WORKING GROUP NAME: ICES WORKING GROUP ON VALUE OF COASTAL HABITAT FOR EXPLOITED SPECIES

Executive summary

This report summarizes the work of the ICES Working Group on the Value of Coastal Habitats for Exploited Species (WGVHES) from 2019 to 2021 (24-28 June 2019, Roma, Italy; 29 June–3 July 2020 and; 21-25 June 2021 e-meetings and, from June 2020 to June 2021, additional monthly 2 hours –meetings to work on one specific goal, see below); participants included scientists within the fields of modelling, marine ecology, fishery management, and conservation biology.

The two primary products of this working group for 2019-2021 were an (i) Analysis of the contribution of juvenile abundance indices in forecasting stock recruitment to better utilize available information for management (ToR d), (ii) Review the application of the nursery habitat concept in management of exploited species and assess the need for refinement of the definition (ToR a), and (iii) review of the role of hard bottom and biogenic habitats in supporting commercially important species (ToR b). The restrictions imposed by COVID on members' personal situations and on logistics (i.e., no travel and e-meetings only since 2019, difficulty to plan common e-meetings joining both sides of the Atlantic) hindered the progress of the WG. While momentum was maintained and progress was made, the initially planned ToR c --lessons learned on the conservation of habitat for exploited species using experiences from different countries was not completed. Moreover, although the "hardbottom review" was submitted for publication, the reviews suggest a major revision, which will be completed and the manuscript re-submitted for publication during next next set of proposed ToRs (see 2022-24 ToRs below).

Progress on ToR a during 2019 to 2021 was the assembly of an extensive literature review on methods for assessing Habitat Quality of Juvenile Fish in Coastal Environments. The importance of accurate and precise quantification of the quality and quantity of juvenile and nursery habitats continues to increase and plays important roles in fisheries stock assessment and sustainable management and in ecosystem restoration. The assembly of the literature database was possible with members working remotely and having check-in e-meetings almost monthly. The WG developed a set of rules and guidelines for evaluating 3221 papers that were identified using a suite of search keywords. A high level of consistency across members ensured consistency and comparability. A total of 996 papers passed screening at the abstract level, and were assigned to members who entered information into an Access database developed by the WG. All papers have been reviewed and their features entered into a universal Access database. Features included basic information on location, species, spatial and temporal scales, and what metrics and measures were used for quantifying habitat quality based on abundance, growth, survival, and juvenile-to-adult linkage. A suite of best-practice, Case Studies are also highlighted. Preliminary graphical analyses of the entire database and identification of key findings were conducted during our virtual 2021 meeting

(June 21-25). This information will form the basis of the initial manuscript on this topic. The database will will provide a rich source of information for further analyses into the future. Significant progress on ToR b was achieved with intersessional work. ToR b will be completed shortly after the next available in-person meeting. Initial progress on ToR c (essential fish habitat and lessons learned) was made at the last in-person meeting of the WG, in 2019. An outline and major points were discussed and agreed upon. Further effort was stopped because of the restrictions on in-person meetings and the WG determined that effort would be better spent on ToR a. ToR c will therefore be re-started and pursued at the next in-person meeting of the WG in 2022.

Work within ToR d was finalized during the present WG term. A paper was published about the use and performance of survey-based pre-recruit abundance indices for possible inclusion in stock assessments of coastal-dependent species (Le Pape et al. ICES JMS 2020). Our analysis of the relationship between survey-based pre-recruit indices and assessment-generated recruitment indices revealed that survey-based pre-recruit abundance indices were sufficiently accurate to provide useful information for predicting future recruitment. The analyses (which included a questionnaire survey of assessment scientists) was that survey-based pre-recruit abundance indices were under-used because of question uncertainties in sampling efficiency, sampling of juveniles in their coastal habitats was outside the geographical area covered by large-scale surveys, and targeted coastal surveys for juveniles are conducted on limited spatial and temporal scales. However, our analysis of the relationship between survey-based pre-recruit indices and assessment-generated recruitment indices revealed that survey-based pre-recruit abundance indices were sufficiently accurate to provide useful information for predicting future recruitment. The results indicate that surveys of juvenile fishes should be further considered in fisheries management and the information leveraged as a complementary source for assessing recruitment dynamics.

Overall, the WG's products demonstrate the importance of habitat considerations for exploited coastal species, and highlight significant gaps in knowledge. Moreover, the role of nursery habitats is changing with climate, which serves as one focal area for our future ToRs. We therefore request that the WG continue for another 3-year term. During the next 3-years we will: (1) continue our efforts on reviewing and synthesizing the existing work on the nursery concept and methods for assessing juvenile habitat in order to inform stock-level and ecosystem-based management (continuation of old ToR a with new analyses of the literature database), (2) revise and re-submit the manuscript on the role of hard bottom and biogenic habitats (continuation of old ToR b) (3) complete our perspectives paper on essential fish habitat, management implications, lessons learned, and restoration (continuation of old ToR c), (4) start work on a new ToR on assessing juvenile habitat under a changing climate and emerging novel ecosystems (new ToR d), and (5) prepare a series of educational outreach briefings that summarize and synthesize the important recommendations from the ~ 10 years that this working group has been operating (new ToR e). This set of five ToRs for the next 3-year term will build

on the existing work of the WG, and address some of the remaining critical knowledge gaps.

Participants 2019 of the ICES working group on the value of coastal habitats for exploited species in Roma, Italy: Elliot Brown, Dave Eggleston, Kenny Rose, Benjamin Ciotti, Josianne Støttrup, , Karen van de Wolfshaar, Olivier Le Pape and Franceso Colloca.

1 Administrative details

Working Group name
ICES Working Group on Value of Coastal Habitat for Exploited Species
Year of Appointment within the current three-year cycle
Third and last year
Reporting year concluding the current three-year cycle
2021
Chair(s)
Dave Eggleston, US
Olivier Le Pape, France
Meeting venue(s) and dates
24-28 June 2019, Roma, Italy (9);
29 June–3 July 2020, e-meeting (14)
21-25 June 2021, e-meeting (15)

2 Terms of Reference

a) Review the application of the nursery habitat concept in management of exploited species and assess the need for refinement of the definition
b) Review and report on evidence that hard bottom and biogenic habitats support commercially important species

c) Collate and document lessons learned on conservation of habitat for exploited species using experiences from different countries
d) Analyse the contribution of juvenile abundance indices in forecasting stock recruitment to better utilize available information

3 Summary of Work plan

Year 1	Finalize projects from the previous period under ToR d and start projects under ToR a and c.
Year 2	Continue work from ToR a
Year 3	Finalize project on ToR a and identify future research priorities

4 Summary of Achievements of the WG during 3-year term

Publications (bold denotes members of the working group)

Directly produced by the group

Le Pape O., Vermard Y., Guitton J., **Brown E.J., van de Wolfshaar K., Lipcius R.N., Stottrup J.G., Rose K.A.,** (2020) The use and performance of survey-based pre-recruit abundance indices for possible inclusion in stock assessments of coastal-dependent species. *Ices Journal of Marine Science*. 77(5), 1953–1965. /10.1093/icesjms/fsaa051.

Lipcius R.N., Eggleston D.B., Fodrie F.J., van der Meer J., Rose K.A., Vasconcelos R. P., van de Wolfshaar K.E. (2019). Modeling quantitative value of coastal habitats for exploited populations. *Frontiers in Marine Science*. 6, /10.3389/fmars.2019.00280.

From group members, linked to their work in the group

Baudron, A. R., Brunel, T., Blanchet, MA., Hidalgo, M., Chust, G., **Brown, E. J.**, Kleisner, K. M., Millar, C., MacKenzie, B. R., Nikolioudakis, N., Fernandes, J. A., & Fernandes, P. G. (2020). Changing fish distributions challenge the effective management of European fisheries. *Ecography*, 43(4), 494-505. https://doi.org/10.1111/ecog.04864

Brown, E. J., Kokkalis, A., & Støttrup, J. G. (2019). Juvenile fish habitat across the inner Danish waters: Habitat association models and habitat growth models for European plaice, flounder and common sole informed by a targeted survey. *Journal of Sea Research*, 155, [101795]. https://doi.org/10.1016/j.seares.2019.101795

Brown, E. J., Reis-Santos, P., Gillanders, B. M., & Støttrup, J. G. (2019). Juvenile fish habitat across the inner Danish waters: Using otolith chemistry to discriminate between hybridising con-familials and contiguous, coastal habitat. *Estuarine, Coastal and Shelf Science*, 220, 111-119. https://doi.org/10.1016/j.ecss.2019.02.025

Caretti, O., D. Bohnenstiehl and **D. Eggleston**. (2021). Spatial variability in sedimentation drives habitat loss on restored subtidal oyster reefs. Estuaries & Coasts. https://doi.org/10.1007/s12237-021-00921-6.

Milisenda, G., Garofalo, G., Fiorentino, F., **Colloca, F.**, Maynou, F., Ligas, A. & Vitale, S. (2021). Identifying persistent Hot Spot areas of undersized fish and crustaceans in southern European waters: implication for fishery management under the discard ban regulation. *Frontiers in Marine Science*, *8*, 60.

Pittman, S. K.L. Yates, P.J. Bouchet, D. Alvarez-Berastegui, S. Andréfouët, S.S. Bell, C. Berkström, C. Boström, C.J. Brown, R.M. Connolly, R. Devillers, **D. Eggleston**, & 26 other co-authors (2021). Seascape ecology: Identifying research priorities for an emerging ocean sustainability science. *Marine Ecology Progress Series*. 663:1-20, https://doi.org/10.3354/meps/3661.

Støttrup, J. G., Kokkalis, A., **Brown, E. J.**, Vastenhoud, B., Ferreira, S., Olsen, J., & Dinesen, G. E. (2019). Essential Fish Habitats for commercially important marine species in the inner Danish waters. Technical University of Denmark. DTU Aqua-rapport No. 338-2019 https://www.aqua.dtu.dk/-/media/Institutter/Aqua/Publikationer/Forskningsrapporter_301_350/338-2019-Essential-Fish-Habitats.ashx?la=da&hash=4BD61604CE09E708D8D739ED4E7D287C9917E0AA

Tableau A., Le Bris H., Saulnier E., **Le Pape O.,** Brind'Amour A. (2019) Novel approach for testing the food limitation hypothesis in estuarine and coastal fish nurseries. *Marine Ecology - Progress Series*. 629 :117-131. /10.3354/meps13090.

Theuerkauf, S., J., **D. B. Eggleston**, B. J. Puckett. (2019). Integrating ecosystem services considerations within a GIS-based, habitat suitability index for oyster restoration. PLoS ONE 14(1): e0210936. https://doi.org/10.1371/journal.pone.0210936

Theuerkauf, S., J., B. J. Puckett, and **D. B. Eggleston**. (2021). Oyster metapopulation dynamics: Sources, sinks and implications for conservation and restoration. *Ecosphere*, July 12 publication date.

van de Wolfshaar, **K. E**, Barbut L, Lacroix. G. (2021) From spawning to first-year recruitment: the fate of juvenile sole growth and survival under future climate conditions in the North Sea. *ICES Journal of Marine Science* /10.1093/icesjms/fsab025

Vaz S., **Le Pape O**. (2019). Quantitative Mapping of Fish Habitat: From Knowledge to Spatialised Fishery Management. In Komatsu T., Ceccaldi HJ., Yoshida J., Prouzet P., Henocque Y. (eds) Oceanography Challenges to Future Earth. Springer, Cham. ISBN 978-3-030-00137-7 ISBN 978-3-030-00138-4 (eBook) /10.1007/978-3-030-00138-4. Chap. 25 pp.313-323 (Springer Nature).

In preparation

Champagnat J., Lecomte J.B., Rivot E., Douchet L., Martin N., Grasso F., Mounier F., Labadie P., Loizeau V., Bacq N., **le Pape O.** (accepted.) All together is better: the multidisciplinary assessment of nearshore nursery habitat restoration for a population of marine fish and related fisheries. *Marine Ecology Progress Series*

Presentations

Champagnat J., Rivot E., **Le Pape O.** (2021). How essential fish habitat impacts population productivity and resilience. Poster, ICES Annual Science Conference. 6-10 September 2021.

Ciotti B. J. (2021). Identification of essential flatfish habitats in south west England. South-West Marine Ecosystems, UK.

Ciotti B. J. (2021). Use of sandy beaches in SW England by juvenile flatfishes: identifying the essential habitats that sustain fisheries. Salcombe and Kingsbridge Estuary Forum, UK.

Eggleston, D, S. Theuerkauf, B. Puckett. (2021). Oyster metapopulation dynamics: Sources, sinks and implications for conservation and restoration. National Shellfisheries Association Annual Meeting (Virtual).

Ciotti B. J. (2020). Identifying Essential Fish Habitat: measures of habitat quality. Severn Estuary Ecological Research Forum, UK.

Le Pape O., Régimbart A., Vaz S. (2019). Integrating essential fish habitats into fisheries management and marine conservation: An ongoing process in France. Communication. General Fisheries Commission for the Mediterranean (GFCM) Working Group on Marine Protected Areas (WGMPA), Rome, Italy, 18-21 February 2019.

Le Pape O., Régimbart A. (2018). Integrating essential fish habitats into fisheries management and marine conservation. An ongoing process in France. Invited conference. FishForum 2018, FAO, Rome, Italie, 10-14 décembre 2018.

Le Pape O., Randon R., Lecomte J.B., Rivot E., Réveillac E. (2019). Estimating life-cycle connectivity of an exploited marine fish: implications for management impacts. Communication. Swimway conference, Hambourg, Allemagne, 24-26 septembre 2019.

Rose, K., Havens, K.J, Hubbart, J., Ihde, T., Karimi, H., Monaco, M.E., Shabman, L., Smith, E., and Stauffer, J. (2020). A proposed framework for analyzing water quality and habitat effects on aquatic living resources of Chesapeake Bay. Chesapeake Community Research Symposium 2020, June 2020, Annapolis MD USA.

van de Wolfshaar, **K. E**, Barbut L, Lacroix. G. (2019). Sole growth and survival under climate change conditions. SWIMWAYs: Understanding connectivity within the life cycles of coastal fish, 24-26 September 2019. Hamburg Germany

5 Final report on ToRs, workplan and Science Implementation Plan

ToR a) Review the application of the nursery habitat concept in management of exploited species and assess the need for refinement of the definition

The work on this ToR focused on a systematic review of methods used to assess juvenile habitat quality. Recent synthesis papers have provided critiques and new suggestions for frameworks to identify nursery habitats for fisheries species. The ability of field methods to collect the necessary data has not been rigorously reviewed, yet is crucial for effective implementation of these frameworks. The aim of our work on this ToR was to identify how the quality of juvenile habitats can be most effectively measured to fulfil a range of management and research needs. Specifically, we sought to:

O1. Systematically review how juvenile habitat quality has been measured in the past, focusing particularly on abundance, growth, survival and juvenile–adult linkage, to evaluate the development and current status of research in this area.

O2. Evaluate the ability of existing and forthcoming methods to measure juvenile habitat quality at appropriate spatial and temporal scales.

O3. Use O1 and O2 to identify future challenges, examples of good practice and future opportunities to measure juvenile habitat quality.

In June 2019 (Face to Face working group meeting in Rome) we brainstormed approaches to the topic and came up with search terms and systematic review metholodogy to tackle the research objectives. We conducted searches of the literature, identifying 3221 papers of potential interest. We screened the titles of these papers to remove 382which did not meet a set of predetermined inclusion criteria.

In June 2020 (online working group meeting), we developed methods to systematically screen abstracts of the papers against inclusion criteria and to validate and crosscheck decisions to ensure consistency across the group. We continued to refine our criteria and methodology to optimise consistency and efficiency using training datasets and excercises.

Between June 2020 and June 2021, we held a series of 11 interim meetings and associated interim tasks. In this interim period, we screened abstracts of all the 2839 papers that remained after title screening phase. This yielded 996 papers for full-text screening and data extraction. We developed methodology and software tools to extract the data and undertook training exercises to ensure consistency among participants. We undertook data extraction on the 996 papers and developed a pipeline for data collation, processing, quality control and analysis in R.

In June 2021 (online working group meeting) we explored results from the systematic review and put this in context of broader expertise of our group to identify the focal points for the review paper. We developed an outline draft that will form the basis of writing efforts over the subsequent months towards intended submission in 2022.

Our work on this ToR over the past 3 years is producing a very comprehensive review of the methods to measure juvenile habitat quality. We expect that this will be a landmark review supporting future research into fish habitat, as well as benefitting managers and policy makers working towards the alignment of

conservation with fisheries management through, for example, Essential Fish Habitat, Natural Capital and Ecosystem-based approaches. In addition to this publication, work on this ToR has had important additional outcomes:

· We developed the knowledge and tools for conducting systematic reviews, including protocols for ensuring consistency and use of Access databases.

· We have generated an exhaustive database of the ca. 1000 studies that have been published in an area that our WG focuses on. This will be an important resource to support the work of WGVHES for over the coming years.

ToR b) Review and report on evidence that hard bottom and biogenic habitats support commercially important species.

This manuscript was submitted and returned with suggestions for a major revision and resubmission. Resubmission of this manuscript is planned for late 2021/early 2022.

ToR c) Collate and document lessons learned on conservation of habitat for exploited species using experiences from different countries

The goal of ToR c is to use the experiences to date as case studies, along with the long history of application of essential fish habitat (EFH) in the U.S, to develop issues and guidance (a perspectives paper) on how to incorporate habitat considerations into fisheries management and ecosystem restoration. Fisheries management continues to progress towards EBFM, and habitat restoration of coastal environments is also increasing, often involving large monetary investments. In both cases, there are technical, scientific, and socio-political factors and influences that can create challenges to implementation of habitat conservation in fisheries management and to large-scale restoration efforts. For example, complex life cycles result in bottlenecks outside of the influence of the habitat of interest, species responses are often a mix of winners and losers, other multiple stressors can dampen responses to changes in habitat, climate change can offset gains by increased habitat, and the public often has unrealistic expectations of the magnitude and speed of ecological responses. In this perspectives paper, the WG will use case studies to illustrate the major benefits, issues, and challenges (lessons learned) associated with explicit consideration of habitat quality and quantity in management and restoration. To the extent possible, we will offer suggestions on how to anticipate and address these issues. This type of paper is made possible by the international mix of WG members and is greatly facilitated by in-person discussion.

ToR d) Analyse the contribution of juvenile abundance indices in forecasting stock recruitment to better utilize available information

The work was based on a review of Recruit-Stock relationships for ICES species for which there are stock assessment reports by accumulating available data from stock assessments. The group investigated the link between juvenile abundance for coastal nursery-dependent species and future recruitment in the stocks, and the interest to integrate juvenile abundance indices in short term forecasts to improve integration into stock assessments. Key questions incluced: (1) What is the frequency of the use of juvenile abundance indices in recruitment

forecasts in the framework of stock assessment groups (and what are the drivers of and the barriers to this use)? (2) When juvenile abundance indices are used, what is the level of accuracy in recruitment forecasts, and what are the drivers of this level of accuracy?

Over the 185 ICES stocks have been examined. Among the 78 stocks with juvenile coastal dependence, 49 use short-term forecasts in stock assessments. Survey-based pre-recruit abundance indices were available for 35 of these stocks, yet only 14 were used to forecast recruitment. The questionnaire indicated that the limited use of survey-based pre-recruit abundance indices was primarily due to sampling inefficiency, which may preclude reliable recruitment estimates. This sampling is inefficient because the juvenile coastal distribution is outside the geographical area covered by large-scale surveys, or targeted coastal surveys are conducted on limited spatial and temporal scales. However, our analysis of the relationship between survey-based pre-recruit indices and assessment-generated recruitment indices revealed that survey-based, pre-recruit abundance indices were sufficiently accurate to provide useful information for predicting future recruitment. We recommend expansion of the use of survey-based indices of pre-recruit abundance in stock assessment and recruitment forecasting, and increased consideration of how to include juveniles in ongoing and future surveys.
One paper (Le Pape et al., 2020, ICES JMS) was finally published in the primary literature.

Science highlights

The group paper on "The use and performance of survey-based pre-recruit abundance indices for possible inclusion in stock assessments of coastal-dependent species.", published June 2020 (ICES JMS, main findings detailed above), was well received and already cited 3 times one year after.

O. Le Pape was invited to give two presentations on "Integrating essential fish habitats into fisheries management and marine conservation:"in December 2018 during the FAO fishforum then in February 2019 during the annual congress of the General Fisheries Commission for the Mediterranean. The aim of these events was to discuss progress on the protection of essential fish habitats under Article 8 of the EU Common Fisheries Policy and its contribution to rebuilding fish stocks in the Mediterranean Sea.

6 Cooperation

During this 3-year period the WG did not formally interact with other ICES WGs.

7 Summary of Working Group self-evaluation and conclusions

One group paper was published and another one is about to reach final stage before submission to a scientific journal. Papers were published by group members that benefitted from their membership of the group. Two ToRs were completed and significant progress was made on another ToR. The working group wants to expand its activities to better quantify habitat value and evaluate its use in management. Members fulfilled relevant advisory roles on habitat

aspects. Group members are advising national governments (France, Denmark, USA) on application of habitat considerations in fisheries management. O. Le Pape was invited to inform the FAO and the General Fisheries Commission for the Mediterranean about progress on the protection of essential fish habitats.

Annex 1: List of participants

Name	Institute	Country (of institute)	Email
David Eggleston	Center for Marine Sciences and Technology, North Carolina State University, 303 College Circle, Morehead City, NC 28557 USA	+1 252 222 6301	eggleston@ncsu.edu
Romuald Lipcius	Virginia Institute of Marine Science, College of William & Mary, P.O. Box 1346, Gloucester Point, VA 23062 USA	+1 757 869 2717	rom@vims.edu
Rochelle Seitz	Virginia Institute of Marine Science, College of William & Mary, P.O. Box 1346, Gloucester Point, VA 23062 USA	+1 757 869 2727	seitz@vims.edu
Josianne Støttrup	National Institute of Aquatic Resources, Technical University of Denmark, Kgs. Lyngby , Denmark		jgs@aqua.dtu.dk
Karen van de Wolfshaar	Wageningen Marine Research, Haringkade 1, Ijmuiden, The Netherlands	+31 317 487177	karen.vandewolfshaar@wur.nl
Elliot J. Brown	DTU Aqua - National Institute of Aquatic Resources, National Institute of Aquatic Resources, Technical University of Denmark, Kgs. Lyngby, Denmark		elbr@aqua.dtu.dk
Olivier Le Pape	Agrocampus Ouest, UMR985 ESE Ecologie et santé des écosystèmes, F-35042 Rennes, France;	+33 223485531	olivier.le.pape@agrocampus-ouest.fr
Kenny Rose	University of Maryland Center for Environmental Science, Horn Point Laboratory, PO Box 775, Cambridge, Maryland USA		krose@umces .edu
Francesco Colloca	Stazione Zoologica "Anton Dohrn", Naples, Italy		francesco.colloca@szn.it
Benjamin Ciotti	University of Plymouth, UK		Benjamin.ciotti@plymouth.ac.uk
Suzanne.Poiesz	NIOZ Royal Netherlands Institute for Sea Research The Netherlands		suzanne.poiesz@nioz.nl
Kieran Hyder	CEFAS, UK		kieran.hyder@cefas.co.uk
Margot Maathuis	Wageningen Marine Research, Haringkade 1, Ijmuiden, The Netherlands		margot.maathuis@wur.nl
Daniele Ventura	Roma University		daniele.ventura@uniroma1.it
Alexander C. Hyman	Virginia Institute of Marine Science, College of William & Mary, P.O. Box 1346, Gloucester Point, VA 23062 USA		achyman@vims.edu
Juliette Champagnat	Agrocampus Ouest, UMR985 ESE Ecologie et santé des écosystèmes, F-35042 Rennes, France;		juliette.champagnat@agrocampus-ouest.fr
Hanna C. Charan-Dixon,	Groningen University		h.c.charan-dixon@rug.nl

Participants in virtual ICES WG VHES Meeting during June 21-25, 2021. From left to right and top to bottom: David Eggleston, Rom Lipcius, Suzanne Poiesz, Karen van de Wolfshaar, Ben Ciotti, Oliver LePape, Francesco Colloca, Challen Hyman, Rochelle Seitz, Elliot Brown, Kenny Rose and Danielle Ventura. Missing from this picture are the following 2021 meeting participants: Kieran Hyder, Juliette Champagnat, Margot Maathuis and Hannah Charan-Dixon.

Annex 2: Recommendations

We recommend participation by several fishery managers during the start of the next WG Meeting (planned for June 20-24, 2022 if continuation approved by ICES). Input form fishery managers will help inform our series of educational briefings, as well as help refine relevant future ToRs.

Annex 3: WGVHES terms of reference

Working group meeting draft resolution for multi-annual ToRs (Category 2)

A **Working Group on the Value of coastal Habitats for Exploited Species** (WGVHES), chaired by B. Ciotti (UK) and E. Brown (DK), will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2022	June	TBD	Interim report by August 2022	
Year 2023	June	TBD	Interim report by August 2023	
Year 2024	June	TBD	Final report by August 2024	

ToR descriptors

ToR	Description	Background	Duration	Expected Deliverables
a	*Testing the nursery role of coastal habitats: a systematic review.*	Many field methods have been used to assess juvenile habitat quality and quantity. The WG will continue its investigation of the usefulness and practicality of these different methods using a systematic literature review assembled in the previous WG term	1, 2	Finalize paper started in previous WG term; Follow-on papers that use the assembled literature dataset on methods
b	*The nursery role of hard bottom habitats.*	A critical gap in our knowledge of juvenile habitat is the lack of information on the value of hard bottom habitats	1	The WG will resubmit the review and synthesis paper on the distribution, measurement, and functional role of hard bottom habitats.
c	*Essential Fish Habitat (EFH): Management, lessons learned, & restoration.*	Many countries are defining essential fish habitat and incorporating this concept into management with mixed success. Habitat restoration is also proceeding, often with high monetary investments. Issues include non-standard definitions and methods for quantification, socio-political and policy challenges, uncertainties in the underlying science, and confusing communication.	1, 2	This working group will produce a paper that uses the US experience, and other past and ongoing examples, to compile "lessons learned."
d	*Role of nursery habitats under climate change & novel ecosystems.* .	How the nursery role of many habitats will be modified with climate change and under novel cosystem conditions continues to be an important issue.	2, 3	The WG will prepare a review and synthesis paper on the possible roles of nursery habitat going into the future.
e	*Application of findings from WG VHES to fisheries management: A synthesis.*	The WG will celebrate 10 years at the end of the requested new 3-year term. To facilitate the transfer and uptake of WG outcomes and outputs to management, a short synthesis of the work realized since 2012 (i.e., everything in one place) would be an effective communication tool.	3	The WG will prepare a short communication or outreach document that outlines the key findings and insights produced by the WG over its existence and highlight how these results have management implications

Summary of the Work Plan

Year 1	Continue the work on ToR a and c. Finalise a first paper on ToR a. Finalise the paper on the review of hard-bottom habitats (ToR b).
Year 2	Continue the work on ToR a and c. Initialize the work on ToR d
Year 3	Continue the work on ToR a, d. Finalise a paper on ToR c. Achieve Tor e by writing a short synthesis of the work realized since 2012, to facilitate the transfer and uptake of WG outcomes and outputs to management.

Supporting information

Priority	The current activities of this Group will lead ICES into issues related to the importance of coastal habitat for fisheries management.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by 10-15 members and guests.
Secretariat facilities	Maria.Lifentseva@ices.dk
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There are no obvious direct linkages.
Linkages to other committees or groups	There are no obvious direct linkages.
Linkages to other organizations	There are no obvious direct linkages.

Annex 4: Copy of Working Group self-evaluation

1. Working Group: Working Group on the Value of Coastal Habitats for Exploited Species (WGVHES).
2. Last final report: 2018.
3. Current Chairs: O. Le Pape (France) and D. Eggleston (USA).
4. Meetings: 2019 Roma, 2020-2021 e-meetings

WG Evaluation

If applicable, please indicate the research priorities (and sub priorities) of the Science Plan to which the WG make a significant contribution.

Our working group efforts have contributed to the following ICES Science Plan objectives: 2 (understanding ecosystems), 3 (impacts of human activities), 4 (observation and exploration), and 6 (conservation and management).

In bullet form, list the main outcomes and achievements of the WG since their last evaluation. Outcomes including publications, advisory products, modelling outputs, methodological developments, etc. *

- Information from the working group review papers produced since 2012 have been integrated into undergraduate and graduate marine science courses taught by D. Eggleston at NC State University US and by O. Le Pape at Agrocampus Ouest France.
- **Lipcius R.N., Eggleston D.B., Fodrie F.J., van der Meer J., Rose K.A., Vasconcelos R. P., van de Wolfshaar K.E. (2019)**. Modeling quantitative value of coastal habitats for exploited populations. Frontiers in Marine Science. 6, /10.3389/fmars.2019.00280.
- **Le Pape O.,** Vermard Y., Guitton J., **Brown E.J., van de Wolfshaar K., Lipcius R.N., Stottrup J.G., Rose K.A.,** (2020) The use and performance of survey-based pre-recruit abundance indices for possible inclusion in stock assessments of coastal-dependent species. .*Ices Journal of Marine Science*. 77(5), 1953–1965. /10.1093/icesjms/fsaa051.

Has the WG contributed to Advisory needs? If so, please list when, to whom, and what was the essence of the advice.

- **Le Pape O.**, Régimbart A., Vaz S. (2019) Integrating essential fish habitats into fisheries management and marine conservation: An ongoing process in France. Communication. General Fisheries Commission for the Mediterranean (GFCM) Working Group on Marine Protected Areas (WGMPA), Rome, Italy, 18-21 February 2019.
- **Le Pape O**., Régimbart A. (2018) Integrating essential fish habitats into fisheries management and marine conservation. An ongoing

process in France. Invited conference. FishForum 2018, FAO, Rome, Italie, 10-14 décembre 2018.

Please list any specific outreach activities of the WG outside the ICES network (unless listed in question 6). For example, EC projects directly emanating from the WG discussions, representation of the WG in meetings of outside organizations, contributions to other agencies' activities.

- There has been cross-fertilization between the working group and research and academic programs of the working group members.
- D. Eggleston. Oyster Restoration Steering Committee, and Coastal Habitat Protection Committee. NC Division of Marine Fisheries and NC Coastal Federation. Ongoing 2019-2021.

Please indicate what difficulties, if any, have been encountered in achieving the workplan.

- E-meetings are drastically too short and less efficient than in-person meetings, however, ZOOM allowed us to stay connected and make progress on ToRs. The overall production of the group was less in 2020 and 2021 compared to 2019.

Future plans

Does the group think that a continuation of the WG beyond its current term is required? (If yes, please list the reasons)

- Yes, group activities to date have identified new topics and emerging issues related to the quantification of habitat value for fisheries management. A new 3-year term is necessary to extend and expand into these areas, and to integrate early career scientists. The value of coastal habitats for exploited species is highly relevant to the new ICES science plan given the focus on integrated ecosystem assessments and advice for ecosystem based management, as well as the impacts of climate change on these nursery systems.

If you are not requesting an extension, does the group consider that a new WG is required to further develop the science previously addressed by the existing WG.

N/A

What additional expertise would improve the ability of the new (or in case of renewal, existing) WG to fulfil its ToR?

- Any additional expertise needed will be evaluated during the new period and *ad hoc* members added as appropriate. We also anticipate including fishery managers in the next WG meeting during June 2022 as described above.

Which conclusions/or knowledge acquired of the WG do you think should be used in the Advisory process, if not already used? (please be specific)

- The work on recruit-stock functions highlights the potential strength of rigorous pre-recruit surveys in helping to tune fishery stock assessments.

- The work on integrating information on nursery habitat quality into population and metapopulation dynamics models is guiding habitat conservation and restoration, as well as facilitating application of EBFM.
- Information on EFH and how best to quantify the nursery role of fishery habitats is not only informing the first 2 bullets above, but also the inclusion of habitat ecosystem services into socio-economic models that monetize ecosystem services.
- Information on the habitat value of hardbottom habitats is informing ecosystem services of a broad range of hardbottom habitats that provide structure for fisheries production (e.g, oil platforms, wind turbines and other artificial reefs), to rock rip-rap used to reduce shoreline erosion, to natural hardbottom areas that can serve as effective juvenile habitat.