Identification and Mapping of Barramundi Nursery Swamp Habitat in the Chambers Bay/Finke Bay Area.

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NON-TECHNICAL SUMMARY

A number of previous studies have demonstrated that very small barramundi (around 8 mm and larger) occupy tidal swamp habitats in coastal areas during their first few months of life, from September. There has been substantial sampling of this type of habitat but generally only in specific areas and the general characteristics, such as vegetation types, soil types etc., of barramundi nursery swamps have not been systematically examined.

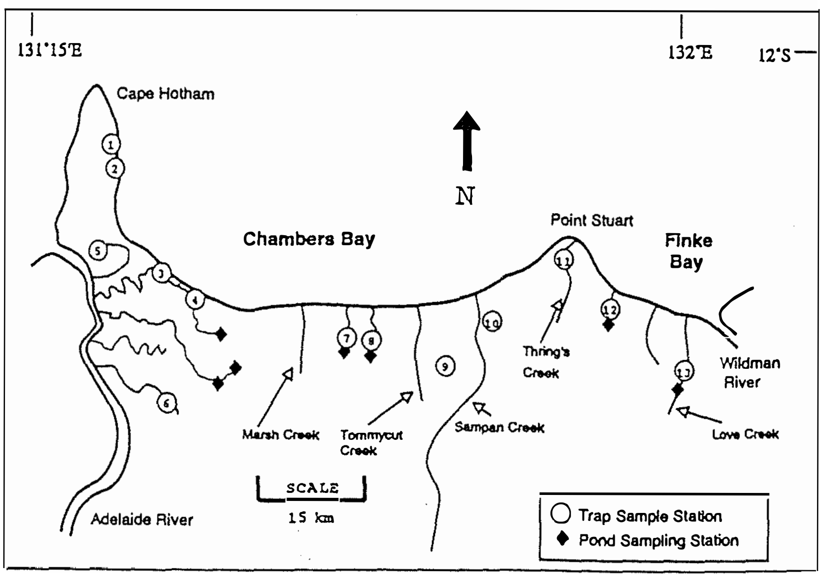
Fishing industry representatives in the NT have recently been involved in debate over the impacts on barramundi nursery habitat of works to control saline intrusion in the study area. Concerns have also been expressed about possible impacts of the practice of ponded pasture being developed by the pastoral industry. Massive saline intrusion in the area has resulted in extensive degradation and loss of important freshwater habitat and throughout the study area there have been earthworks conducted to prevent further intrusion. In some instances those earthworks could deny small barramundi access to vital nursery habitats. There is also concern that barramundi which gain access to nursery swamps during the wet season floods then become trapped in the waters remaining behind the saline intrusion control bunds and die when the ponded area dries out. The fact that the barramundi nursery habitats are located at the interface between fresh water and saline tidal swamps presents a substantial risk that they will be mistakenly "rescued" from saline intrusion.

The aim of the project was to determine the precise location and characteristics of barramundi nursery swamps in areas between the Wildman and Adelaide Rivers in order that they might be protected.

The original scope of this project was extended to include investigation of the physical changes in nursery swamp habitat and usage by barramundi during and after the wet season. The extension was a direct response to local industry concerns that saline intrusion control works and ponded pasture development were having negative impacts on barramundi populations in the study area.

Thirteen coastal swamp areas between Cape Hotham and the Wildman River were sampled monthly from September to January using hide traps to assess the presence or absence of barramundi (Figure 1).

Figure 1 Map of barramundi nursery swamp sampling sites - Cape Hotham to Wildman River



The hide trap, designed to exploit the fright response of small barramundi, consists of a 60 cm diameter ring of steel wire covered with fine mesh and a 30 cm length of teased out rope. The ring of mesh is placed on the bottom of the tidal swamp area and the weighted rope material placed in the centre. When the trap is approached small fish take refuge in the rope material. The trap is then lifted and the contents washed into a cup set into the centre of the trap. Access to the swamp areas was gained by helicopter. To set and retrieve traps at all 13 stations took around 10 hrs flying time each month. At each station salinity, temperature and water depth were measured each month. Vegetation types at each site were also recorded.

At eight sites waters ponded behind bunds built for saline intrusion control were examined during April and May to determine the presence, absence or relative abundance of juvenile barramundi of 20 to 30 cm. Sampling at those sites was limited because of constraints on access, time and sampling methods. Crocodiles were a significant danger at all sites. Access was either by airboat, where sampling was conducted by electrofishing, or by helicopter which meant that castnetting was the only method used.

Small barramundi were found at three locations, two on small tidal creeks off Chambers Bay (Stations 7 and 8) and one off Finke Bay, just east of Point Stuart (Stations 12). All three were within 3 km of the coast at the top of small tidal creeks, where those creeks enter freshwater floodplain swamps and significantly all were blocked by saline intrusion control bunds.

At those sites where barramundi were taken, small scats (*Selenotoca multifasciata*) and tarpon (*Megalops cyprinoides*) were also common. Studies in Leanyer Swamp near Darwin and in Papua New Guinea also found a close association of scats and tarpon with barramundi. At two stations (Station 1 at Cape Hotham and Station 13 on Love Creek) both of those species were found but barramundi were not. Given the close association between these species it is quite possible that those two sites are used by barramundi although none were captured. In the case of Love Creek this suggestion is reinforced by the similarity of the salinity regime and vegetation types as well. Three plant species, *Schoenoplectus littoralis*, *Cyperus scariosus* and *Sporobolus virginicus* were common to the three sites at which barramundi were found and are considered to be likely indicators of a habitat suitable for small barramundi.

None of the sites in the Adelaide River catchment yielded any barramundi nor were the scats and tarpon commonly found with barramundi recorded. Many of the bunded coastal areas which were to be sampled were not tidally inundated until November and some not at all, despite quite high spring tides. It is possible that bunding has resulted in infilling of the tidal channels feeding these areas. The sites on Cape Hotham, remote from the Mary River channels did not yield any barramundi and during September and October and November at least were hypersaline. Salinity was very high (up to 120 ppt) in most areas prior to onset of the wet season in December. At two of the sites where barramundi were found salinity dropped dramatically in December but remained high at most others.

At three of the ponded areas studied (Station 8 off Chambers Bay, Station 12 off Finke Bay east of Point Stuart, and at Love Creek) significant numbers of barramundi were found. At Station 8 two were caught and up to 20 more were seen. These fish were trapped with no access to the sea but it is not likely that large numbers of barramundi would die at that site. At Love Creek substantial numbers of barramundi were captured but in that situation the bund was breached and fish had access to the sea. At Station 12, there is a spillway built into the bund at about the level of high tide. Very large numbers of barramundi were present above that bund in April when there was 30 – 40 cm of water flowing through the spillway. By mid-May flow out of the spillway had virtually ceased and very few barramundi remained in the ponded water. Apparently the large numbers present in April had left via the spillway. This is a very significant finding, suggesting that a simple spillway in saline a intrusion control bund could allow access by barramundi in and out of the swamp while virtually eliminating the negative impacts of saltwater intrusion, whether natural or man-induced. Further study of this situation during the next wet season would be very useful.

BACKGROUND

Previous published studies of barramundi nursery habitats (Moore 1982; Russell and Garrett 1983, 1985; Davis 1985; Griffin 1985, 1987) have demonstrated that very small barramundi (around 8 mm and larger) occupy supralittoral swamp habitats in coastal areas. There has been substantial sampling of this type of habitat but generally only in specific areas. The general characteristics, such as vegetation types, soil types etc., of barramundi nursery swamps have not been systematically examined.

Local fishing industry representatives have recently been involved in debate over the possible impacts on barramundi nursery habitat of works to control saline intrusion in the study area. Concerns have also been expressed about possible impacts of the practice of ponded pasture being developed by the pastoral industry in the area. Saline intrusion in the area has resulted in extensive degradation and loss of important freshwater habitat (Woodroffe and Mulrennan 1993) and throughout the study area there have been earthworks conducted to prevent further intrusion of saltwater. In some instances those earthworks could deny small barramundi access to vital nursery habitats. There is also concern that barramundi may gain access to nursery swamps during the wet season floods and then become trapped in the waters remaining behind saline intrusion control bunds to die when the ponded area dries out later in the year. The fact that the barramundi nursery habitats are located at the interface between fresh water and saline tidal swamps presents a substantial risk that they will be mistakenly "rescued" from saline intrusion.

The aim of the project was to determine the precise location and characteristics of barramundi nursery swamps in areas between the Wildman and Adelaide Rivers.

The original scope of this project was extended to include investigation of the physical changes in nursery swamp habitat and usage by barramundi during and after the wet season. The extension was a direct response to local industry concerns that saline intrusion control works and ponded pasture development were having negative impacts on barramundi populations in the study area. This report will document results in two phases.

OBJECTIVES

To assess the precise location and characteristics of barramundi nursery swamps in areas between the Wildman and Adelaide Rivers. In consultation with local industry representatives the scope of the project was extended to include study of some ponded areas above saline intrusion control bunds to determine whether or not barramundi were gaining access to those areas and then becoming trapped as floods receded.

METHODS

Nursery Swamp Identification.

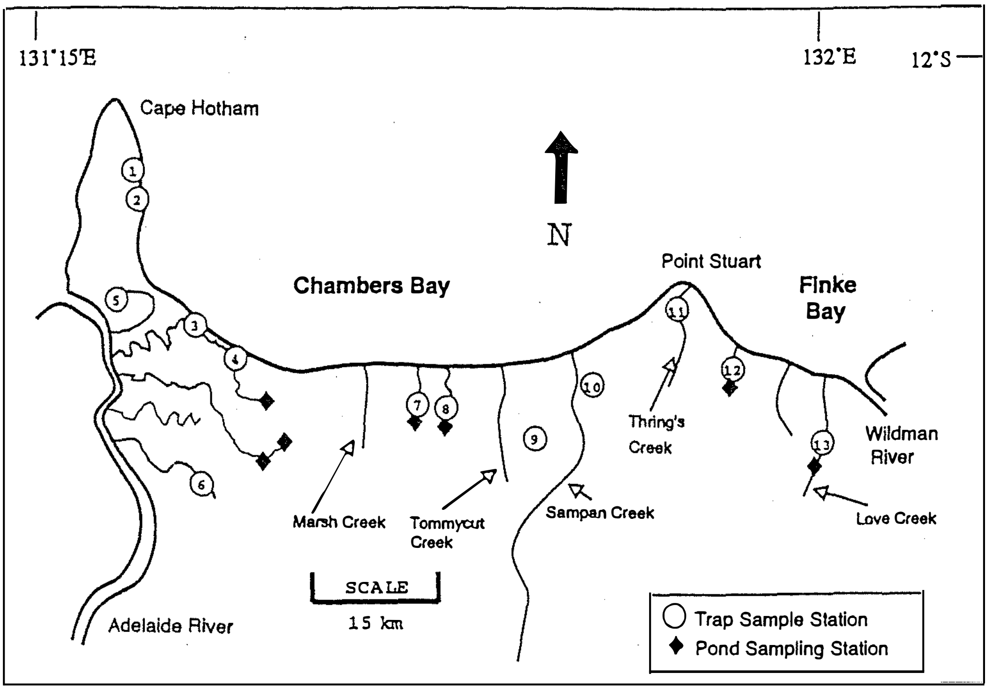
Study area.

The study area selected (Figure 1) extends from Cape Hotham in the west almost to the Wildman River in the east. A total of 13 sites (Table 1), selected on the basis of tidal access, proximity to the coast and vegetation types, were sampled.

Table 1. Location of trap sampling sites.

Stn No.	Location	Drainage	Lat/Long	Creek Distance from Coast (km)
1	Cape Hotham	Chambers Bay	131°18'E 12° 07'S	2.0
2	Cape Hotham	Chambers Bay	131°18'E 12° 08.4'S	1.5
3	Cape Hotham	No 1 Creek/Adelaide	131°22'E 12° 15.3'S	11.0
4	Cape Hotham	No 1 Creek/Adelaide	131°24'E 12° 16.5'S	16.0
5	Adelaide River	Wiltshire/Adelaide	131°16.2'E 12° 12.8'S	10.0
6	Adelaide River	No. 3 Creek/Adelaide	131°21'E 12° 21.8'S	15.0
7	West of T'cut	Chambers Bay	131°36.9'E 12° 19'S	2.5
8	West of T'cut	Chambers Bay	131°37.4'E 12° 18.5'S	2.5
9	West of Sampan	Tommycut/Ch.Bay	131°43.3'E 12° 20.1'S	9.0
10	Off Sampan	Sampan/Ch. Bay	131°47.9'E 12° 18.9'S	7.0
11	Thring's Creek	Finke Bay	131°54.1'E 12° 14.6'S	2.0
12	Below Rock Bund	Finke Bay	131°56.2'E 12° 17.1'S	0.5
13	Love Creek	Finke Bay	132°00'E 12° 19.9'S	4.5

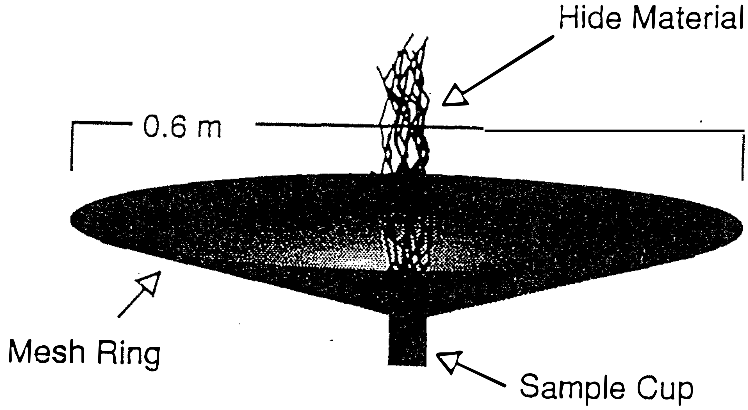
Figure 1 Map of barramundi nursery swamp sampling sites - Cape Hotham to Wildman River



Sampling Methods

The main sampling method used was a simple hide trap which exploits the normal fright response of small barramundi and other fish. The trap (Figure 2) consists of a 60 cm diameter ring of heavy gauge galvanised steel wire covered with fine mesh (0.9 mm x 1.0 mm) and a 30 cm length of teased out polypropylene rope. The ring of mesh is placed on the bottom of the tidal swamp area and the weighted rope material placed in the centre. When the trap is approached small fish take refuge in the rope material. The trap is then lifted and the contents washed into a removable cup set into the centre of the trap. This method was used successfully to sample barramundi in Leanyer Swamp from 1982 to 1984 (Griffin 1985). When time and terrain permitted sampling was also conducted with a scoop net. A higher than expected level of interference with traps was experienced. In some instances the rope bundle was removed, presumably by birds. In some cases the whole trap was extensively damaged, crocodiles or feral pigs being the most likely culprits. At two sites in particular (4 & 5) the traps were caused to float, rendering them ineffective on occasions as fish would probably choose to seek refuge under the floating trap rather than in the hide material. The flotation is thought to be caused by gases released from algal mats becoming trapped in the fine mesh material. This problem was eventually overcome by adding an extra weight ring of 5 mm diameter steel to the trap. Access to the swamp areas was gained by helicopter in all cases. To set and retrieve traps at all 13 stations usually took between 9 and 11 hrs of flying time each month.

Figure 2. Details of the hide trap used for barramundi sampling.



Traps were set three days after the highest spring tide each month from September to January and checked two days later. The traps were left in place until the following month. In the intervening four weeks some of the traps became completely covered in fine mud. Others continued to function effectively providing a double sample for the month. All the traps were cleaned and reset prior to each months main sample. Salinity, water temperature and water depth were recorded monthly at each station. Prior to November some of the proposed sample sites were not inundated at all. Conditions in some of the areas sampled were most inhospitable in terms of temperature and salinity in September and October prior to any rainfall and when tidal inundation was minimal. After December sampling was largely unsuccessful because of flooding of most sample sites. With the flooding problems arose with a lack of safe landing conditions for the helicopter and an unacceptable danger from crocodiles at some sites.

Each site was photographed both at ground level and from the air. Dominant vegetation types were recorded during June 1995 with the assistance of the Northern Territory Herbarium. It was originally planned to sample and identity the vegetation types early in the project during September to November 1994 but this proved impossible as much of the vegetation was dormant at that time and could not be readily identified.

It was originally intended that automatic cameras be set up at some stations to record actual conditions in the swamps but this did not occur because suitable technology was not developed in time.

Bund/Pond Studies

At eight sites areas of water ponded behind bunds built for saline intrusion control were examined to determine the presence, absence or relative abundance of barramundi. Four of those sites (7, 8, 12 and 13) were also adjacent to trap sites, three of which yielded barramundi. Sampling at those sites was limited because of constraints on access, time and methods which could be applied. Crocodiles were a significant danger at all sites, ruling out seining as a sampling method and limiting the usefulness of castnetting. Access to ponded areas on the Adelaide River, between Marsh Creek and Tommycut Creek and at Love Creek was by airboat. Each of these sites was sampled only once. Access to Station 12 was by helicopter only. At the sites accessed by airboat sampling was conducted by electrofishing. At Station 12 castnetting and angling were used.

DETAILED RESULTS

Nursery Swamp Identification

Barramundi were found at only three of the thirteen locations sampled. Two of those were adjacent to Chambers Bay (Stations 7 and 8) and the third just east of Point Stuart adjacent to Finke Bay (Station 12). All three were within 3 km of the coast at the top of small tidal creeks, where those creeks enter freshwater floodplain swamps and all were blocked by saline intrusion control bunds. Details of fish and crustaceans taken at each of the sites are contained in Table 2.

Table 2. Details of major taxa taken at 13 trap stations, September 1994 - January 1995.

Station	Name	Barra	Scats	Tarpon	Mullet	Penaeids	Gudgeons
1	Double	No	Yes	Yes	No	Yes	Yes
2	Crocodile Flat	No	No	No	No	Yes	Yes
3	Big Flat	No	No	No	No	Yes	Yes
4	T-Bar	No	No	No	No	Yes	Yes
5	Adelaide	No	No	No	No	Yes	No
6	Long Channel	No	No	No	No	No	Yes
7	Flat Creek	Yes	Yes	Yes	No	Yes	Yes
8	Tree Creek	Yes	Yes	Yes	Yes	Yes	Yes
9	Paperbarks	No	Yes	No	No	Yes	No
10	Swim Creek	No	No	No	Yes	Yes	No
11	Thring's	No	No	No	No	No	No
12	Rock Bund	Yes	Yes	Yes	No	Yes	Yes
13	Love Creek	No	Yes	Yes	Yes	Yes	Yes

At those sites where barramundi were taken scats (*Selenotoca multifasciata*) and tarpon (*Megalops cyprinoides*) leptocephalae were also common. Studies in Leanyer Swamp near Darwin (Griffin, unpublished data; Davis, 1985) and in Papua New Guinea (Moore, 1982) also found a close association of *Selenotoca* and *Megalops* with barramundi. At two stations (Station 1 at Cape Hotham and Station 13 on Love Creek) both *Selenotoca* and *Megalops* were found but barramundi were not. Given the close association between these species it is quite possible that those two sites are used by barramundi although none were captured in this study. In the case of Love Creek this suggestion is reinforced by the similarity of the salinity regime and vegetation types as well.

The sites in the Adelaide River catchment (Stations 3, 4, 5, 6) did not yield any barramundi nor were the scats and tarpon leptocephalae commonly found with barramundi recorded. One area of interest is the dead paperbark swamp area between Sampan and Tommycut Creeks. This area, which has only been tidally inundated in the last 20 years or so could possibly be providing new, expanded barramundi nursery habitat. In fact this site yielded very little and conditions were generally inhospitable. In January after considerable rainfall numerous penaeid prawns and one scat were found at that site, suggesting that at least late in the wet season it may provide suitable habitat but that it is not a significant barramundi habitat. The Thring's Creek site was problematical and sampling was hampered by variable tidal inundation. The sampling sites were frequently dry or almost dry when traps were checked. Further sampling at this site is warranted. Many of the bunded coastal areas which were to be sampled were not tidally inundated until November and some not at all, despite quite high spring tides. It is possible that bunding has resulted in infilling of the tidal channels feeding these areas. The sites on Cape Hotham, remote from the Mary River channels did not yield any barramundi and during September and October at least were hypersaline. During December and January conditions in those areas were more hospitable but they could not be effectively sampled in January because of high water levels. All of the sites yielding barramundi were within 3 km of the coast. Studies by CSIRO (Davis 1985) did however find early juvenile barramundi in the main channel of the South Alligator River up to 77 km inland and 10 km up Murganella Creek. That study did not find any barramundi larvae or early juveniles in or adjacent to the Mary River.

Nursery Swamp Characteristics

Salinity and Temperature

Salinity was very high at most stations during September, October, November and December declining during January under the influence of monsoonal rains (Table 2). Barramundi were found at salinities as high as 67 ppt and temperatures as high as 38.5 °C. Similar conditions of temperature and salinity were observed in barramundi nursery habitat adjacent to the Norman River by Garrett and Russell (1983).

At Stations 4, 9 and 10 a phenomenon known as "solar ponding" was observed in November with the temperature at the bottom being almost 8 °C higher than at the surface in less than 20 cm of water. This was presumably caused by a layer of new tidal water overlaying a layer of residual tidal water which was of substantially higher salinity because of evaporation. In such circumstances, if conditions are still, the two layers do not mix and solar energy becomes trapped and concentrated in the lower layer. Temperatures up to 47 °C observed in the lower layer are clearly unsuitable for normal marine organisms and no catches were recorded where such conditions occurred.

Table 2. Surface salinity (ppt) and temperature (°C) at trap stations. (ns = not sampled)

	September		October		November		December		January	
Stn No.	Salinity	Temp °C	Salinity	Temp °C	Salinity	Temp °C	Salinity	Temp °C	Salinity	Temp °C
1	92.4	36.0	62.8	35.5	42.8	35.5	39.8	35.0	ns	ns
2	43.0	33.0	Dry	Dry	44.3	30.5	39.6	38.0	42.1	32.5
3	111.0	39.0	54.0	38.5	44.3	38.0	38.2	36.0	30.4	32.5
4	85.0	39.0	70.6	37.5	121.0	38.5	48.3	38.0	30.5	33.5
5	77.1	35.0	52.5	37.0	47.1	35.5	36.3	35.5	33.1	34.0
6	54.8	32.5	47.8	32.5	44.3	34.0	23.1	35.0	ns	ns
7	Dry	Dry	Dry	Dry	44.9	38.0	18.3	38.5	0.0	31.0
8	Dry	Dry	59.9	35.5	64.9	35.5	9.0	39.0	ns	ns
9	101.0	38.0	57.4	38.5	62.6	39.5	45.2	40.0	27.0	37.5
10	67.8	34.0	64.6	36.5	67.3	38.5	44.1	35.0	18.1	38.0
11	Dry	Dry	53.1	36.0	ns	38.5	44.1	40.0	18.3	40.0
12	Dry	Dry	Dry	Dry	46.8	38.5	42.3	38.0	ns	ns
13	83.6	37.0	55.4	34.5	57.6	36.8	38.3	38.0	0.3	38.0

Vegetation

Assessment of the vegetation in the bunded areas was sometimes confounded by the presence of some introduced species used to stabilise the bund or to provide pasture. Those species have been excluded from this analysis. Generally the three sites where barramundi were found early in the season (ie. the tidal part of the swamp systems) had only limited vegetation of a small number of species. Station 7 had no vegetation at all in the water early in the season but was fringed with *Sporobolus virginicus* and *Cyperus scariosus* . Station 8, adjacent to Station 7, was a narrow and very shallow creek lined with mangroves (*Avicennia marina*). The creekbed was fringed with *Sporobolus virginicus* and *Schoenoplectus littoralis*. . The saltwater couch, *Sporobolus virginicus*, was found at most sites, as it is at almost all areas where saltwater meets freshwater. At the other site containing barramundi (Station 12) vegetation was dominated by *Schoenoplectus littoralis*, with *Cyperus scariosus*, *Sporobolus virginicus* and *Xerochloa imberbis*. Sedges (*Eleocharis* spp) were common at most sites away from the direct influence of highly saline tidal water. These were often the dominant native vegetation fringing the upper fresh/brackish parts of coastal swamp and floodplain systems but were actually present at only two trap sites, stations 2 and 6. Species indicating very high soil salinity levels were found at stations 1, 4 and 5. These were the succulents, *Sesuvium portulocastrum, Halosarcia indica* and *Batis argillicola*. The presence of these plants could indicate that conditions, at least early in the breeding season, are too saline for barramundi, although some *Sesuvium* was found at Station 7 where barramundi were found. The only consistent indicators of the presence of barramundi appear to be *Schoenoplectus littoralis*, *Cyperus scariosus* and *Sporobolus virginicus*, although *Sporobolus* was almost ubiquitous. Even these indicators could not be considered definitive. Further work on vegetation characterisation is warranted.

It is interesting (and cause for concern) that all three sites at which small barramundi were taken in traps are affected by bunds built to control saline intrusion. Further study of the real impacts of such bunds on barramundi habitat access and availability is essential.

Bund/Pond Studies

Barramundi were only common at three of the eight ponded areas examined, stations 8, 12 and 13. Stations 8 and 13 were sampled only once. At Station 8 only two barramundi were caught but approximately 20 others were seen but not caught. At this site there was no route for these fish to gain access to the sea.

At Station 13 a total of 17 barramundi (1 x 1+ and 16 x 0+) were caught by electrofishing, almost all of them on the upstream side of the bund. The bund was breached in several places and barramundi in that area probably would have been able to escape to the sea as the floodplains dried. Further sampling of that location has not been possible.

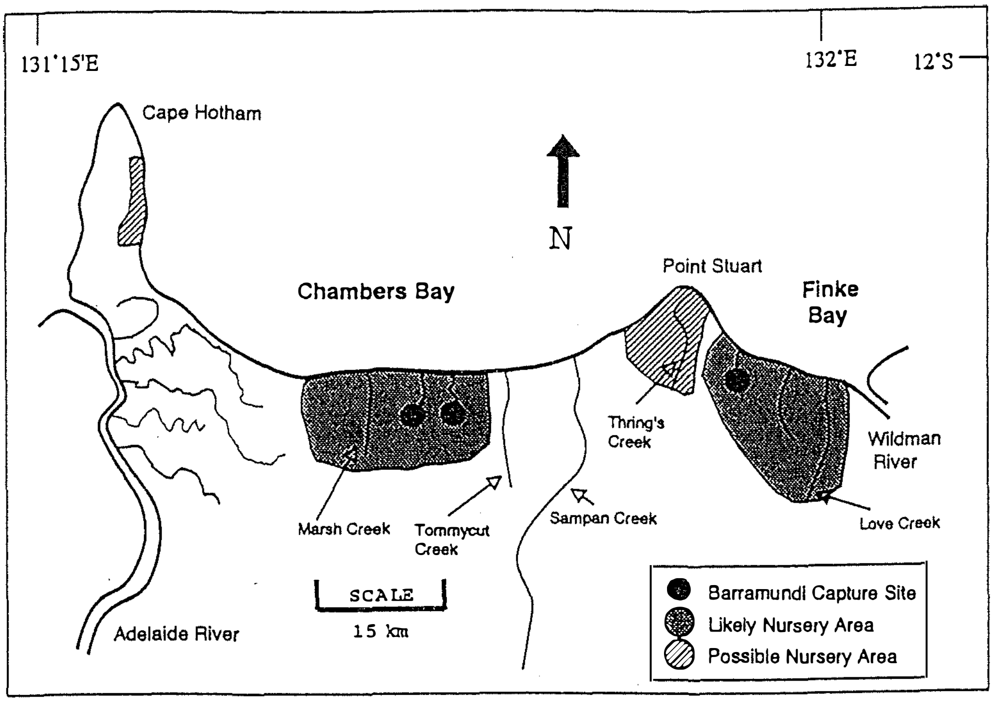
At Station 12 the bund has a rock basket spillway set at about the level of high tide. That Station was visited 3 times from April to June. Access was gained by helicopter only and the only effective sampling method available was castnetting. On 3 April 1995 water was flowing 30-35 cm deep through the spillway and large numbers of barramundi (size range 20 - 40 cm) were seen above the spillway and around the edges of the ponded area. Three casts of the castnet caught 12 barramundi. Other small fish, mainly rainbow fish (*Melanotaenia* sp and chanda perch *Ambassis* sp), were extremely abundant above and below the spillway. These fish were being actively preyed upon by barramundi. This site was sampled again on 4 May 1995 when flow through the spillway was reduced to approximately 10 cm. Small numbers of barramundi were present in the ponded area with three casts catching five barramundi. The large numbers of barramundi seen in April were not seen on this occasion. Again vast numbers of small forage fish were present. A further visit on 16 May found only a trickle of water up to 5 cm deep over the spillway, again with very dense aggregations of small fishes present. No barramundi were seen and four casts above the bund caught only one barramundi. In this instance it appears that the large numbers of barramundi present in this ponded area in April left the area via the spillway as the water level receded. Intensive study of this situation over the next wet season could prove very informative about behaviour of barramundi (and other fish) in ponded areas. It is possible that sustained flow through a single outlet is one of the cues which barramundi require in order to know when to leave a floodplain area, whether it be natural or artificial.

The three ponded areas examined on the Adelaide River drainage (Woolner North, Woolner 1 and Water Tower) yielded only one barramundi. These three bunds were built across wide tidal channels or palaeochannels up to 6 years ago. Regular tidal influence occurs below Woolner 1 and Woolner North. Water Tower is upstream of Woolner 1. The ponded areas above Woolner 1 and Woolner North appear to be in transition from marine habitat to freshwater habitat, having freshwater vegetation types and mangroves co-existing. The water in these areas was brackish at the time of sampling but is no doubt fresh during the flood season and increasingly saline as the ponds dry. The water above Water Tower bund is entirely fresh, with freshwater vegetation typical of the area. Extensive electrofishing in this water yielded only one barramundi and no other significant fish species (tarpon, mullet etc.) were seen. This suggests either that barramundi do not gain access to this habitat or, if they do enter, they depart before floods recede to the point where they cannot leave. Without further sampling it cannot be determined which is the case. No barramundi were captured or seen above the bunds at Woolner 1 and Woolner North. Because of the relatively high salinity levels electrofishing was not very effective. At Woolner North large schools of popeye mullet (*Rhinomugil nasutus*) were observed and numerous small penaeid prawns (*Metapenaeus eboracensis*) were captured by castnetting. A flock of approximately 200 pelicans was also present. This brief study indicates that these bunds do not trap large numbers of barramundi but this may be because they are not able to gain access above the bunds. It is also possible that barramundi were present above the bunds at Woolner 1 and Woolner North but were not caught because of the inefficiency of electrofishing in brackish water. More sampling during higher flood levels might be informative.

Summary and Conclusions

Of the 13 sites examined by use of hide traps three were found to be utilised by barramundi. They were Stations 7 and 8 adjacent to Chambers Bay and Station 12 between Point Stuart and Love Creek. A further two sites, Station 1 on Cape Hotham and Station 13 on Love Creek, did not yield any barramundi but did yield scats and tarpon, two species commonly associated with barramundi. One of those sites (Love Creek) also had vegetation types common to those sites which had barramundi. In the later stage of the study barramundi of 25-30 cm were found to be reasonably common at that site. These factors combined suggest that the extensive area of saline/brackish swamp at Love Creek area is a significant barramundi nursery habitat. It is also significant that all three of the sites which did have barramundi are on streams which are blocked by saline intrusion control bunds. Barramundi were not found at any of the stations within the Adelaide River drainage, nor were conditions at those stations indicative of them being significant barramundi nursery areas. Assessment based on all of the likely indicators (presence of very small barramundi or other indicator fish species, presence of indicator vegetation types, suitable salinity regime and presence of juvenile barramundi) suggests that the coastal floodplain areas between Point Stuart and the Wildman River and between Tommycut Creek and Marsh Creek are significant barramundi nursery areas (Figure 3). Two areas with some indicators but no confirmed presence of either very small or juvenile barramundi are suggested as possible nursery areas. They are the tidal swamps on Cape Hotham fed from Chambers Bay and the coastal floodplains of Swim Creek and Thring's Creek near Point Stuart. Within the contraints of this study it has not been possible to define the boundaries of these areas with certainty and without further study the nursery area definition is indicative only.

Figure 3. Suggested extent of barramudi nursery habitat in the Chambers Bay/Finke Bay area.



It is of considerable interest that some of the areas regarded as likely nursery swamp areas did not contain any water until October or even November. Current understanding of barramundi spawning and early juvenile behaviour is that spawning commences in September and that small juveniles enter the supralittoral nursery swamps some two weeks later (Russell and Garrett 1983; Davis 1985; Griffin 1985). In this instance this would clearly be impossible where the swamp areas were dry in September and October. This being the case the small barramundi must presumably have a secondary habitat choice, most likely in pools in mangrove areas along the coast. Investigation of use of this habitat would be useful but will be extremely difficult.

The situation at Station 12 where it appears that large numbers of juvenile barramundi have been able to escape via the spillway from the ponded area as the water level receded is worthy of further study. It is possible that in such situations provision of a spillway at an appropriate level may provide for effective exclusion of saltwater for soil conservation and pastoral utilisation while simultaneously allowing access and escape for juvenile barramundi.

BENEFITS

Improved knowledge of the characteristics of barramundi nursery swamps will be a definite benefit in identifying areas which require special protection from the negative impacts of development. This will benefit the local commercial and recreational fishing sectors by decreasing the risk that sensitive areas will be affected. The local pastoral industry, Landcare Group and government Conservation staff will also be better equipped to assess the likely impact of saline intrusion control measures on barramundi habitat. The fact that spillways in bunds are apparently effective in allowing movement of barramundi into and out of nursery areas will be of direct benefit to those concerned with saline intrusion into pastoral land and conservation reserves. Such knowledge is also likely to be of benefit in other areas and states where barramundi occur, in Queensland in particular. This flow of benefits is essentially the same as proposed.

INTELLECTUAL PROPERTY

No significant intellectual property is expected to be developed.

FURTHER DEVELOPMENT

This research has indicated that spillways are probably effective in permitting movement of barramundi into and out of nursery areas where saline intrusion control bunds are seen as necessary. One site where a spillway already exists offers considerable opportunity for further study of this situation during the next wet season. Sampling could be conducted in the spillway during the time of exodus. When flow ceases through the spillway it would be possible to conduct total sampling of the isolated ponded area by poisoning to determine the magnitude and composition of the residual fish population. The ponded area dries totally every year so the actual mortality added by the research would be effectively nil. This would be a substantial operation involving property owners, the NT Museum, NT University and other government bodies.

Two other bunded sites on Chambers Bay where barramundi were found below the bunds are also prospective experimental areas. One site without a spillway could be compared with an adjacent and topographically similar site into which a spillway was incorporated. While such comparisons will be logistically difficult and will be more qualitative than quantitative, the results could be of great value.

Several sites located during this study at which barramundi were not found but which have a number of characteristics of barramundi nursery habitat are worthy of further examination during the next breeding season.

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FINAL COST

Final financial statement to be supplied separately.

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Amateur Fishermen's Association NT

NT Dept of Lands, Planning and Environment

NT Dept of Parks and Wildlife

Management of Woolner, Marrakai, Swim Creek and Carmor Plains Stations

Lower Mary River Landcare Group

Mary River Technical Working Group

Northern Territory Legislative Assembly Sessional Committee on the Environment

Australian Nature Conservation Agency

Queensland Dept of Primary Industry

Queensland Commercial Fishermen's Organisation

WA Fisheries Department

REFERENCES

Davis, T.L.O. (1985). Seasonal changes in gonad maturity and abundance of larvae and early juveniles of barramundi, *Lates calcarifer* (Bloch), in Van Diemen Gulf and the Gulf of Carpentaria. Australian Journal of Marine and Freshwater Research **36**, 177-90.

Griffin, R.K. (1985). The importance of mangrove/coastal wetland to three commercial fisheries in the Northern Territory; particularly for Barramundi *(Lates calcarifer). In* Bardsley, K.N., J.D.S. Davies, C.D. Woodroffe (Eds) Coasts and tidal wetlands of the Australian monsoon region. Mangrove Monograph 1 . Australian National University, North Australian Research Unit, Darwin, Australia.

Griffin, R.K. (1987). Life history, distribution and seasonal migration of barramundi in the Daly River, Northern Territory, Australia. *In* M.J. Dadswell, R.J. Klauda, C.M. Moffitt, and R.L. Saunders (Eds). Common Strategies of Anadromous and Catadromous Fishes. American Fisheries Society Symposium **1**, 358-63.

Moore, R. (1982). Spawning and early life history of barramundi, *Lates calcarifer* (Bloch), in Papua New Guinea. Australian Journal of Marine and Freshwater Research. **33**, 647-61.

Russell, D.J. and R.N. Garrett (1983). Use by juvenile barramundi, *Lates calcarifer* (Bloch), and other fishes of temporary supralittoral habitats in a tropical estuary in northern Australia. Australian Journal of Marine and Freshwater Research. **34**, 805-11.

Russell, D.J. and R.N. Garrett (1985). Early life history of barramundi, *Lates calcarifer* (Bloch), in north-eastern Queensland. Australian Journal of Marine and Freshwater Research. **36**, 191-201.

Woodroffe, C.D. and M.E. Mulrennan (1993). Geomorphology of the lower Mary River plains, Northern Territory. North Australia Research Unit, Australian National University, Darwin.

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