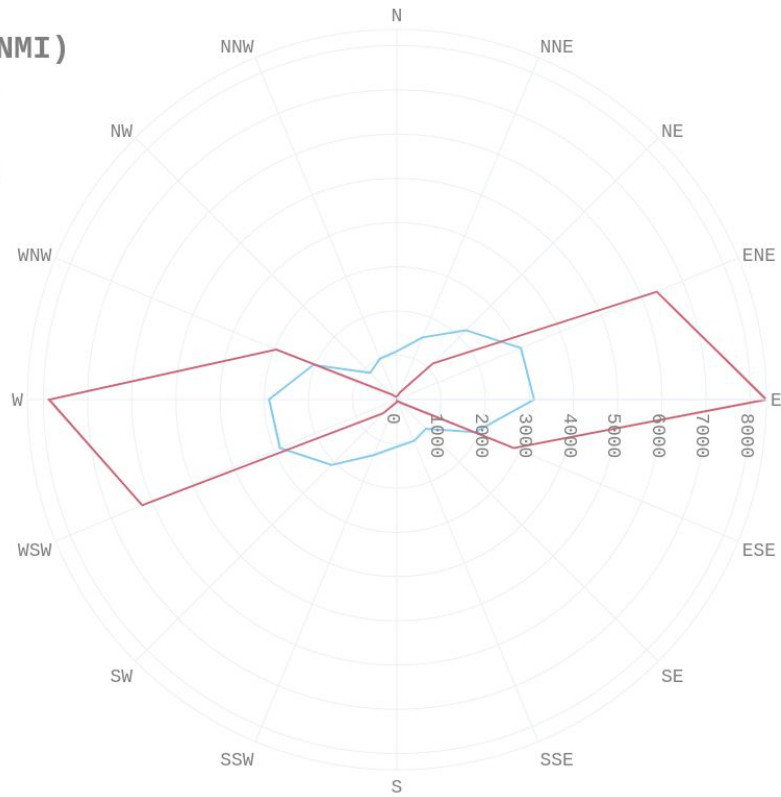
(C) Polar plots

Item C.1

Total distance (NMI) traveled in each direction

By movement type (towing vs. transit); all boats; years 2008-2019

Movement Type
— towing
— transit

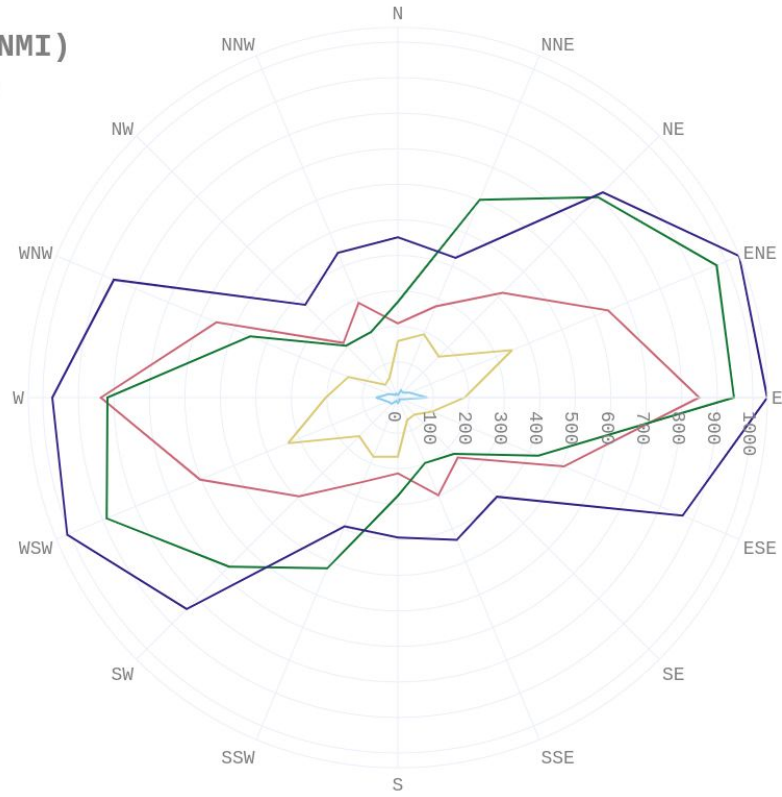


Item C.2

**Total distance (NMI)
traveled in each
direction**

By boat; towing only;
years 2007-2019

- Boat
- Nicole Danielle/
 - Miss Kathy
 - Mary Vee
 - Lauren Kim
 - Jersey Devil
 - Michael Jr



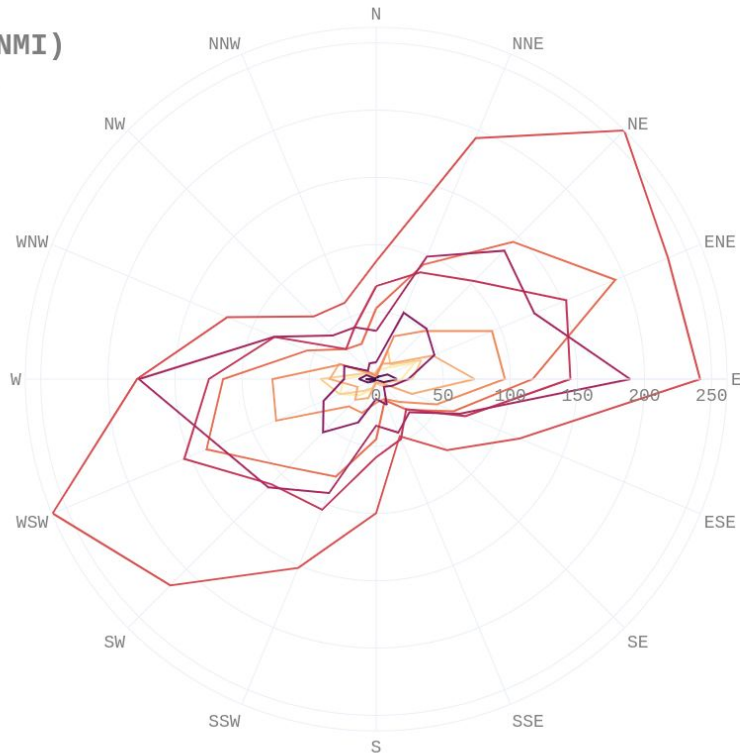
Item C.3

Total distance (NMI) traveled in each direction

"Jersey Devil" only; by year; towing only

Year

- 2011
- 2012
- 2013
- 2014
- 2015
- 2016
- 2017
- 2018
- 2019
- 2009
- 2010
- 2008



(D) EDF Renewable Zone Fishing

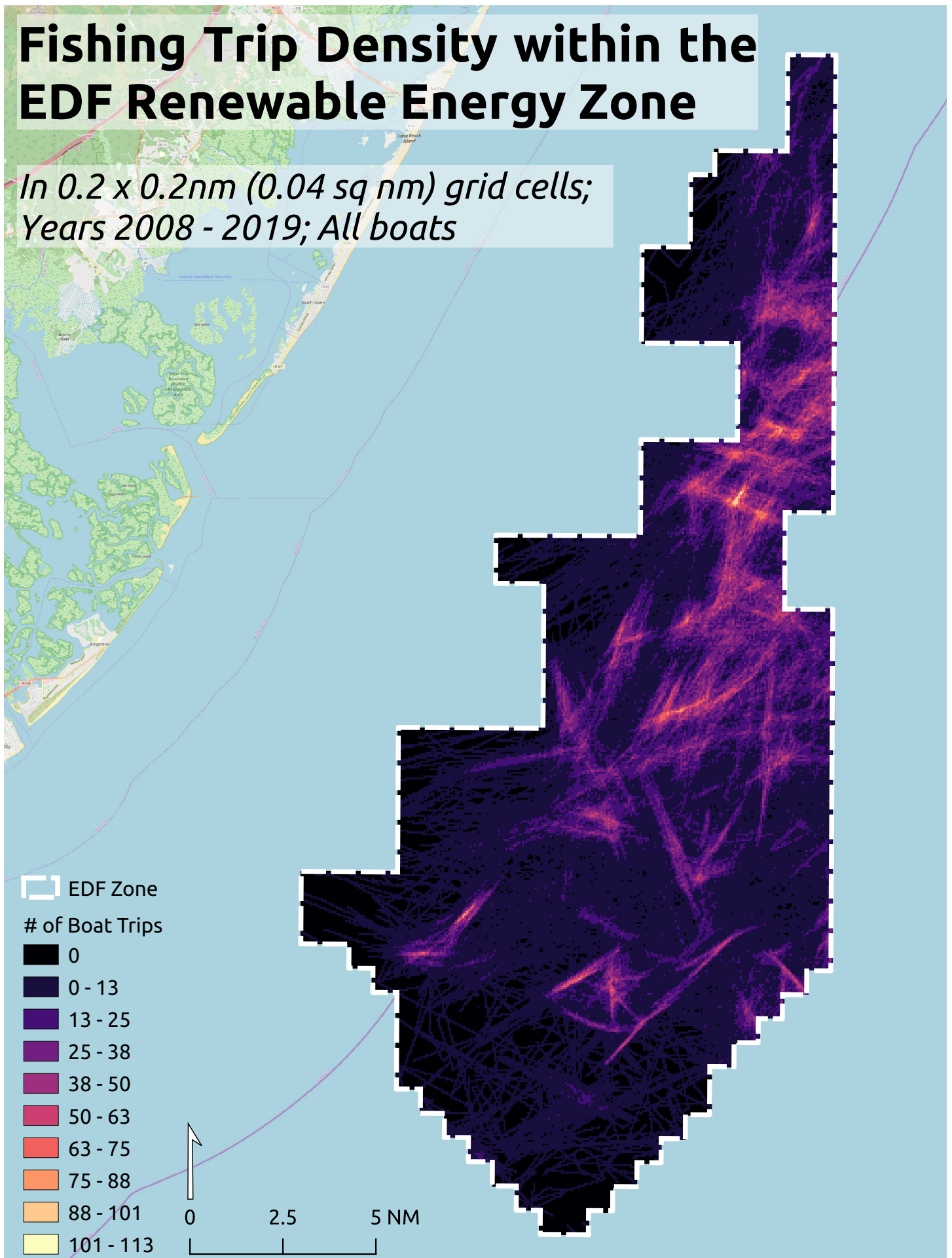
Item D.1

YEAR	% OF FISHING WITHIN EDF
2007	8.2%
2008	1.1%
2009	7.5%
2010	6.8%
2011	1.6%
2012	1.6%
2013	3.2%
2014	3.7%
2015	13.8%
2016	30.0%
2017	26.2%
2018	15.5%

(E) Line density maps

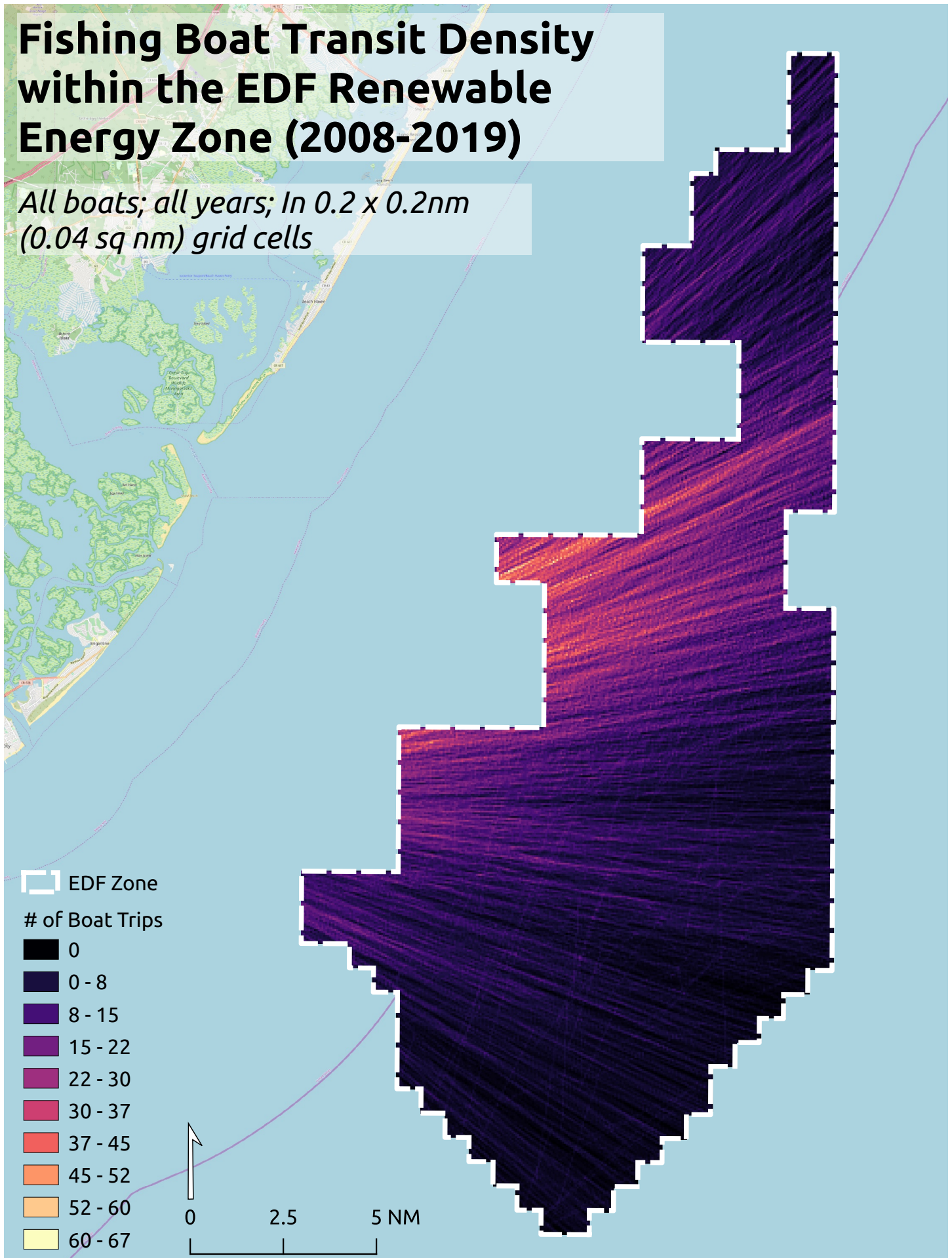
Fishing Trip Density within the EDF Renewable Energy Zone

*In 0.2 x 0.2nm (0.04 sq nm) grid cells;
Years 2008 - 2019; All boats*



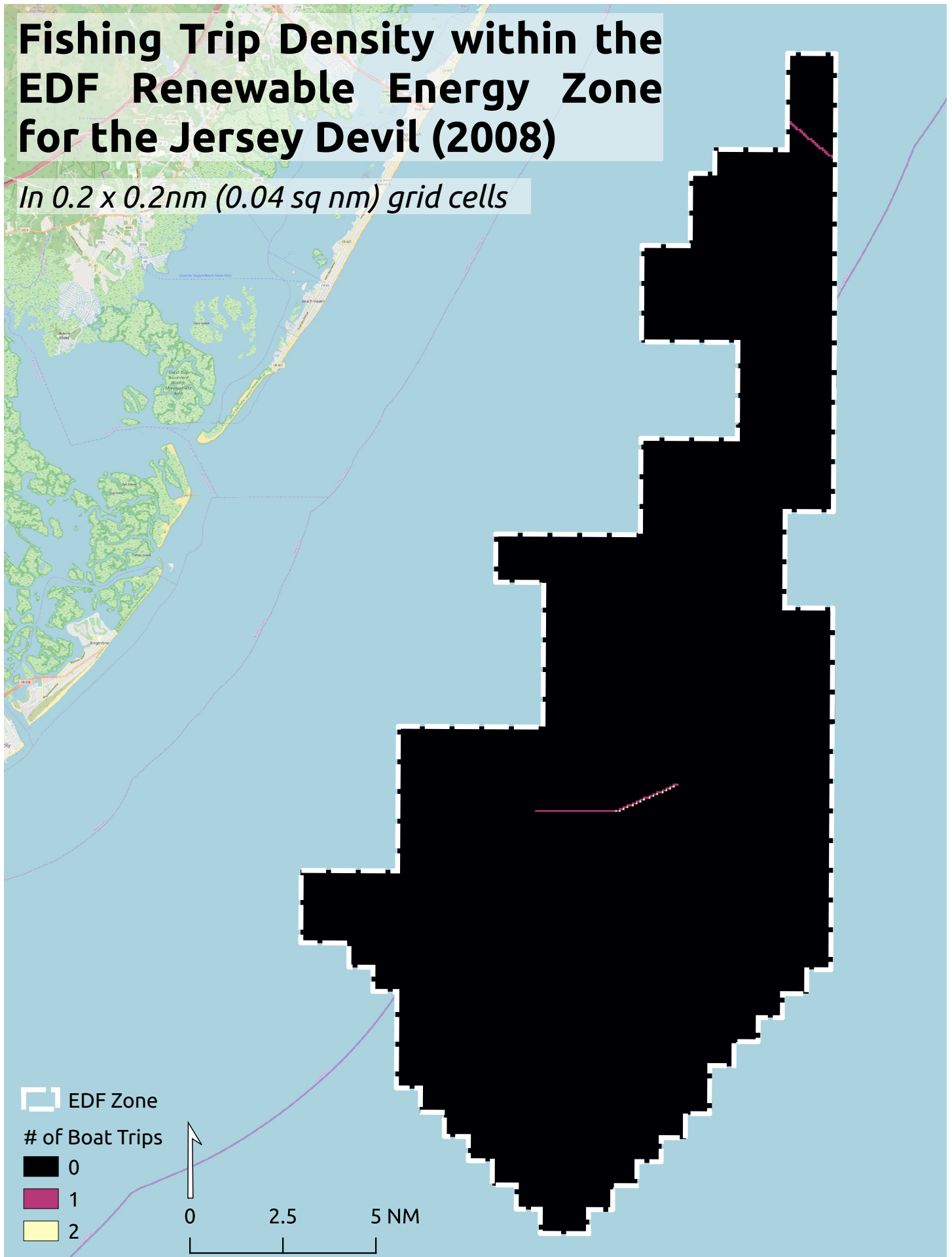
Fishing Boat Transit Density within the EDF Renewable Energy Zone (2008-2019)

All boats; all years; In 0.2 x 0.2nm (0.04 sq nm) grid cells



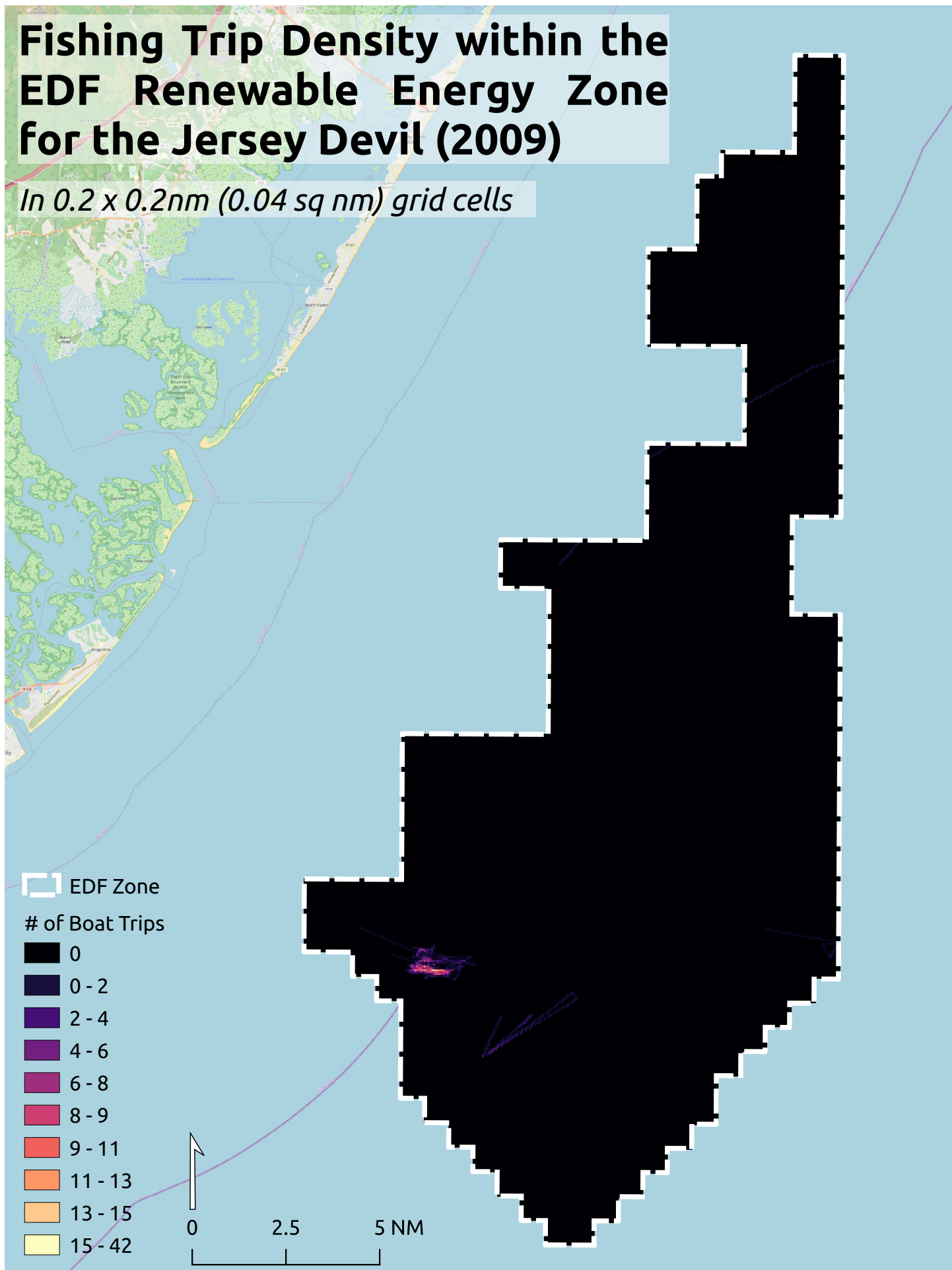
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2008)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



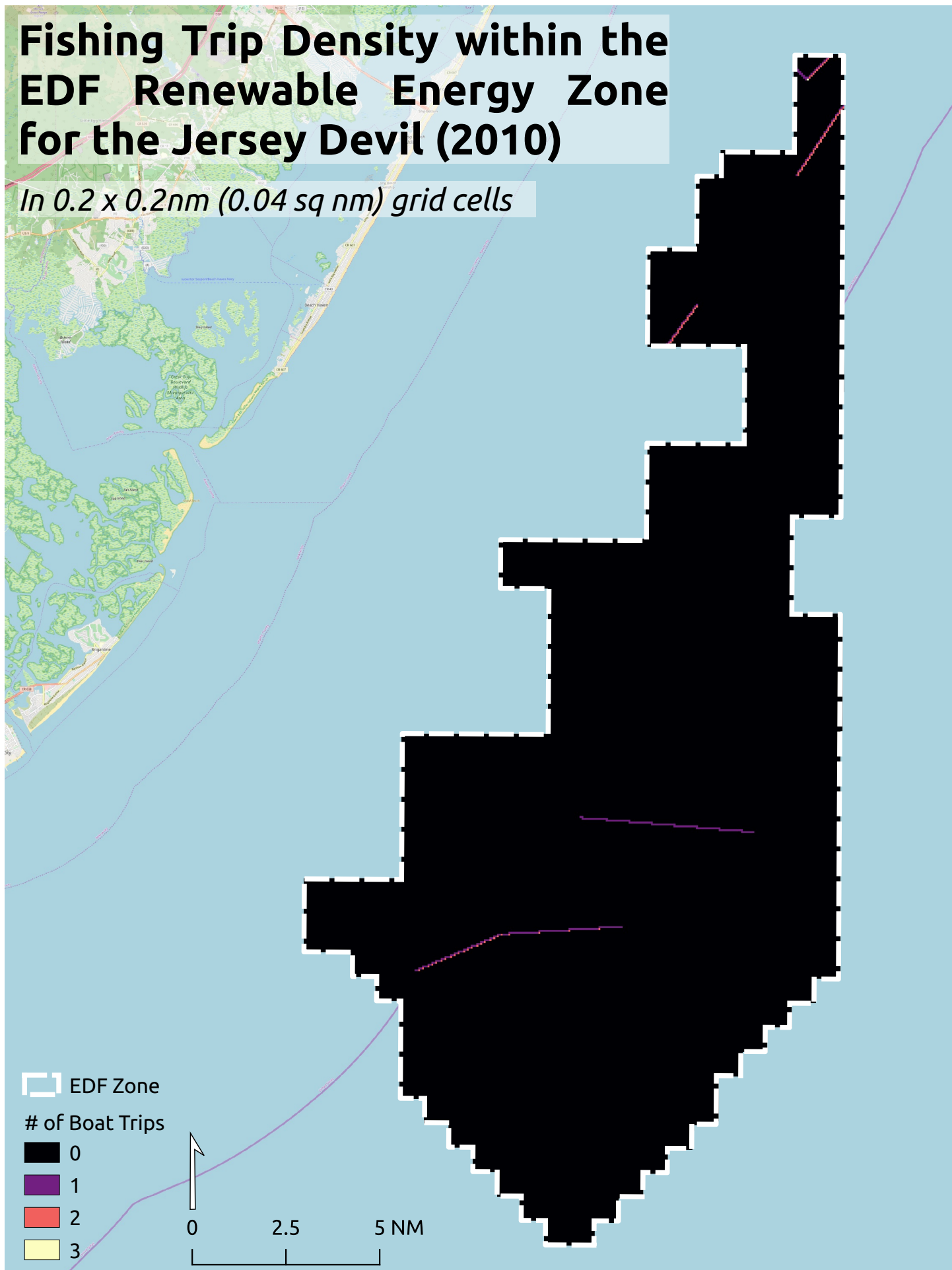
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2009)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



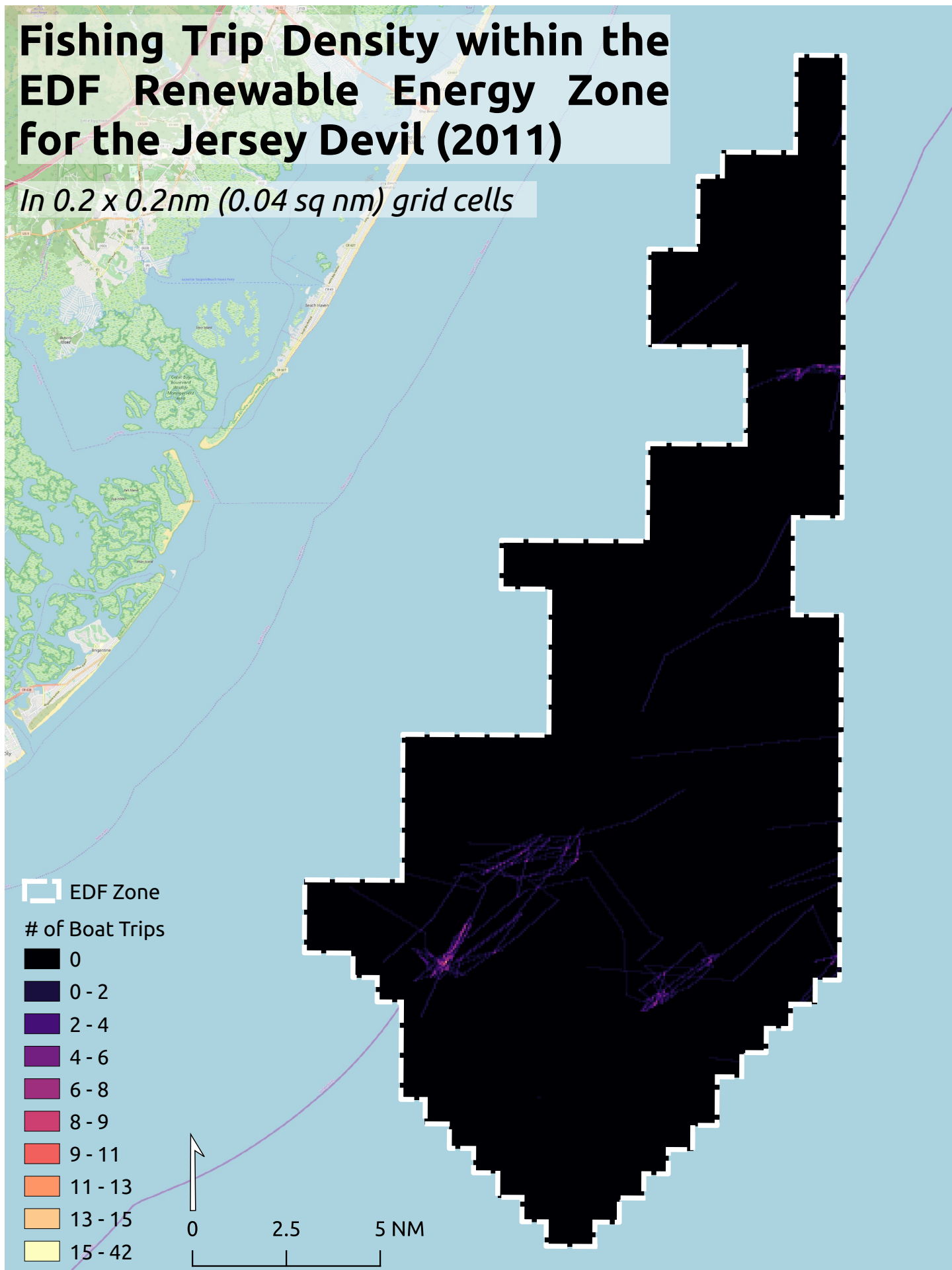
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2010)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



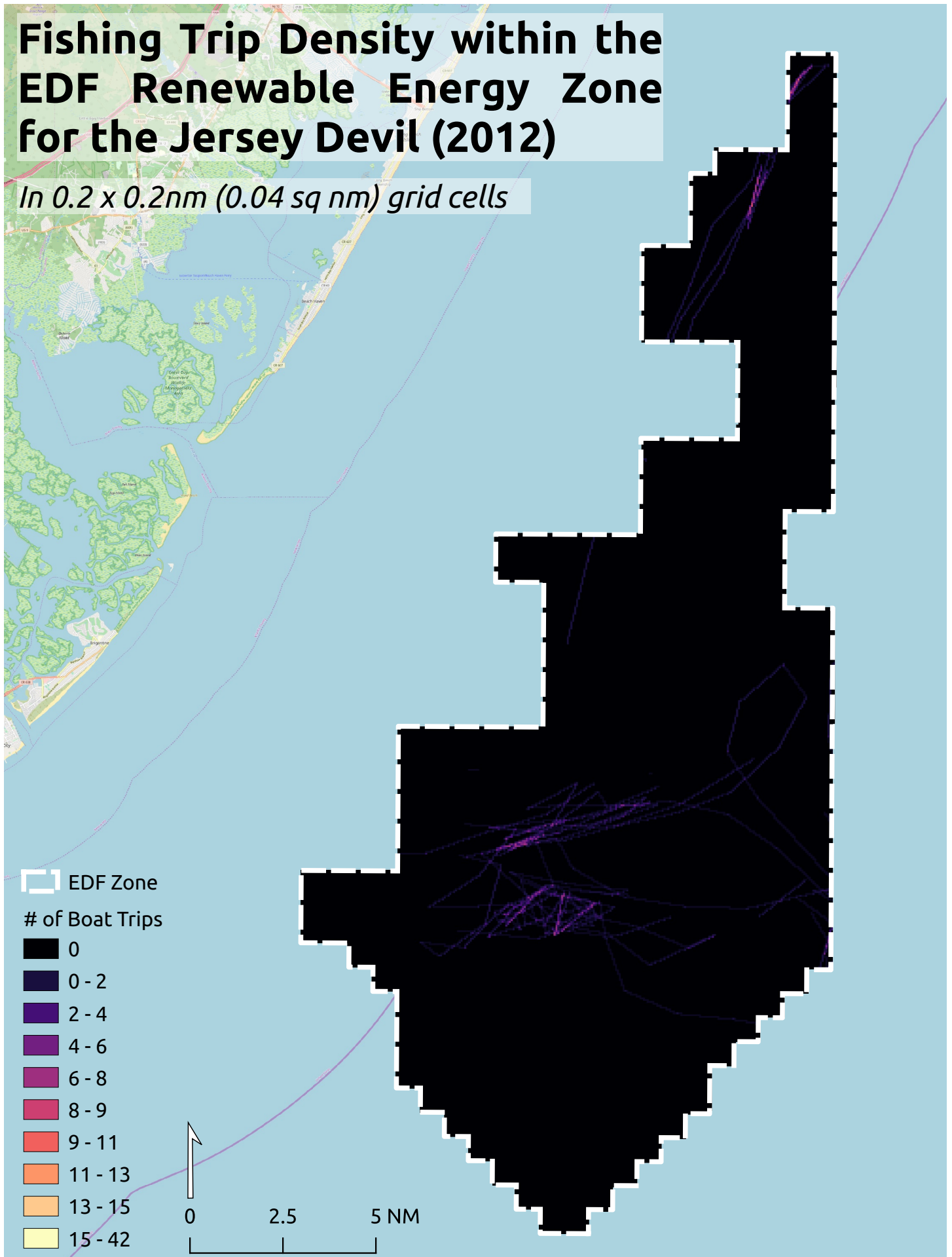
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2011)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



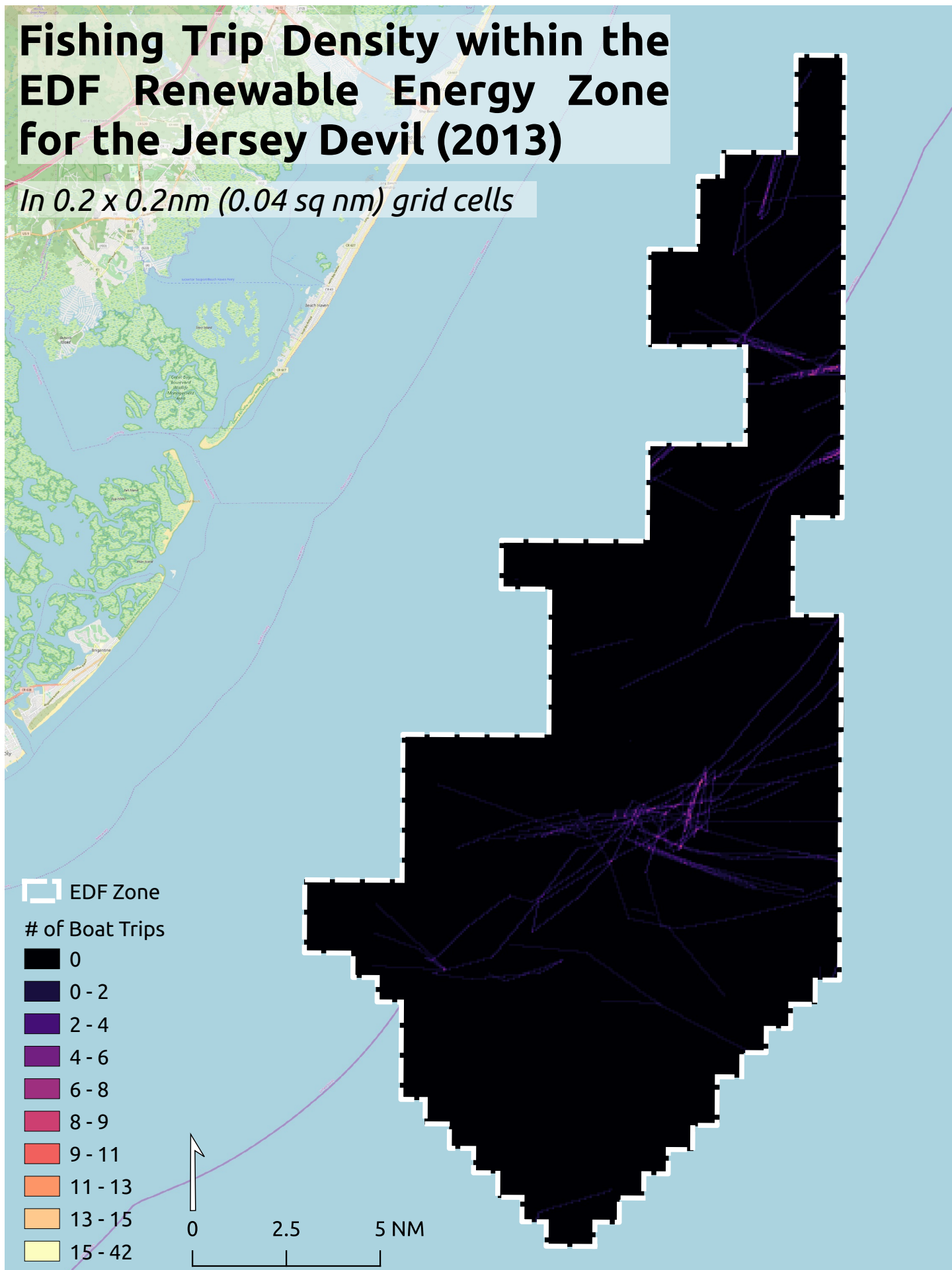
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2012)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



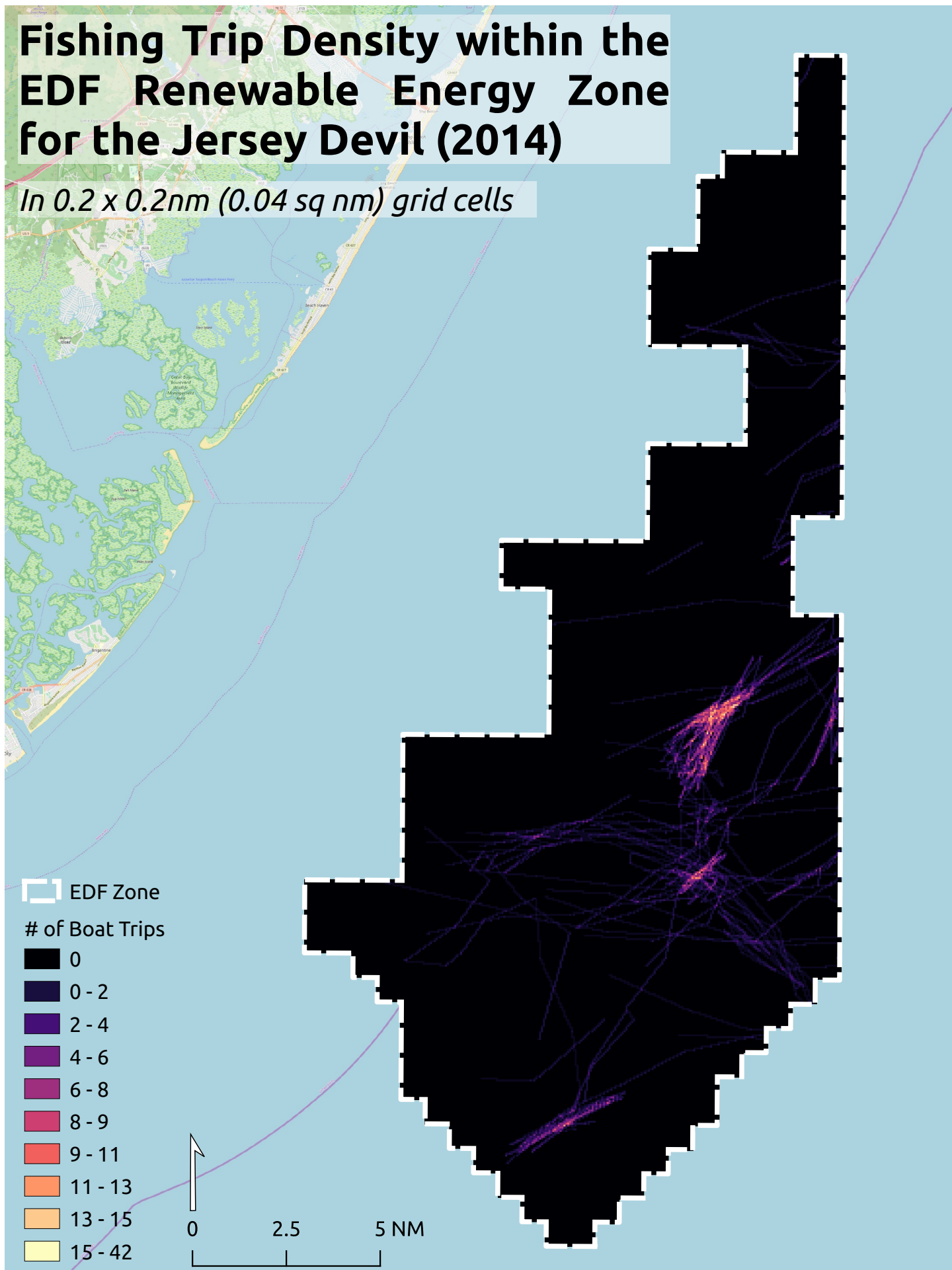
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2013)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



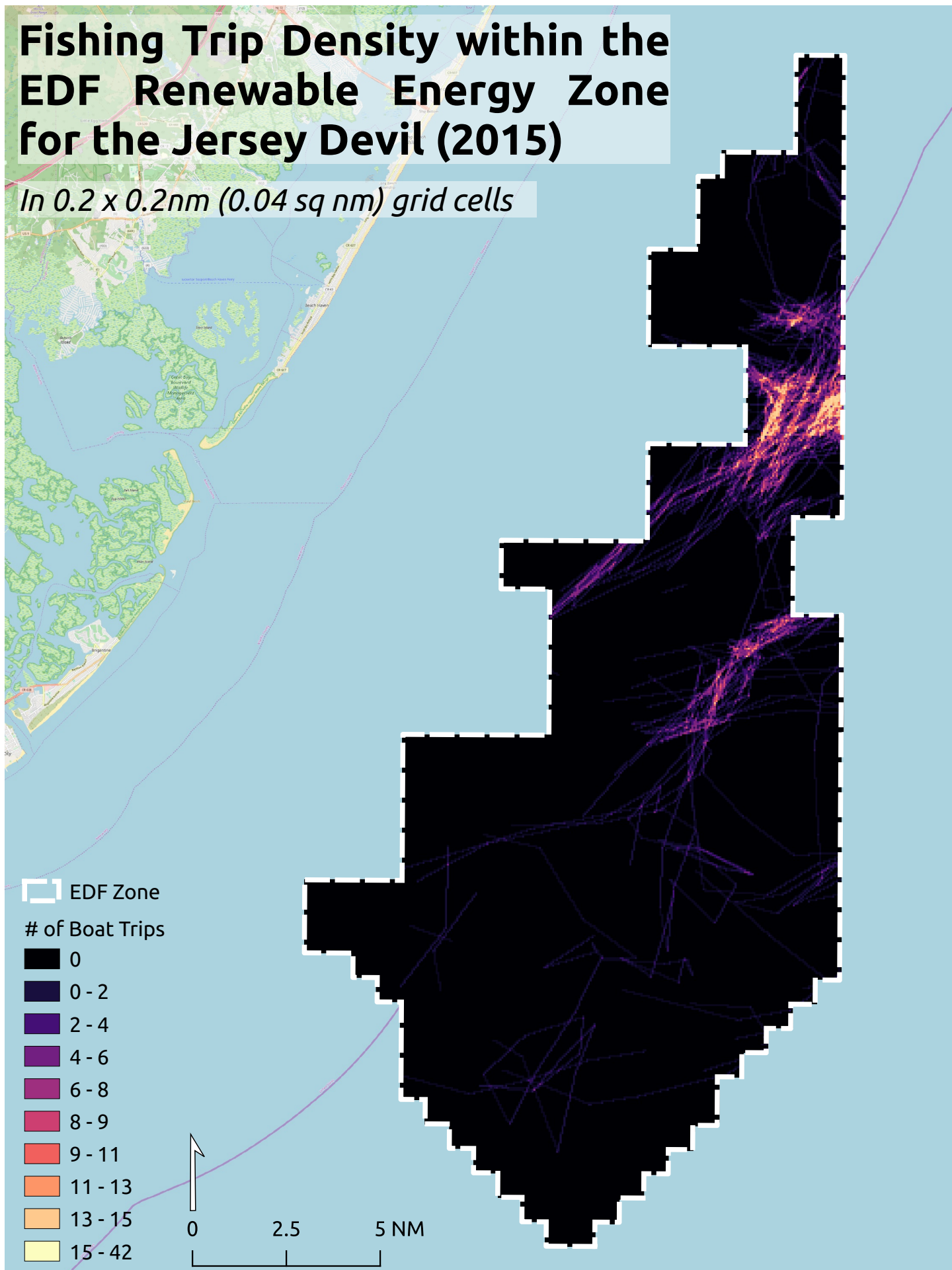
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2014)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



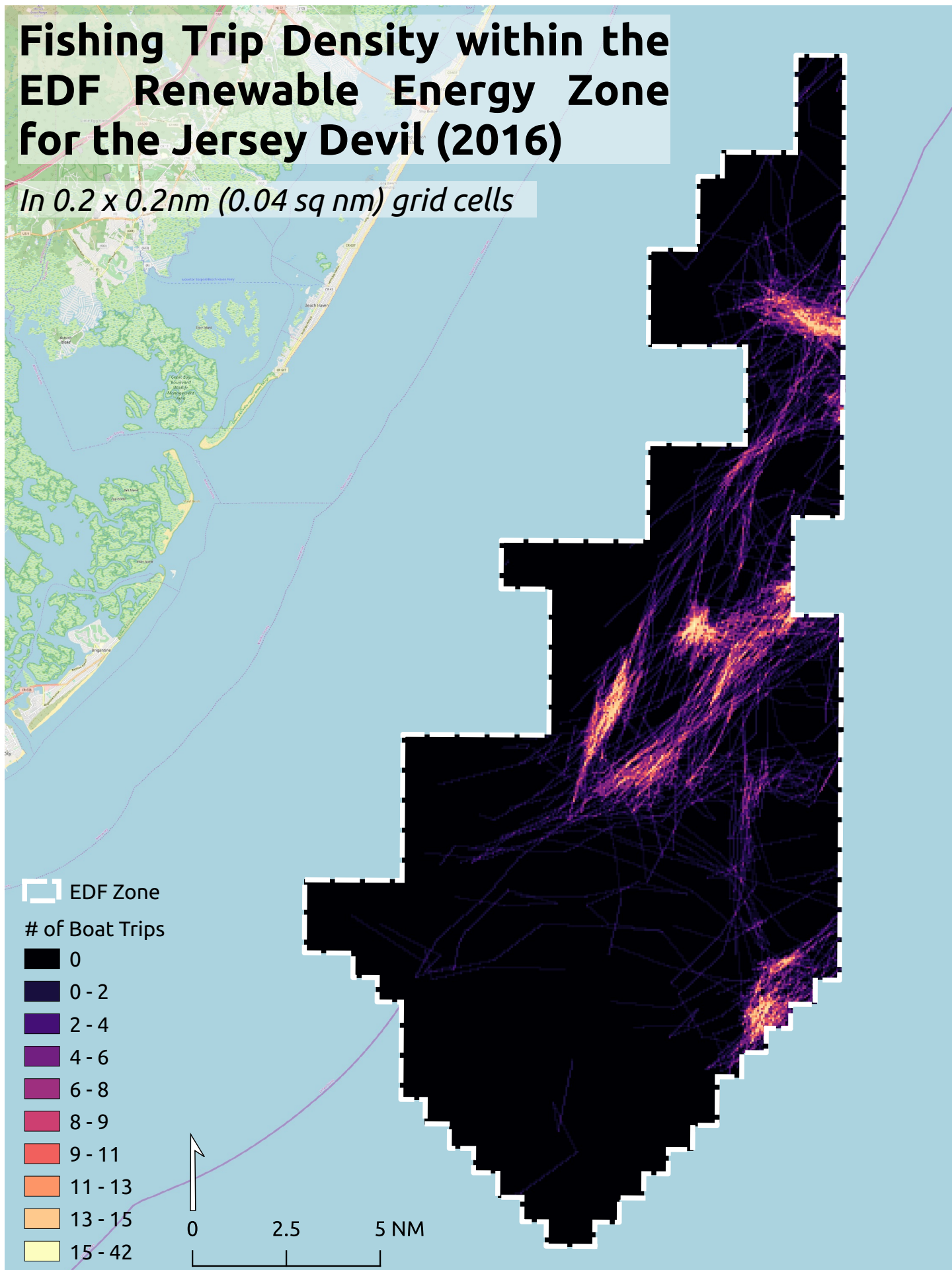
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2015)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



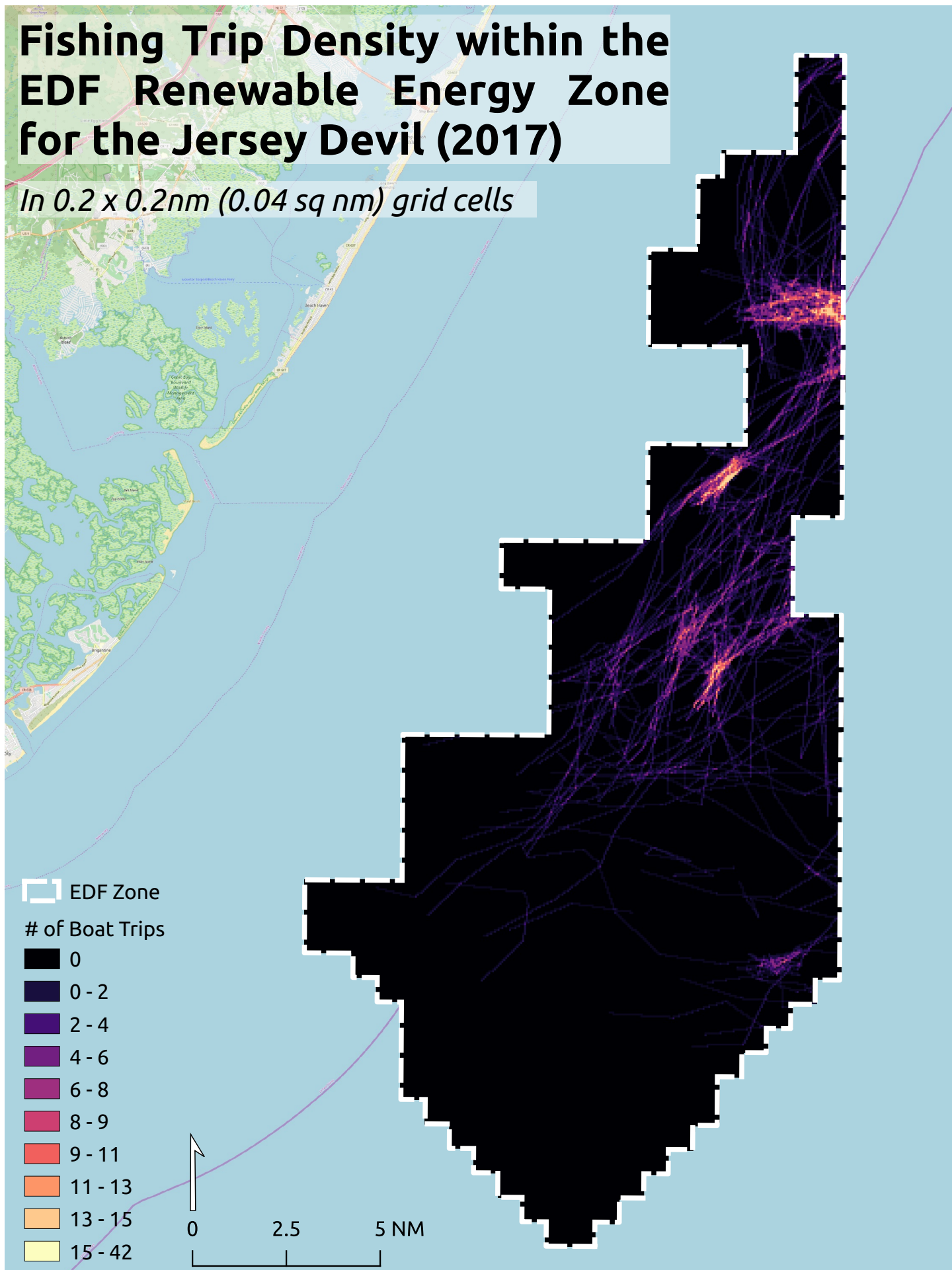
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2016)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



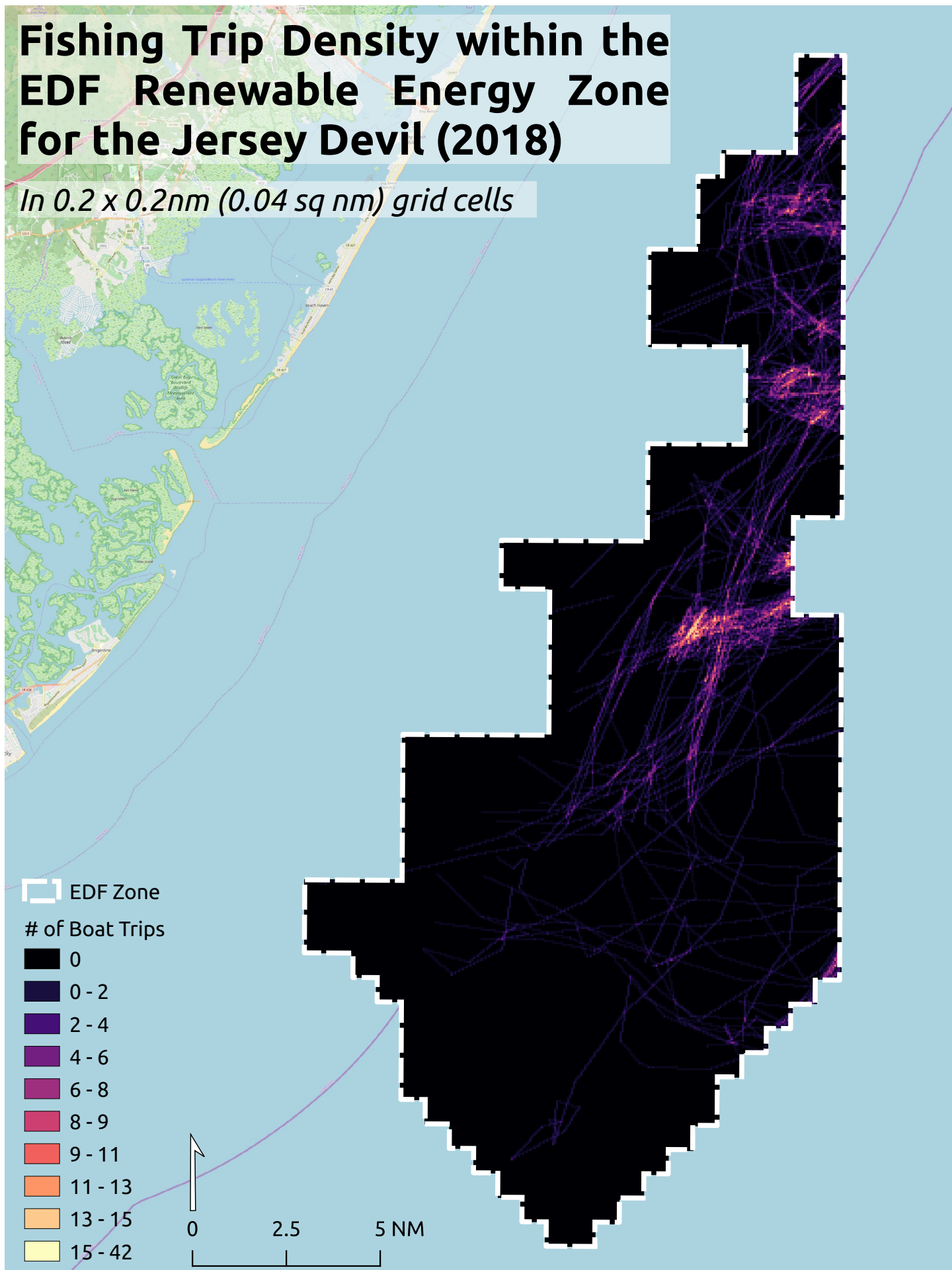
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2017)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



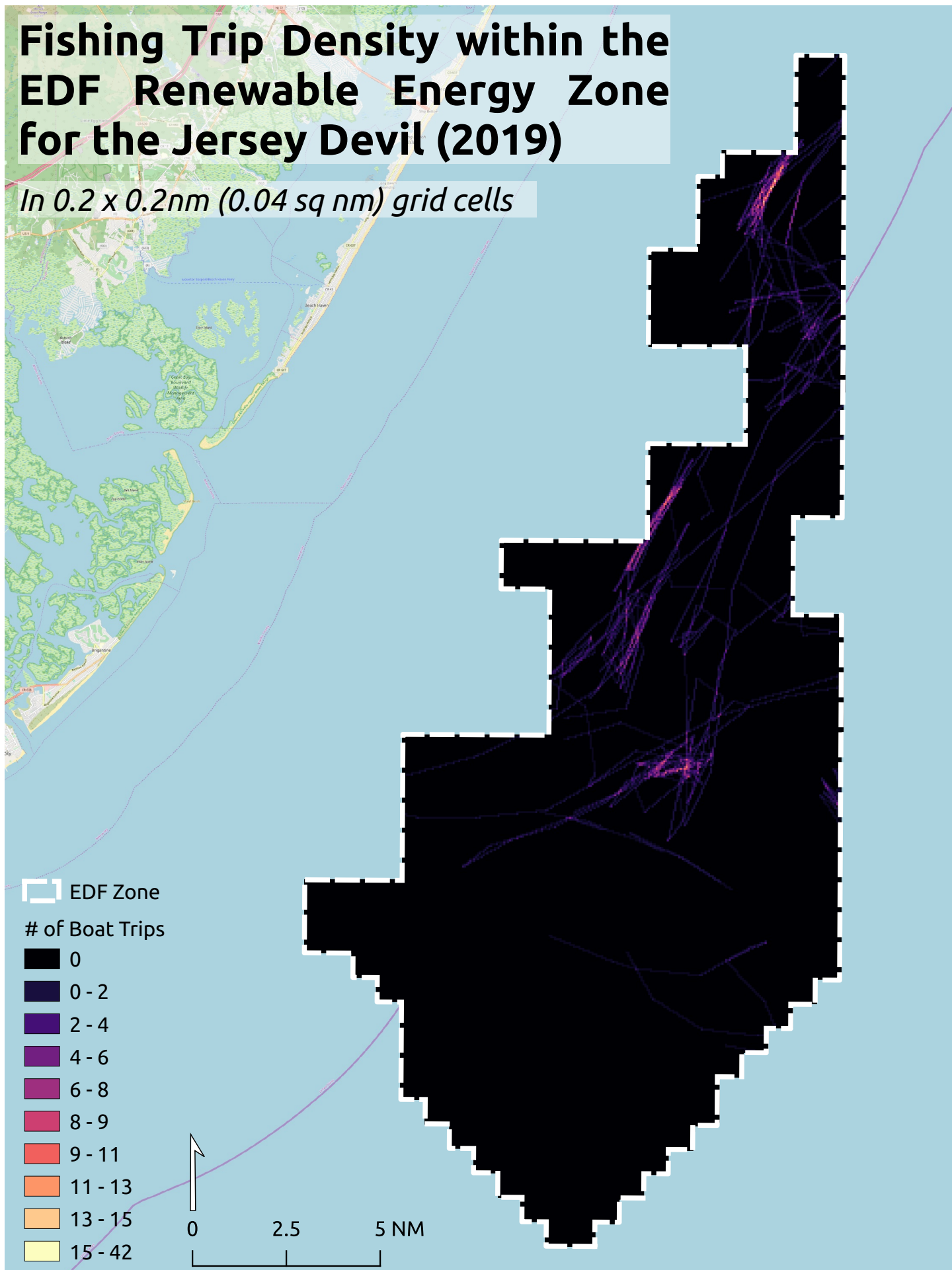
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2018)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



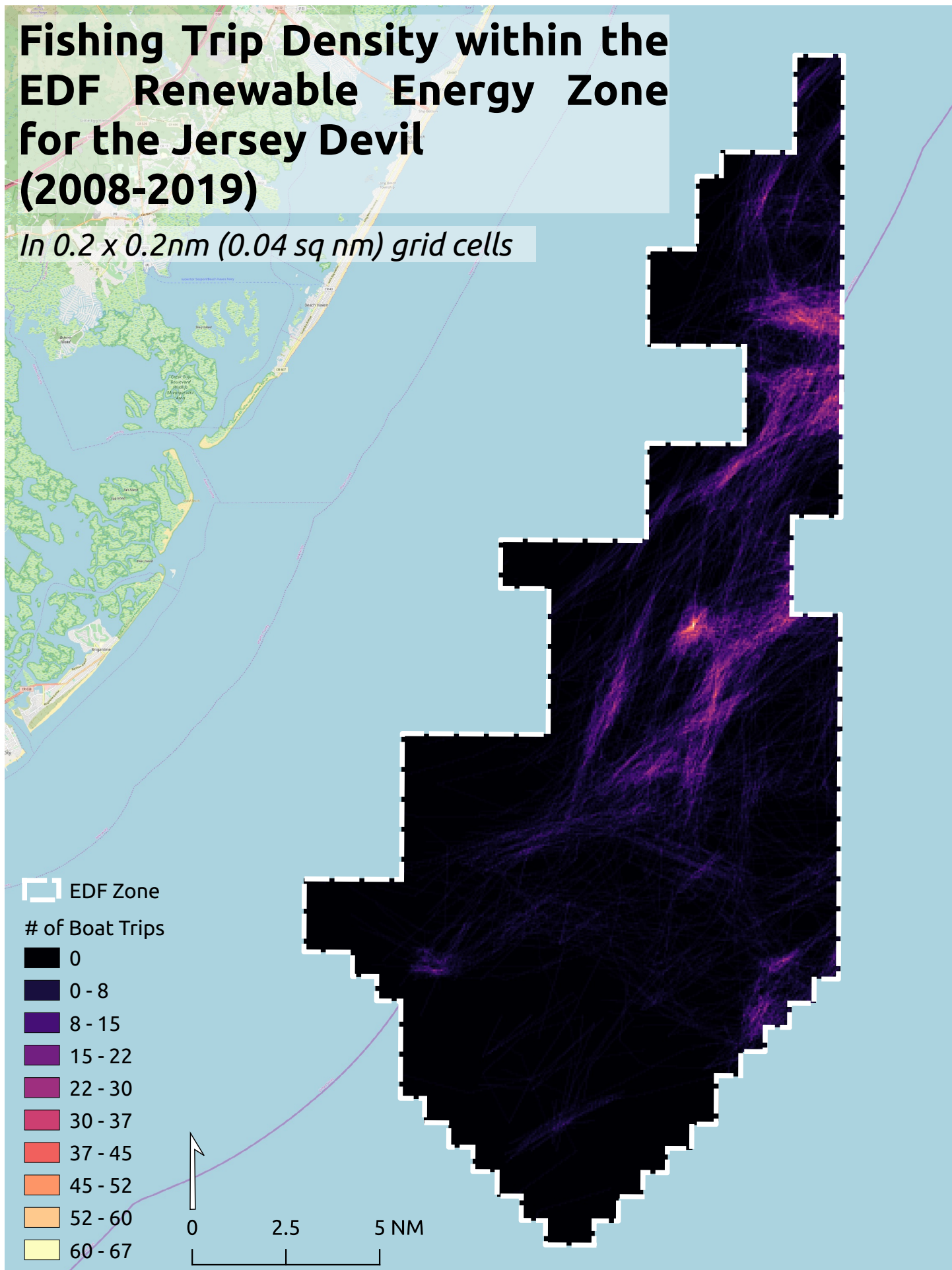
Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2019)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



Fishing Trip Density within the EDF Renewable Energy Zone for the Jersey Devil (2008-2019)

In 0.2 x 0.2nm (0.04 sq nm) grid cells



Last Tow, LLC

Fishing Route Analytics Report: Ocean Wind

Prepared by



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Overview

Last Tow LLC is working to help plan for wind turbine development that will be minimally disruptive to local fishing operations.

This is the second Fishing Route Analytics Report that has been compiled. For the first report, Azavea was contracted by Last Tow to perform analytics on past fishing trips within the Atlantic Shores leasing area. The objective was to help give LaMonica Fine Foods a better understanding of the spatio-temporal characteristics of these fishing trips which will help inform Atlantic Shores' placement of wind turbines and inter-array cables.

In the second Fishing Route Analytics Report, Last Tow contracted Azavea to reproduce the same analysis for the Ocean Wind leasing area. This report outlines the work and findings for the Ocean Wind analysis.

Trip data

This section describes the format of the dataset and analysis process in detail. The process that this section describes was designed during the creation of the first report project and applied to the Ocean Wind analysis. The graphics represent examples from Atlantic Shores but illustrate the same dynamics as Ocean Wind.

Last Tow provided NOAA Vessel Monitoring System (VMS) point data of periodic time stamped locations for each ship. Approximate trip paths were generated by arranging the points in chronological order and then connecting them. In the absence of actual travel path data, the ships were assumed to have traveled in a straight line from each point to the subsequent one. For each segment, estimates were calculated for speed and direction based on the coordinates and timestamps of the starting and ending points.

Classifying fishing and transit segments

For the purpose of the analysis, it was necessary to separate the 'transit' (i.e. travel to and from fishing locations) from the 'towing' (i.e. engaged in active fishing) segments. The raw point data did not include a record of the fishing status of the boat at that time so each segment needed to be classified into these two categories. At the suggestion of Last Tow, all segments in which the boat was traveling at an estimated speed of four knots or fewer were classified as towing and the rest were labeled as transit.

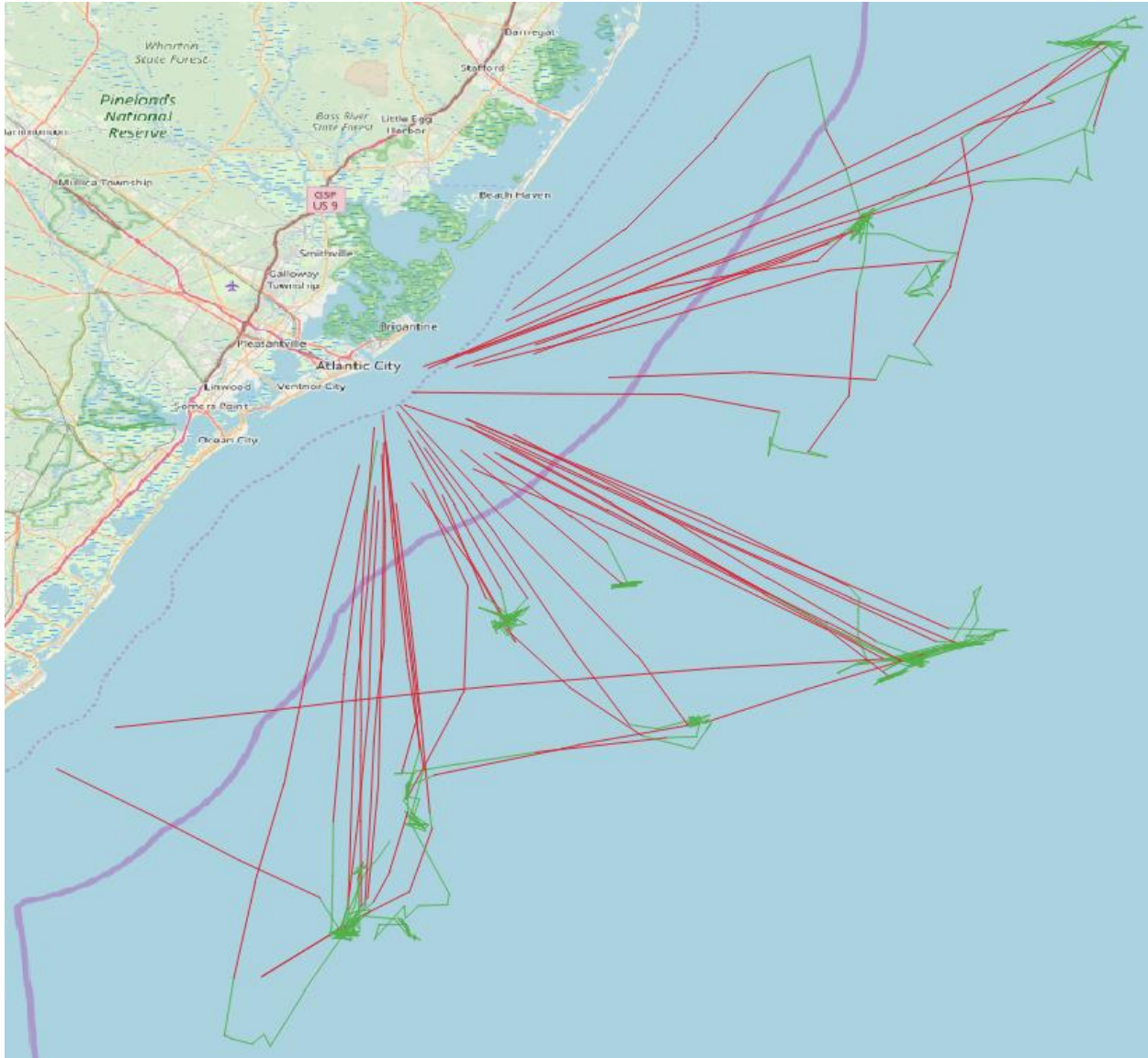


Fig 1. In this and other maps, red and green lines indicate segments that were originally classified as 'transit' and 'towing', respectively. This shows all of the transit and towing segments for a single year of one boat.

While this rule worked to an extent, there were exceptions. For example: in the first-pass analysis, there were cases in which a single fishing segment would be found within an otherwise uninterrupted stretch of transit. It was usually not clear exactly why the boat slowed down for that one segment. However, it was clear from context that the boat had not simply slowed to fish in the middle of its transit.

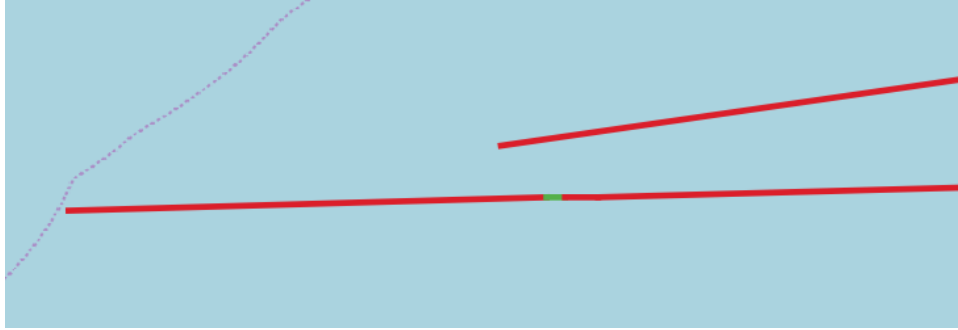


Fig 2. An example of a misclassified transit segment

On the flip side, there were misclassified towing segments. Continuous fishing periods are easily identifiable because they consist of many consecutive short transit segments that zig and zag back and forth across a bounded space. Occasionally these contextually obvious towing segments would have a speed greater than 4 knots. This was often due to the inconsistency in the time intervals between readings. Generally, points were recorded about an hour apart but there were some cases in which they were as frequent as a few minutes. The abbreviated segments yielded much greater variance in the estimated speeds. It is possible for a boat in the act of fishing to travel faster than 4 knots over the small sample of a few minutes.

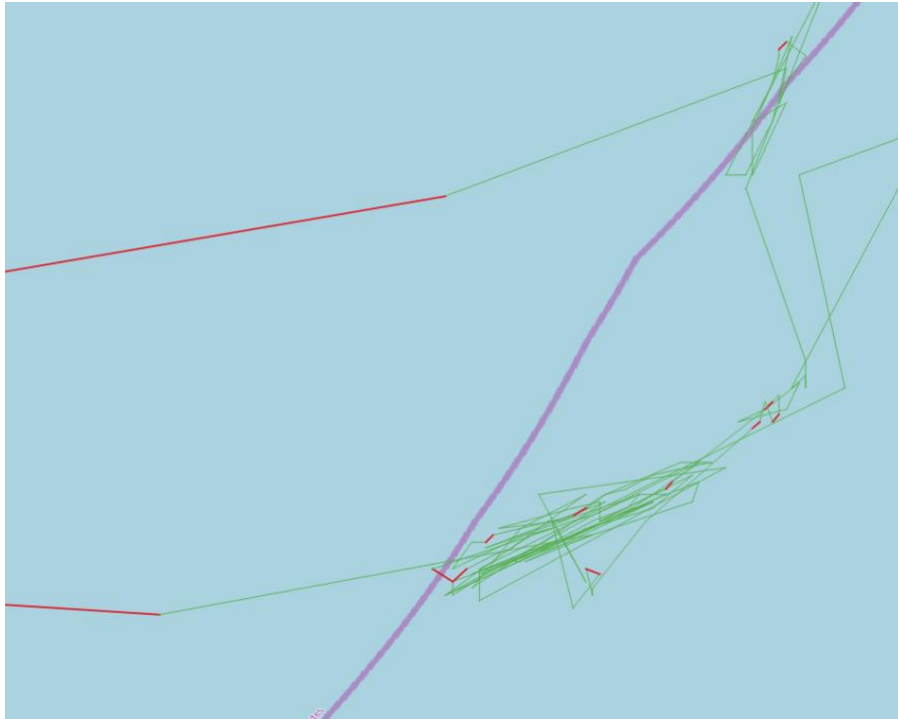


Fig 3. An example of a fishing trip with a series of short segments. Because the readings were so frequent there were many small fishing segments that had speeds greater than 4 knots and were therefore misclassified as transit.

Several different rules were explored in an effort to try to remove these outliers. Ultimately, an algorithm was implemented to examine all segments that were bounded by two segments of the opposite type. It checked the speed, direction, and distance of the segment in question and compared the values to predefined thresholds. If two out of three criteria were met, the classification of the segment would change.

The three thresholds for reclassifying a travel segment to towing were: a speed of 4.6 knots or fewer, a duration of fewer than 36 minutes, and a distance of fewer than 1.2 nautical miles. These thresholds were determined by iterating over a series of options and finding the combination that yielded a significantly larger change in the number of trip polygons (described in the next section) than others. This suggests that the aforementioned thresholds found a natural break in the data and did a better job of classifying than others.

<i>Outlier threshold options</i>	<i>Decrease in trip polygons from previous set</i>
Duration: < 0.4 hrs; Distance: < 0.8 nm; Speed: < 4.2 knots	--
< 0.5 hr; < 1 nm; < 4.4 knots	8
< 0.6 hr; < 1.2 nm; < 4.6 knots	36
< 0.7 hr; < 1.4 nm; < 4.8 knots	7
< 0.8 hr; < 1.6 nm; < 5.0 knots	15
< 0.9 hr; < 1.8 nm; < 5.2 knots	8
< 1.0 hr; < 2.0 nm; < 5.4 knots	11
< 1.1 hr; < 2.2 nm; < 5.6 knots	12

The decrease in the number of trip polygons for the selected threshold was the only statistical outlier within the group (i.e. the value was more than two standard deviations from the mean).

Fishing trip polygons

After filtering out transit segments, an approach was developed to measure the size and shape of a “fishing trip.” This is distinct from what this report will refer to as an ‘event’ which is the set of collective boat movements between leaving shore and returning. In this context, a fishing trip is defined as the set of continuous towing segments (i.e. the familiar clusters of green lines from fig. 1). Fishing trips do not include the transit portion of an event. There are some cases in which a boat would travel out from shore, fish in an area for a period of time, travel to another area, fish again, and then return to shore. In this case, the event would include multiple trips. Last Tow believed that the shape of a trip would be

more instructive than that of an event because the trip shape is the geographic unit that will actually need to fit into the turbine grid.

The fishing trip polygons were defined as the convex hulls of all points within a fishing trip. A convex hull, in this context, is the smallest convex polygon that contains all of the points within the set. This means that the resulting polygon will have no interior angles greater than 180 degrees and no line between any two vertices will pass outside of the polygon.

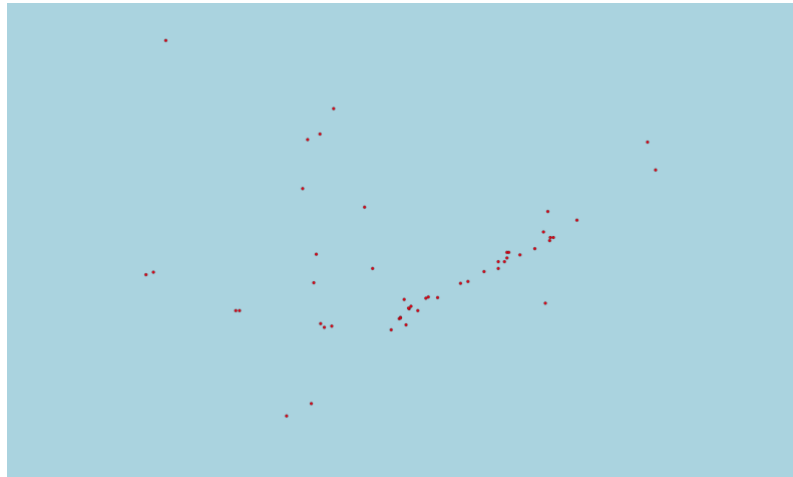


Fig 4. Example creation of a fishing trip polygon: All of the consecutive fishing trip points.



Fig 5. The points after they had been connected to make segments

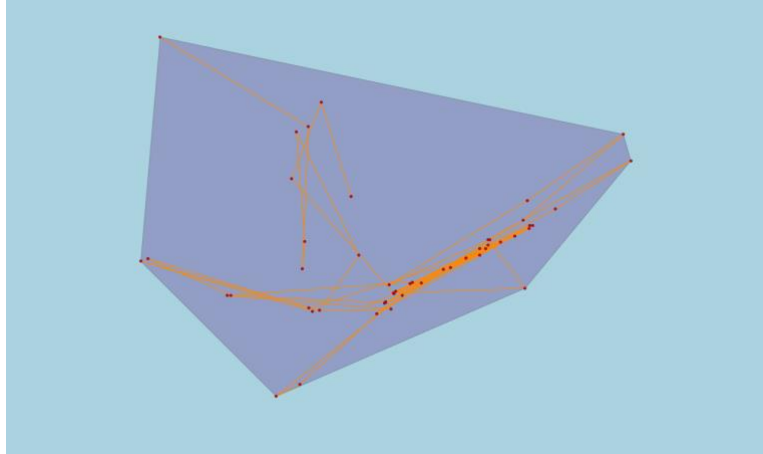


Fig 6. The convex hull of all segments within this fishing trip

It would be possible to draw a smaller polygon that also encompassed all of the points but the convex hull would be more predictive of the actual amount of area needed for a similar future trip: If another boat fished in this same area as shown in figs. 4-6, it would not exactly repeat the pattern. It would be more likely to occupy the same amount of general area (i.e. the polygon) but move to slightly different space.

Analysis

Analysis of the derived datasets (i.e. segments and trip polygons) had four main components:

1. Trip shape analysis
2. Ship travel path density
3. Travel direction
4. Proportion of fishing within Ocean Wind lease area

Trip shape analysis

Last Tow decided to limit fishing trip mapping and analysis to trips with a duration greater than 10 hours. This helped to eliminate outlier trips that could have occurred for a number of different reasons. It also removed small polygons that were the result of residual segment misclassification. The analysis was focused on the trips that were most characteristic of normal fishing events. It also only included fishing trips for which at least 30% of the area overlapped with the Ocean Wind lease area. Between 2007 and 2019 there were 162 qualifying trips.

Distribution of fishing trip areas

Trips with total durations of 10+ hours; All ships, all years

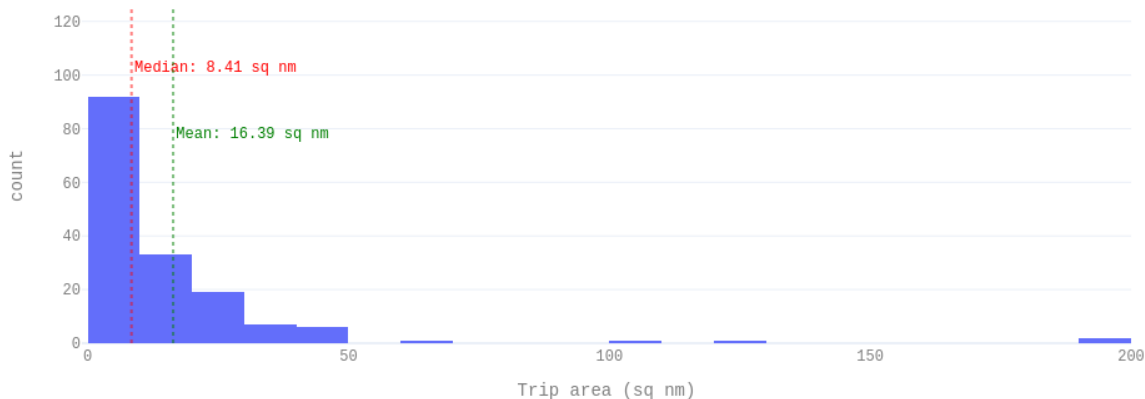


Fig 7. Left-skewed distribution of trip sizes

The average size of fishing trips (16.39 sq nm) was higher than the median (8.41) due to some large outliers. Over half (92, 56.8%) of the trips were smaller than 10 sq nm and 37 (22.8%) were smaller than 5.

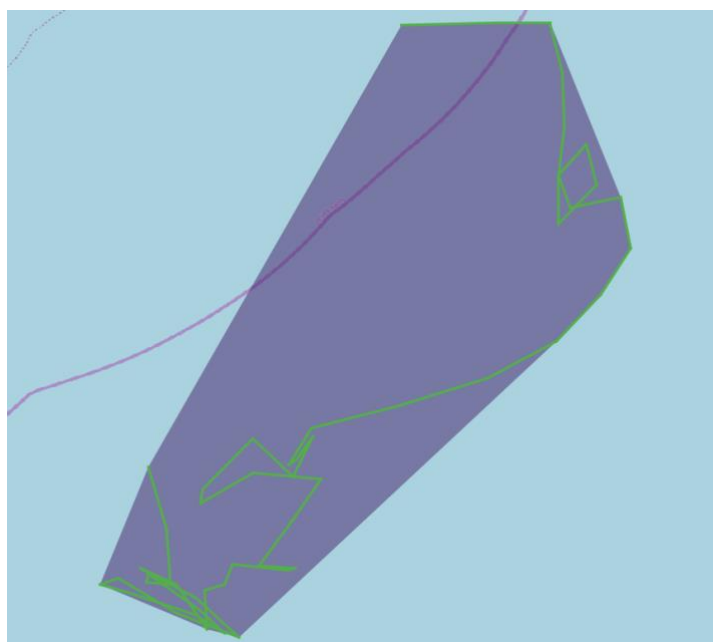


Fig 8. An outlier large fishing trip (120.3 sq nm) with a particularly meandering path

The qualifying trips (i.e. those lasting longer than 10 hours) had a roughly normal distribution with a long right tail. This is because there were some outlier trips lasting longer than 50-60 hours but the outlier short trips were removed. The longer outliers led to an average (33.59 hours) that was greater than the median (23.87 hours).

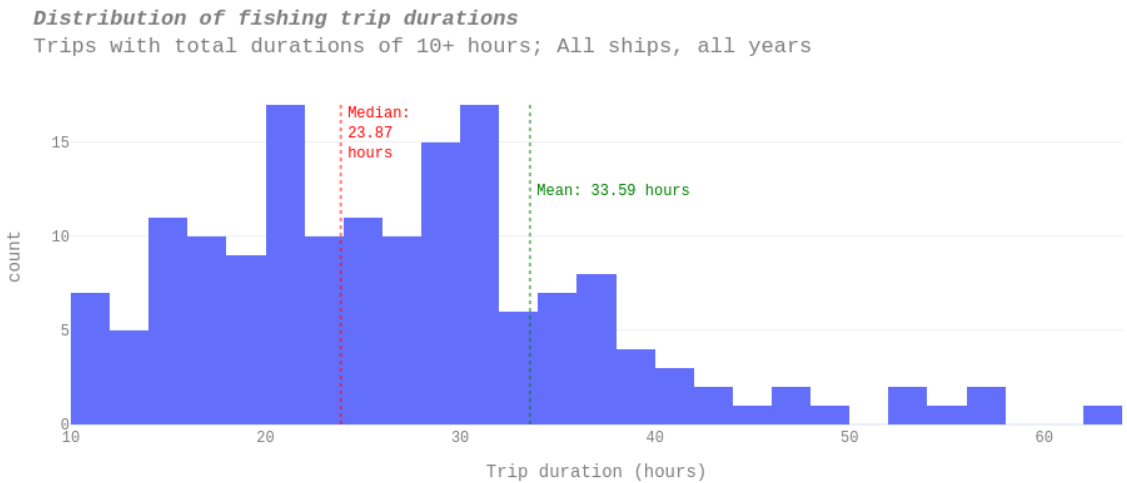


Fig 9. Distribution of trip durations

Surprisingly, there seemed to be little to no correlation between size and duration. Some ships fished in very compact patterns while others covered more ground in the same amount of time.

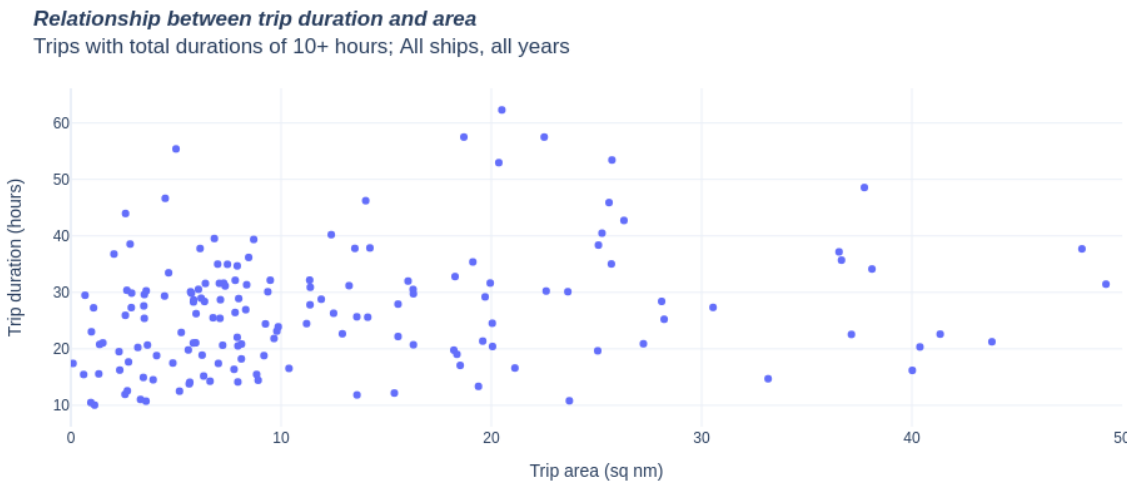


Fig 10. Very little correlation between trip duration and area

Given the large number of polygons within a confined area, it would be difficult to map all of the trip polygons and still get a sense of what they looked like, so representative samples were selected. Fig 11 shows a sample of 10 fishing trip polygons are in the middle of the area distribution, with five each on either side of the median. In other words these are ‘typically sized’ polygons.

Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 10+ hours long

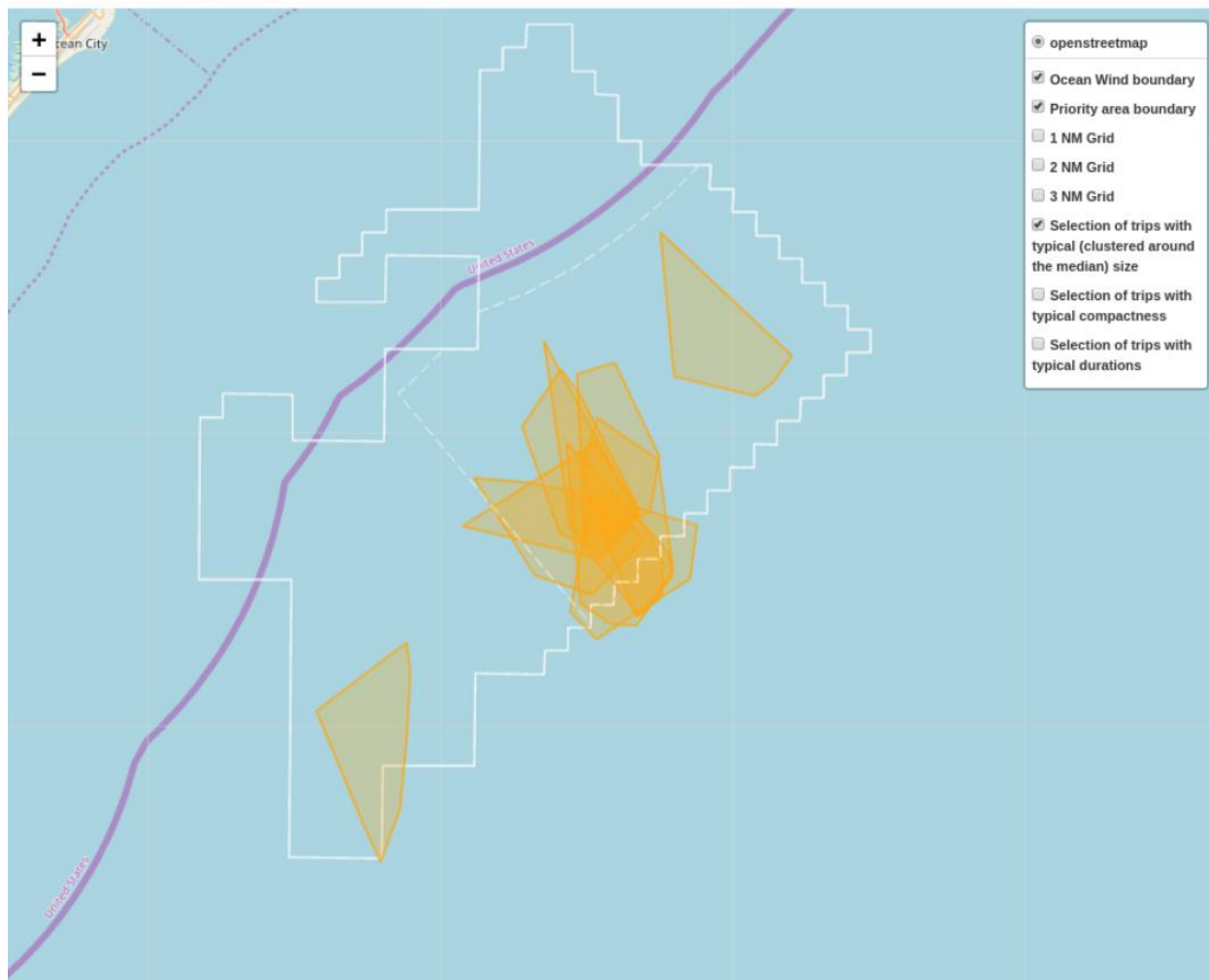


Fig 12. A selection of representatively sized polygons, overlaid with the Ocean Wind boundary

The appendix includes maps of additional samples that are selected using the same process but for duration and compactness (perimeter to area ratio).

A set of points were also generated that could simulate the future grid of wind turbines and give the map viewer a rough sense of how the size and shapes of past trips would fit into it. These grids are not aligned with planned turbines nor are they oriented in the correct direction. They are simply meant to give a visual reference of different grid distances.

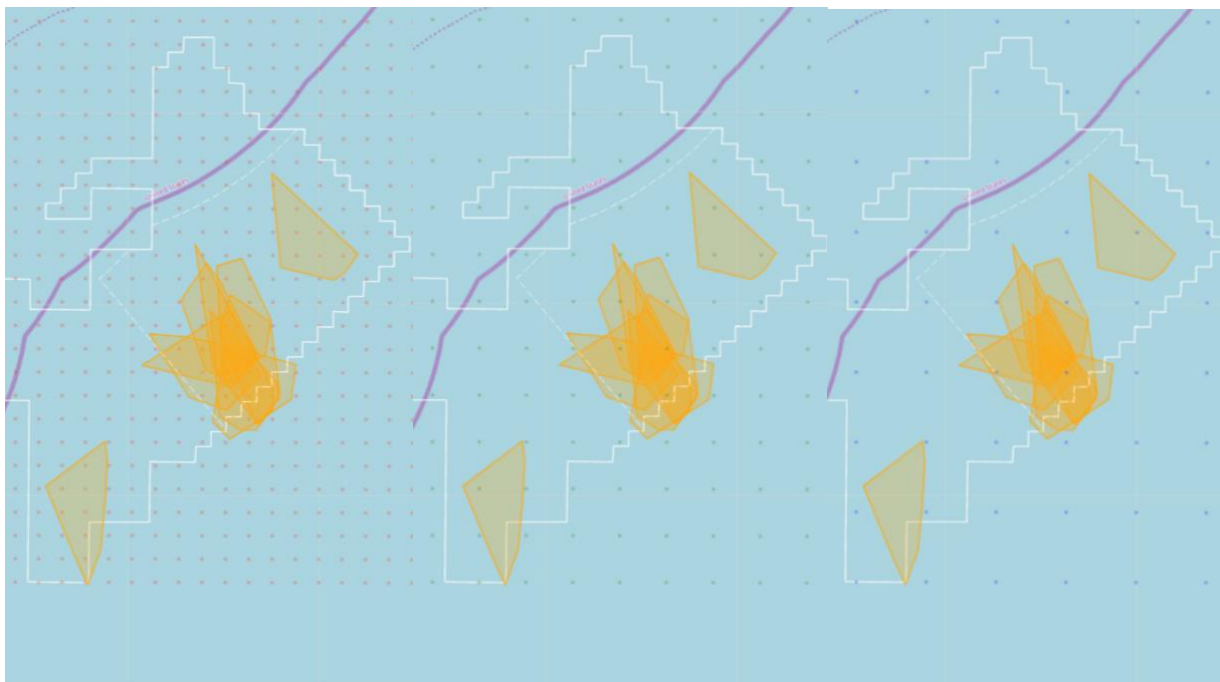


Fig 13. Typically sized fishing trip polygons overlaid with potential turbine grids spaced out at 1nm x 1nm (left), 2nm x 2nm (center), and 3nm x 3nm (right)

Ship travel path density

In addition to the size and shape of each fishing trip, Last Tow was also interested in understanding which parts of the Ocean Wind leasing area have been highly trafficked by fishing boats in the past. Line density maps were developed to measure and visualize boat traffic.

The segment data that was derived from original point locations was used to determine the paths. The Ocean Wind leasing area is broken up into 0.2nm x 0.2nm grid cells. The value associated with each grid cell corresponds to the number of boats that passed through it (boats in the act of fishing, in the case of fig. 14). There are three main concentrations of fishing activity within the Ocean Wind leasing area. All three are roughly on the Southeast edge. Two of them fall predominantly within the priority area, which is outlined by the thinner white line.

Fishing density within Ocean Wind Area
All years, all boats

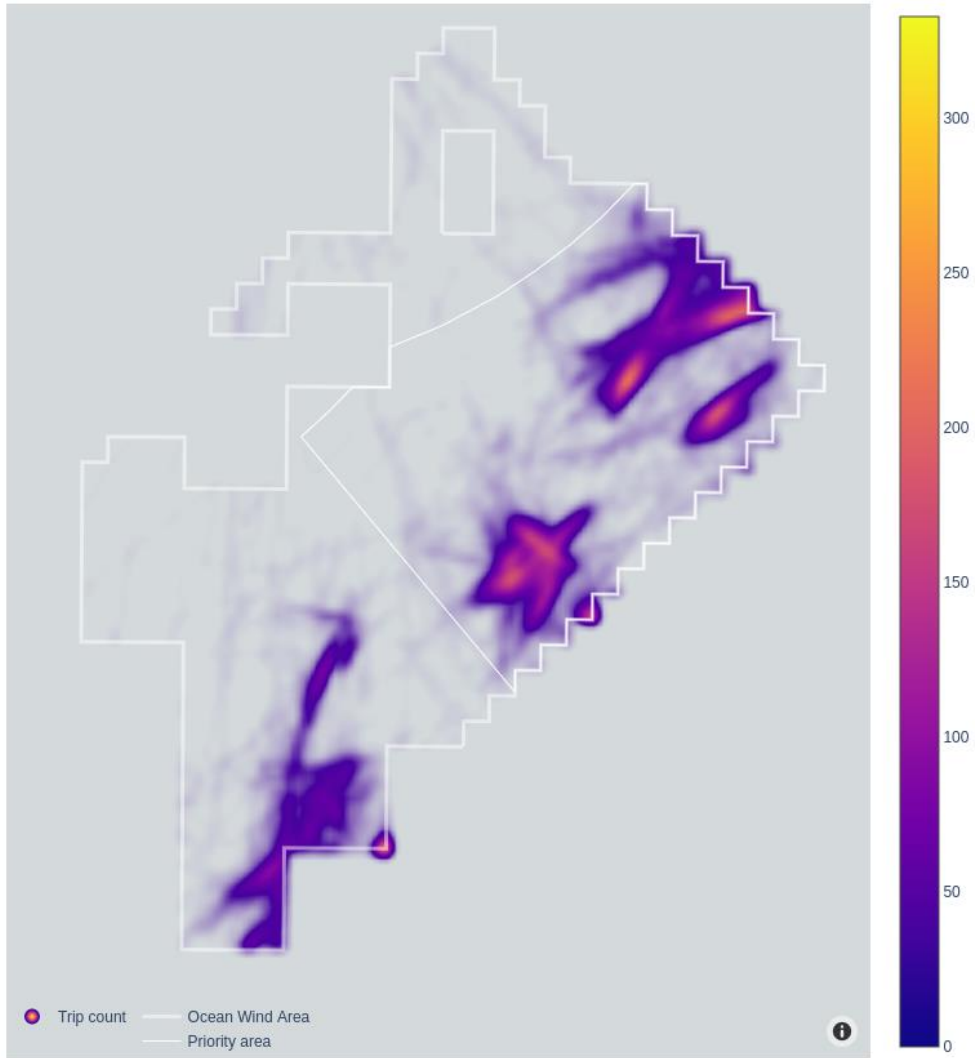


Fig 14. Density of fishing segments, all years

As you can see in fig. 15, boats in transit occupied different parts of the region than those that were fishing.

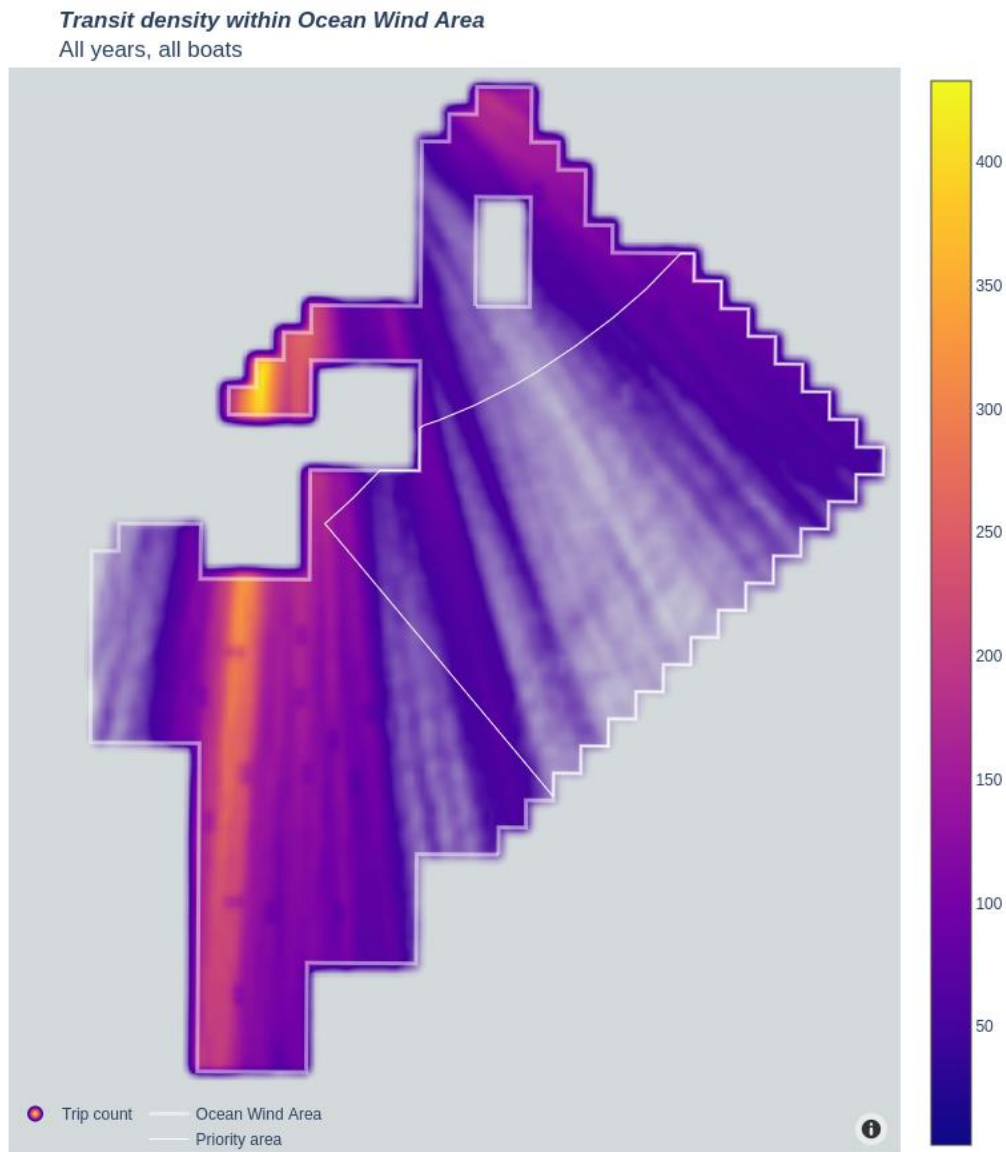


Fig 15. Density of transit trips within the Ocean Wind leasing area

Travel direction

The orientation of the turbine grid could affect the ability of future ships to recreate past routes so the direction of travel of past trips within the Ocean Wind leasing area was quantified. Each segment was sorted into one of 16 different directional buckets (e.g. N, NNE, NE, ENE, etc.).

The polar plot in fig 16 shows which directions fishing boats traveled in most frequently over the extent of the dataset. The radial axis indicates the total mileage of all boats in a specific direction. For example,

over the course of all years, all boats moved in the East-Northeast direction for about 900 nautical miles while fishing within the Ocean Wind leasing area.

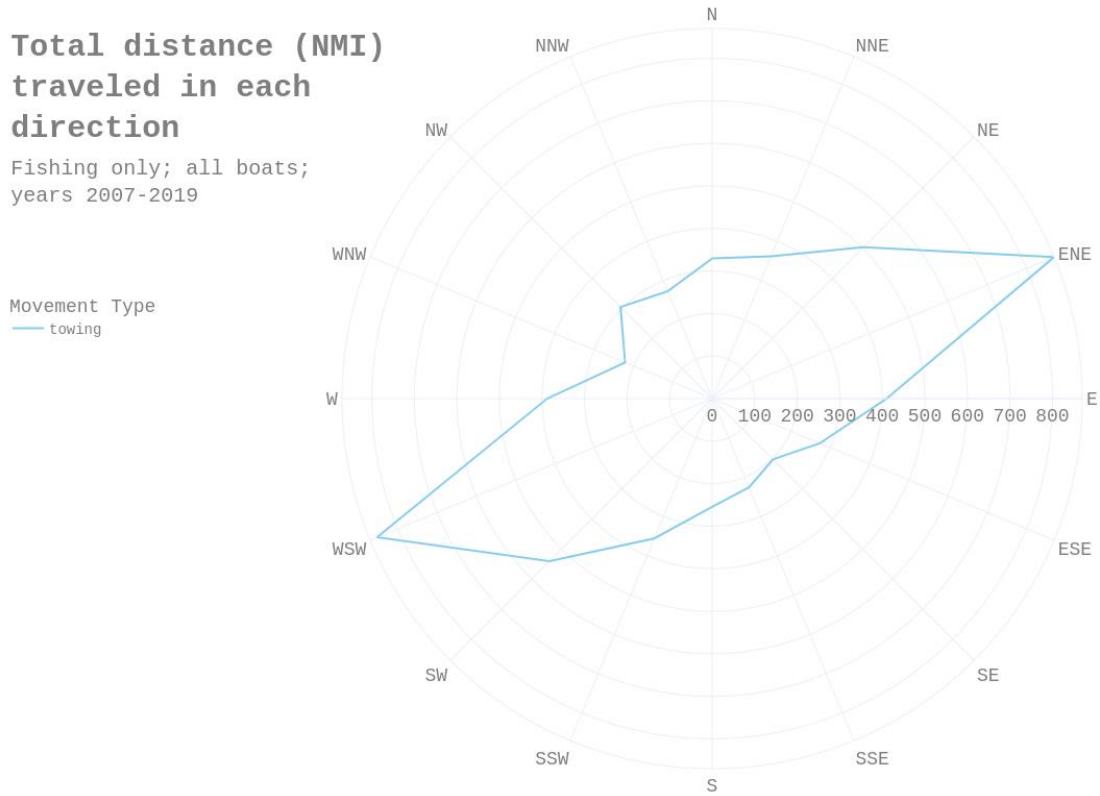


Fig 16. Fishing boats in the Ocean Wind area were more oriented towards East-West than North-South movement when fishing

By contrast, fig 17 shows that boats in transit traveled North-South much more frequently through the leasing area when they were in transit. It also shows that most of the time that boats were navigating through the Ocean Wind leasing area, they were in transit.

Total distance (NMI) traveled in each direction

By movement type (towing vs. transit); all boats; years 2007-2019

Movement Type
 — towing
 — transit

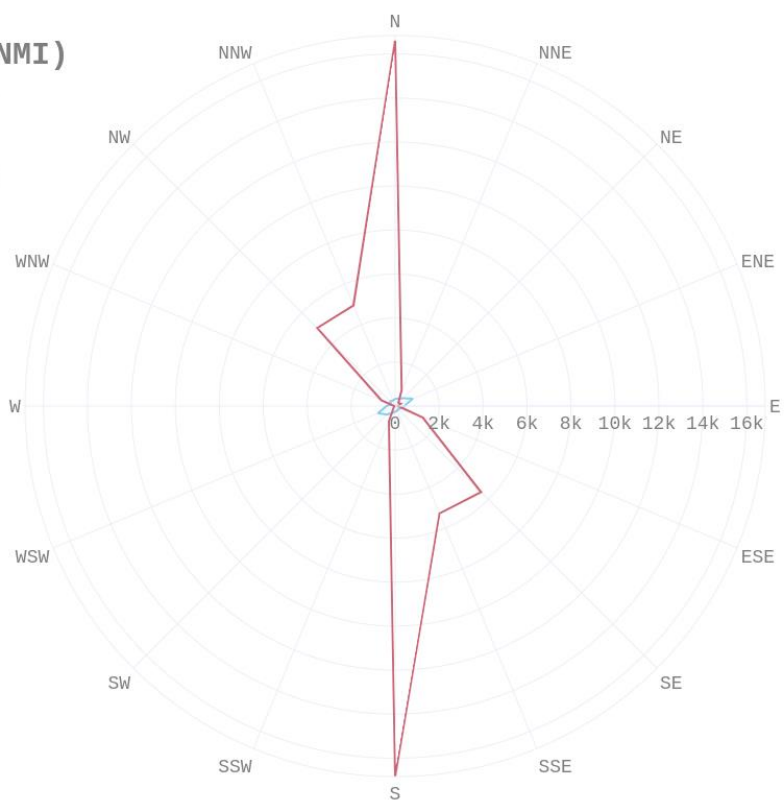


Fig 17. The fishing boats traveled in very different directions when towing as compared to when simply in transit

This appendix includes an additional polar plot that shows the total direction of travel broken down by company over all years.

Proportion of Fishing Within Ocean Wind leasing area

Last Tow interested in understanding the annual breakdown of total fishing time spent inside and outside of the Ocean Wind leasing area as well as the priority area within it. Fig 18 represents those results in table form.

YEAR	% OF FISHING WITHIN OCEAN WIND	% OF FISHING WITHIN PRIORITY ZONE
2009	0.2%	0.0%
2010	0.4%	0.4%
2011	0.4%	0.2%
2012	0.2%	0.1%
2013	0.3%	0.2%
2014	0.2%	0.1%
2015	0.2%	0.1%
2016	0.1%	0.1%
2017	0.6%	0.6%
2018	0.6%	0.5%
2019	0.2%	0.2%

Fig. 17. Percentage of all fishing hours that occurred within the Ocean Wind leasing area.

This table shows what percentage of all fishing hours occurred within the Ocean Wind leasing area as well as the priority area. As you can see, over 99% of all fishing took place outside of the leasing area. Of the total fishing hours within it, the proportion within the priority area fluctuated but in general it was between 50 and 100% of all Ocean Wind fishing hours.

Appendix

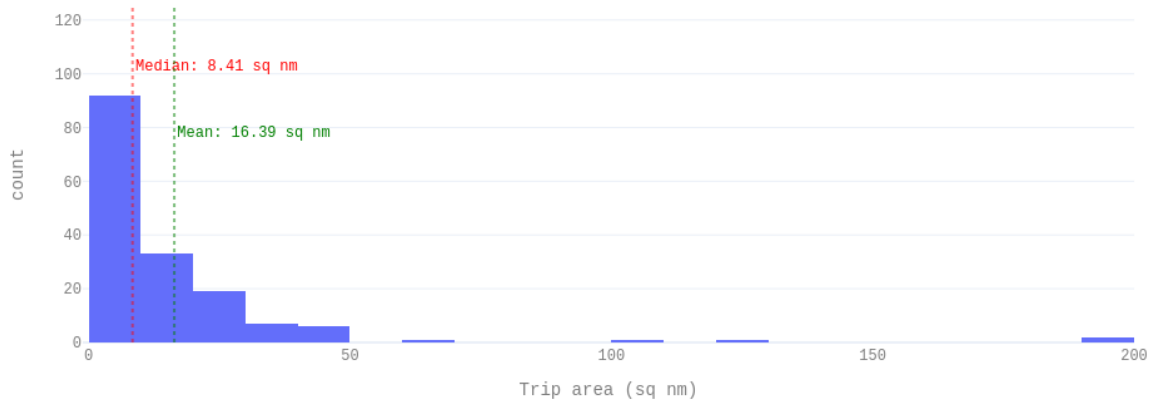
- A. Fishing trip charts
- B. Fishing trip maps
- C. Polar plots
- D. Ocean Wind leasing area fishing
- E. Line density maps

(A) Fishing Trip Charts

Item A.1

Distribution of fishing trip areas

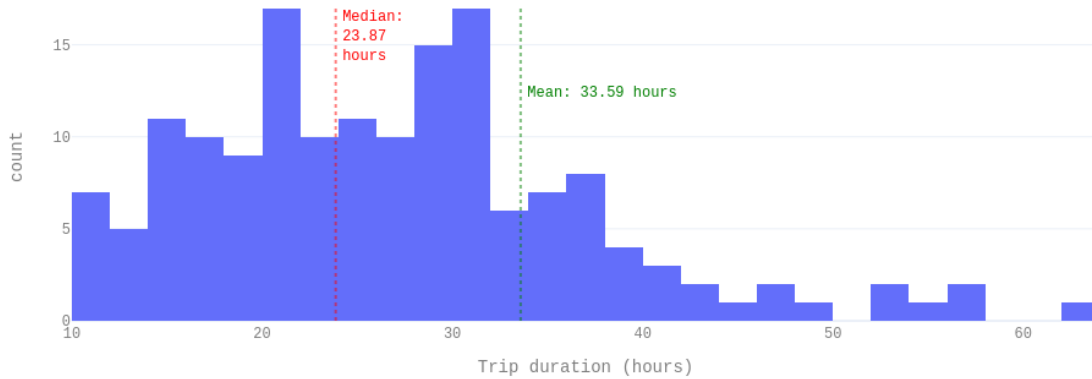
Trips with total durations of 10+ hours; All ships, all years



Item A.2

Distribution of fishing trip durations

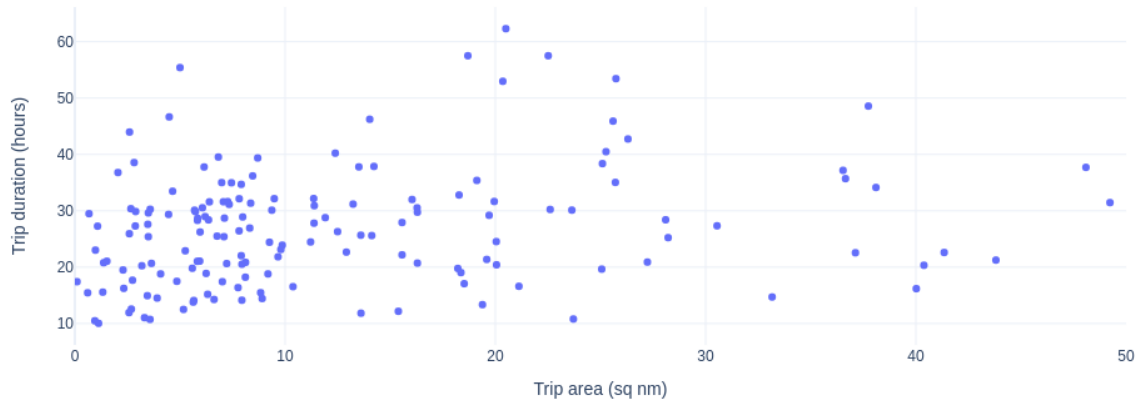
Trips with total durations of 10+ hours; All ships, all years



Item A.3

Relationship between trip duration and area

Trips with total durations of 10+ hours; All ships, all years

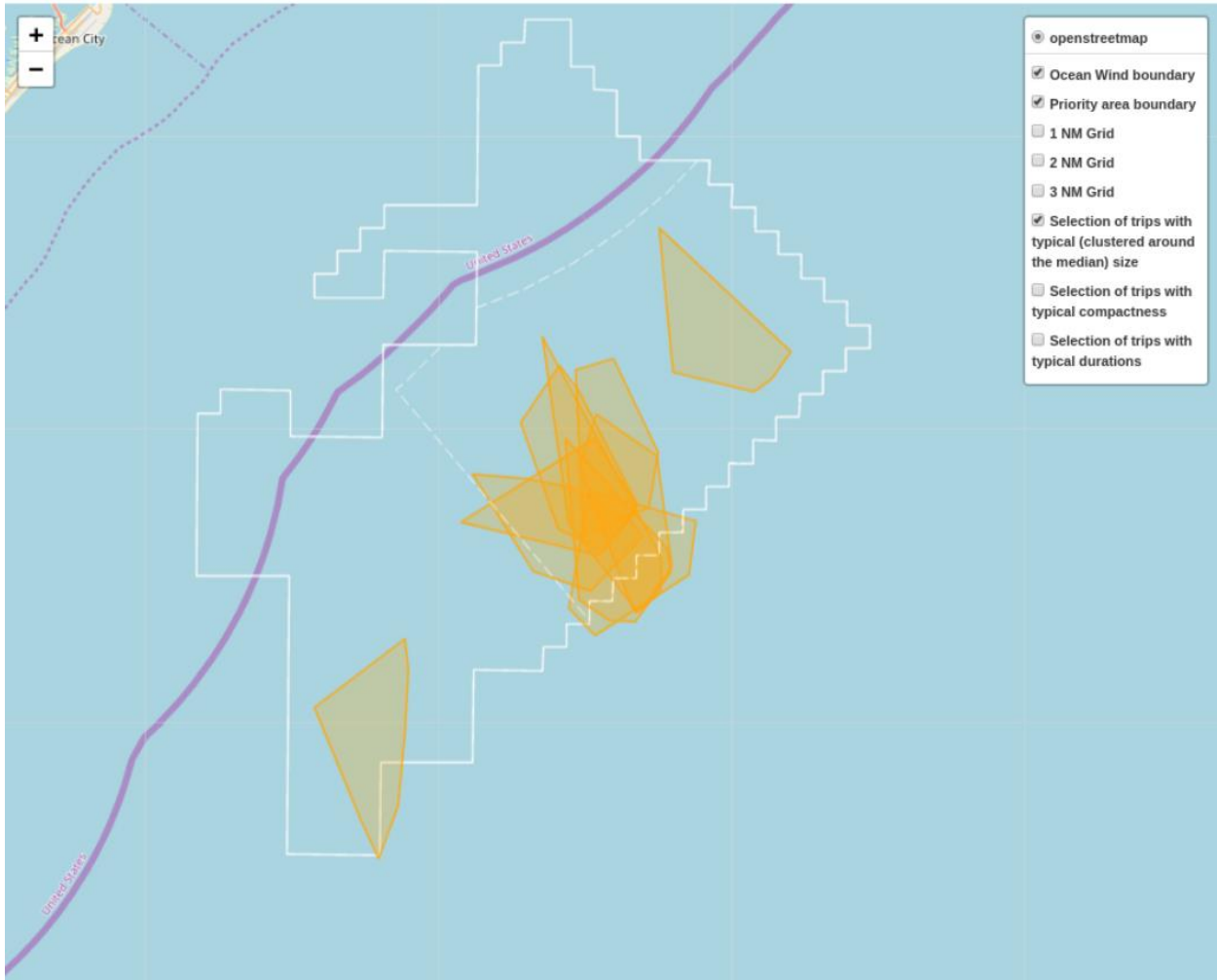


(B) Fishing trip maps

Items B.1 - Size

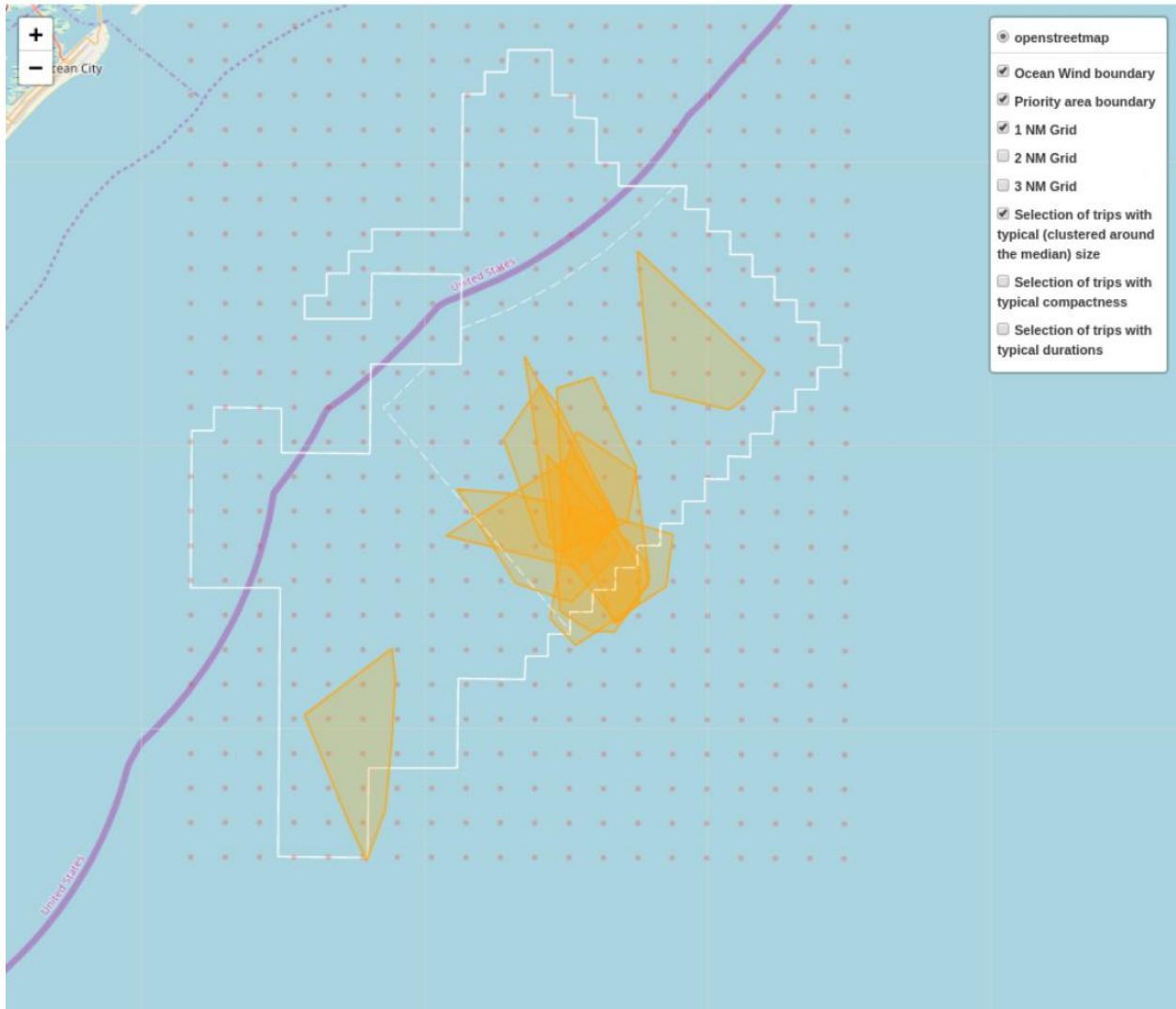
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths;
from all trips 10+ hours long



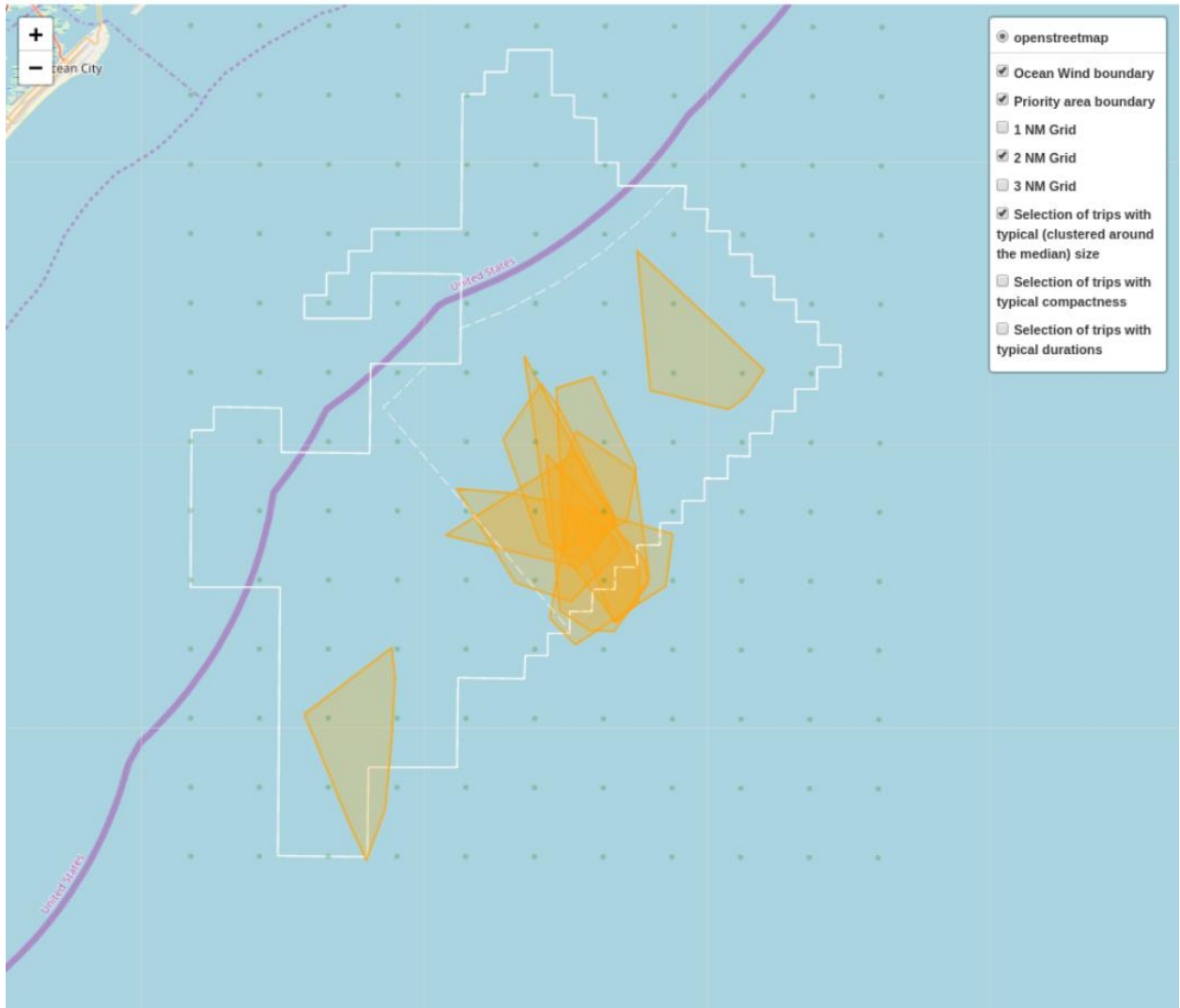
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 10+ hours long



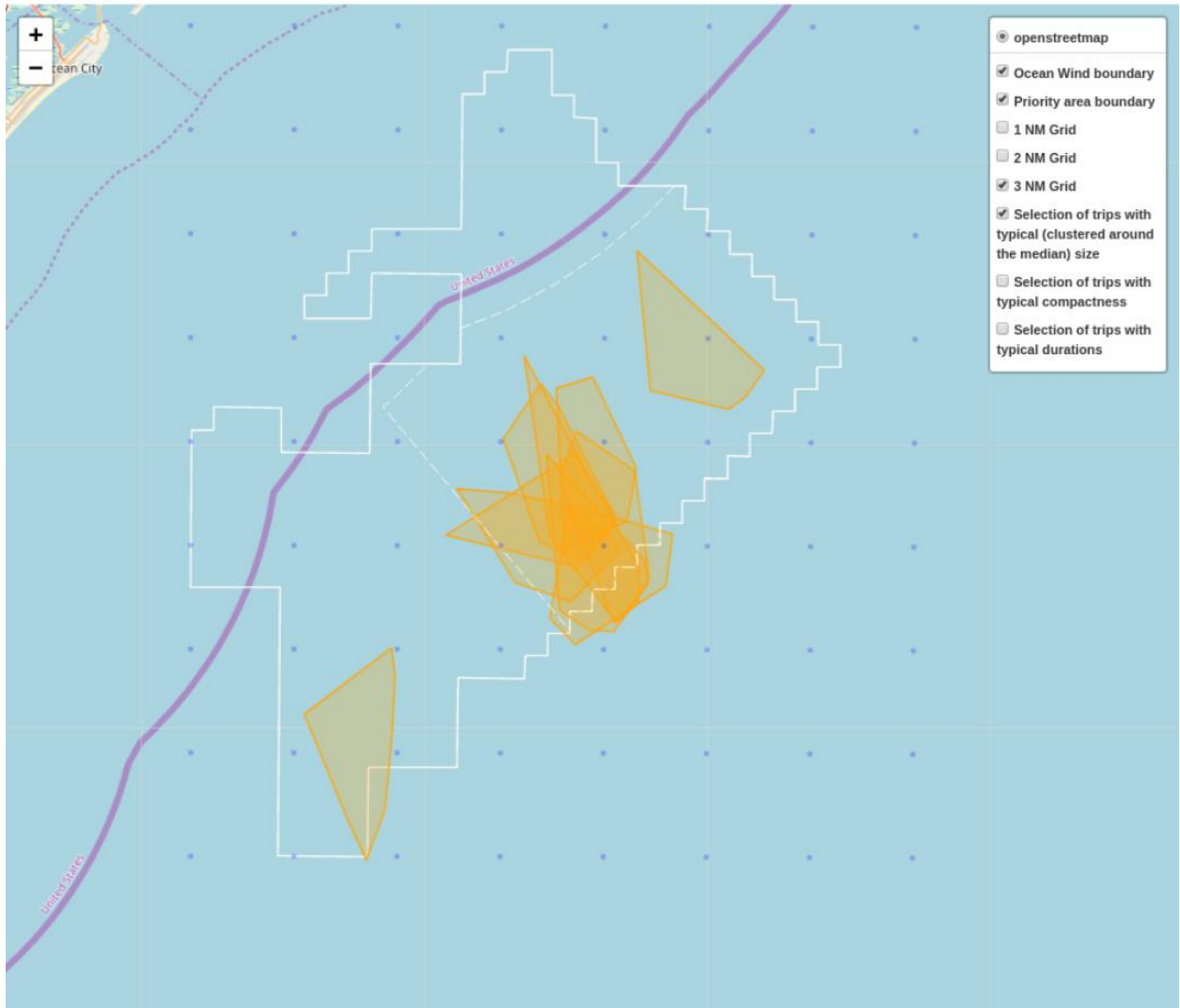
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths;
from all trips 10+ hours long



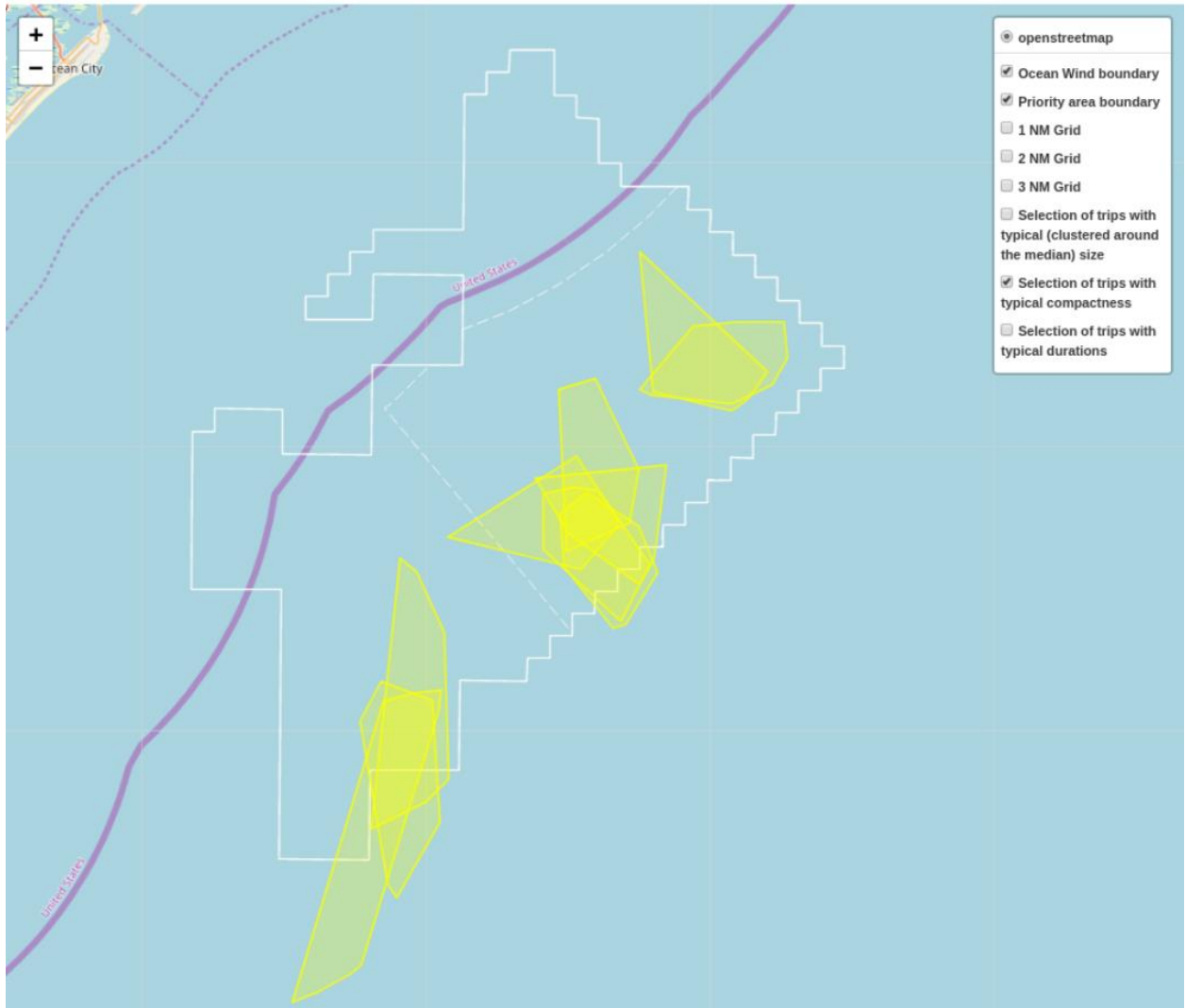
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 10+ hours long



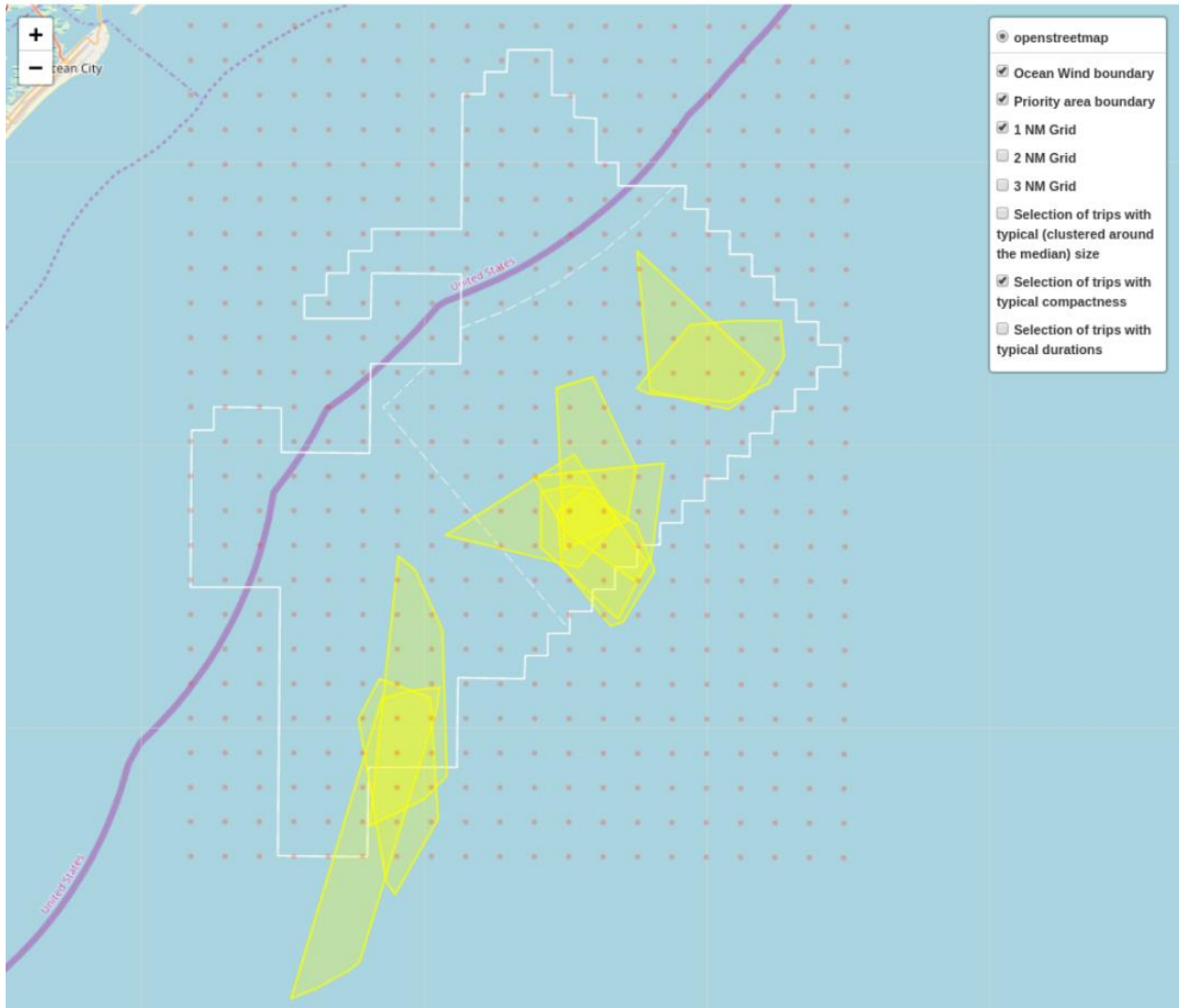
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 10+ hours long



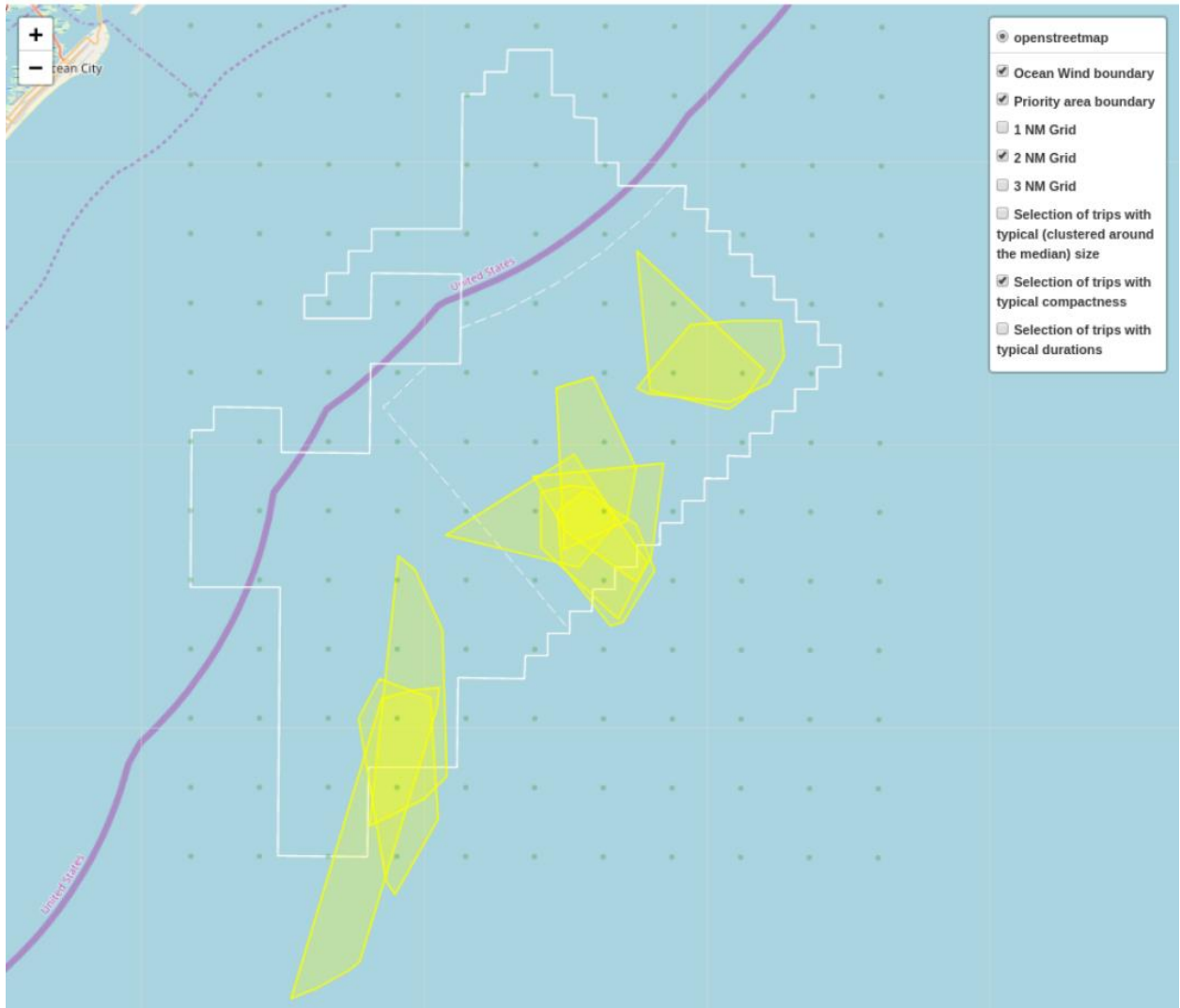
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths;
from all trips 10+ hours long



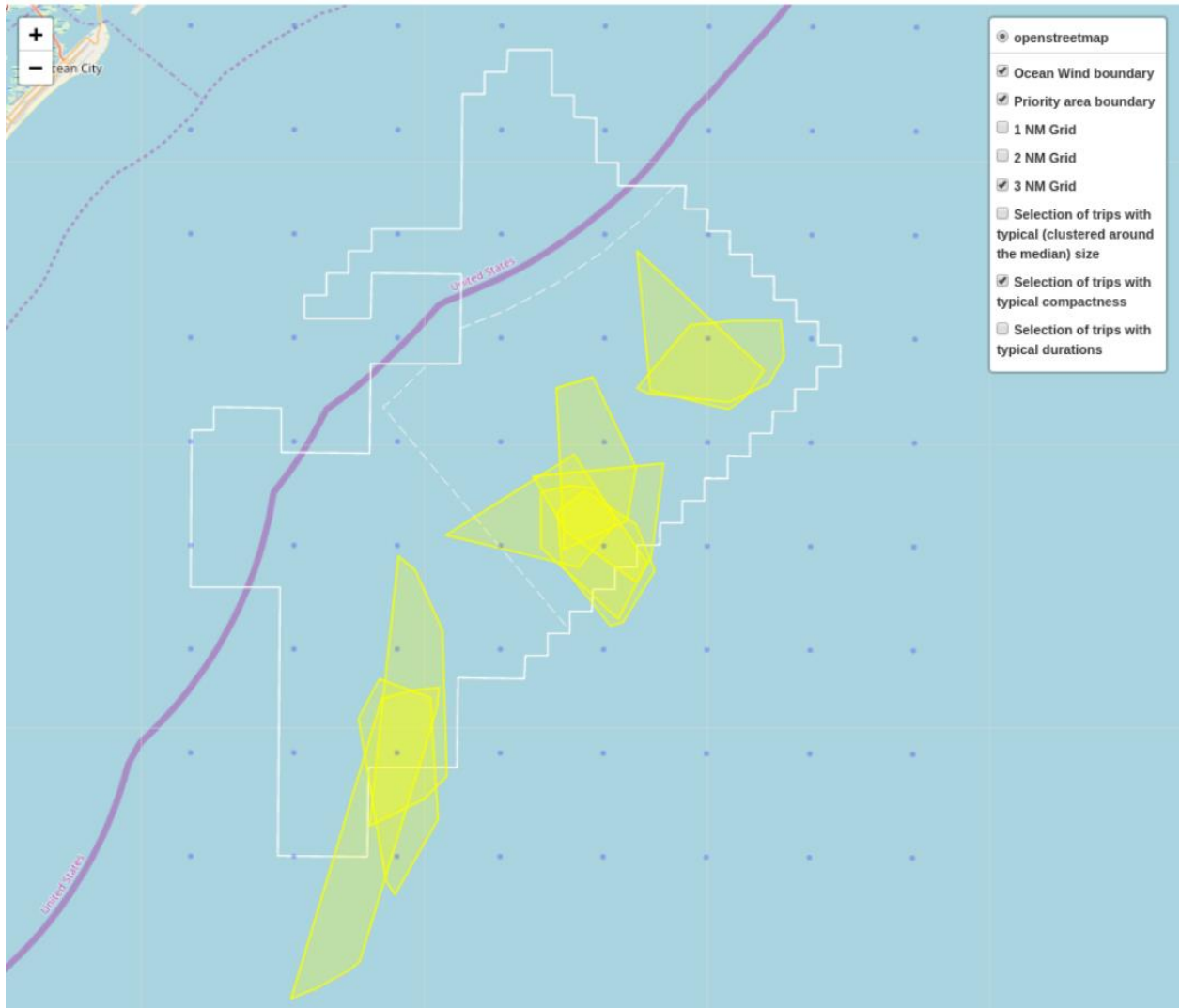
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths;
from all trips 10+ hours long



Fishing trip shapes within Ocean Wind region

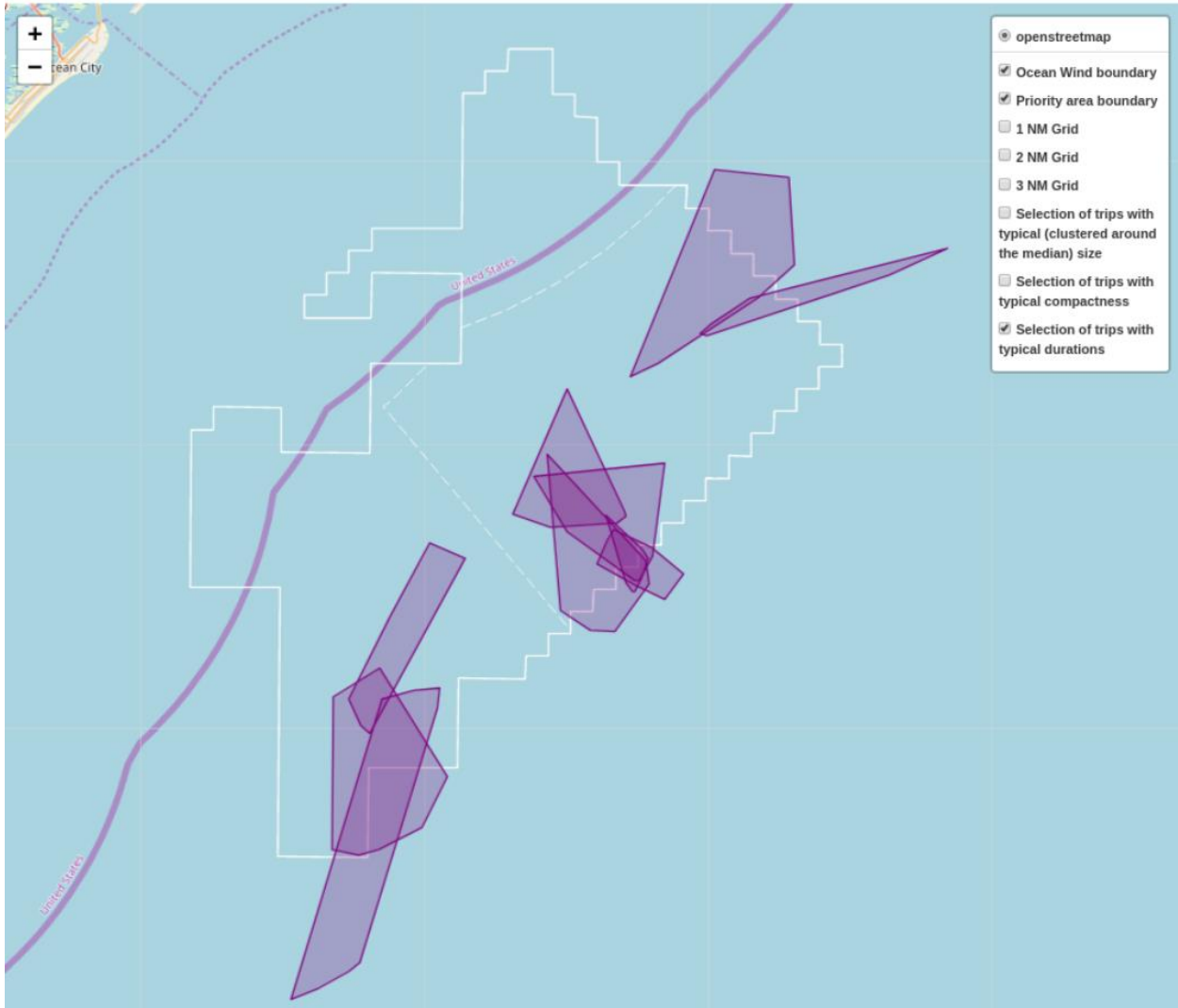
Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 10+ hours long



Items B.3 - Duration

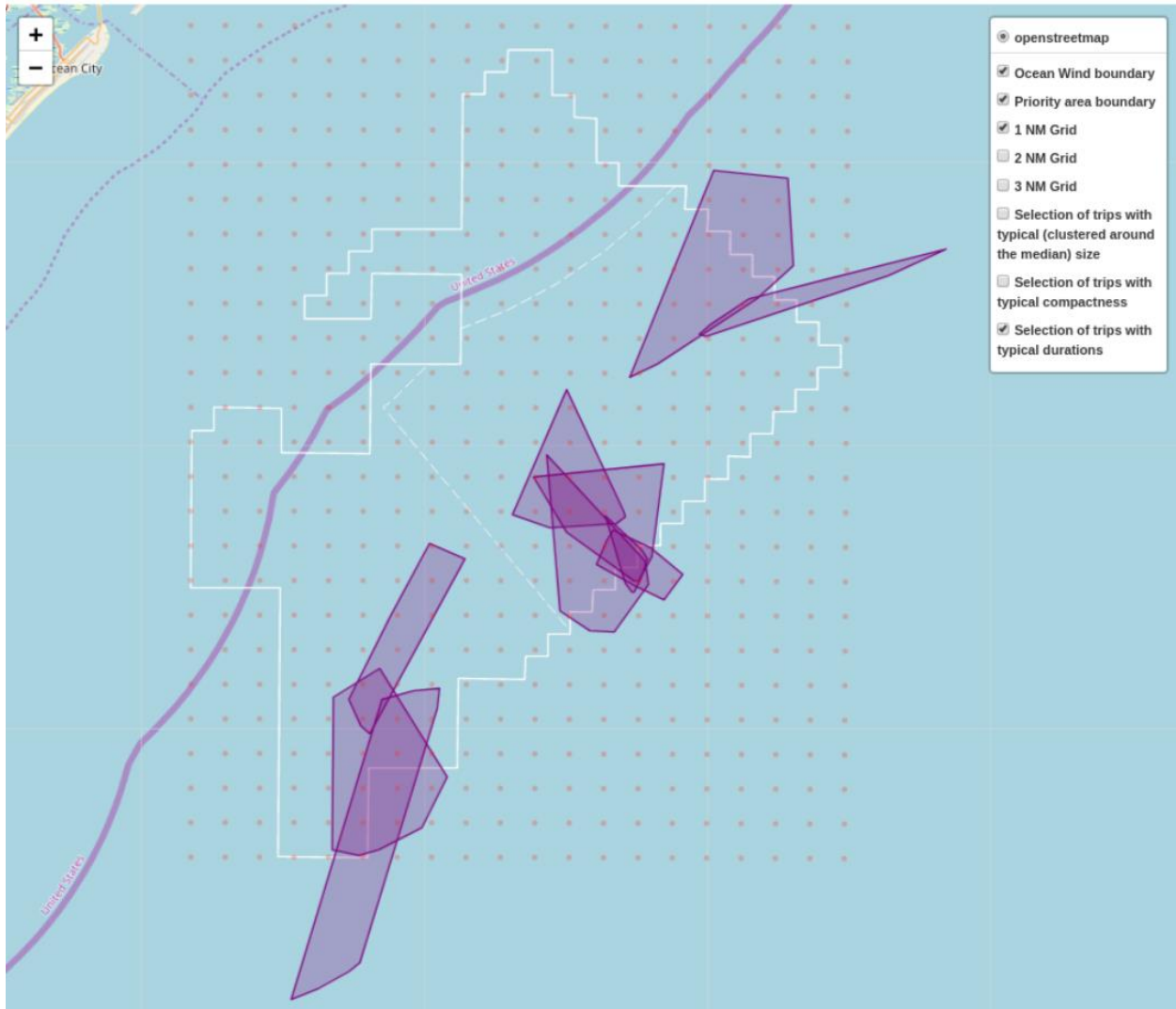
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths;
from all trips 10+ hours long



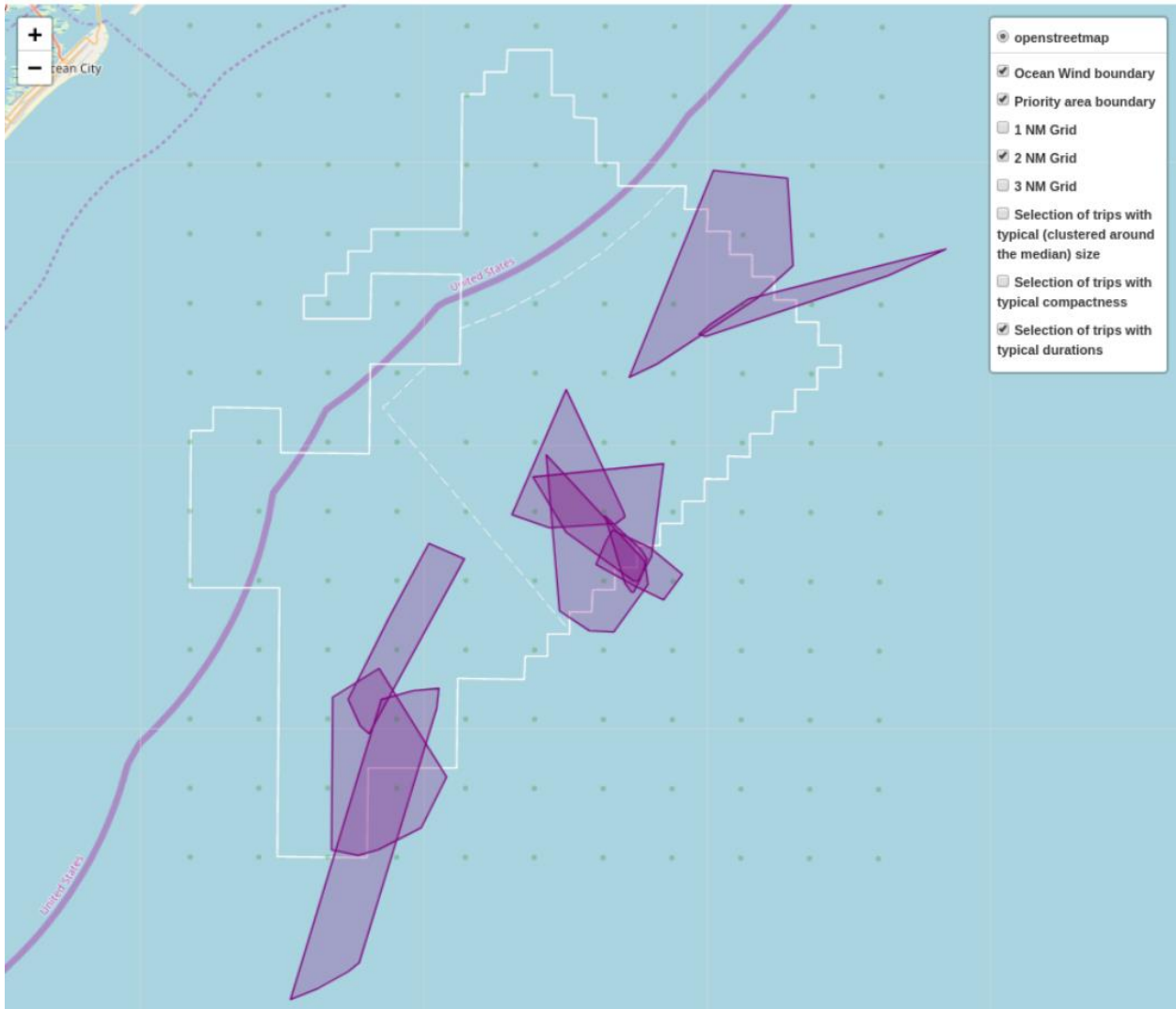
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 10+ hours long



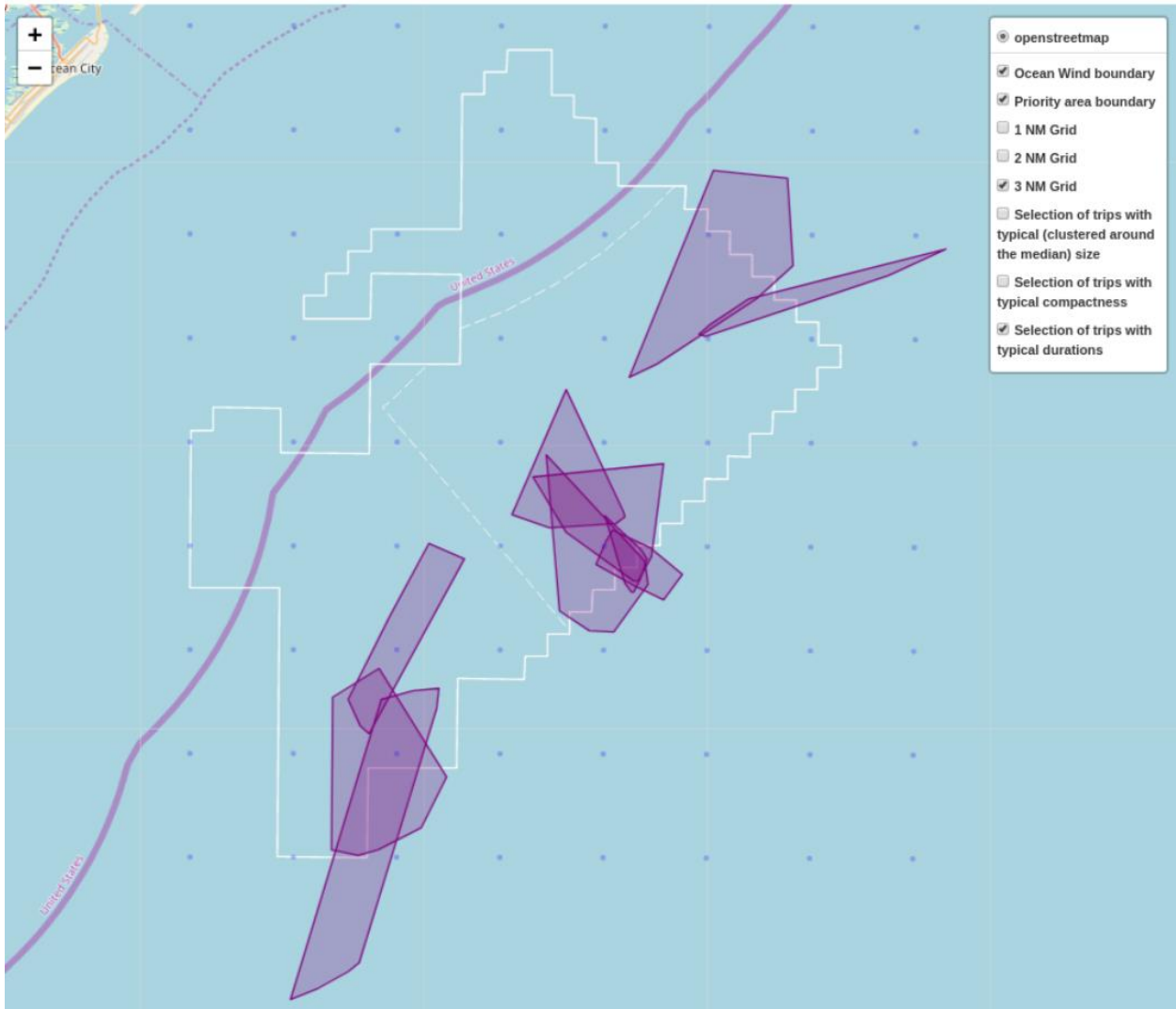
Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 10+ hours long



Fishing trip shapes within Ocean Wind region

Selected trip polygons overlaid with potential wind turbine grids spaced out at various widths; from all trips 10+ hours long



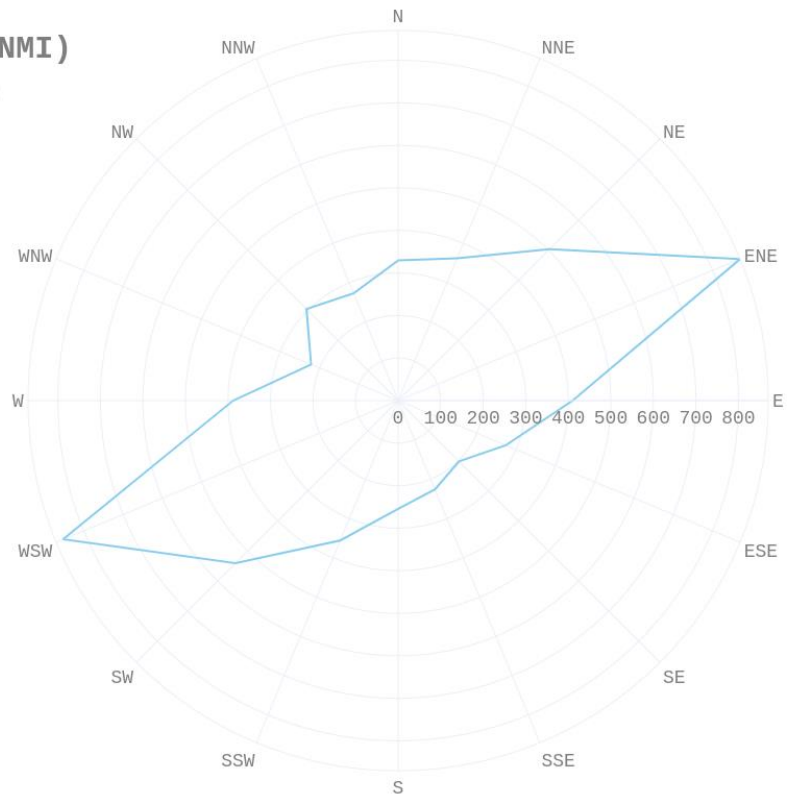
(C) Polar plots

Item C.1

Total distance (NMI) traveled in each direction

Fishing only; all boats; years 2007-2019

Movement Type
— towing

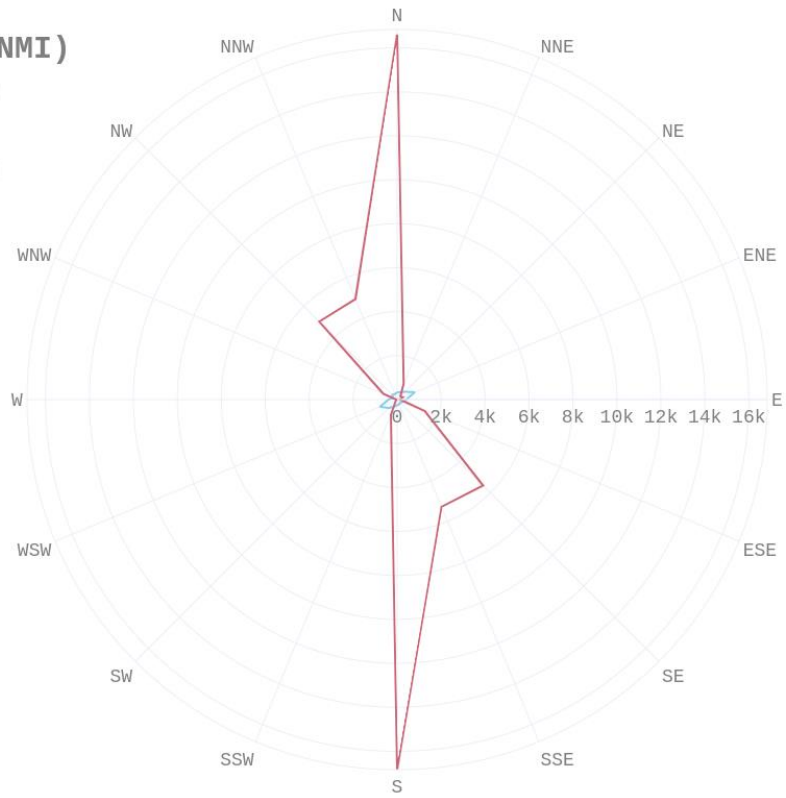


Item C.2

**Total distance (NMI)
traveled in each
direction**

By movement type (towing
vs. transit); all
boats; years
2007-2019

Movement Type
— towing
— transit

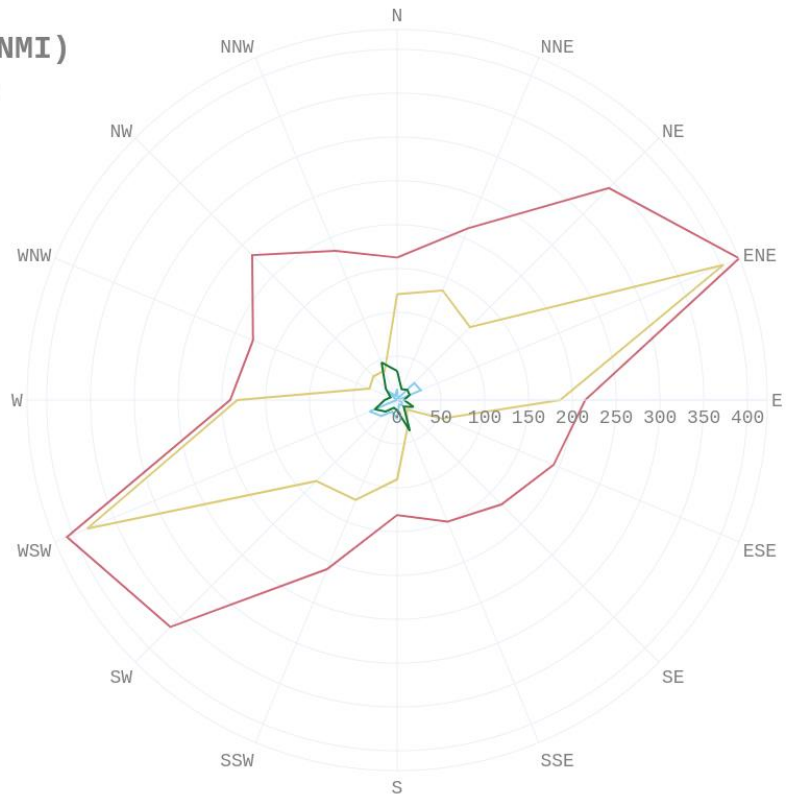


Item C.3

Total distance (NMI) traveled in each direction

By company; towing only; years 2007-2019

Company
 acf
 oceanside
 tmt
 yannis



(D) Ocean Wind Leasing Area Fishing

Item D.1

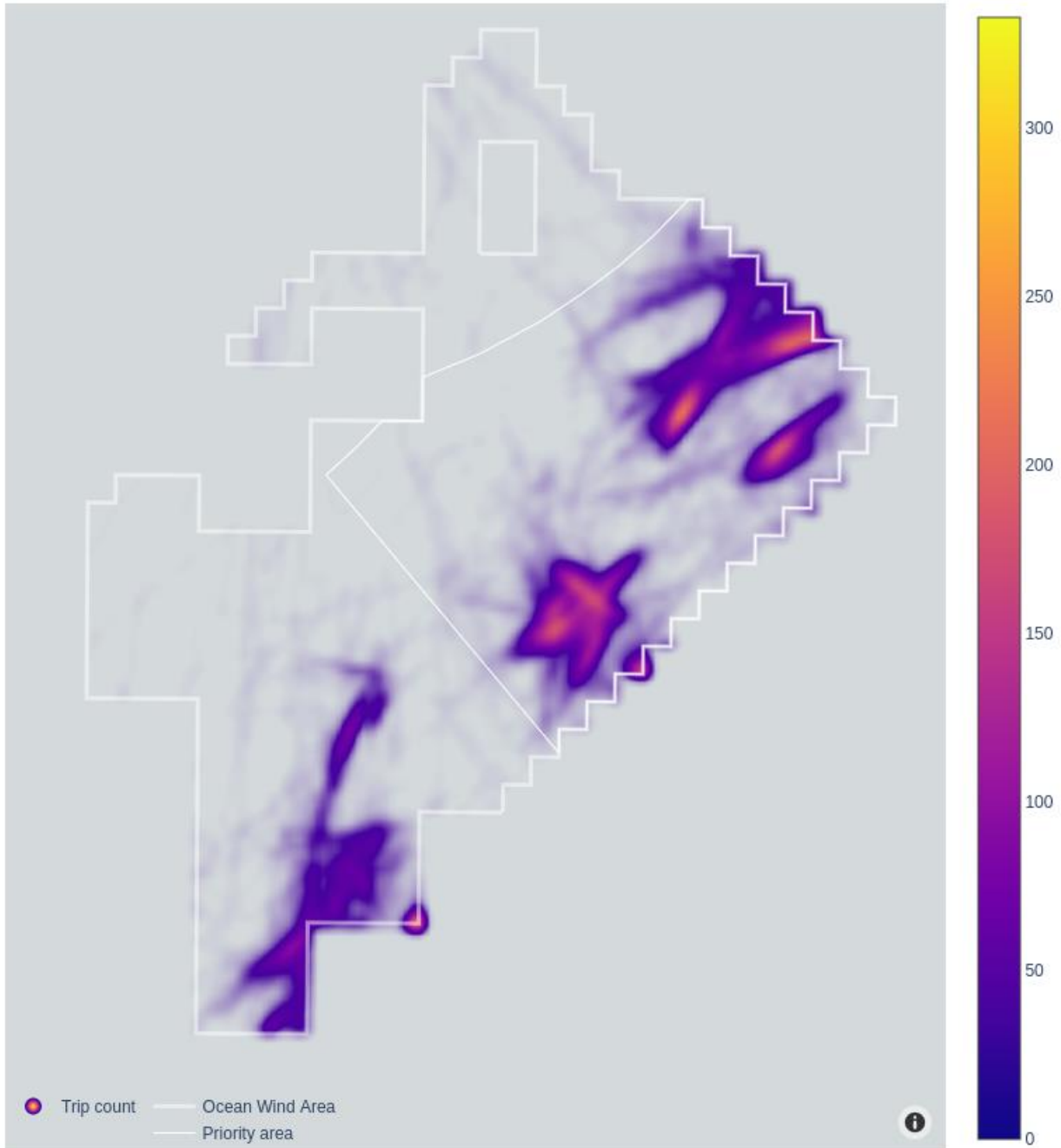
YEAR	% OF FISHING WITHIN OCEAN WIND	% OF FISHING WITHIN PRIORITY ZONE
2009	0.2%	0.0%
2010	0.4%	0.4%
2011	0.4%	0.2%
2012	0.2%	0.1%
2013	0.3%	0.2%
2014	0.2%	0.1%
2015	0.2%	0.1%
2016	0.1%	0.1%
2017	0.6%	0.6%
2018	0.6%	0.5%
2019	0.2%	0.2%

(E) Line Density Maps

Item E.1

Fishing density within Ocean Wind Area

All years, all boats



Item E.2

Transit density within Ocean Wind Area

All years, all boats

