Knysna Basin Project

Director's report to the AGM on 19th November, 2015-11-01

The Greening of the Estuary!

The Green Tide

This extraordinary estuary (picture) and its complex of biochemical cycles has seen a long standing equilibrium become unstable in which the normal is exchanged for the abnormal and its unpleasant consequences. I refer to the blooming of green macroalgae mainly of sea lettuce or *Ulva* in the lower estuary. Throughout the ecological year much of our time has been spent observing the various growth forms of a large floating macroalgal assemblage which because of its abundance and duration in the estuary is called the Green Tide.

International experience links such blooms to an increase in nitrogen and phosphorus in the sediments and water column of the estuary. Our investigations during summer and winter confirm this hypothesis. A new report on the status of the estuary has been sent for review and hopefully to press. Not that this solves the problem, but it directs attention from ephemera, easily forgotten, to an established record of an important environmental event which points unerringly to our weak perception of how we, *Homo sapiens,* or wise men, are causing change. Note that we have been helped by the heavy rains during October, the last period of rain washed the eastern marshes free of broken fragments of green tide. To date it does not seem to be returning in anything like the earlier abundance so typical of macroalgal blooms.

During the summer of 2013/14 we experienced a Red Tide made up of millions of single-celled plants which float suspended in the water column enjoying the warm and nutrient rich surface waters of the coastal seas and the Knysna Estuary. Fortunately this specific Tide was not overtly toxic so animal life of the estuary and particularly those that feed on the microplankton were not seriously affected. This summer (2014/15), the microplankton was replaced by a macroplankton plant, *Ulva,* a sea weed, commonly known as 'sea lettuce'. The plant is made up of sheets of single cells which float indiscriminately in the water and are distributed with the tide in the lower basin of the estuary. They, in common with the microplankton, require light and large quantities of nutrients to grow, eventually bloom.

While this plant has been present throughout the lower estuary including the Ashmead Channel for many years it had not previously overwhelmed the intertidal shores or adjacent water. This summer has seen an explosion of the plant which at low tide covered the sand and muddy shores with slippery green sheets of sea lettuce. During high summer the intertidal shore at Lands End, Leisure Isle, was covered by rows and rows of decaying plants thrown up by tides and winds – an unpleasant sight which prevented serious use of the beach. A similar accumulation of plant biomass occurred in upper Ashmead and fragments of the plant sheets are picked up by the tide and spread over the adjacent saltmarsh. The dead fragments of the plant take on the appearance of 'loo' paper much to the consternation of the public, blaming the sewage works for discharging raw sewage over the marshes. Understanding the biology of this plant provides an alternative and correct explanation of this feature of summer marshes.

Decaying mats of sea lettuce at Costa Sarda (left) and Lands End (right) during summer 2015.

I asked the question “What was so particular about this summer in the estuary that precipitated this bloom?” It did not bloom in other estuaries. This suggested that some feature of the summer estuary triggered the rapid and sustained growth of the plant. A review of the ecological literature pointed to the world-wide and frequent occurrence of a green macro-algal floating plant that belongs to the genus *Ulva* .In all cases where blooms of the macro-algae occurred **nutrient enrichment** of the estuary waters is involved.

Careful review of the likely sources of nutrients, nitrogen and phosphorus compounds in the catchment of the Knysna Estuary pointed to the final effluent of the WWTW (sewage works), storm water flow, agricultural seepage and an oceanic phenomenon, ‘upwelling’ whereby seasonal south easterly winds induce an offshore movement of warm near shore surface water. This results in deep colder and nutrient rich water rising from deeper levels to take its place. In the Knysna Estuary this is identified by quite sudden drops in water temperature in the marine embayment – the strongly tidal area of the marine embayment downstream of the rail bridge. This summer temperature drops as much as 12° C was recorded that restricted swimmers from enjoying a summer activity. While this condition is relieved as the tide changes from flood to ebb, the overall effect is to sustain the nutrients,

specially nitrate, in the lower estuary at levels that were higher than during periods when upwelling is less likely, e.g. winter.

It is likely that early summer rains which increased the flow in the Knysna River were accompanied by increases in nitrate loading. When these changes are added to the increases in WWTW outflow during summer, it is not unreasonable to expect nitrate quantities to exceed those of past summers. These changes linked to coastal upwelling during the summer of 2014/15, provided a trigger that set conditions for green algal growth to reach bloom proportions and accumulate in deep piles of decaying plants on at Costa Sarda, Ashmead and Lands End, Leisure Isle.

It would appear that we have joined the international community from USA to Australia faced with the task of reducing the enriching nutrients of nitrogen and phosphorus hidden in our wastes and so freely thrown into the estuaries around which we live.

Until there is persistent and determined effort by **Society and its collective components** to tighten up its lax environmental morals we can expect repetition of these blooms and suffer their impacts on the biology of the Estuary and its environmental quality. **We have been warned!!**

I point to 4 four dominant environmental factors which contribute to these changes:

1. The very necessary Improvements in the services to the previously disadvantage communities within the Basin have increased demands on the WWTW and potable water supply; the former increasing the loads of N and P in the final effluent and the latter exacting demands on the raw water supplies from the Knysna River and other raw water sites.

2. The soils of the minor catchments within the Basin are unstable and once disturbed are easily eroded – hence the large mass of sand and silt which accumulate in the trap excavated immediately upstream of the Geo Rex Drive bridge or culvert. If this sand trap had not been excavated and the spoil dumped on the banks of the lower Bongani River, the road would have flooded and much of the sand and silt deposited in the delta and Ashmead Channel.

3. Of equal importance is the instability of the surface soils in the Salt River catchment. This stream has been an agent for infilling of the main channel for many years and with it decreasing water transparency and the loss of eelgrass and associated macroinvertebrates. The predatory load of bait collection is developing changes in the biochemistry of the sandy and muddy shores of the estuary. Repeated disturbance of the anoxic sediments liberates nutrients encouraging further the growth of green macroalgae and loss of feeding habitats for water birds.

4. There is no end to the demands we make of the goods and services of this paramount estuary. And when it shows signs of deterioration we look to others for the cause! But do we reduce our expectations – seemingly NO!

Collaboration

Notwithstanding these dramatic environmental changes, the Knysna Basin Project team has come together offering their various skills and interests and continues to provide a fine sense of belonging to something important and is made up of the following:

Alan Hodgson and his graduate students from Rhodes University are contributing to our understanding of the diversity within the estuary and man-made structures such

as Marinas and in the greater estuary. The alien community among this diversity will be described by Professor Alan Hodgson. Frances and Peter Smith fly like swallows on a clear and faithful trajectory to their home on Leisure Isle where like our feathered friends spend the summer developing and working with the Project Their own research field, Shoresearch, is enriches our stores of knowledge about the diversity of the intertidal shores of the estuary. This experience adds to the value and interest of their Shore meetings where members and interested persons – the mudlarks – join in sampling the often muddy areas and help reveal the known and rare animals within the sediments.

So much of this ecological review is linked to a positive educational program which under the direction of Maureen Lake and her team is creating an atmosphere of learning through a ‘hands on approach’ to the life of the estuary and how it is supported. Our thanks are due to an award made by the Knysna Municipality that allowed us to enlarge the scope of our impact. In like manner we greatly appreciate the award of funds by Knysna Rotary Club which allowed the team to purchase a projector and screen – directly beneficial to our overall educational and communication needs.

The seahorse project of Louw Claassens and Mike Davies in the TIHOA marina canals is enriched through the innovated thinking of Louw and Mike and about which Louw will be talking later. This research into the ecology of Knysna’s own iconic beast owes much to the generosity of the Trustees of the TIHOA and to individual grants given monthly to the research funds under the control of John Edwards and his team at AQB: noting that their time and professional skills are given *gratis*, a substantial contribution in real terms to the Project overall.

Underpinning our sense of a team are the presence and studies of Dr Richard Barnes, recently retired from the Department of Zoology at Cambridge University and appointed a research fellow in this Department and even more recently, awarded an Honorary Professorship in the Department of Zoology and Entomology, Rhodes University. Our readers will recognise that Professor Barnes comes to us with a breadth of knowledge and experience of estuaries and wetlands throughout the temperate and subtropical regions of Earth unequalled in the specificity of his research into the patterns of macroinvertebrates with eelgrass beds or meadows. The Knysna estuary possesses the largest areas of tidal and subtidal eelgrass wetlands along the coastline. Richard Barnes has stressed repeatedly the real ecological significance of this habitat in the stability of the estuary. To establish this as an undeniable fact has required weeks of sampling within the sand and mud shores repeated annually followed by detailed enumeration of species and abundance. This is normally done during the austral summer while on his return to Cambridge Professor Barnes begins with the numerical analysis.

I am particularly pleased to record an increase in our inter-university and institutional engagements and interaction with biologists from Stellenbosch University, Rhodes, NMMU, CSIR, SANParks and DWAS. Owen Govender, Senior Ranger, GRNP, will summarise the latest bacterial data from the estuary in his talk.

This interaction is accompanied by further studies in **real time** of physical and chemical events in the water column of the estuary, particularly during flooding. We owe the advances in this direction to Mr Konrad Taeuber, Chairman of Taueber & Corssen Board Trustees, Johannesburg, and now resident in the Thesen Islands Marina. Through his close watch of the estuary in all its moods Konrad's vision of equipment capable of measuring parameters such a salinity and temperature and

tide level in real time has become a reality and is matched by a number of studies developed in America estuaries and tidal water inlets, notably Long Island Sound. . Advances in computer technology and the electronic equipment design that allow digitization of changes in parameter values stimulated Konrad Taeuber to draw upon these advances in seeking a an instrument assembly that will record changes in the estuary. Messrs Hach Ott of South Africa provided the technical skills and through their offices the purchase and installation of a suitable array of electronic equipment now assembled in the TIHOA marina at two measuring stations. Richard Taeuber will demonstrate the nature of the equipment in use and the results obtained during his talk.

Funding

The financial statements record that the Project is in a satisfactory state. As I mention earlier in this report, the Seahorse project and its contiguous studies are well supported through the award of research grants from Rhodes and NMMU to the principal researchers and generous donations from members of TIHOA. Recently Ms Louw Claassens was successful in the award of a substantial grant from the Rufford Foundation, London, to support her research studies. Ms Claassens was also successful earlier in the year in the award of the Allanson Scholarship by Rhodes University.

Capital grants to support the purchase and installation of the multiprobes at two sites in the TIHOA marina were made through the Taeuber & Corssen Trust, Johannesburg. This support adds materially to enriching the research potential of the Project and will attract serious students in the near future.

Publications and science meetings

I have included under this heading the fine and sensitive work that Lorraine Cloete provides in the development of the website and Facebook pages. These media outlets are as important as our scientific reports and similarly require careful attention to detail.

Aspects of the Project's work were presented by Louw Claassens at the South African Marine Science Symposium, Stellenbosch and in July at the Zoological Society Symposium, Grahamstown, at which she was cited for the best prepared short oral presentation. Couple these with illustrated talks to the Trustees of the TIHOA, and I am pleased with growth of the Project's scientific communication. The following are peer reviewed papers and those under review are reported below.

Allanson, Brian R., Lucienne Human and Louw Claassens 2015) **(in review).** Observations on the distribution and abundance of macroalgae along an intertidal shore, Knysna River Estuary. *African Journal of Botany.*

Barnes R. S. K and Ian W. Hendy. (2015). Functional uniformity underlies the common spatial structure of macrofaunal assemblages in intertidal seagrass beds *Biological Journal of the Linnaean Society, 115: 114 – 146.*

Barnes, R.S.K. abd I.W. Hendy (2015). Seagrass-associated macrobenthic functional diversity and functional structure along an estuarine gradient. *Estuarine, Coastal Shelf Science. 164: 233 -243.*

Claassens, Louw (2015) **(in review).** Distribution and habitat association of the Knysna seahorse (*Hippocampus capensis)* in a man-made marina residential estate in the Knysna Estuary, South Africa. *Experimental Marine Biology and Ecology*.

Hodgson, Alan N, 2014Hodgson AN, Dickens J. 2012. Activity of the mangrove snail *Cerithidea decollate* (Gastropoda: Potamindidae) in a warm temperate South African estuary. *Estuarine, Coastal and Shelf Science.* 109: 98-106.

Hodgson AN, Booth, AJ, David-Engelbrecht V, Henninger TO. 2014. Some life-history parameters of the non-native amiphipod *Platorchestia platensis* (Talitridae) in a warm temperate South African estuary. *Transactions of the Royal Society of South Africa.* 69: 1-10.

Pollard M, Hodgson AN. In Press. *Mytilus galloprovincialis* (Mollusca: Bivalvia) in a warm temperate South African estuarine embayment. *African Journal of Aquatic Science.*

Pinchuck SC, Allanson BR, Hodgson AN.(**in press)**. Evolutionary retention of defensive lateral pedal glands in the smallest siphonariid limpet (Gastropoda: Pulmonata). *African Zoology*

Nelson A. F. Miranda, Renzo Perissinotto, Richard S.K. Barnes, Brian R. Allanson (**in pre**ss).Grazing dynamics of *Littorina saxatilis* (Olivi, 1792) and a sympatric native gastropod determined by the gut fluorescence technique in Knysna Estuary, South Africa. *Estuarine, coastal Shelf Science.*

Pinchuck, Shirley C., Brian R Allanson and Alan N Hodgson (**in press**). Lateral pedal gland stucture in the smallest siphonariidd; limpert (Gastropoda: Pulmonata). *African Zoology.*

Acknowledgements

The Trustees and our chairman, Ian Corbett, give unstintingly of their time and skills to ensure that the Project's affairs are administered wisely. John Kennedy keeps meticulous records of our business and as I have alluded earlier, John Edwards of AQB, chartered accountants, Knysna, retains careful control of the funds. Special mention should be made of the help provide by Letitia Cooper of AQB who, through careful analysis, keeps the diverse origins of funding separate and functional.

A note of sincere thanks to Peter and Frances Smith who increase the visibility of the Project's work through the press and radio Knysna; and finally to Alan Hodgson who either alone or with his graduate team speed down from Rhodes, Grahamstown to attend Trustees meeting and ensure that the marine ecology studies in the estuary are successful: recognising that the estuary is 400 km from the university, makes one realise the meaning of devotion to ones discipline.

Brian Allanson

Director
16 November 2015