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REPORT

Shoreline development and degradation of coastal fish reproduction habitats

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Abstract Coastal development has severely affected habitats and biodiversity during the last century, but quantitative estimates of the impacts are usually lacking. We utilize predictive habitat modeling and mapping of human pressures to estimate the cumulative long-term effects of coastal development in relation to fish habitats. Based on aerial photographs since the 1960s, shoreline development rates were estimated in the Stockholm archipelago in the Baltic Sea. By combining shoreline development rates with spatial predictions of fish reproduction habitats, we estimated annual habitat degradation rates for three of the most common coastal fish species, northern pike (*Esox lucius*), Eurasian perch (*Perca fluviatilis*) and roach (*Rutilus rutilus*). The results showed that shoreline constructions were concentrated to the reproduction habitats of these species. The estimated degradation rates, where a degraded habitat was defined as having $\geq$3 constructions per 100 m shoreline, were on average 0.5 % of available habitats per year and about 1 % in areas close to larger population centers. Approximately 40 % of available habitats were already degraded in 2005. These results provide an example of how many small construction projects over time may have a vast impact on coastal fish populations.

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Keywords Coastal zone management · Essential fish habitat · Habitat loss · Human impact · Species distribution modeling

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INTRODUCTION

With increasing human populations in coastal areas worldwide, the pressures on the coastal ecosystems are rising. Coastal development is a factor that has had a dramatic effect on near-shore habitats in the last century and is one of the primary threats to biodiversity (Lotze et al. 2006; Hanski 2011). In particular, coastal development affects over 80 % of the coastline in many regions of Europe, thus, being responsible for much of the observed habitat degradation and loss (Airoldi and Beck 2007). For species dependent on specific habitats during some part of their life-cycle, habitat degradation may have negative population effects (e.g., Rochette et al. 2009). Even small local disturbances, e.g., construction of a jetty or dredging a channel for recreational boating, can have long-term negative effects on vulnerable coastal habitats (Jordan et al. 2008). Shoreline construction is a slow process that alters the environment over human generations. If allowed to proceed too far, it may give rise to profound changes in ecosystem functioning, which are not only difficult to detect in advance, but, given that the drivers can only be slowly managed, may also be unavoidable once the changes are underway (Biggs et al. 2009). Thus, for efficient planning and policy development, there is a need to quantify the total extent and rate of change of these small-scale development projects and to assess their potential impacts on near-shore habitats (Seitz et al. 2013).

In the countries bordering the Baltic Sea, about 26 million people live within a 50-km distance from the coast (Sweitzer et al. 1996), and coastal development is intense in many areas. In this study, we focused on coastal development in the Stockholm archipelago region of the northwest Baltic Proper. This archipelago is of high recreational value, e.g., in terms of housing, recreation, and fisheries (Söderqvist et al. 2005). Since around the mid 1900s, there has been an

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increased recreational use of the archipelago with subsequent development of the shores (Kindström and Aneer 2007). Also the increased population, together with a change in recreational habits, has led to an increase in boating and associated construction of jetties and marinas, as well as dredging to gain access by boat to shallow shores. Recreational boating and ferry traffic have been shown to lead to a decrease in vegetation cover and change in the composition of the submerged vegetation community (Eriksson et al. 2004), which can adversely affect the juvenile fish community that utilizes these shallow, sheltered areas for reproduction, i.e., as spawning and nursery areas (Jude and Pappas 1992; Sandström et al. 2005).

The spatial distribution of species and habitats in marine environments is poorly known. Recent decades have, however, seen a rapid development of species distribution modeling methods, allowing researchers and managers to produce predictive maps of the underwater environment and its associated biota (Elith and Leathwick 2009). In the Baltic Sea, several recent research programs have significantly benefited our understanding and knowledge of habitat distributions in general (Al-Hamdani and Reker 2007; Bučas et al. 2013; Lindegarth et al. 2014) and coastal fish habitats in particular (Härmä et al. 2008; Kallasvuo et al. 2009; Sundblad et al. 2009, 2011, 2013; Snickars et al. 2010; Bergström et al. 2013). For instance, using statistical non-linear relationships between life-stage specific occurrence and environmental descriptors, Sundblad et al. (2011) used predictive distribution models to map key reproduction habitats of three of the most common species in the Baltic Sea coastal fish community, northern pike (*Esox lucius*), Eurasian perch (*Perca fluviatilis*) and roach (*Rutilus rutilus*). Pike and perch are large piscivores important both for ecosystem functioning and for commercial and recreational fisheries, while roach is an important benthivore and prey species for large predators. During their first year of life, all three species utilize shallow, sheltered near-shore habitats with suitable vegetation and temperature development during spring and summer (Gillet and Dubois 1995; Sandström et al. 2005; Snickars et al. 2009, 2010; Sundblad et al. 2011, 2013). These species are all sensitive to disturbances related to boating activities, either directly or indirectly. For pike, existing studies have shown negative effects on young-of-the-year (YOY) abundance of marinas and ferry routes, as well as a negative impact of dredging (Sandström et al. 2005). Indirectly, the primary vector appears to be habitat degradation, i.e., a reduction in production following changes in habitat structure and function caused by effects on local hydrology and the vegetation community. As boating changes both vegetation composition and cover, probably mainly through resuspension of surface sediments leading to turbidity, fish reproduction habitats in the vicinity of marinas and ferry routes produce fewer recruits than pristine habitats (Eriksson et al. 2004; Sandström et al. 2005). Also, dredging may negatively alter temperature conditions, but the effect on fish reproduction is difficult to separate from boating, as dredging is used to increase boat access (Sandström et al. 2005). Fish reproduction may also be affected by shear stress from propellers and increased sedimentation on eggs and larvae (Hassler 1970; Auld and Schubel 1978; Killgore et al. 2001) or toxic substance emissions (Tjärnlund et al. 1996).

The amount of reproduction habitats of perch has been shown to limit population sizes in the Baltic Sea (Sundblad et al. 2013), and access to suitable reproduction habitats can be expected to be critical to the other two species as well. Nevertheless, protection of these habitats by the European Natura2000 network of protected areas is poor (Sundblad et al. 2011). The two habitat types "Large shallow inlets and bays" (1160) and "Coastal lagoons" (1150), as defined by the European Habitats directive, are now classified as vulnerable and endangered, respectively, in the Baltic Sea area. This Red List threat classification is based on a reduced quality of the biotopes during the last 50 years, meaning that they are considered to be facing a moderately severe and severe risk of collapse, respectively, throughout their distribution (HELCOM 2013). On a national level, Sweden implemented a Shore Protection Act in 1952 to ensure that people had access to recreation areas along the water, including all coasts, lakes, and water courses regardless of their size. In 1975, the act was extended to include not only the shoreline but also the water area. In essence, the Shore Protection Act prohibits new constructions, including buildings, jetties, piers, or similar, as well as any measures that "substantially alter the living conditions" for the biota (SFS 2009). The regulating authority, local municipalities, has been responsible for both the implementation of the Shore Protection Act as well as granting exemptions. However, errands have traditionally been handled on a case-by-case basis, with an, at least locally, generous policy on exemptions.

In this study, we demonstrate how shoreline construction, in the form of jetties, marinas, and other constructions extending into the water, is concentrated to fish reproduction habitats, illustrating a conflict of interest between development and habitat conservation. By utilizing estimates of shoreline development from 1960 onward, in combination with fish habitat maps based on predictive modeling, we estimate rates and current levels of habitat degradation.

MATERIALS AND METHODS

The study was carried out in the Stockholm archipelago in the northwest Baltic Proper, in five areas where earlier studies by the Stockholm County Administrative Board have surveyed coastal constructions using aerial photographs (Fig. 1; Anonymous 2004; Kindström and Aneer 2007). The

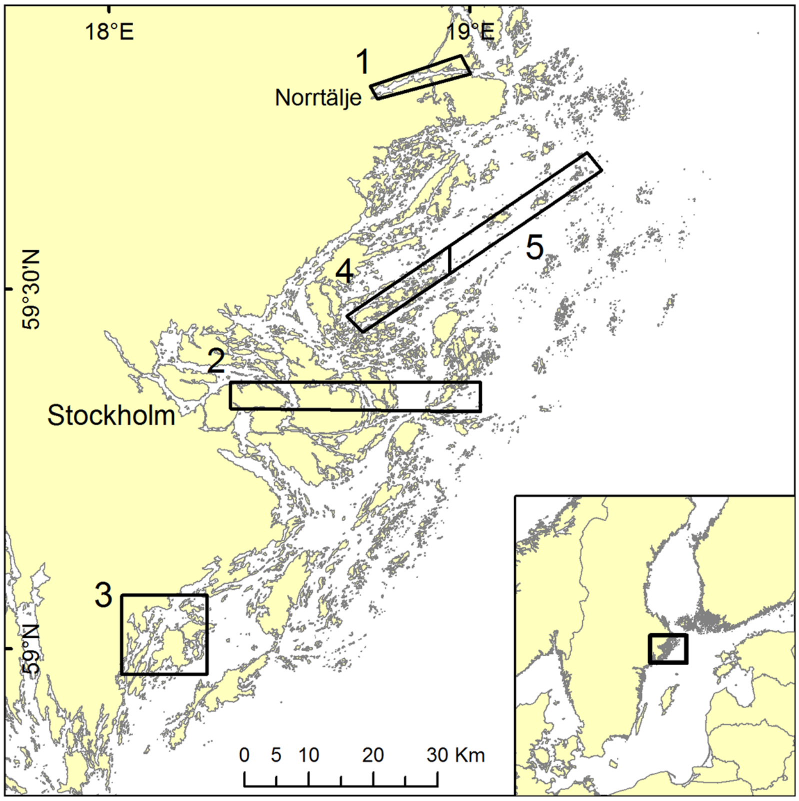

Fig. 1 The study was conducted in the northwest Baltic Proper, in the archipelago areas outside Stockholm, Sweden. Shoreline constructions have been inventoried in five areas, ranging from the inner to the outermost archipelago

study sites ranged from densely to sparsely populated areas and had been chosen to reflect the conditions from the inner to the outermost archipelago (Kindström and Aneer 2007).

Shore Types and Shoreline Development Rates

As data for this study were collated from various sources, and the analyses involved several steps, we have included a conceptual model to aid the methodology description (Fig. 2). Initially we utilized the previously developed classification based on aerial photographs taken 1960, 1986, and 1999 to estimate shoreline development rates (Anonymous 2004; Kindström and Aneer 2007). Photographs were stereo montaged during interpretation and in addition to digitizing jetties and marinas, the occurrence of quays, boathouses, or other types of properties that were connected to the shoreline and extended into the water, were also included. The number of constructions along the shoreline was estimated in a GIS using neighborhood statistics with a radius of 100 m. The resulting raster had a spatial resolution of 25 m and was used to classify all shores into one of five *shore types* depending on the number of constructions per 100 m shoreline (Kindström and Aneer 2007). Based on the results of their study, the cumulative occurrence of *shore types*, No constructions, ≥1, ≥3, ≥5, or ≥8 constructions per 100 m shoreline, was summarized per area and year. In addition, using linear interpolation annual *shoreline development rates* between the years 1960, 1986, and 1999 were estimated.

Second, a more recent study based on digital aerial photographs provided two additional datasets, (i) the number of jetties in 1999 and 2005 and (ii) the proportion of shore types in 2005 (Törnqvist and Engdahl 2010). Using the first dataset, an analysis of the development of the number of jetties between 1999 and 2005 was made. Classification of shore types in 2005 was done using the same procedure as 1960–1999 but with higher resolution photographs (1 m, in color). The high-resolution images had a higher degree of detection of jetties and other constructions, which made a direct comparison of shore types between 2005 and earlier estimates slightly biased. Therefore, we primarily used the earlier datasets (1960–1999) for calculation of shoreline development rates and the latter dataset (2005) for comparison between the proportion of constructed shoreline and the proportion of affected habitat (Fig. 2).

Distribution Modeling of Fish Reproduction Habitats

Pike, perch, and roach reproduction habitats had previously been mapped using predictive species distribution

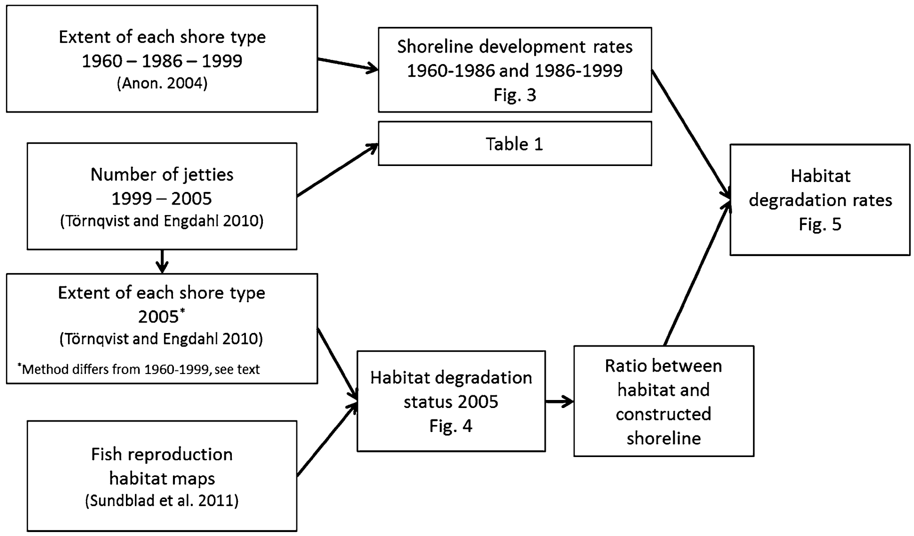

Fig. 2 Conceptual model of the data used and the analyses leading up to estimates of annual habitat degradation rates. Shoreline development rates were estimated based on a classification of shore types dependent on the number of constructions per 100 m for 1960–1999, and on the number of jetties for 1999–2005. High-resolution photographs from 2005 had been used to map the most recent distribution of shoreline constructions, which were used together with the predicted distribution of reproduction habitats in GIS overlay analyses to obtain the 2005 habitat degradation status. By multiplying the observed shoreline development rates 1960–1999 with the ratio between habitat and constructions, i.e., their overlap, observed in 2005, annual rates of habitat degradation could be estimated

modeling (Sundblad et al. 2011; Fig. 2). Fish sampling largely corresponded in time with the most recent inventory of shoreline constructions from 2005. Sampling of perch eggs was conducted during spring in 2003 using visual observations of egg strands (Snickars et al. 2010), and sampling of YOY pike and roach was conducted in late summer 2005–2006 (Sundblad et al. 2011). The models used to predict the distribution of reproduction habitats were evaluated by their cross-validated discriminatory ability, i.e., the ability to correctly separate suitable from non-suitable habitats, using ROC-values (Sundblad et al. 2011). ROC-values range between 0.5 and 1 where 0.5 equals chance, and 1 is perfect discrimination. The discriminatory ability was 0.77 and 0.71 for perch and roach, respectively (Sundblad et al. 2011). The pike model had a lower cross-validation value (0.66). However, external validation showed 88 % correct presence classification, which together with the small area predicted as suitable reproduction habitat, indicated that also the pike model performed satisfactorily (Sundblad et al. 2011).

Habitat-Construction Overlap and Habitat Degradation Rates

To assess the *habitat degradation status* of the fish reproduction habitats in 2005, the most recent shoreline construction assessment from 2005 was used in GIS overlay analyses together with the maps of fish habitats, separately for each species. Habitats within 100 and 300 m outside the shoreline, respectively, were included. These distances were chosen in an attempt to incorporate the uncertainty of effect distances, stemming from various potential mechanisms, and to match the management regulations. The Shore Protection Act normally stretches 100 m from the shoreline but may be extended up to 300 m if needed to include areas that are ecologically sensitive or of national interest.

Annual *habitat degradation rates* were estimated from the annual *shoreline development rates* observed 1960–1986 and 1986–1999, respectively. The shoreline development rates were multiplied with the ratio between the proportion of affected habitat and the proportion of constructed shoreline in 2005, calculated as means across study areas. Since the uncertainty related to the potential effect distances, i.e., 100 and 300 m, was low, and the amount of affected habitat was similar for all three species (see "Results" section), we used the average ratio across effect distances, all fish species, and lastly across constructed shore types, i.e., $\geq$1, $\geq$3, $\geq$5, and $\geq$8 constructions per 100 m. This approach implicitly made two assumptions that the overlap between reproduction habitats and constructions was constant over time and that development rates were not affected by the amount of shoreline actually being constructed. In order to simplify the results section, we only present the habitat degradation rates for shores with $\geq$3 constructions per 100 m shoreline. We estimated that each jetty leads to direct habitat loss along an on average 10–15-m wide stretch of the shoreline through loss of habitat-forming vegetation. This density of constructions thus corresponds to a direct loss of 30–45 % of the habitat along the shoreline and is well above the threshold of construction previously shown to affect fish communities (Bilkovic and Roggero 2008).

RESULTS

Shoreline Development

The proportion of shoreline without constructions decreased from 1960 to 1986 and 1999, while the proportion of shores with ≥1, ≥3, ≥5, and ≥8 constructions per 100 m increased (Fig. 3). Although the absolute increase in shoreline development was higher for ≥1 and ≥3 constructions per 100 m, a larger relative increase, i.e., development rate, was seen for ≥5 and ≥8 constructions per 100 m. The relative increase showed that shoreline development was primarily driven by few new constructions (≥1 and ≥3 constructions per 100 m shoreline) between 1960 and 1986, while between 1986 and 1999 new constructions primarily increased construction density. In 2005 over 40 % of the shores had ≥1 construction, 23 % of the shoreline had ≥3 constructions per 100 m and 10 % had ≥8 constructions per 100 m (Fig. 3).

The number of jetties continued to increase between 1999 and 2005 with a 1.5 % (±0.4 SD) mean rate of change per year (Table 1) reaching a total of 3748 jetties in the studied areas. At the same time, very few jetties were removed or lost (0.05 % ± 0.03 SD). In 2005, there was on average 4.9 (±3.2 SD) jetties per kilometer shoreline.

Habitat Degradation Rates

In 2005, approximately 70 % of the fish reproduction habitats had at least 1 construction per 100 m shoreline and 40 % of available habitats had ≥3 constructions per 100 m shoreline (Fig. 4). By comparing the ratio between the proportion of constructed shoreline in 2005 (Fig. 3) and available habitat (Fig. 4), it became evident that constructions were concentrated to the three fish species reproduction habitats. For each percent constructed shoreline, 1.5 % (±0.3 SD) of the reproduction habitats was simultaneously constructed.

Annual rates of habitat degradation were higher in 1986–1999 compared to 1960–1986 (Fig. 5). As an average across areas, approximately 0.5 % of habitats for pike, perch and roach reproduction were constructed each year. The highest habitat degradation rates were observed in the vicinity of larger population centers (Area 1 and 2), with around 1 % of available habitats being constructed each year.

DISCUSSION

We have shown that shoreline constructions in a Baltic Sea archipelago region were concentrated to fish reproduction habitats. Almost 70 % of reproduction habitats for pike, perch, and roach were affected by shoreline constructions to some extent (at least one construction per 100 m shoreline), and 40 % of the habitats had ≥3 jetties per 100 m shoreline.

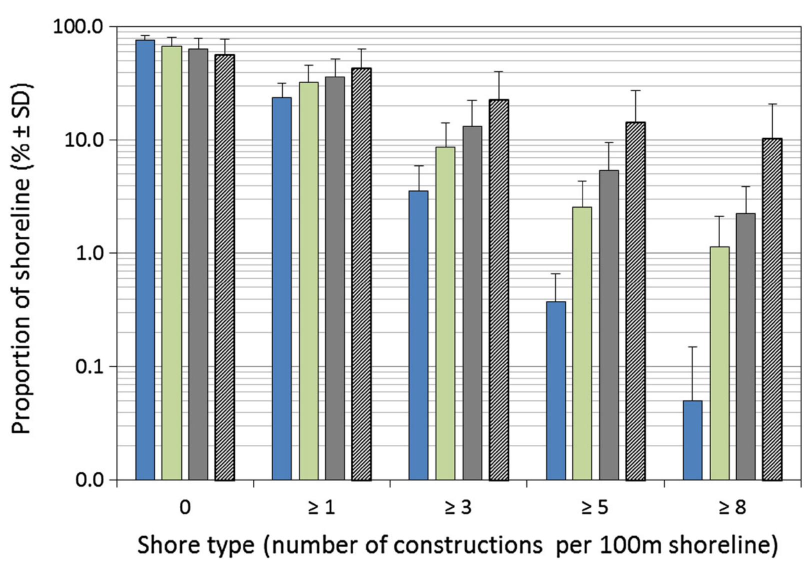

Fig. 3 Extent of five shore types, classified based on the cumulative number of constructions per 100 m, across five study areas in 1960 (*blue*), 1986 (*green*), 1999 (*gray*) and 2005 (*dashed*). The most recent classification (2005, *dashed*) was based on high-resolution photographs with a higher rate of detection of constructions than the previous classifications thereby making comparisons between 2005 and earlier years to some extent biased. The y-axis is log-transformed. 1960–1999 is based on data from Kindström and Aneer (2007) and 2005 is based on data from Törnqvist and Engdahl (2010)

Table 1 Jetty development between 1999 and 2005 and total area of reproduction habitats per species and area. Total area of reproduction habitats are from Sundblad et al. (2011)

Area	Total no. of jetties		No. of jetties removed	No. of jetties per km shoreline (2005)	Net change (%)	Annual rate of change (%)	Total area reproduction habitat (km^2)		
	1999	2005					Pike	Perch	Roach
Area 1	456	514	2	8.6	12.7	2.1	1.9	0.1	2.6
Area 2	1548	1653	8	7.8	6.8	1.1	2.7	0.4	5.3
Area 3	588	629	3	2.4	7.0	1.2	6.1	0.4	10.2
Area 4	613	673	2	4.3	9.8	1.6	2.9	0.2	6.1
Area 5	129	140	0	1.5	8.5	1.4	0.2	–	0.5
Average (±SD)	667 (529)	722 (561)	3 (3)	4.9 (3.2)	9.0 (2.4)	1.5 (0.4)			

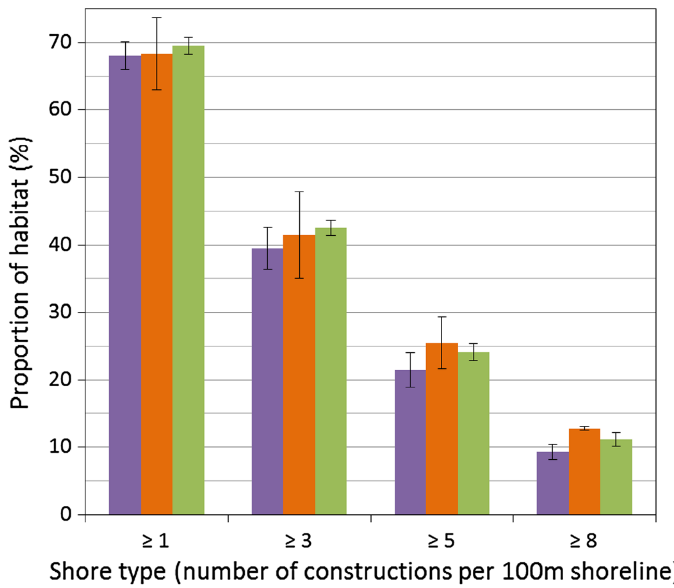

Fig. 4 Mean proportion of recruitment habitats for pike (*purple*), perch (*orange*), and roach (*green*) across 100 and 300-m distance from the shoreline of shores with ≥1, ≥3, ≥5, or ≥8 constructions per 100 m in 2005

The rates at which shorelines were developed increased between 1960 and 1999 (Fig. 3), and the number of jetties continued to increase by approximately 1.5 % every year between 1999 and 2005 (Table 1). If the degradation rate that was observed in areas close to larger cities (Area 1–2; Fig. 5) becomes the norm also in relatively undisturbed areas, it would take around 60 years, from 2005, to exploit all available reproduction habitats for three of the most common species in the coastal fish community. In fact, the rate of change in number of jetties 1999–2005 was higher in the more remote areas (Areas 3–5) than in the area close to the city of Stockholm (Area 2; Table 1), which had the highest habitat degradation rate between 1986 and 1999 (Fig. 5). While this may have indicated a policy shift in Area 2, it also provides support to our scenario by highlighting an increased development rate in areas that had previously experienced relatively low development pressure. However, this simplistic scenario is based on a linear development without any saturation function as well as a static preference to place constructions in environments functioning as reproduction habitats. Although these assumptions may be unrealistic, the scenario highlights how the current degradation rate may accumulate over time to pose a serious threat to fish reproduction habitats. From a European perspective, our results are not surprising, as many countries have estimated a 50–80 % loss of habitats consisting of coastal wetlands and sea grass beds (Airoldi and Beck 2007). Our estimate of habitat degradation rates is the first for the Baltic Sea and exposes a conflict of interests between shoreline development on the one hand, and habitat conservation and fisheries management on the other.

The strong overlap between shoreline constructions and fish reproduction habitats was expected, as constructions are not randomly allocated. It is advantageous to place jetties in

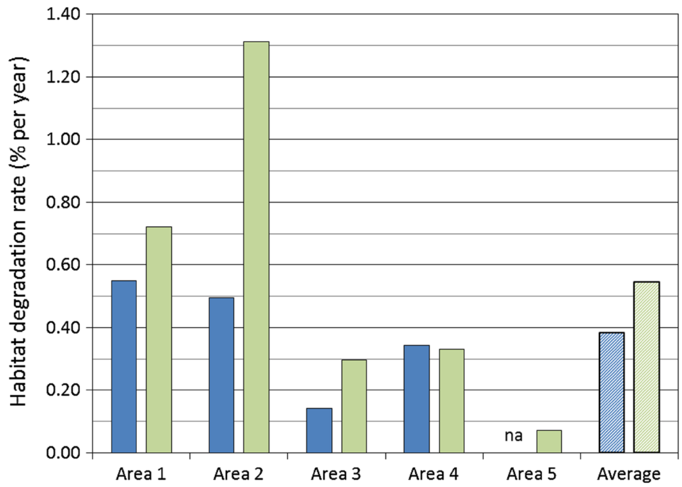

Fig. 5 Annual habitat degradation rates for shores with ≥3 constructions per 100 m, based on the overlap between fish reproduction habitats and constructed shoreline in 2005 and annual shoreline development rates between 1960 and 1986 (*blue*) and 1986 to 1999 (*green*). No inventory was available for Area 5 in 1960

wave sheltered sites in order to reduce construction costs and the risk of damage to constructions and boats. These sites simultaneously host the habitats functioning as spawning and nursery areas for coastal fishes. Moreover, as sheltered sites are less common further out in the archipelago (Snickars et al. 2009), it is likely that the overlap between constructions and reproduction habitats is stronger as suitable environments are scarce (see ***Supp. Mat.). In order to avoid such overlaps, the sites prospected for new constructions should be carefully evaluated regarding their suitability for fish reproduction. Importantly, such considerations need also be made in a spatial context larger than the individual construction in order to accurately estimate potential cumulative and long-term impact on fish communities (Jordan et al. 2008). Although the Swedish Shore Protection Act states that new constructions that "substantially alter the living conditions" for the biota are prohibited (SFS 2009), the difficulty lies in estimating at what scales, spatial and temporal, there may be an impact. These difficulties have led to a development where municipalities often provide exemptions from the act, which may have significant long-term effects on coastal fish populations. The Shore Protection Act was tightened in 2009, with supposedly stricter requirements for exemptions and a stronger regional coordination (SFS 2009). Whether the stronger regulations have come into effect was not possible to evaluate in our analysis as it relied on data from before 2009. Nonetheless, our results underscore the importance of the conclusion of Sandström et al. (2005)—in order to minimize negative effects on fish reproduction, coastal constructions, and associated boating should as far as possible be allocated to deeper and more exposed environments.

The small differences among species found in this study were probably due to the fact that the three fish species utilize similar habitats for their reproduction, as demonstrated by Sundblad et al. (2011). These species are strongly associated to large, structurally complex vegetation during their earliest life-stages, and the types of habitats that are affected by shoreline development in this area can largely be characterized as shallow, sheltered areas with lush soft-substrate vegetation that provide suitable conditions for fish reproduction (Sandström et al. 2005; Snickars et al. 2009; Sundblad et al. 2011, 2013). These types of habitats encompass a high biodiversity of both vegetation and invertebrates (e.g., Hansen et al. 2008), and shoreline development may, therefore, impact a wider range of organisms than suggested in this study. However, inferring causality from the spatial overlap between constructions and this specific habitat type is difficult. Although sedimentation on eggs and larvae increases mortality (e.g., Auld and Schubel 1978), we consider indirect effects via changes in vegetation to be the most likely mechanism for degrading the production potential of fish reproduction habitats. Shoreline constructions and associated boating reduce vegetation cover, height, and species richness, most likely via resuspension of surface sediments and associated increases in turbidity (Eriksson et al. 2004; Sandström et al. 2005). Structural habitat complexity provides protection from predation and increases food abundance (Grenouillet and Pont 2001), and the physical changes following boating activities can thus be expected to reduce the quality of the fish reproduction habitat (Sandström et al. 2005).

Fish species are often dependent on specific habitats during their early life-stages, and availability of healthy coastal habitats is crucial for many important fish species (Seitz et al. 2013). In the Baltic Sea, shallow, near-shore reproduction habitats have been shown to be crucial for maintaining population abundances of perch and pikeperch (*Sander lucioperca*; Sundblad et al. 2013). The relationships for these species were non-linear and indicated that habitat availability becomes particularly important in areas where availability is low, such as in outer archipelago areas. In the long term, even relatively small local losses may have negative effects on populations, impacting both ecosystem functioning and the sustainability of fisheries (Eriksson et al. 2011). Although it is difficult to assess the potential impact of a single development project, it is important for managers both to know the shoreline development status and trends in their area to appreciate the potential cumulative effects of constructions on fish reproduction and overall biodiversity. This knowledge is central for sustainable long-term management of the coastal ecosystem, especially considering the fact that potential feedback mechanisms may make ecosystem changes difficult to detect before the system switches to an alternative state (Biggs et al. 2009). Such a feedback could be generated by shoreline constructions by reducing vegetation cover (Sandström et al. 2005), leading to a lower quality of the reproduction habitats needed to maintain population sizes (Sundblad et al. 2013). Consequently, as the abundance of large predatory fish is reduced, so is the top-down control of epiphytic algae (Eriksson et al. 2011), which, if abundant, potentially further reduce the quality of the reproduction habitat by limiting vegetation cover, leading to a negative spiral.

Coastal constructions such as jetties, or associated minor dredging projects, are often limited in spatial extent, why the effects are localized, and change is slow. This means that cumulative and long-term effects on the system become difficult to detect. Nevertheless, quantifying cumulative impacts becomes progressively more important as the pressure on coastal habitats has been steadily increasing (Lotze et al. 2006). Recently, the ecological importance of coastal habitats, in terms of fish production, was illustrated by the fact that 44 % of the exploited species on which ICES gives advice utilize shallow coastal habitats during some part of their life-cycle (Seitz et al. 2013). These species comprised 77 % of the landings (Seitz et al. 2013), stressing the need for holistic assessments of human pressure impacts on the ecological and economical value of ecosystem goods and services associated with near-shore coastal habitats.

We have in this study highlighted how predictive habitat modeling in combination with mapping of human pressures may be used to estimate the aggregated effects of many small development projects. System effects following these types of slow drivers of change are, however, difficult to manage, particularly when feedback mechanisms may continue to drive the system even after large-level changes have become apparent (Biggs et al. 2009). Coastal development progresses slowly and over relatively long-time periods and thus provides an illustrative example of shifting baselines (Pauly 1995), whereby an increasing amount of constructed shoreline gradually becomes the norm. Our results date back to 1960, corresponding to a time period during which the Stockholm archipelago was subject to a massive increase in recreational use and associated boating activities. Our results show that large changes have taken place in the development of the shoreline and that habitat degradation has accelerated during the study period. Given the high value of shallow, sheltered coastal areas not only for fish production, but also for biodiversity in general, protecting the remaining pristine habitats should be of the highest priority for coastal zone planning and management.

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