

Management in action: addressing the impacts of instream structures on Declared Fish Habitat Areas in coastal Queensland

Lawrence, Mary¹, Dawn Couchman¹, Dave Sully¹ and John Beumer¹

¹Department of Primary Industries and Fisheries, GPO Box 46 Qld 4001

ABSTRACT

Fish habitats throughout Queensland are under increasing pressures from the installation of a diversity of instream structures. These pressures and impacts also exist within the declared Fish Habitat Area (FHA) Network and are of greater concern. In response, the Queensland Department of Primary Industries and Fisheries has developed a framework and guidelines for conducting a physical inventory and data storage to identify and plot structures within declared FHAs and to assess the impacts of structures on fish habitats. The framework includes a Decision Support System for the identification of priority structures for delivery of enhanced management responses. The framework and guidelines were based on trial inventories within two declared Fish Habitat Areas in north Queensland. The presentation will describe how the framework was developed and used to identify priorities for management.

INTRODUCTION

Connectivity between fish habitats is critical for fish and other aquatic organisms to complete their life cycles and maintaining access to a diverse mosaic of healthy fish habitats is critical to sustaining fish populations (Meynecke et al., 2008). To meet the demands of expanding residential, industrial and agricultural development in the coastal zone, various instream structures have been developed throughout freshwater, estuarine and marine fish habitats. Instream structures include floodgates, levee banks, jetties, pontoons, boat ramps, revetments, moorings and road crossings. These structures can impact fish habitats by modifying flow regimes and causing permanent physical disturbances that result in direct habitat loss (Burns, 2001; Adams, 2002). Other structures may form complete or partial barriers that prevent or severely limit important migrations and movements of fish and other aquatic species within these areas (Fairfull & Witheridge, 2003). Negative impacts of instream structures lead to population declines, reduced distributions of species and degraded fish habitats, which can have detrimental effects on Queensland's fisheries.

These pressures and impacts also exist within the declared Fish Habitat Area (FHA) Network and are of greater concern. In response to development pressures in the coastal zone, DPI&F established the declared Fish Habitat Area (FHA) network in the late 1960s (McKinnon et al., 2003). The declared FHA network protects key estuarine and inshore areas of fish habitats (e.g. vegetation, sand bars, rocky headlands) that sustain the fish on which our fisheries rely, from alteration and degradation from development impacts. The *Fisheries Act 1994* regulates the types of developments that are permitted within FHAs, assisted and supported by DPI&F policies and guidelines. All new developments, including the building, placing and maintenance of structures, in declared FHAs are required to be subject to assessment to ensure development impacts are minimised.

Despite this legislative and policy framework, development impacts that conflict with current FHA policies and management arrangements do exist in these Areas. Of most concern are the impacts of those structures constructed before FHA declaration, or structures that are illegal either without an approval or contrary to an approval. There is a high risk that the associated impacts of such structures on fish habitats are unacceptable, particularly those that have not been subject to the development assessment process.

First developed in June 2007, the instream structure inventory (ISI) project started in February 2008 following funding approval under the second phase of the Natural Heritage Trust. The project complements the Queensland Wetlands Programme. The project was to develop a framework and guidelines for conducting a physical inventory and data storage for identifying and plotting all man-made structures that impact on estuarine and marine fish habitats and movement of fish in

declared FHAs in coastal Queensland. This included development of a Decision Support System (DSS), to assist NRM and key stakeholder groups to prioritise individual structures and identify those that continue to have a negative impact on fish habitat or fish passage. This would lead to informed management decisions for strategic modification or removal of problem structures in cooperation with investment strategies of NRM agencies.

METHODS

Study areas

Development of the framework and guidelines was based on trial inventories within two declared FHAs in north Queensland: Trinity Inlet (7 212 ha) and Hinchinbrook (12 268 ha). The locations of these FHAs are shown in Figure 1. The Trinity Inlet and Hinchinbrook FHAs are downstream of extensive catchments, reflect the urban and rural levels of development respectively, and provide data on the different impacts of development that instream structures pose as a consequence of land use and on downstream and inshore wetland values.

Data collection

Field data was collected in April and May 2008, using a TDS Nomad personal digital assistant (PDA). The PDA was uploaded with Arcpad (V.7.0.1), project area maps and a modified version of the fish barrier menu system v.4, a GIS based digital assessment system originally developed by NSW DPI (NSW DPI, 2006).

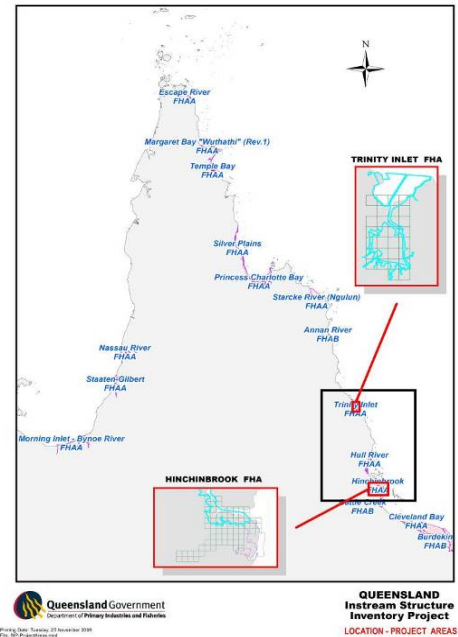


Figure 1. Location of project areas encompassing Trinity and Hinchinbrook declared FHAs

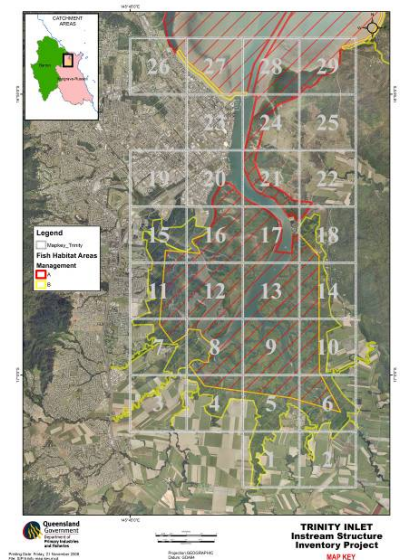


Figure 2. Trinity Inlet project area map

All project area maps incorporated the latest GIS data layers (watercourses, vegetation, infrastructure, waterholes and bores, land tenure) and existing approval information (fisheries development approvals, QT boat ramps, prescribed tidal works, Section 86 approvals) with base layers (Digital Cadastral Data Base (DCDB), topographic, wetlands mapping and imagery). A one-minute grid of the project area was used to allow fieldwork progress to be monitored. An example of the Trinity Inlet project area map with background imagery is shown in Figure 2.

Data collection involved recording the GPS location of each structure and information on the relevant data attributes. Attributes were split into the following broad categories: general, spatial location, site details, non-barrier, barrier type, barrier details, fish passage details, habitat, vegetation, threats (or impacts), location and ownership. Details regarding specific data attributes and application of the fish barrier menu system are outlined in FHG 007 *Fisheries guidelines for conducting an inventory of instream structures in coastal Queensland*.

Development of DSS and prioritisation of structures

A Decision Support System (DSS) was developed and used to score and prioritise structures for management responses, based on a number of criteria. Due to the different nature of impacts of barriers and non-barriers, these groups of structures were considered separately during this

process. Prioritisation criteria were based on those developed by DPI&F (Marsden *et al.*, 2006) to prioritise fish barriers in the Mackay Whitsunday region. The criteria were separated into two categories: habitat value and fish-friendly. Habitat value criteria indicate the value of habitat that surrounds a particular structure as classified by habitat class, extra fisheries value, habitat condition, and location in relation to the FHA. Fish-friendly criteria include structure type and disturbance area (non-barriers) or barrier type and impact (barriers). Fish-friendly criteria measure the severity of a structure's impacts on either fish habitats or fish passage.

Values were assigned under each criterion, to derive a habitat value score and a fish-friendly score for each structure. Each structure was assigned a position in a prioritisation matrix based on these scores (matrix concept presented in Figure 3). The matrix separated structures into four main quarters: less fish-friendly structures in high value habitat (quarter 1); less fish-friendly structures in low value habitat (quarter 2); more fish-friendly structures in low value habitat (quarter 3); and more fish-friendly structures in high value habitat (quarter 4).

Identification of structures that occur within each matrix quarter allowed priorities to be developed for each project area. Structures identified in quarter 1 were considered as being of highest priority for management response; these structures had relatively high impacts on fish habitats and were located in relatively high value habitat. Fish-friendly structures in areas of high value habitat (quarter 4) were considered a low priority for management responses. Separate matrices were developed for barriers and non-barriers.

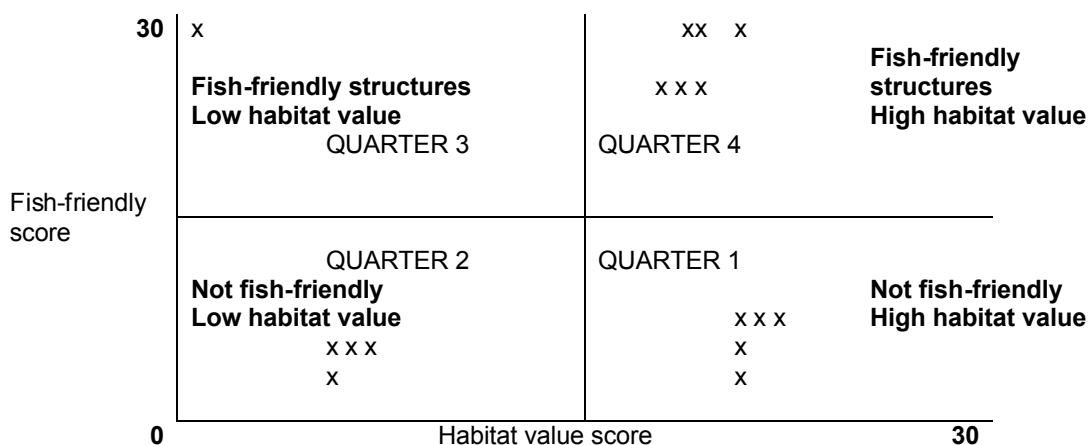


Figure 3. Prioritisation matrix concept diagram.

Following identification of priority structures, they were evaluated in terms of the impacts and related management considerations that applied within structure categories. While it is acknowledged that a range of management considerations (e.g. current/ancillary uses, presence of acid sulfate soils, availability of funding, etc.) should be applied in the assessment of individual priority structures before initiating a response, it was not within the scope of the project to investigate these. The project aimed however to provide NRM and key stakeholders with an overview of some of the management considerations that apply within structure categories and starting point in the decision making process to address problem structures.

RESULTS & DISCUSSION

Although the project areas extended outside of the declared FHA boundaries, this paper is limited to the results of inventories within the Trinity Inlet and Hinchinbrook declared FHAs. Table 1 displays the number of different structures identified in each of the declared FHAs. The relative number of structures in each of the Trinity Inlet declared FHA (51) and Hinchinbrook declared FHA (16) reflects the respective urban and rural nature of development. Of the 16 structures located

within the Hinchinbrook declared FHA, none posed a barrier to fish passage. The 51 structures identified within the Trinity Inlet FHA consisted of 6 barriers and 45 non-barriers.

Table 1. Summary of structure categories identified in the Trinity Inlet FHA and Hinchinbrook FHA

Structure category	Trinity Inlet FHA	Hinchinbrook FHA
BARRIERS		
Floodgates	1	0
Levee banks/bunds	2	0
Stream crossings	3	0
NON-BARRIERS		
Fill, slab	4	5
Stabilisation	3	0
Pile supported	4	7
Pipe outlets	2	0
Rubbish/wreckage	9	4
Moorings	23	0
Total # structures	51	16

Prioritisation process

Scoring of structures against habitat value and fish-friendly criteria and application of the prioritisation matrix resulted in identification of priority structures for each declared FHA. A summary of the number of structures in each matrix quarter is shown in Table 2. The majority of structures in both FHAs were located in quarters 1 and 4, which represent structures located in areas of relatively high habitat value. Consisting of less fish-friendly structures, quarter 1 of the matrix identified 23 priority structures in Trinity Inlet FHA and 9 priority structures in the Hinchinbrook declared FHA.

Table 2. Number of structures in each quarter of the prioritisation matrix.

	Number of instream structures			
	Quarter 1: less fish-friendly structures; high habitat value	Quarter 2: less fish-friendly structures; lower habitat value	Quarter 3: fish-friendly structures; lower habitat value	Quarter 4: fish-friendly structures; high habitat value
Trinity Inlet FHA	23	2	1	25
Hinchinbrook FHA	9	0	0	7

Structures in quarter 1 represented 6 different categories in the Trinity Inlet FHA and 2 categories in the Hinchinbrook FHA, summarised in table 3. In both FHAs, the rubbish/wreckage and fill/slab structure categories were the most highly represented categories of structures within quarter 1.

Table 3. Structure categories in quarter 1 of the Trinity Inlet and of the Hinchinbrook matrices

Structure category	Trinity Inlet FHA	Hinchinbrook FHA
Barriers	2	0
Fill/slab	4	5
Stabilisation	3	0
Pile supported	3	0
Pipe outlets	2	0
Rubbish/wreckage	9	4
TOTAL	23	9

Quarter 1 contained all structures that were classified as rubbish/wreckage during the entire inventory process in each of the FHAs. Including dumped material or rubbish and abandoned derelict vessels, the rubbish/wreckage category consists of unauthorised structures that conflict with declared FHA management and are of large concern.

The fill/slab structure category included boat ramps, slipways, wharves, housing/huts and other structures that are directly installed on the substrate. In having typically large footprints and causing permanent loss of fish habitats these structures are generally considered as high impact. Incorrect placement of boat ramps on erosive river bends can also lead to bank erosion upstream or downstream of the structure.

The prioritisation of these two relatively high impact structure categories in quarter 1 demonstrates the value of the prioritisation matrix as an effective tool in identifying high impact / problem structures in FHAs.

Management considerations for priority structures: Hinchinbrook declared FHA

All structures prioritised in quarter 1 of the Hinchinbrook matrix were categorised as either fill/slab or rubbish/wreckage (listed in table 4).

Table 4. Priority structures (in matrix quarter 1) for the Hinchinbrook declared FHA

Structure grouping	Structure ID	Habitat value score	Fish-friendly score	Total score
Fill, slab	HERB020BR	18	6	24
	HERB002ON	22	2	24
	HERB005ON	22	2	24
	HERB120ON	28	2	30
	HERB013BR	22	10	32
Rubbish/wreckage	HERB003ON	22	4	26
	HERB001DM	22	12	34
	HERB004DM	22	12	34
	HERB012DM	22	14	36

In the case of the rubbish/wreckage structure category the management of these materials and structures relates to the physical removal of these materials from fish habitats and restoration of the impacted sites. Within declared FHAs, no approval can be supported for the dumping of materials or the deployment of derelict vessels. Potential management actions include determining the persons responsible for the dumping of the materials and the derelict vessels, a coordinated program to remove the materials and vessels from within the boundaries of the declared FHAs, and restoration of impacted sites.

Management of structures in the fill/slab category relates to regulating launching/retrieving to designated areas, provision of ancillary facilities for parking (vehicles/trailers) on non-tidal lands, maintenance of revetments, maintenance of boat ramps and slipways, and using appropriate materials/preservatives used for decking on wharves. Within declared FHAs, subject to the management level, public structures can be approved and private structures may be approved. Potential management actions include determining the legality of the existing structures and their fate, ensuring public access is regulated, employing fish-friendly design and construction, and best management practices are used on wharf and revetment maintenance. Where removal of structures occurs, rehabilitation may be appropriate for impacted areas.

CONCLUSIONS

The project developed a framework for the identification and prioritisation of instream structures within declared FHAs for management responses. Through establishing a systematic and integrated approach to addressing structure impacts on fish habitats, the framework will contribute significantly to the strategic protection and management of fish habitats within Queensland's declared FHA network.

FHG 007 *Fisheries guidelines for conducting an inventory of instream structures in coastal Queensland* have been developed to provide both government (e.g. State agencies, Councils) and non-government (e.g. Natural Resource Management bodies) organisations with the capacity to undertake inventory projects throughout Queensland. The guidelines consist of two user-friendly parts: an inventory protocol that describes the inventory process, including the identification of structures and their location and assessment of structure impacts; and a response protocol, including the Decision Support System, to facilitate prioritisation of problem structures for delivery of enhanced management responses.

Future projects would involve conducting structure inventories in other declared FHAs and remedial actions on priority problem structures. Training workshops would be provided for NRM, local government and key stakeholder groups, including onground demonstration and application of the protocol and associated software.

TAKE HOME MESSAGES

- A new framework has been developed to identify and prioritise instream structures in coastal Queensland
- User-friendly guidelines are available for NRM groups, local government and other key stakeholders wishing to undertake inventory work

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