INVESTIGATIONAL REPORT

AN INVENTORY OF SANDMINING OPERATIONS IN KWAZULU-NATAL ESTUARIES: Thukela To Mtamvuna

SEPTEMBER 2007

Nicolette Demetriades

Marine & Estuarine Research

A report for

COASTWATCH, WESSA KZN

in collaboration with;

EZEMVELO KZN WILDLIFE

& the

ENVIRONMENTAL MANAGEMENT DEPARTMENT OF ETHEKWINI MUNICIPALITY

MARINE & ESTUARINE RESEARCH

P.O. Box 417

Hyper-By-The- Sea

4053

Ph: +27 31 572 2705

Fax: +27 31 572 5171

cell: +27 82 451 8078

email: estuary@mer.co.za

Report prepared for :

Di Dold WESSA KZN

Report prepared by :

Nicolette Demetriades
Marine & Estuarine Research

This report should be referenced as:

Demetriades N 2007 An Inventory of Sandmining operations in Kwazulu Natal estuaries: Mtamvuna to Thukela. Investigational report for Coastwatch, WESSA KZN

Photo front page: One of many sandmining operations on the Mvoti estuary – August 2007

Acknowledgements

The author would like to acknowledge with gratitude the assistance of Prof Ticky Forbes on all the three aerial surveys, Ezemvelo KZN Wildlife for providing the plane and pilot Greg Nanni who flew us safely over the coastal strip; Bianca McKelvey and Santosh Bachoo both of EKZNW for assistance on two of the surveys and Ethekwini Municipality for assisting with a helicopter survey of the southern systems when nobody could face another circular light aircraft flight.

TABLE OF CONTENTS

Terms of Reference

TERMS OF REFERENCE

MER was requested by WESSA KZN to undertake a survey of sandmining operations in the estuaries of KZN. The main aim of the project was to provide an inventory of the currently active mines with the following objectives:

- Provide an indication of the scale of the operations in the province specifically where these relate to or influence estuaries
- Provide an assessment of the direct ecological footprint and permit compliance where possible.
- Provide an update of current operations on the ground and allow comparison with the registered list of legal operators

AN INVENTORY OF SANDMINING OPERATIONS IN KWAZULU-NATAL ESTUARIES: Thukela To Mtamvuna



1 BACKGROUND

Estuaries – important habitats

Estuaries are well-known for their biodiversity, productivity (particularly fish and invertebrates) and the functions they perform, such as nursery areas for marine fish, conduits for fish that move between the sea and the river (e.g. eels), and feeding sites for migratory birds. These habitats are considered one of the most threatened ecosystems in the country due to the large number of coastal developments that have taken or are planned to take place. This is particularly true for KwaZulu-Natal where a community degradation index was applied to 62 estuaries and it was revealed that 78% were 'moderately, strongly or severely degraded' (Ramm 1990). Within this context it is therefore considered vital to directly prevent and actively manage impacts to estuaries and ensure sustainability of function in the short, medium and long term as well as taking into account the importance of the estuary at local, regional and national scales.

Potential ecological impacts of sandmining

Extraction of material from within or near a streambed will have a direct impact on the stream's physical habitat characteristics. These characteristics include channel geometry, bed elevation, substrate composition and stability, instream roughness elements (large woody debris, boulders, etc.) depth, velocity, turbidity, sediment transport, stream discharge and

temperature. Altering these can have deleterious impacts on both instream biota and the associated riparian habitat.

The negative impacts to biota are caused by three main processes: (1) alteration of the flow patterns resulting from modification of the river bed, (2) an excess of suspended sediment and (3) damage to riparian vegetation and instream habitat. The disturbance activities can also disrupt the ecological continuum in a number of ways. Local channel changes can propagate impacts upstream or downstream and can trigger lateral changes. Alterations of the riparian zone can result in changes in channel conditions that can impact aquatic ecosystems in a similar way to some inchannel activities. The interconnectedness of channels and riparian systems requires the simultaneous evaluation of potential disruptions of the riparian zone.

The present study aimed to provide an inventory of sand mining operations within the estuaries of KwaZulu-Natal to provide an understanding of the current situation and facilitate appropriate management of this important industry.

2 METHODS

Aerial surveys were conducted along the KwaZulu-Natal coast from the Thukela estuary in the north to the Mtamvuna estuary in the south during four separate flights[1] conducted on the 13th September 2006, 2nd February, 11th March and 4th July 2007 (Figure 1). Each estuary was completely surveyed as well as a river section immediately upstream. The length of each survey path on each river varied according to the length of the estuary and size of catchment (flight track logs available digitally from the author). The position of any past and present sandmining operations observed were recorded using a *Garmin GPS Map 76CS* global positioning system and each site was photographed.

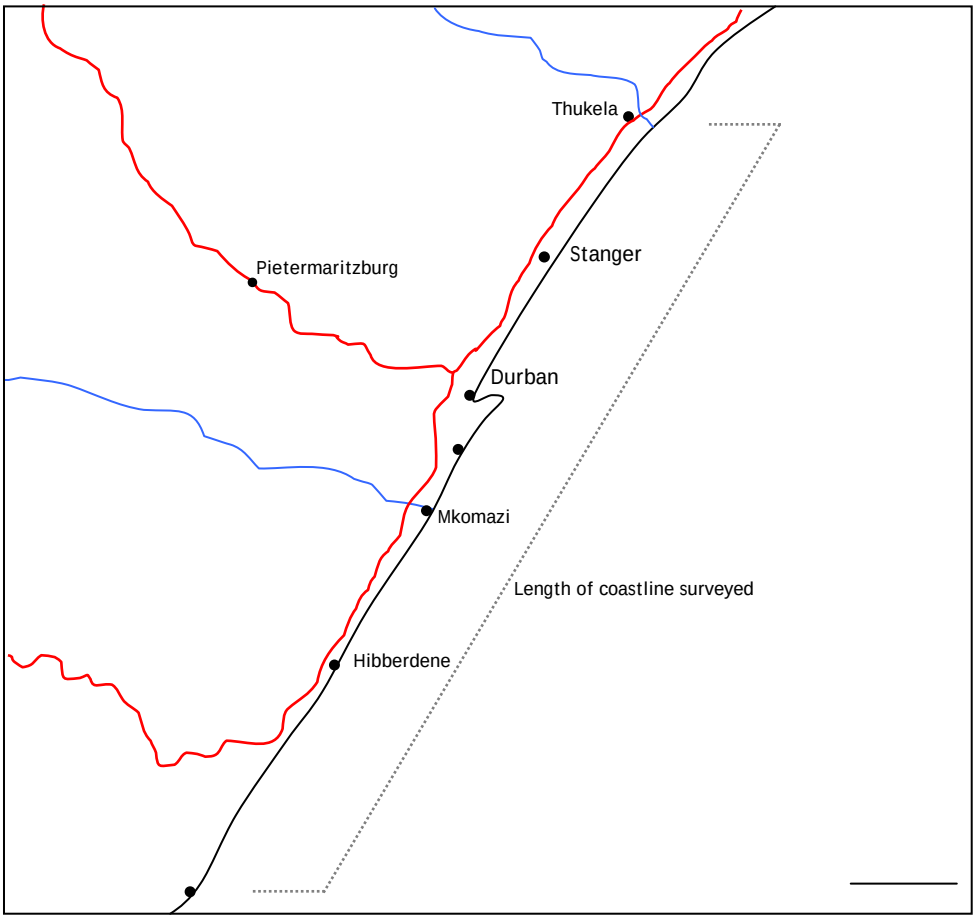

Figure 1: *Strip of the Kwazulu Natal coastline surveyed for sandmining operations with major towns, rivers and roads indicated.*

[1] Fixed wing aircraft and helicopter

3 ASSUMPTIONS AND LIMITATIONS

This study aimed to provide an inventory of sandmining activities in KZN estuaries and a limited reach of river upstream of each estuary. It does not, therefore, document sand mining activites along the entire river reach and thus cannot be considered a complete inventory of sandmining operations in KZN rivers. It should also be noted that the surveys represent snapshots in time and sandmining operations may move or change position from those recorded here.

The co-ordinates of each operation were recorded from an aircraft and thus there may be a slight inaccuracy in the precise locations of the mines. This would not prevent relocation of an operation on the ground but may be noticeable if mapped. Whilst this survey has provided some indication of the negative impacts of sand mining operations it does not provide a complete understanding of impacts on the ecological functioning and status of the estuarine systems.

The estuarine boundaries for the estuaries considered in sections 4.1 – 4.18 are derived in some instances from the reserve determinations which have been conducted by DWAF and in the absence of these have been assumed to occur at the 5 m contour. This would allow for the highest extent of backflooding in the smaller temporarily open estuaries.

4 SURVEY RESULTS

Of the 64 rivers surveyed, eighteen of these were found to have sand mining activity within the coastal zone with a minimum total of 60 operations (Table 1). The operations observed were found in the larger river systems with estuaries from three classification categories (Whitfield 2005) *viz* river mouth (2), permanently open (2) and temporary open systems (16).

Each of the systems where operations were observed are dealt with in more detail in sections 4.1 – 4.20 below.

***Table 1**: The estuaries of KwaZulu Natal with an indication of the presence and number of sandmining operations between August 2006 and August 2007*

	Estuary	Sandmining activity			Sandmining activity
1	Kosi		38	Mkumbane	
2	Mgobozeleni		39	Sezela	
3	St. Lucia		40	Mdesingane	
4	Mfolozi		41	Fafa	✓ (2)
5	Nhlabane		42	Mvuzi	
6	Richards Bay		43	Mtwalume	✓ (2)
7	Mhlathuze		44	Mnamfu	
8	Mlalazi		45	KwaMakosi	
9	Siyaya		46	Mfazazana	
10	Matigulu (Nyoni)		47	Mhlungwa	
11	**Tugela**	✓ (1)	48	Mhlabatashane (Mzimayi2)	
12	Zinkwazi		49	Umzumbe	✓ (3)
13	Nonoti		50	Intshambili	
14	Mdlotane		51	Koshwana	
15	Mvoti	✓ (8 - 10)	52	Damba	
16	Seteni		53	Mhlangamkulu	
17	Mhlali	✓ (4)	54	Mtentweni	
18	Tongati	✓ (2)	55	Mzimkulu	✓ (5)
19	Mdloti	✓ (3)	56	Mbango	
20	Mhlanga		57	Boboyi	
21	Mgeni	✓ (5 ??)	58	Zotsha	
22	Durban Bay		59	Mhlangeni	
23	Sipingo		60	Vungu	
24	Mbokodweni (Umbogentwini)	✓ (8)	61	Kongweni	
25	Manzimtoti	✓ (1)	62	Uvuzana	
26	Little Manzimtoti		63	Bilanhlolo	
27	Lovu	✓ (8)	64	Mvutshini	
28	Msimbazi		65	Mbizane	✓ (1)
29	Mgababa		66	Kaba	
30	Ngane		67	Umhlangankulu	
31	Umkomaas	✓ (8)	68	Mpenjati	✓ (2)
32	Mahlongwana		69	Kandandhlovu	
33	Mahlongwa	✓ (2)	70	Tongazi	
34	Mpambanyoni	✓ (1)	71	Kuboboyi	
35	Nkomba		72	Sandlundlu	
36	Mzimayi		73	Isolwane	
37	Mzinto		**74**	**Mtamvuna**	

4.1 Thukela

Estuarine classification: River mouth

Locality: 29°13'26"S;31°29'57"E

Co-ordinates of sandmining operations:

1. 29° 13' 3.98"S; 31°26' 54.83"E

Specific observations and comments:

- Only one very small localised operation on the north bank of the river west of the N2 bridge.
- Although small, the operation has cleared important stabilising riparian vegetation and created a potential erosion point
- This river and estuary is a likely target for future sand mining applications as there are many large sandbanks present
- Presently appears that access is prevented due to land ownershp
- This river is an important source of sand for the prograding (depositional) coastline north of the Thukela (Forbes & Demetriades 2000) and this function may be threatened by two proposed new large dams. Sandwinning would exacerbate this
- The source of sand for the proposed north Thukela estates need sto be carefully considered

4.2 Mvoti

Estuarine classification: River mouth

Locality: 29° 24' 03" S; 31° 20' 18" E

Co-ordinates sandmining operations:

1. S29 22.984 E31 14.855
2. S29 21.541 E31 14.585
3. S29 22.038 E31 14.697
4. S29 20.901 E31 14.516
5. S29 21.464 E31 14.085

Specific observations and comments:

- While the GPS co-ordinates listed above suggest 5 distinct operations it is likely that there are 8 – 10 operators. These were, however, almost impossible to separate as the operations run continuously with no recognisable boundaries between them.
- Each of the operations has a separate access road to the river stretch thus increasing negative impacts associated with heavy vehicles and machinery on the floodplain
- Mobilisation of large areas of unconsolidated sediments are very likely resulting in sedimentation of the estuary and changes to the sediment composition. This translates into a direct loss of estuarine habitat and productivity.
- Disruption of benthic communities within estuary and at the riverine estuarine interface
- Removal of riparian habitat and decrease in floodplain function will adversely affect the estuarine system
- Changes in downstream turbidities (water clarity) which strongly influence estuarine biotic communities particularly fish.
- There is a strong risk of erosion due to large number of sand mining operations in close proximity

***Plate 1**: Individual sand mining operations on the Mvoti River. Many show clearly the irresponsible operating practices – riparian zone clearing, diversion of flow, stockpiling on edge of river, multiple access points across floodplain and creation of large erosion areas*

4.3 Mhlali

Estuarine classification: Temporarily open/closed estuary

Locality: 29° 27' 40" S; 31° 16' 39" E

Co-ordinates sandmining operations:

1. S29 27.694 E31 12.436
2. S29 27.618 E31 11.959
3. S29 27.629 E31 11.272
4. S29 26.758 E31 13.848

Specific observations and comments:

- The GPS co-ordinates listed above refer to old and current operations.
- The previous mining operations show no evidence of rehabilitation of the vegetation or aquatic areas.
- Current operations have been spread along the river banks stripping riparian vegetation and exposing loose unconsolidated sediment
- Large sand stockpiles (± 3 – 4 m) along the edge of the river are vulnerable to rising water levels during freshettes and floods.

***Plate 2**: Past and present sand mining operations on the Mhlali river. Past operations have been left with little evidence of rehabilitation while current operations make large areas and volumes of sediment vulnerable to erosion and create berms resulting in river diversion..*

4.4 Tongati

Estuarine classification: Temporarily open/closed estuary

Locality: 29° 34' 21" S; 31° 11' 07" E

Co-ordinates sandmining operations:

1. S29 33 45.04 E31 8 55.08
2. S29 33 48.84 E31 9 2.85

Specific observations and comments:

- Only two relatively small operations, west of the N2 highway, were observed on the river reach of the Tongati estuary
- While these are small relative to the operations on systems further north the Tongati is a smaller estuary and the relative impacts of the operations are likely similar.
- Operations were again characterised by haphazard removal of riparian vegetation and river diversion.
- The Tongati estuary has shallowed significantly over the past 20 years and operations which increase erosion and movement of sediment into the river will ultimately result in the further sedimentation of the estuary.

4.5 Mdloti

Estuarine Classification: Temporarily open/closed estuary

Locality: 29° 39' 07" S; 31° 07' 43" E

Co-ordinates sandmining operations:

1. S29 38 56.12 E31 5 13.70
2. S29 37 46.66 E31 3 10.24
3. S29 38 0.43 E31 3 2.95

Specific observations and comments:

- Three relatively small operations were observed on the Mdloti river, both located west of the N2 highway
- Operations were again characterised by destruction of riparian vegetation along the river banks with little evidence of rehabilitation of the past operations.
- Construction of sand berms across the river to facilitate movement of trucks results in diversion and constriction of flow and the sediment used in berm construction becomes yet another source of sediment to the estuary during high flows.

***Plate 3**: Past and present sand mining operations on the Mdloti estuary. Note that there is no evidence of rehabilitation of old sites. Infilling of the river channel in Verulam (right centre) is of particular concern*

4.6 Mgeni

Estuarine Classification: Permanently open (now a temporarily open/closed estuary

Locality: 29° 48' 35" S; 31° 02' 27" E

Co-ordinates sandmining operations:

1. 29°48'24.54"S 30°59'11.26" E
2. 29°48'6.13"S 30°58'39.00" E (just above N2 freeway old sites not rehabilitated and continues upstream from this point for 4 km)
3. 29°45'23.59"S 30°54'48.64" E (small ad-hoc operations from rural area)

Specific observations and comments:

- The small amount of remaining riparian habitat has been surface stripped over large areas to expose the sand beneath making these areas vulnerable to erosion
- There has been major infilling of the estuary to create platforms in the past and still seems to continue
- previously mined areas left without rehabilitation

4.7 Mbokodweni

Estuarine Classification: Temporarily open/closed estuary

Locality: 30° 00' 29" S;30° 56' 12" E

Co-ordinates sandmining operations:

1. 30 00 24.5S 30 53 26.3E
2. 30 00 07.1S 30 54 10.8E
3. 30 00 36.5S 30 53 09.2E
4. 30 00 44.8S 30 52 39.8E
5. 29 59 22.3S 30 52 05.1E
6. 29 59 48.7S 30 52 13.7E
7. 29 59 19.0S 30 51 10.1E
8. 29 58 10.2S 30 48 36.5E

Specific observations and comments:

- Eight large operations within 15 kms of the coast
- All of these range haphazardly, clearing large areas of vegetation from the floodplain
- Several *ad-hoc* berm roads constructed across the river constrict flow and adversely impact on water quality and habitat integrity.
- High flows in this system as a result of waste water discharge probably result in scouring of exposed areas and deposition of the eroded material in the estuary.

4.8 Lovu

Estuarine Classification: Temporarily open/closed estuary

Locality: 30°06'47" S; 30°51'12" E

Co-ordinates sandmining operations:

1. S30 06 17.1 E30 50 10.5
2. S30 05 49.6 E30 49 05.9
3. S30 05 18.0 E30 48 52.1
4. S30 05 21.2 E30 49 10.5
5. S30 04 40.2 E30 49 33.8
6. S30 05 27.0 E30 47 59.1
7. S30 05 10.3 E30 47 11.1

Specific observations and comments:

- This is a very heavily mined system on a par with the Mvoti estuary
- The pictures clearly illustrate the extent of the operations
- 3 m high berms are constructed down the centre of the river channel rendering them extremely vulnerable to erosion

Plate 4: *Sand mining operations on the Lovu estuary clearly illustrating infilling, river diversion and destruction of riverine habitat.*

4.9 Mkomazi

Estuarine Classification: Permanently open estuary

Locality: 30°12'03"S;30°48'11"E

Co-ordinates sandmining operations:

1. S30 10 52.6 E30 45 45.4
2. S30 10 43.1 E30 45 11.0
3. S30 10 43.6 E30 44 57.0
4. S30 10 29.2 E30 43 49.6
5. S30 08 14.8 E30 34 41.1
6. S30 10 40.30 E30 46 28.67

Specific observations and comments:

- This is another intensively exploited system and one of the only ones where the sandmining operations take place within the estuarine boundary areas (Ifafa is another of these)
- Research conducted by MER in this estuary over the last 10 years has allowed observation of the sustained exploitation and major modifications of the riparian and riverine habitats.
- The upper estuary is characteristed by river diversions, unconsolidated sediments and general habitat instability.
- Invasion of the riparian areas by invasive alien species
- Increased turbidities during low flow periods as well as an increase in the sandbanks in the lower estuary and very likely linked to the activities of the sand mining operations upstream.

***Plate 3**: Sand mining operations on the Mkomazi estuary. No evidence of rehabilitation as the sandmining operation moves downstrea. Berms are built across almost 2/3rds of the channel and sediments continuously turned over.*

4.10 Mahlongwa

Estuarine Classification: Temporarily open/closed estuary

Locality: 30°16'06"S;30°45'54"E

Co-ordinates sandmining operations:

1. S30 12 58.1 E30 42 35.8
2. S30 15 17.6 E30 45 03.4

Specific observations and comments:

- Two small operations which appear to serve the building requirements of the local community.
- Not immediately apparent if both sites were still being actively mined.
- Small catchment with very little potential to generate high sand yields.

4.11 Mpambanyoni

Estuarine classification: Temporarily open/closed estuary

Locality: 30°16'06"S;30°45'54"E

Co-ordinates sandmining operations:

1. S30 16 52.16 E30 43 1.46

Specific observations and comments:

- Only one operation approximately 5 km upstream of mouth
- Fairly large area of vegetation clearance and extensive channel modification
- No indication of rehabilitation of an adjacent previously mined site.

4.12 iFafa

Estuarine Classification: Temporarily open/closed estuary

Locality: 30°27'17"S;30°39'13"E

Co-ordinates sandmining operations:

1. S30 26 45.2 E3038 37.1
2. S29 15 53.5 E31 26 19.8
3. S29 17 16.7 E31 23 03.9

Specific observations and comments:

- Some major mining taking place upstream of the N2 with significant channel modification, loss of riparian vegetation and stockpiling of sand
- Sand mining or channel modification in front of the Ifafa Marina complex. Piles of sand clearly visible along the river bank

4.13 Mtwalume

Estuarine Classification: Temporarily open/closed estuary

Locality: 30° 29' 07"S; 30°38'02" E

Co-ordinates sandmining operations:

1. S30 26 45.2 E3038 37.1
2. S29 15 53.5 E31 26 19.8
3. S29 17 16.7 E31 23 03.9

Specific observations and comments:

- Two mines 4 – 5 km upstream of estuary mouth.
- Significant channel dredging and loss of riparian vegetation.

4.14 Umzumbe

Estuarine classification: Temporarily open/closed estuary

Locality: 30°36'48"S;30°32'52"E

Co-ordinates sandmining operations:

1. S30 35 20.0 E30 30 03.9
2. S30 35 34.2 E30 31 31.9
3. S30 36 24.5 E30 33 00.5

Specific observations and comments:

- Major changes to the channel
- Loss of riparian and floodplain vegetation
- No indication of rehabilitation activity

4.15 Mzimkulu

Estuarine classification: Permanently open estuary

Locality: 30°44'23"S;30°27'32"E

Co-ordinates sandmining operations:

1. S30 42 17.7 E30 23 27.0
2. S30 42 29.4 E30 24 01.6
3. S30 42 41.3 E30 24 44.5
4. S30 43 02.5 E30 26 07.8
5. S30 42 50.1 E30 26 33.6

Specific observations and comments:

- A heavily impacted system with a large number of sand mining operations.
- The lower reaches show significant sediment accumulation in the recent past sandmining activities have arguably contributed to this situation.
- High sediment loads are particularly obvious during high flow periods.
- The same loss of riparian and floodplain habitat is apparent on this river.and

4.16 Mbizane

Estuarine Classification: Temporarily open/closed estuary

Locality: 30°54'34"S;30°20'02"E

Co-ordinates sandmining operations:

1. S30 54 04.1 E30 19 13.2

Specific observations and comments:

- Only one small operation which appeared to be operated by a local landowner.

4.17 Mpenjati

Estuarine Classification: Temporarily open/closed estuary

Locality: 30°58'21"S;30°17'02"E

Co-ordinates sandmining operations:

1. S30 58 16.2 E30 17 03.3
2. S30 58 06.3 E30 16 40.8

Specific observations and comments:

- Two operations – one close to the mouth of the estuary and one above the N2 bridge.
- Long standing operations which unfortunately occur in a proclaimed nature reserve. Activities which are not compatible with the presumed goals of a nature reserve.

3 CONCLUSIONS AND RECOMMENDATIONS

An attempt was made in the listing of those KZN estuaries where sandmining was observed to emphasise those points which were specific to particular systems. It would however have been apparent very rapidly that the techniques and methods used in all the systems would have been sufficiently similar to generate very similar environmental impacts. It also appeared that the mining operations were conducted without much environmental consideration.

While it was possible to determine the number of systems where sandmining was taking place, it was not possible to ascertain with any certainty the number of operations nor the number of operators involved, particularly in systems such as the Mvoti where mining was observed to stretch along several kilometres of river bank and to involve a series of front end loaders supplying a a continual stream of trucks. In addition requests to the Department of Minerals and Energy to provide information on the number of permits issued per system and the total number of permits issued did not meet with any success. This meant that the third objective i.e. to provide an indication of the numbers of unpermitted operations was not possible.

The generally obvious and most apparent impacts of the sandmining operations include the high levels of disturbance associated with road access construction often across flood plains, the continual movement of large trucks and earth moving equipment, the destruction of flood plain and riparian vegetation and loss of the associated habitats, the mobilisation of sediments through road construction, destruction of aquatic habitats through dredging and mechanical diggers, release of fine sediments into the water column which then flow downstream reducing water clarity and ultimately settling out on plants and benthic animals. In addition, fuel and oil spillages from heavy equipment and the discarding of broken down equipment adds to the impacts on the natural environment. Long term effects on worked out areas are apparent in the appearance of invasive alien plant species indicative of the absence of any rehabilitation. Personal observations further indicate that provision of toilet facilities and observance of the provisions of the health and safety act are generally lacking. Personal experiences also show that the sediments in worked over areas are often extremely unstable, and the deeper holes left after excavation has occurred are frequently not apparent due to the turbidity of the water and present potential lethal hazards to local people using the rivers and estuaries.

The importance of estuaries lies in the goods and services they provide to other closely linked habitats. Many goods rely on the productivity of these systems a characteristic closely linked to the benthic organisms, both plants and animals, which inhabit these areas. Sand mining within estuaries disrupts the benthic structure thereby destroying much of what makes these systems productive and unique. As already discussed the estuaries of KwaZulu-Natal have already been placed under severe pressure and the disruption of foodwebs and communities by physical disturbance is not something which estuarine biota can adapt to nor can it be easily mitigated. For this reason, it is recommended that the authorities seriously consider the prevention of sand mining within estuarine boundaries.

It is also apparent that there is an urgent need to understand the sand yields of the KZN rivers as well as the downstream users of this sand. This requires that the determination for a particular river reach includes site-specific topographic, hydrologic, and hydraulic investigations. This would allow an understanding of the amount of sand that can be removed from the area without causing erosion or degradation beyond acceptable limits, either at the site or downstream. This has become particularly important in the wake of the beach erosion events of early 2007.

4 REFERENCES

Cao Z & Pender G 2004 Numerical modelling of alluvial rivers subject to interactive sediment mining and feeding *Advances in Water Resources*, *Volume 27, Issue 5*, *Pages 533-546*

Forbes A.T. & Demetriades N.T. 2000 Impacts of proposed dams on the Thukela estuary and inshore marine environment: A synthesis. Unpublished report prepared for the Department of Water Affairs and Forestry by Marine & Estuarine Research. 33 pp.

G. Mathias Kondolf *1994* Geomorphic and environmental effects of instream gravel mining *Landscape and Urban Planning*, *Volume 28, Issues 2-3*, *April*, *Pages 225-243*

APPENDIX A

COMPLETE SET OF SURVEY PHOTOS – separate adobe file **appendix a.pdf**