



Basin Head Marine Protected Area: 2016-2017 Management Plan Implementation Progress Report

Fisheries and Oceans Canada, Gulf Region
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2017

Gulf Region Basin Head Management Series 2017/01






Gulf Region Basin Head Management Series

The Gulf Region Basin Head Management Series of publications are reports on management initiatives and monitoring undertaken in the Basin Head Marine Protected Area in the Gulf Region. This series consist of monitoring progress reports, operational management plan, consultant reports, scientific studies, workshops and other public documents related to the Basin Head Marine Protected Area. The Basin Head Management Series was established in 2014. Reports in this series have been written by or prepared under the guidance of staff of the Department of Fisheries and Oceans - Gulf Region. The content of this series is meant as a source of information for public and internal dissemination.

Série sur la gestion de Basin Head dans la région du golfe

La série de publications sur la gestion de Basin Head de la région du golfe regroupe des rapports au sujet d'initiatives de gestion et de surveillance entrepris dans la zone de protection marine de Basin Head dans la région du golfe. Cette série se compose principalement de rapport de progrès sur la surveillance effectué à Basin Head, plan de gestion opérationnel, d'études scientifique, de rapports de consultants, d'ateliers et d'autres documents publics relié à la zone de protection marine de Basin Head. La série sur la gestion de Basin Head a été créée en 2014. Ces rapports ont été rédigés par le personnel du Ministère des Pêches et des Océans ou ont été préparés sous la direction de ceux-ci – dans la région du golfe. Le contenu de cette série se veut une source d'information pour une diffusion publique et interne.




Gulf Region Basin Head Management Series

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2016-2017 MANAGEMENT PLAN IMPLEMENTATION PROGRESS REPORT**

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1.0 INTRODUCTION

The Basin Head Marine Protected Area (MPA) was designated on September 26, 2005. This MPA has been established via regulations under the statutory authority of Canada's *Oceans Act* (Basin Head Marine Protected Area Regulations <http://laws.justice.gc.ca/eng/regulations/SOR-2005-293/>).

The MPA encompasses Basin Head, a tidal lagoon, as well as an adjacent offshore buffer zone, in eastern Prince Edward Island within the Gulf of St. Lawrence (Figure 1). The MPA was designated by regulations to conserve and protect a unique form of an otherwise common marine alga, Irish moss (*Chondrus crispus*). This form of *Chondrus* is thought to exist only within the confines of Basin Head. Sheltered habitats often influence morphology of algae, resulting in relatively expanded blades. However, spriggy outer coastal plants sharing the habitat have not developed into the giant form; therefore, this giant moss is also genetically distinct, and not simply an artifact of environmental conditions. What is uncertain is its origin. What is especially interesting and requiring management and protection is its obligate association with mussels. Thus, the MPA was designated under the *Oceans Act* Section 35, paragraph (1) c (conservation and protection of unique habitats), as well as paragraph (1) e (to fulfil the mandate of the Minister).

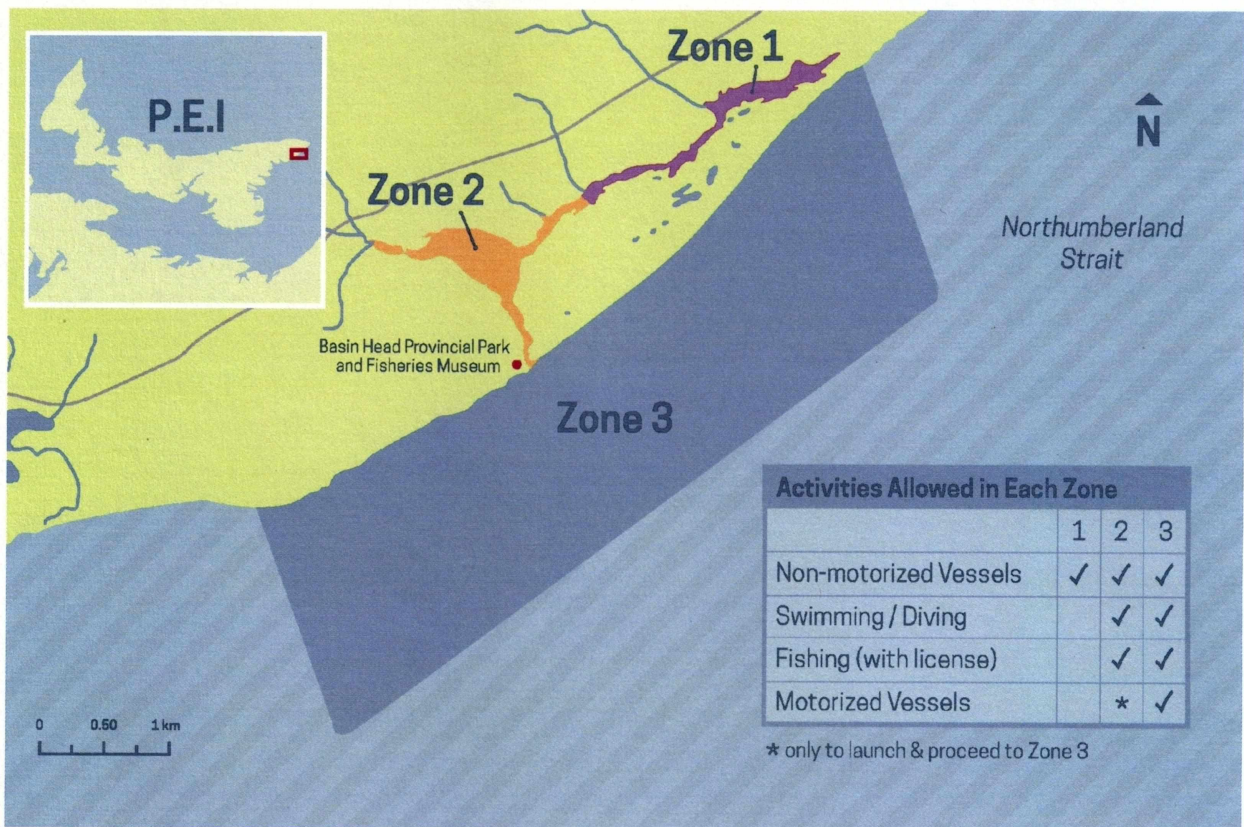


Figure 1: Basin Head Marine Protected Area

Zone 1: Northeast Arm

The Northeast Arm extends from the main Basin east for approximately 3 kilometres. The inner channel has been given the highest level of protection because this is where the unique Basin Head strain of Irish moss is found. Because of its vulnerability, motorized vessels are not



ABSTRACT

This Progress Report for the Basin Head Marine Protected Area outlines the activities and monitoring, associated with the four regulatory conservation objectives, that occurred during the 2016-17 fiscal year (April 2016 to March 2017). This report also highlights the different management actions taken in 2016-17 and the future steps and priorities for the integrated management of the Basin Head Marine Protected Area.

RÉSUMÉ

Ce rapport de progrès pour la zone de protection marine de Basin Head décrit les activités et la surveillance associé avec les quatre objectifs de conservation réglementaires qui ont eu lieu au cours de l'année financière 2016-17 (avril 2016 à mars 2017). Ce rapport met également en lumière les différentes mesures de gestion prises en 2016-17 ainsi que les prochaines étapes et les priorités pour la gestion intégrée de la zone de protection marine de Basin Head.

permitted in this zone; there is no commercial or recreational fishing, nor any other potentially destructive activities allowed. Swimming and diving are also not permitted in this zone.

Zone 2: Lagoon

This zone includes the main basin area, or lagoon, and extends from the inner channel west and south to include the entire lagoon. This zone acts as a buffer for the more sensitive Northeast Arm (or inner channel). The lagoon zone can tolerate minor disturbance, therefore swimming, diving, and non-vessel based fishing activities are allowed. Motorized vessels are permitted at the boat launch. They cannot enter the inner channel and must proceed directly to the open water.

Zone 3: Outer Coast

The large outer coastal area protects the integrity of the sand dune structure at Basin Head. This zone extends from the mouth of the lagoon one nautical mile south and covers an area of 3 nautical miles east to west, adjacent to the eastern end of the lagoon. In this zone, the only restrictions are on those activities that could alter the coastline in such a way as to endanger the fragile dune system, and therefore the lagoon itself. All other activities are allowed.

The updated Basin Head MPA Operational Management Plan (OMP) was published in 2016, to serve as a guide for informed decisions in the management of this unique ecosystem. The management plan forms the basis for development of comprehensive conservation and management strategies. It provides information on regulatory measures, monitoring, enforcement and compliance, managing certain human activities via an activity approval process and other non-regulatory management measures. It also provides the details required to ensure that management decisions, prohibitions, and activity applications and processes are clearly understood.

Personnel from Ecosystems Management, Fisheries and Oceans Canada (DFO), Gulf Region are responsible for efforts at achieving the objectives described in the OMP. Management of the MPA is also guided by the advice of the local community and stakeholders, other federal and provincial government departments, and Aboriginal groups, acting through the Basin Head MPA Advisory Board.

The Basin Head MPA OMP is intended to serve as a "living" document which may be amended as required to ensure management objectives and monitoring requirements are met. The OMP is scheduled to be reviewed every five years with provisions for amendments on a continuing basis. The periodic reviews will examine the conservation objectives of the MPA to determine if they remain appropriate, evaluate the success of management actions in achieving the conservation objectives, and identify emerging priorities for subsequent reviews of the OMP.

The purpose of this Progress Report is to record activities in the Basin Head MPA during the 2016-17 fiscal year. This report and past reports will serve as guides for the Operational Management Plan review.

2.0 MANAGEMENT HIGHLIGHTS FOR 2016-17 (refer to Fig. 2)

- In 2016, DFO deployed dissolved oxygen and pH continuous recorders in the Northeast Arm in addition to regular monitoring for water quality (May – November) and aquatic species populations (June – August).

- Sock cultivation of Irish moss at the mouth of Northeast Arm resumed in 2016 using Basin Head Irish moss supplied from on-land tank cultivation at the National Research Council (NRC) marine station at Sandy Cove, Nova Scotia. The aim was to develop biomass both for field experiments and for rehabilitating portions of the Arm from which the Irish moss-mussel ecosystem had disappeared since 2005.
- Relocating clumps using the wading transect method proved to be difficult, Irish moss clumps were marked using numbered agricultural flags, starting in 2014. Surveys in 2014 led to the conclusion that without intervention, the population of giant Irish moss was facing imminent extinction. During biomass surveys, the diameter, location and means of attachment of each mussel-moss clump located in the Irish moss beds were recorded. Water depth at low tide, sediment type and depth, numbers of mussels in each clump, morphology and reproductive status were all recorded for each tagged clump in order to characterize the population and its preferred habitat.
- Aerial images collected using a drone in 2015 and 2016 were used to develop a detailed map of the Northeast Arm that was pulled into GIS and georeferenced so that locations of individual Irish moss clumps and various habitat features (including water depth at low tide, sediment depth) could be mapped and displayed.
- In 2015, mussels were brought into Basin Head to stabilize the remnant Irish moss population and to provide anchorage for giant Irish moss that was propagated in suspended cultivation. Artificially constructed clumps were introduced into areas of bottom similar in depth and bottom type to the preferred habitat of the remnant population, and monitored. These conservation and restoration activities continued through 2016, resulting in a year-to-year increase in Irish moss biomass in Northeast Arm. In 2015, 237 clumps were planted into the two existing Irish moss beds (Main Bed and Corduroy Road) and a test plot of planted clumps was established at Oyster Cross, west of Main Bed. In 2016, an additional 858 clumps were planted in the two core beds, and test strips of clumps were installed in other sections of Northeast Arm where depth and bottom type appeared to be promising. Overall, there was an estimated loss of approximately 10% of enhanced and planted clumps over the three years (2014-2016), signalling the potential for rehabilitating the population by planting engineered clumps.
- Annual surveys revealed that some Irish moss-mussel clumps moved during both summer and winter, and that fragmentation of Irish moss occurred from mid-summer through early autumn.
- Giant Irish moss is now present in three locations in Northeast Arm (NE Arm): in the Main and Corduroy Road beds and at Oyster Cross; however, bottom conditions at Oyster Cross are less current-swept and more prone to smothering by *Ulva*, resulting in relatively poor retention of Irish moss on the mussels in this test area in 2016.
- The 2016 estimate of naturally-occurring Irish moss biomass is approximately 0.9 m² at Oyster Cross, 1.8 m² at Fireweed Bank and another 0.5 m² in others areas of NE Arm. The total estimated biomass for 2016 is 30.7 m² compared to 10.6 m² in 2015.
- In 2016, surveys were conducted along transects within the Irish moss bed at Main Bed and Corduroy Road to establish baselines for absolute water depth and sediment depth that can

be compared to future surveys to determine changes through time that may result from land use and climate changes.

- Systematic cross-channel surveys were also conducted along nine transects outside of the Irish moss beds, documenting water and sediment depths and bottom types at 2-m intervals. This allowed for maps to be developed showing the position and extent of habitat throughout the NE Arm that could support Irish moss-mussel clumps.
- In 2016, two water pressure loggers were installed in NE Arm to investigate tidal flux. Measurement of current strength on the bottom and at mid-water was attempted over several tidal cycles, with limited success owing to equipment failure. Hobo light meters were also deployed for short periods of time in an attempt to define the light environment experienced by Irish moss. Light measurements were difficult owing to the persistent accumulation of silt on the sensors. More work is planned for 2017 using alternate technologies.
- Documentation of nutrient concentrations in bottom sediments at 11 sampling stations ranging from the inner reaches of NE Arm to the boundary of Zone 1 (fully protected area) were undertaken in October 2016. Preliminary results reveal differences between Irish moss beds (Main and Corduroy Road beds) and other sites, as well as a gradient of declining nitrogen concentration moving from the top of NE Arm to the mouth. Sampling will be continued in spring, summer and autumn of 2017.
- In 2015, a study of historical aerial photos of Basin Head was undertaken to estimate the degree of change in the location of the salt marsh edge along the south bank of NE Arm. Considerable changes followed the opening up of the new entrance to the Main Basin in the 1930s but change has been relatively slow since the 1960s. Nevertheless, sods eroded from marsh edges litter the bottom every spring and as these break apart over the summer and fall, the debris sometimes smothers Irish moss clumps. Using aerial photos collected by drone in 2015 and 2016, the locations of sods that either pre-existed or appeared in each year in the central NE Arm (close to Main Bed) were documented so that these could be studied in 2017.
- To monitor rates and processes of settlement of Irish moss on hard substrate, six native sandstone rocks were placed in the main Irish moss bed in August 2014. The rocks were colonized by Irish moss, but these did not appear to be the giant form. Samples were collected in 2016 for genetic analysis; the results are expected in 2017.
- A series of studies were initiated in 2014 with the University of Prince Edward Island (UPEI) to evaluate Irish moss – green crab interactions in Basin Head. Green crab population assessments were conducted by UPEI using various trapping methods. Laboratory and field experiments focused on the direct and indirect interactions among green crabs, Irish moss and blue mussels. Further experiments (2017) will focus on the influence of Irish moss clump sizes on those interactions. UPEI researchers have been granted a further 2 years of field research support which will end March 2018.
- Irish moss – mussel – crab interactions were also investigated by DFO researchers in 2015 using crab inclusion/exclusion cages and planted meter square test plots that were documented in 2015 and 2016. Field experiments by DFO led to a better understanding of the size range of mussels vulnerable to crab predation, and the influence of mobile

sediments, marsh sods and *Ulva* mats on Irish moss and mussels. Based on the experimental results, measures to help sustain the Irish moss population were developed such as; adding oyster shells to clumps to help prevent them from sinking into soft silt; maintaining a distance of at least 30 cm between planted clumps to reduce the chances of smothering by *Ulva*; removal of artificial materials such as rebar stakes left by previous work in Basin Head that accumulated *Ulva*; augmenting large plants with additional mussels, and seeding areas between clumps with extra mussels. Test strips of Irish moss–mussel clumps were planted outside of the existing beds; survival in these areas will be assessed in 2017. Detailed research results will be formally reported.

- Densities of green crab reported in 2014 and 2015 were relatively low compared to numbers seen in the past in Basin Head. This may have been due to the unusually long (and cold) winters. By contrast, the winter of 2015-16 was relatively short and mild, with little accumulation of ice and snow on the NE Arm. The 2016 field season had densities of 5-40 crabs/trap/day in the NE Arm and 0-25 crabs/trap/day in the Basin. Standard surveys of two sites within Basin Head and two sites located in a reference location (Murray Harbour) will continue to be conducted during the field season of 2017.
- An 8 week green crab trapping pilot project was launched in 2016 by the Department of Fisheries and Oceans (DFO). Green crabs were trapped every day during the months of October and November. An estimated 30 000 crabs were removed from Basin Head; 72% were males and 41% measured between 50-59 mm; 28% were females and 64% measured between 40-49 mm.
- Systematic sampling of benthic organisms was conducted along transects in the Irish moss beds in 2015, which revealed that large areas of the bottom that used to support a diverse array of plants and animals were barren. Few species were found in very small numbers in some quadrats. During 2016, it was noted that where Irish moss-mussel clumps were planted, they attracted a diverse array of spat and mobile benthic fauna; therefore, the planting of clumps is resulting in resurgence in benthic faunal populations.
- In general, there was an overall decline in ecosystem health in Basin Head between 2000 and 2015. Irish moss biomass and bed size suffered net loss year to year, and eelgrass cover within the NE Arm was almost entirely annihilated. As of 2016, there is still seasonally heavy coverage of large areas of the bottom by *Ulva* and the abundance and diversity of benthic invertebrates is poor outside of the Irish moss beds. There are persistently high concentrations of nitrogen and phosphorus in the water and hypoxic or anoxic conditions at the inner end of NE Arm in the summer. There is a noticeable loading of sediments into the estuary each year from agricultural runoff, *Ulva* bloom decomposition and degradation of ice scoured marsh sods. Plans for 2017, include studies to elucidate the connection between land use and water chemistry, and an exploration of the impact of ice on marsh integrity.
- The Interdepartmental Letter of Agreement (ILA) between DFO Gulf Region and the National Research Council (NRC), for the maintenance of 10 kg of Basin Head *Chondrus* at the NRC's Sandy Cove facility, was renewed for 2016-2017. Biomass from the holding stock at NRC was reintroduced to Basin Head and placed into cultivation on site to provide plants for both experimental purposes and for planting trials.

- The Basin Head Marine Protected Area (BH MPA) Advisory Board met on November 24, 2016 at the Fisheries and Oceans Area Office in Charlottetown, PEI. Members were updated on research conducted in the 2015 field season, on communication, and outreach activities. Several presentations on the different research and monitoring conducted in Basin Head were given in the Charlottetown Area Office; such as, the green crab pilot project.



Figure 2. Map of Basin Head Marine Protected Area with lettered streams and numbered sites.

3.0 CONSERVATION OBJECTIVES AND ACTIONS TAKEN

Conservation objectives describe the desired ecological outcome of establishing an MPA and are based on the best available scientific and traditional ecological knowledge. These objectives guide the MPA establishment and management process by providing the basis for determining management measures. They also allow the setting of limits within which the nature and magnitude of human impacts on ecosystems and/or key ecological features of the MPA are assessed. Economic opportunities compatible with these conservation objectives may be permitted within the MPA or within specific zones.

There are four conservation objectives for Basin Head MPA:

Conservation objective 1: Maintain the quality of the marine environment supporting the *Chondrus crispus*.

Conservation objective 2: Maintain the physical structures of the ecosystem supporting the *Chondrus crispus*.

Conservation objective 3: Maintain the health (biomass and coverage) of the Basin Head *Chondrus crispus*.

Conservation objective 4: Maintain the overall ecological integrity of the Basin Head lagoon and inner channel. This includes avoidance of excessive *Ulva* growth, maintenance of adequate oxygen levels, and maintenance of diversity of indigenous flora and fauna.

Management actions taken during the 2016-17 fiscal year to fulfill short and long-term management goals for both regulatory and non-regulatory conservation objectives are shown in Table 1 and 2, respectively.

Table 1. Basin Head MPA Regulatory Conservation Objectives and Management Actions.

	Management Goals	Action Taken in 2016-2017
Regulatory Conservation Objective: Maintain the quality of the marine environment supporting the Basin Head <i>Chondrus crispus</i>	Short Term Goals (3 years): To maintain twice-monthly water quality monitoring (May through November) at 11 water stations within the MPA. Information will be collected on nitrate, nitrites, phosphates, chlorophyll, turbidity, temperature, dissolved oxygen and salinity.	11 sites sampled weekly from May to November, 2016, near high tide. Sampling of nutrients in sediments was initiated in 2016 at 11 sites in Northeast Arm. Dissolved oxygen continuous recorders were deployed in the Northeast Arm in 2016. pH continuous recorder deployed at Corduroy Road bed in 2016. This probe got lost, no data was retrieved.
	To monitor continuous water temperature in the Inner Channel station and the Main Basin.	Temperature loggers at three permanent locations were retrieved, downloaded, and re-deployed to provide year-round monitoring. Temperature was recorded every 60 mins.
	Long Term Goals (10 years): By using the data collected, determine if there is a significant decline in the quality of the marine environment supporting the Basin Head Irish moss.	Young's Hill Road continued to be monitored, twice a year, as a point source of sedimentation. Observations on runoffs into the lagoon are noted. Souris and Area Branch of the PEI Wildlife Federation (SAB) has been enhancing the main branch (1-2 km) for the last four years from East Point Rd. to a hanging culvert on Snake Rd. In 2015, they reported the culvert blockage to the PEI Department of Transportation, Infrastructure and Energy. In 2016, approx. 200 Brook Trout were observed downstream of the culvert on East Point Rd. Blockage remains; trout are being electrofished out and placed on opposite side.

	Management Goals	Action Taken in 2016-2017
		DFO researchers are analysing the accumulated water chemistry data (2001-2016) to determine whether there have been positive trends in water quality over time. Preliminary data review does indicate a possible improvement between 2001 and 2008, and an anomalous drop in nutrient concentrations in 2012-2013 followed by a return to "normal" in 2014. This triggered the initiation of a land use and water quality research effort to be pursued in 2017.
Regulatory Conservation Objective: Maintain the physical structures of the ecosystem supporting the <i>Chondrus crispus</i>	Short Term Goals (3 years): Establish the limits of the barrier dune structure at the ocean entrance and northern limit.	An estuary model, which was developed in 2011, can be used to study scenarios of physical changes to the dune system and entrance channel. The model will be enhanced using tidal flux data collected in 2016, and detailed current metering planned for 2017.
	Long Term Goals (10 years): Monitor the land use activities and erosion of the watershed area.	An investigation of erosion from the marsh edge over time was performed in 2015, leading to documentation of eroded marsh sods in 2016 and planned monitoring of marsh sod degradation for 2017. A land use survey was conducted in the winter of 2016-17; results will be reported in spring 2018.
	Develop water circulation model to evaluate any water circulation changes.	Tidal flux (water pressure) loggers deployed in 2016; current metering to follow in 2017. These data will be used to refine the hydrological model for Basin Head. Water chemistry monitoring includes weekly salinity measurements, which may also indicate water circulation trends over time.
Regulatory Conservation Objective: Maintain the health (biomass and coverage) of Basin Head <i>Chondrus crispus</i>	Short Term Goals (3 years): Establish monitoring transects within the <i>Chondrus crispus</i> bed to evaluate biomass and coverage. Due to drastic decline in <i>Chondrus</i> , aerial photography and glass bottom boat deemed no longer useful and Irish moss survey is now done by walking/swimming along transects spaced 4 m apart until biomass increases.	The 2015 wading transect method used to evaluate Irish moss biomass was continued through 2016 to establish annual rates and patterns of loss and movement and to characterize conditions that allowed clumps to be retained from year to year.

Management Goals	Action Taken in 2016-2017
<p>Continue weekly photo mosaic at three locations (i.e. eastern end of the arm, vicinity of the <i>Chondrus</i> bed and Ching's Bridge) to quantify the green algae (<i>Ulva lactuca</i>) coverage.</p>	<p>Photographs were taken at Ching's Bridge, Elliot's Look Off and Foul Bay from May to November 2016, to establish a record of green algal (<i>Ulva</i>) bloom development and decline. Camera surveillance of Main Bed initiated in winter 2016-17 has provided additional information on near-shore development of <i>Ulva</i> mats in central NE Arm.</p>
<p>Long Term Goals (10 years):</p> <p>Maintain the biomass and coverage of the Basin Head <i>Chondrus crispus</i> to healthy and sustainable levels.</p>	<p>A major factor in the <i>Chondrus</i> decline has been the invasive green crab (Cairns <i>et al</i> 2012.), which removed successive year classes of mussels, leaving only a few ageing individuals to hold the Irish moss population in place. Experiments have shown that eutrophication and the resulting smothering of areas by <i>Ulva</i> and anoxic silts also contributes to loss of clumps.</p> <p>Sock cultivation of Irish moss at the mouth of NE Arm continued through 2016 using free-floating fronds found in NE Arm as well as cultivated stock from the NRC marine station at Sandy Cove.</p> <p>To monitor rates and processes of settlement of Irish moss on hard substrate, six native sandstone rocks were placed in the main Irish moss bed in 2014 and monitored for 3 years. Spriggy moss plants were quickly established on these rocks, and mussels also became attached to them. Genetic results expected in 2017.</p> <p>The ILA with NRC was renewed for maintenance of Basin Head <i>Chondrus</i> culture (10 kg) at the NRC research facility in Sandy Cove, Nova Scotia.</p> <p>A small number of two year old commercial mussels were brought into Basin Head in 2015 to stabilize existing Irish moss clumps and to make new clumps using Sandy Cove cultivars. Additional mussels were brought in to support more extensive plantings in 2016. The new clumps</p>

	Management Goals	Action Taken in 2016-2017
<p>Regulatory Conservation Objective:</p> <p>Maintain the overall ecological integrity of the Basin Head lagoon and inner channel.</p>	<p>Short Term Goals (3 years):</p> <p>To continue the Community Aquatic Monitoring Program (CAMP) to monitor trends in community abundance and diversity of fish and benthic invertebrates within the Basin Head lagoon.</p>	<p>were planted within each existing bed as well as in square meter areas outside of the beds, and in a larger contiguous plantation west of the Main Bed (Oyster Cross). Test strips of clumps were also laid out across the channel in selected locations at the end of the 2016 field season. Data from these test strips will guide plantings in 2017.</p> <p>The CAMP Program was conducted in 2016 from June to August in Basin Head.</p>
	<p>To create detailed contour maps of percent cover by major plant species.</p>	<p>Benthic transects conducted in 2015 across NE Arm inside the Irish moss beds revealed the almost complete absence of fauna and flora over large areas. This reinforced the need for active management to stabilize the giant moss population and to restore productivity and biodiversity.</p> <p>A drone was used to collect images that could be stitched together and georeferenced to develop a mosaic for mapping the locations of Irish moss clumps in NE Arm. The images also aid in monitoring marsh edge erosion and appearance and disappearance of marsh sods in the channel.</p>
	<p>Long Term Goals (10 years):</p> <p>Maintain the diversity of indigenous flora and fauna within the Basin Head MPA by evaluating the effectiveness of the monitoring plans, indicators and triggers up to date.</p>	<p>Current conditions revealed by systematic sampling are dramatically different from the baseline data on <i>Zostera</i>, <i>Ulva</i> and <i>Chondrus</i> that was collected prior to 2007. <i>Zostera</i> is almost completely absent from NE Arm, and by 2014, the Irish moss had been reduced by 99%. Ongoing research has flagged green crab and eutrophication as the primary threats to the giant Irish moss population that remains. Rising summer seawater temperatures may also pose a threat in the future.</p>

	Management Goals	Action Taken in 2016-2017
		In 2015 and in 2016, trials were initiated to test the viability of stabilizing existing clumps with young mussels and the planting of clumps made from commercial mussels and cultivated giant Irish moss. These trials are ongoing and have shown success thus far.

Table 2. Basin Head MPA Non-Regulatory Conservation Objectives and Management Actions.

	Management Goal	Action Taken in 2016-2017
<p>Non-Regulatory Objective:</p> <p>To ensure the participation of interested and affected stakeholders in the operation of the MPA.</p>	<p>Short Term:</p> <ul style="list-style-type: none"> Continuation of Advisory Board meetings to ensure stakeholder support and involvement. <p>Long Term:</p> <ul style="list-style-type: none"> Increase Aboriginal involvement in the MPA. 	<p>An Advisory Board meeting was held in Charlottetown on November 24, 2016.</p> <p>Through the efforts of the SAB field coordinator, collaboration was established with Abegweit First Nation that resulted in participation of several Aboriginal field workers in Basin Head research and monitoring in 2016.</p>
<p>Non-Regulatory Objective:</p> <p>To increase the public awareness of the <i>Chondrus crispus</i>, the ecosystem of the Basin Head MPA and its conservation measures.</p>	<p>Short Term:</p> <ul style="list-style-type: none"> Update the Basin Head MPA information on the DFO website on demand. http://www.dfo-mpo.gc.ca/oceans/mpa-zpm/basin-head-eng.html To enhance the existing on site laboratory to maximize education potential. <p>Long Term:</p> <ul style="list-style-type: none"> To increase public awareness through publication of brochures, interpretive touchscreen kiosk and involvement in community events. 	<p>There is an existing link to MPA information on the DFO website.</p> <p>The on-site wet lab on the cannery wharf is frequently the site for processing of samples. Visitors who stop by to ask questions are welcomed by the field staff. There is an interactive computer kiosk and brochures about the MPA in the Basin Head Fisheries Museum. In addition, an interpretive sign was installed in spring 2016.</p> <p>Eco tours in the main basin were conducted by SAB.</p> <p>SAB communicates regularly to local stakeholders through the "Souris and Area Watershed News" on activities that involve Basin Head.</p>
<p>Non-Regulatory Objective:</p> <p>To promote</p>	<p>Short Term:</p> <ul style="list-style-type: none"> To continue to collaborate with Island Nature Trust, SAB and UPEI to meet the monitoring 	<p>A contract with SAB was in place to provide assistance with the summer and fall water monitoring program. In the fall of 2016, SAB also conducted</p>

	Management Goal	Action Taken in 2016-2017
scientific research to increase the level of understanding of the Basin Head MPA.	<p>requirements identified in the Operational Management Plan.</p> <ul style="list-style-type: none"> • Development of Activity Plans and Approvals as outlined in Section 5.0 of the Basin Head MPA Regulations. <p>Long Term:</p> <ul style="list-style-type: none"> • To continue to identify potential partners for collaborative research projects. 	<p>an 8 week green crab pilot project.</p> <p>Approval Process in Place; 11 activity plans for 2016 season were submitted and approved.</p> <p>Dr. Gail Chmura (McGill University) was invited to bring students to do some preliminary investigation of the salt marsh in 2016; however this activity has been delayed.</p>
<p>Non-Regulatory Objective:</p> <p>To maintain and enhance the quality of the Basin Head ecosystem.</p>	<p>Long Term:</p> <ul style="list-style-type: none"> • To implement best management practices to reduce the impact of nutrient enrichment on marine environmental quality within the Basin Head ecosystem. • To reduce the spread of aquatic invasive species in the Basin Head ecosystem by public awareness or stewardship initiatives. 	<p>A land use survey was conducted; results should be ready by spring 2018. It has been reported that farmers are more diligent in the use of fertilizer, partly because of the cost; also new farm practices are being examined or considered for soil conservation.</p> <p>Monitored through the Aquatic Invasive Species program (AIS) (2009-2010) and CAMP (ongoing). The AIS program will mostly be re-established for tunicate prevention, as more and more tunicate observations have been recorded in the Gulf region.</p> <p>A study was initiated by UPEI in 2014 to evaluate the green crab population. Interactions among Irish moss, mussels and green crab continued to be investigated experimentally by UPEI in 2015 and 2016.</p> <p>The Basin Head Watershed Management Plan continues to be implemented.</p>

4.0 ACTIVITY PERMIT APPLICATIONS

MPA regulations recognize that certain activities within an MPA may be consistent with conservation objectives. For some of these activities, Basin Head MPA regulations stipulate requirements for activity plan submissions and specify approval conditions. Ministerial approval of activity plans is one of the primary means of governing the activities proponents undertake in MPAs.

Proposed activity plans are reviewed to assess environmental impacts of the individual activity

along with the cumulative effect of all activities in the MPA, and to ensure that the activity is for the purpose of the conservation and/or management of the MPA, or for allowable scientific or educational purposes. Thus, the requirement of the submission of an activity plan for certain activities is an important regulatory mechanism used to limit human impacts in MPAs before they occur.

Table 3. Activity Approvals in Basin Head MPA during 2016-17.

	Study Name	Researcher	Affiliation	Purpose	Date Approved
1	Temperature loggers	David Cairns	DFO - Gulf	To obtain a long-term and continuous temperature record for Basin Head (January – December 2016)	May 3, 2016
2	Irish moss monitoring	Irene Novaczek	DFO - Gulf	Estimate the quantity of Irish Moss in the Basin Head MPA by wading transects at low tide (January – December 2016)	May 3, 2016
3	Water quality monitoring – multi-site	Sara Richard	DFO - Gulf	Annual water quality monitoring (nutrient load and hydrographic parameters) (May to November).	May 3, 2016
4	Drone Surveys	David Cairns	DFO - Gulf	To provide accurate mapping of Irish moss locations and other biological features (January – December).	April 25, 2016
5	Community Aquatic Monitoring Program	Monica Boudreau	DFO - Gulf	Monitor the diversity of fauna and flora captured in the Basin Head lagoon (June to August)	May 3, 2016
6	Assessing Basin Head's green crab relative densities and their potential effects on Basin Head's	Pedro A. Quijon	UPEI	Assessing green crab relative densities and their potential effects on the Irish moss (August 15, 2014 – December 15, 2019)	May 3, 2016

	Irish moss				
7	Educational outreach within the Basin Head MPA	Fred Cheverie	Souris and Area Branch of the PEI Wildlife Federation	The educational activity will consist of a beach seine haul which will provide "hands-on" experience to further explore the marine community within the Basin Head MPA and educate the public. This activity is part of the eco-tourism venture of Basin Head organized by the local watershed group (SAB) and will occur up to a maximum of four times per week (June to October).	May 3, 2016
8	Irish moss biomass enhancement	Irene Novaczek	DFO - Gulf	Enhancing the Irish moss biomass by cultivation of giant Irish moss, engineering of mussel-moss clumps, and planting of clumps (May 2015 to June 2019)	May 3, 2016
9	Installation of dissolved oxygen and pH loggers	Sara Richard	DFO - Gulf	Measure dissolved oxygen and pH levels using loggers (May to November)	May 5, 2016
10	Bottom survey and sediment sampling	Irene Novaczek and David Cairns	DFO - Gulf	Data will be collected on water depth and sediment type. Data on current strength and light density will determine best places to plant IM.	April 25, 2016
11	Drifting Material Survey	Irene Novaczek	DFO - Gulf	To carry out a survey of drifting material at 3 locations in NE Arm to document movement of floating IM and to recover it to make artificial clumps.	April 15, 2016

5.0 ENFORCEMENT AND COMPLIANCE

As the Basin Head area is a frequent tourist destination and high traffic area for both visitors and locals, the local DFO Conservation and Protection office patrol the area regularly to ensure compliance under the Management of Contaminated Fishery Regulations (MCFR's) and the Basin Head Marine Protected Area Regulations (BHMPAR) as well as the Maritime Provinces Fishery Regulations (MPFR's). There have been no issues reported, or identified, in regard to contraventions of the MCFR's or MPFR's. No enforcement issues were identified in the fiscal year 2016-17. These land based patrols are conducted throughout the year. Note: oyster harvesting at the boundary of Zone 1 is the only commercial fishing now done in Basin Head.

6.0 PUBLIC AWARENESS AND EDUCATION

Public education and outreach are critical factors in ensuring the long term success of an MPA. Compliance with MPA regulations is higher when community members, MPA users and the general public are aware of objectives and management strategies of an MPA. Education and outreach tools are most effective when they target appropriate user groups, stakeholders and the public, present a straightforward message, and use the most appropriate product to communicate the message.

Currently brochures and display panels explaining the purpose of the MPA are available to the public at the nearby Basin Head Fisheries Museum.

An interactive display kiosk was installed at the Basin Head Museum in 2014 using a computer monitor with touch-screen technology to give historical and biological information on Basin Head, as well as general information on the Canadian MPA program.

Brochures were updated in 2015 and an interpretive sign was installed on site in spring 2016 (Figure 2).

During the summer of 2016, SAB conducted educational activities consisting of a beach seine haul, which provided “hands-on” experience to explore the marine community within the Basin Head MPA. This activity was part of an eco-tourism venture and occurred up to four times per week throughout the summer.



Figure 3: Sign installed at Basin Head in spring 2016. (photo credit: I. Novaczek)

7.0 NEXT STEPS AND PRIORITIES

DFO will focus on several priorities related to the implementation of the management plan in the next fiscal year. Priorities include:

- Continue annual consistent monitoring of water quality, habitat integrity and biota, to maintain ecological integrity for the long term.
- Synthesis/ analysis of water quality monitoring data.
- Continue multi-year studies, which include Irish moss cultivation, trial plantings and studies on population dynamics, clump dynamics and the effects of green crabs on the Irish moss.
- Discussions with the Mi'kmaq Confederacy of PEI (MCPEI) and the Province of PEI have continued regarding the condition and potential repair of the Basin Head boat slip.

8.0 REFERENCES

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