

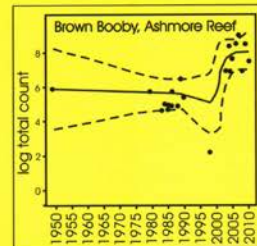
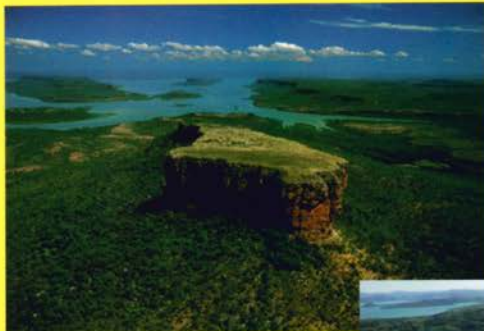


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The Kimberley Coast – Saltwater Country – a Traditional Owner’s perspective

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The Traditional Owners of the coast of the Kimberley region, known as Saltwater Country, comprised today of the Bardi Jawi, Malaya, Wanjina Wunggurr Dambimangari, Wanjina Wunggurr Uguu, and Balangarra peoples, have a long history of association with the landscape, seascape, flora and fauna of this region. Their history stretches back at least 30,000 years, during the last Ice Age, and before the time of the marine flooding of the Kimberley region. Since the time of the marine flooding, perhaps some 7000 years ago, when the present Kimberley coast was formed, they have had a close association with the coastal landscape, the islands, the seascape, the coastal flora and fauna, and the marine life. Archaeological research shows the long term association of Saltwater people and the coastal environment since the marine flooding.

The global geoheritage significance of the Kimberley Coast, Western Australia

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Abstract

The Kimberley Coast in north-western Australia is of global geoheritage significance. It is a large-scale ria coast, with a well developed intricate indented rocky shoreline, with local nearshore islands (archipelago), and a distinct suite of coastal sediments. In addition to its intrinsic geoheritage values, its unique geological and geomorphological features are found in an unspoiled wilderness setting in which the ensemble of natural processes are still operating. The Kimberley Coast is cut into Precambrian rocks: the sandstones and basalts of the Kimberley Basin and, in the southern areas, into folded sedimentary rocks and metamorphic rocks of the King Leopold Orogen. The rocks of the region are well exposed along the shore to providing a global classroom by which to study the region's stratigraphy, structure, and lithology. The coastal forms in the Kimberley region have been determined by the structure and lithology of regional geology, interfaces between major geological units, by marine inundation of onshore landforms, and by the sizes, shapes and configuration of rivers, creeks, their tributaries, and other valley tracts in the region. The coast, however, is not just a continuous rocky shore composed of cliffs, and cliffs with benches, as it also has local sediment-filled gulfs and embayments, cliff shores fringed by mangroves, cliff shores with bouldery ribbons in the tidal zone, and stretches of beaches, and in the embayments, muddy tidal flats, spits, cheniers, tidal creeks cut into the tidal flats, and (embayment-head) alluvial fans. Locally, the coast is composed of algal reefs and coral reefs, beach rock, and various types of tempestites. The Kimberley Coast presents several features of geoheritage significance: 1. with ~ 700 km of (simplified) coastal length, it presents the best and most extensive expression of ria morphology in Australia, and also one of the best developed globally; 2. the occurrence of the shore in a monsoonal subhumid/humid tropical macrotidal setting, with processes distinct to this setting; as a tropical climate ria, in terms of size and morphology, it is globally unique; 3. the morphology of the shores, variable in form in response to the grain of the country (viz., the Kimberley Basin versus the King Leopold Orogen) and lithology; 4. variation of rocky shores along its length in terms of mesoscale shore types; 5. the sedimentary packages that occur in the region; 6. mangrove-lined rocky shores and embayed shores, with the latter also related to freshwater seepage; and 7. biogenic and diagenetic coasts.

Keywords: Kimberley Coast, ria coast, tropical coast, macrotidal, Proterozoic rocks, geoheritage

Geological setting, marine geomorphology, sediments and oceanic shoals growth history of the Kimberley Region

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Abstract

The offshore sedimentary basins of the Kimberley region are becoming established as a major hydrocarbon province, but the region is also known for its marine wilderness values. Its position close to a plate boundary is reflected in significant rates of continental margin subsidence. In addition to the “normal” continental margin geomorphic units of shelf, slope and rise the offshore Kimberley region has well developed plateaux (e.g. Scott Plateau), terraces (e.g. Rowley Terrace), and banks (e.g. Sahul rise, Sahul bank) which interrupt the otherwise gentle seaward slopes present, and provide foundations for the offshore reefs, including the Sahul shoals, Ashmore, Seringapatam, and Scott Reef and the Rowley Shoals. The continental shelf is a vast low gradient ramp with sandy bioclastic sediments reflecting both the modern biota and a history of past sea level and oceanographic changes, so that sediments are a mixture of modern bioclasts, particles stranded by sea level rise, and precipitated carbonate grains (ooids and peloids) which were dominant prior to Leeuwin Current onset some 12,000 years ago. Whilst little is known about the nearshore fringing reefs, in areas of macro-tides and significant sediment input, the morphology, internal architecture and growth history of reefs and shoals of the Oceanic Shoals Bioregion indicates that these are long-lived features which have survived despite relatively high rates of continental margin subsidence and oscillating sea levels of the Pleistocene glaciations. However, drowning by sea level rise was the fate of some of the reefs and shoals of the Sahul Shelf, situated at the leading edge of the downturning Australian Plate, in contrast to continuing reef growth at Scott Reef and the Rowley Shoals to the south. In the morphological series provided by the three Rowley Shoals, differential subsidence is the primary control on rates of lagoon infill controlling platform morphology. This study demonstrates the resilience of reefs on the subsiding margin whilst linking reef morphology to the relative amount of pre-Holocene subsidence.

Keywords: geomorphology, Kimberley, continental shelf, sediments, Oceanic Shoals Bioregion, coral reefs, sea levels, growth history, subsidence

Notes on the origins and biogeomorphology of Montgomery Reef, Kimberley, Western Australia

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Abstract

Montgomery Reef, lying at the boundary of Camden Sound and Collier Bay is a very large rock platform (c. 400 km²) in an open sea setting of the Kimberley Bioregion, Western Australia. It is not a coral reef platform in the strict sense but an ancient terrestrial structure, probably a flat-topped mesa, with a Holocene veneer of marine biogenic sediments superimposed over inherited terrestrial geomorphic features. The eastern end of the reef, at least, has base rocks (beneath the coralgal veneer) of dolomite, underlying quartz sandstone mapped as Pentecost Sandstone, an upper member of the Paleoproterozoic Kimberley Group. The dolomite is an unrecognised formation and its well preserved stromatolites are undescribed. Although the coral fauna on the reef platform is moderately diverse, coral reef-building is located primarily in the impounded pools lagoons of the reef platform. There is very little coral growth on the reef-front. An unusual feature is the relative importance of rhodoliths that form massive containment banks around the perimeter of the reef and are responsible for creating the high lagoon habitats. Field observations suggest that rhodoliths may be the most important contemporary reef-builders on Montgomery Reef with very high primary production inferred.

Keywords: Montgomery Reef, Holocene reef growth, rhodoliths, corals, stromatolites, biogeomorphology

Kimberley beach and barrier systems: an overview

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Abstract

The 4340 km long Kimberley coast is dominated by usually steep rocky shores, which occupy over 80% of the open coast. It also contains extensive areas of mangroves particularly in embayments and 1360 generally sandy beaches, which occupy 713 km (16%) of the more exposed open coast. Because of the high tide ranges (3–11 m) and generally low short waves ($H_b = 0.1$ m, $T = 3\text{--}5$ sec) most beaches have a relative tide range > 10 and consequently are predominately tidedominated (71%), with 25% fronted by coral and rock flats, 3% tide-modified and only 1% wavedominated. Beach location and length is controlled by the geology, with most bounded by rock headlands and backed by rocky slopes and with an average length of only 0.5 km. Only 31% of the beaches are backed by some form of barrier development. In these low regressive barriers dominate with 264 consisting of beach ridges, 35 backed by usually low stable foredunes, while usually minor dune transgression backs only 70 beaches.

Keywords: Kimberley coast, beach, beach types, barriers, dunes

Kimberley region, Western Australia: products of coastal form, oceanographic setting, sedimentary suites, sediment supply, and biogenesis

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Abstract

Coastal sediments in the Kimberley region occur in generally macrotidal environments with variable wave energy, reside in different coastal forms, and illustrate various styles of facies development and sedimentation leading to varying types of stratigraphic packages. The sedimentary patterns and stratigraphic patterns are determined by the coastal setting in terms of coastal morphology, oceanographic factors such as tide-dominated or wave-dominated prevailing conditions, or cyclone generated conditions, sediment delivery, and the dominance of gravel versus sand versus mud. The main stratigraphic packages range from gravel-dominated sequences and sand-dominated sequences, to shoaling sand-to-mud sequences to mud-dominated sequences, with local variations such as sequences with embedded sand lenses (buried spits/cheniers), and thin sediment sequences on rocky pavements. Bouldery shores, tempestites, sandy beaches, and sandy beach-ridge systems represent one extreme of the stratigraphic patterns, with gravel and sand dominated systems. King Sound and Cambridge Gulf represent an intermediate pattern, with sand-to-mud sequences, reflecting shoaling from low tidal to high tidal sedimentation. Port Warrender and the Lawley River Delta and local mud-filled embayments represent the other extreme of the patterns, with sediment sequences dominated by mud. In ria and embayment coastal settings, the most complex array of facies occur, representing the intricacy of sedimentation in sedimentologically diverse embayments; these include tidal-flat sediments, tidal creek sediments, sand underlying spits/cheniers, high-tidal alluvial fans, and beaches. Biogenesis can be a major factor in facies development, with effects ranging from mangrove-influenced sedimentation to fauna bioturbation and skeletal contribution.

Keywords: Kimberley Coast, tropical coast, coastal sediments, coastal stratigraphy

King Sound and the tide-dominated delta of the Fitzroy River: their geoheritage values

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Abstract

There are numerous geological and geomorphic features in King Sound and the tide-dominated delta of the Fitzroy River that are of International to National geoheritage significance. Set in a tropical semiarid climate, the delta of the Fitzroy River has the largest tidal range of any tidedominated delta in the World. Within King Sound, the Quaternary stratigraphy, comprised of early Holocene gulf-filling mud formed under mangrove cover and followed by middle to late Holocene deltaic sedimentation, and the relationship between Pleistocene linear desert dunes and Holocene tidal flat sediment are globally unique and provide important stratigraphic and climate history models. The principles of erosion, where sheet, cliff and tidal creek erosion combine to develop tidal landscapes and influence (mangrove) ecological responses also provide a unique global classroom for such processes. The high tidal parts of the deltaic system are muddy salt flats with groundwater salinity ranging up to hypersaline. Responding to this, carbonate nodules of various mineralogy are precipitated. Locally, linear sand dunes discharge freshwater into the hypersaline salt flats. With erosion, there is widespread exposure along creek banks and low tidal flats of Holocene and Pleistocene stratigraphy, and development of spits and cheniers in specific portions of the coast.

Keywords: King Sound, tide-dominated delta, Fitzroy River delta, tropical climate, geoheritage.

New insights into the Kimberley phytoplankton and their ecology

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Abstract

The Kimberley is a remote region where the eastern edge of the Indian Ocean interacts with the broadening continental shelf of Northern Australia to generate massive tides. During a 2010 research voyage the phytoplankton communities of the region were elucidated from a combination of light microscopy, remote sensing and size fractionated pigment analysis. In strong contrast to previous work from the NW Shelf and the Gulf of Carpentaria $\geq 80\%$ of the phytoplankton at the shelf break (~ 200 m water depth) and further offshore were found to be $< 2 \mu\text{m}$ (picoplankton) and dominated by *Synechococcus*. Streaks of *Trichodesmium* were visible but cell counts suggested they were only the 9th most abundant taxa. Pigment analysis indicated coccolithophorids were consistently $\sim 20\%$ of the total phytoplankton biomass across the region of the cruise. Shelf scale blooms of coccolithophorids are periodically reported in the shallow seas of Northern Australia but only small blooms were observed in MODIS (Moderate Resolution Imaging Spectroradiometer) true colour images from the Kimberley region during the voyage. In shallower waters closer to shore the concentration of phytoplankton rose dramatically. There were concomitant changes in community composition including a decline in *Prochlorococcus* and pelagophytes and a rise in the diversity and abundance of medium to large diatoms. This distinctive, near shore, diatom community was spatially heterogeneous and largely composed of species previously reported as rare in northern Australia.

Keywords: ecology, biogeography, picoplankton, pigments.

Potential effects of *Lyngbya majuscula* blooms on benthic invertebrate diversity and shorebird foraging ecology at Roebuck Bay, Western Australia: preliminary results

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Abstract

Nutrient enrichment can significantly alter biodiversity, producing shifts in assemblages of primary producers and favouring, for example, cyanobacterium blooms. These variations in the assemblage of primary producers consequently affect the primary consumers that depend on them. However, the consequences of these blooms for higher trophic levels are still unclear. Roebuck Bay, in the west Kimberley region is one of the main non-breeding areas for migratory shorebirds in Australia. The bay is characterised by an extremely high diversity and biomass of benthic invertebrates, which places this tropical intertidal area among the richest mudflats in the world, and it is likely that this rich benthic fauna supports the shorebird populations. Recent studies in Roebuck Bay have detected nutrient enrichment, with increasing frequency of cyanobacteria blooms. Here we present the preliminary results of the potential effects that *Lyngbya majuscula* (cyanobacterium) blooms have on the benthic invertebrate diversity and shorebird foraging ecology at Roebuck Bay. A site where *Lyngbya majuscula* was present showed a significant diminution in the diversity of benthic invertebrates relative to areas without a bloom. Also, although there was no apparent *Lyngbya*-induced change in the main prey of Bar-tailed Godwits *Limosa lapponica*, there was a change in the foraging behaviour of godwits in the area affected by *Lyngbya*, which appears to relate to a shift in diet. Nevertheless, although we found a correlation between *Lyngbya* presence and shifts in invertebrate assemblages, further work is required to confirm our findings.

Keywords: *Lyngbya majuscula* blooms, benthic invertebrate, shorebirds, Roebuck Bay, Kimberley

Natural variability of macro-zooplankton and larval fishes off the Kimberley, north-western Australia: preliminary findings

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Abstract

During the austral autumn, spatial (regional cross-shelf) and temporal (tidal cycle and springneap cycle) variability of macro-zooplankton and larval fishes off the Kimberley coast were examined in conjunction with the physical oceanography. Though surface waters were isothermal across the study area, strong stratification was evident and warm, high salinity surface waters overlaid a cooler, less saline water mass. There was no evidence of frontal features over the shelf or at the shelf break. Variability of macro-zooplankton, particularly krill and larval fishes, was defined by significant cross-shelf structuring in relation to isobath; higher concentrations were recorded for coastal waters, compared to shelf and oceanic waters. *Pseudeuphausia latifrons* was the dominant krill species in shelf waters, whereas the more speciose oceanic assemblages were dominated by species of the genus *Stylocheiron*. The greater diversity and concentrations of larvae of neritic teleost families for assemblages at the 50 m isobath distinguished coastal waters from those further offshore and within the more turbid waters of King Sound. Assemblages in proximity to the Lacepede Islands were also taxonomically distinct. The occurrence of larvae of commercially valuable teleost fishes, such as the Lutjanidae, Serranidae and Scombridae, in the study region is an important consideration for environmental and fisheries management. This study provides a baseline which can be used to evaluate anthropogenic disturbance to the Kimberley pelagic ecosystem.

Keywords: Macro-zooplankton, larval fishes, euphausiids, assemblages, oceanography

The coastal habitats and vegetation of the Kimberley region

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Abstract

Incorporating the areas of the rocky Kimberley Coast, flanked by the deltaic gulfs of Cambridge Gulf and King Sound, as well as the Dampier Peninsula, the Kimberley region host a complicated coastal zone with a plethora of coastal habitats. The smallest scale of habitat includes rocky cliff, scree slopes, gravelly/bouldery shore, sandy beaches, spits, dunes, tidal mud flats, alluvial fans, and the contact between some of these habitats and freshwater. The main vegetation units include mangroves, shrubby chenopods (which include succulent halophytic shrubs), saline marsh, sedgelands, rushlands, dune scrub, dune grasslands, and teatree thickets. The spatially and temporally variable landscape, sediments/soils, and hydrochemistry expressed at the coast mean that the coastal vegetation habitats are the most complex habitats in the Kimberley region. This review found that to date these have not been fully explored or described botanically.

Keywords: Kimberley Coast, coast, coastal habitats, mangrove, saltmarsh, mangal, chenopod

Freshwater seepage along the coast of the western Dampier Peninsula, Kimberley region, Western Australia

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Abstract

Controlled by the stratigraphic relationships along the shore of the western Dampier Peninsula, there are several mechanisms that deliver freshwater of the hinterland to the shore zone. These include seepage along the edge of the red sand dunes, rivulets discharging into tidal embayments, impounding of rivulets and streams by dunes, and freshwater discharges onto the low tidal zone from the subsurface. These freshwater sources, known as springs, jila (permanent water source) or soaks, are of great cultural value to the Yawuru and other indigenous groups of the Dampier Peninsula. Two of the most interesting are those that illustrate seepage of freshwater into the muddy upper shore zone and the interaction of hinterland groundwater and tidal flat carbonate mud, viz., the seepage lines at the edge of the “pindan” terrain where it borders the mud of tidal flats resulting in linear *Melaleuca* thickets fringing the “pindan”, and the headwaters of scalloped embayments where rivulets discharge surface and groundwater onto/into the tidal flat forming a complex of wetland vegetation. Areas of marked freshwater seepage along the interface of the hinterland and the carbonate mud tidal flats can also be zone of dissolution, resulting in solution excavation of the muds and the development of wetland basins.

Keywords: Kimberley Coast, Dampier Peninsula, tropical, coastal wetlands, freshwater seepage

Mangroves of the Kimberley Coast: ecological patterns in a tropical ria coast setting

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Abstract

Mangroves along the Kimberley Coast occupy an unparalleled position globally: they reside in a tropical humid to subhumid climate in the species-rich setting of the Old World Mangroves, and are located along a macrotidal ria shore. This setting provides a range of habitats for mangroves related to larger scale hinterland influences, coastal landforms, coastally expressed geological patterns, shoreline sedimentation patterns, and climate. The mangrove habitats of the Kimberley coast range from rocky (cliff) shores to classic ria shores with tidal flats, tidal creeks, spits, and high-tidal alluvial fans, to rocky-shore-dominated ravines, amongst others. Depending on coastal type, sedimentary setting, and the local species pool, the mangroves form habitat-specific assemblages and characteristic floristic and structural zones within the mangrove formations. The complexity of mangrove habitats and their relationship to the megascale coastal forms of this coastal setting is of international conservation significance.

Keywords: Kimberley Coast, mangroves, mangrove ecology, ria coast, mangrove habitats

Holocene growth history and evolution of the Scott Reef carbonate platform and coral reef

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Abstract

As a prominent isolated oceanic atoll-like reef within the Oceanic Shoals Biozone to the west of the Kimberley coast, Scott Reef is a small carbonate platform located in a distal ramp setting on Australia's Northwest Shelf. Rising from depths of 400–700 m it is a complex of two large isolated coral reefs separated by a deep channel; the pear-shaped North Reef and the crescent-shaped South Reef. Small differences in subsidence rates indicate differential subsidence between the paired platforms. Holocene (MIS 1, last 10 ka) reef initiation was at 11.3 ka, soon after Meltwater Pulse 1B thereby bracketing the Holocene growth phase to the subsequent deglaciation sea-level rise. The crest of southeast North Reef (and the rising sea-level) reached close to present sea level (-1.5m LAT) by 2.7 ka ago. There is no record of the southwest Australian sea level high stand of about +2m some 7 ka BP. The Holocene reef growth history record obtained for this long lived and resilient reef system is one of the most detailed yet for the western margin of Australia.

Keywords: Scott Reef, Kimberley, North West Shelf, Oceanic Shoals Biozone, global sea levels, marine isotope stages, subsidence, carbonate platform, cores, growth history, coral reef

Reconnaissance of species-rich coral reefs in a muddy, macrotidal, enclosed embayment, – Talbot Bay, Kimberley, Western Australia

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Abstract

Preliminary observations are presented on species-rich coral reefs in a mud-dominated, macrotidal, virtually landlocked embayment on the Yampi Peninsula. The reef platforms stand 6–7 m above water level at extreme low spring tide. High lagoons on the top of the platforms, impounded by crustose algal terraces and banks of rhodoliths, provide habitat for a moderately diverse assemblage of scleractinian corals with up to 30% live cover. Reef flats in the lower-littoral zone around the periphery of the fringing reef platforms, and on small patch reefs scattered throughout the bay, support species-rich coral assemblages with live coral cover up to 90% even though heavily affected by mud. There is dynamic interaction between coral reef growth and the development of massive mud banks in the bay. Drilling will be required to determine the geological origins, age and composition of these massive reef structures. If they are entirely of Holocene construction they would represent a remarkably high rate of coral reef growth in such a mud-dominated environment.

Keywords: Kimberley, Talbot Bay, coral reef, reef origin, reef profiles, macrotidal, mud-dominated

Patterns in marine community assemblages on continental margins: a faunal and floral synthesis from northern Western Australian atolls

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Abstract

Corals and fishes are the most visually apparent fauna on coral reefs and the most often monitored groups to detect change. In comparison, data on noncoral benthic invertebrates and marine plants is sparse. Whether patterns in diversity and distribution for other taxonomic groups align with those detected in corals and fishes is largely unknown. Four shelf-edge atolls in the Kimberley region of Western Australia were surveyed for marine plants, sponges, scleractinian corals, crustaceans, molluscs, echinoderms and fishes in 2006, with a consequent 1521 species reported. Here, we provide the first community level assessment of the biodiversity of these atolls based on these taxonomic groups. Four habitats were surveyed and each was found to have a characteristic community assemblage. Different species assemblages were found among atolls and within each habitat, particularly in the lagoon and reef flat environments. In some habitats we found the common taxa groups (fishes and corals) provide adequate information for community assemblages, but in other cases, for example in the intertidal reef flats, these commonly targeted groups are far less useful in reflecting overall community patterns.

Keywords: biodiversity, marine communities, species turnover, Mermaid Reef, Rowley Shoals, Scott Reef, Seringapatam Reef

Marine benthic flora and fauna of Gourdon Bay and the Dampier Peninsula in the Kimberley region of north-western Australia

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Abstract

Surveys undertaken to characterise the marine benthic habitats along the Dampier Peninsula and further south at Gourdon Bay in the Kimberley region of Western Australia were augmented with epibenthic sled sampling of soft and hard bottom habitats. This paper describes the species collected, their biomass and relative abundance for the main groups of marine macrophytes and invertebrates. Five localities were surveyed; Gourdon Bay, Quondong Point to Coulomb Point, Carnot Bay to Beagle Bay, Perpendicular Head and Packer Island. Sampling was limited to fifteen epibenthic dredge operations from a range of habitat types and was designed to target the most common habitat types and to obtain species identifications of the most important species and those which typified different habitat types. Surveys covered a total of 1,350 m² of seabed in depths between 11 and 23m. We identified 415 taxa comprising: 1 seagrass, 43 algae, 52 sponges, 30 ascidians, 10 hydroids, 14 scleractinian corals, 52 other cnidarians, 69 crustaceans, 73 molluscs and 71 echinoderms. Despite the limited nature of the sampling, a significant number of new species, range extensions and new records for Western Australia and Australia were recorded. Within the algae, one range extension (*Halimeda* cf. *cuneata* f. *digitata* not previously recorded in Western Australia) and one possible new species of *Areschougia* were recorded. Two range extensions were present in the ascidians; the solitary ascidian *Polycarpa* cf. *intonata* has previously only been recorded in Queensland and *Cnemidocarpa* cf. *radicosa* only in temperate Australian waters. There were several range extensions for the crustacea, for example, the sponge crab, *Tumidodromia dormia*, has only been recorded in Queensland. One species of

holothurian of the genus *Phyllophorus* could not be identified from the literature available and may represent a new species. Similarly, a small species of the echinoid *Gymnechinus* could possibly be a new species. The collections of hydroids, hard corals, crinoids and molluscs contained no new species or range extensions. There was difficulty in identification of some groups to species level due to the status of the current taxonomic literature (e.g. Cnidaria, Porifera and ascidians) and there may be a number of new species among the material collected. Among the anthozoa, there is at least one new species of *Chromonephthea* and potentially 10 range extensions to Western Australia. *Sinularia* cf. *acuta* and *Chromonephthea curvata* are both new records for Australia with both previously recorded in Indonesia only. Among the better known taxa (e.g. molluscs, echinoderms, corals), most of the taxa identified to species level have been recorded to occur throughout north-western Australia, however the diversity recorded in this study is less than other parts of the Kimberley and this is almost certainly a result of the small overall area sampled and the single method of collection utilised. The most important species on soft bottom habitats in terms of biomass was the heart urchin *Breynia desorii* (up to 326 g.m⁻²). Sponges were the dominant fauna by biomass (up to 620 g.m⁻²) on hard bottom habitats and biomass was dominated by a few large cup and massive sponge species (e.g. *Pione velans* and two unidentified *Sphaciospongia*). The biomass of other filter feeders, especially ascidians (e.g. *Aplidium* cf. *crateriferum*), soft corals (e.g. *Chromonephthea* spp.), gorgonians (e.g. *Junceella fragilis* and *Dichotella gemmacea*) was also high, indicating the importance of these groups in characterising hard bottom habitats. Although low in biomass, crinoids such as *Comaster multifidus* and *Comatula pectinata* were abundant in samples that included a high biomass of other filter feeders.

Keywords: marine, benthic flora, benthic fauna, Kimberley, Gourdon Bay, Dampier Peninsula

**Fish-habitat associations in the region offshore
from James Price Point
– a rapid assessment using Baited Remote Underwater
Video Stations (BRUVS)**

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Abstract

A “snapshot” of the fish-habitat associations in the vicinity of James Price Point was obtained during a single expedition in October 2009, when Baited Remote Underwater Video Stations (BRUVS) were deployed in coastal waters to survey the demersal and semi-demersal ichthyofauna. A total of 7108 individuals from 116 species of fishes, sharks, rays and sea snakes were recorded from 154 sites. Bony fishes were represented by 8 orders, and cartilaginous fishes were well represented by the Carcharhiniformes, Rajiformes and Orectolobiformes. There were 2 species of hydrophiid sea snakes. Multivariate analysis showed that species responded to the amount of epibenthic cover in the study area and that there was an interaction between depth and sediment composition, as well as depth and epibenthic cover, in defining four fish assemblages to the north and south of James Price Point. Diversity appeared to increase with depth amongst these assemblages. The sandy seabed offshore from James Price Point was inhabited by a “deep sandy” fish assemblage, which intruded inshore across the study area, and was characterised by the presence of ponyfish (*Leiognathus*), threadfin bream (*Nemipterus*) and queenfish (*Scomberoides*). On either side were shallow, northern and deeper, southern, assemblages inhabiting “gardens” of macroalgae, filter-feeders and some seagrass beds. These epibenthic habitats at the northern and southern ends of the survey area were clearly important to many species, but in general there appeared to be little association of particular vertebrate species or biotic habitat types with the James Price Point area itself. The study area was notable for the diversity and abundance of the fauna, given the shallow depth, lack of rugose seafloor topography and lack of sub-tidal coral reefs in the area sampled. Coarse comparison with the fauna at similar distance to shore in similar latitudes in the Great Barrier Reef Marine Park, the Burrup Peninsula and the Kimberley indicated that the study area had more small pelagic planktivores and more large semi-demersal predators. There was also an absence of some species normally associated with muddy seafloors and fringing coral reefs that are common on BRUVS set elsewhere in regions with less extreme tidal ranges.

Keywords: fish-habitat, James Price Point, Kimberley, BRUVS

Are Western Australian waters the least productive waters for finfish across two oceans? A review with a focus on finfish resources in the Kimberley region and North Coast Bioregion

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Abstract

The marine ecosystems of Western Australia, including those in the Kimberley, are classified as being of moderate to low productivity. This is primarily a consequence of the influence of the Leeuwin Current, the eastern boundary current that flows poleward delivering warm, low nutrient waters, and only sporadic short-term upwelling events to shelf habitats off the Western Australian coast. This, coupled with little riverine inflow from old weathered terrestrial systems, results in low levels of primary and secondary production in habitats along most of the coast. The consequence is that finfish fisheries in the Kimberley and throughout the State typically land a diverse range of long-lived species with low levels of productivity, resulting in relatively low levels of sustainable catches. The consequences for monitoring, management and stakeholder aspirations are presented. Additional challenges for finfish fisheries in the Kimberley and North Coast finfish fisheries are also discussed.

Keywords: fisheries, finfish, productivity, Western Australia, Kimberley, North Coast Bioregion

Use of historic fisheries data to determine trends in relative abundance and body size of sailfish, *Istiophorus platypterus*, off northwestern Australia

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Abstract

Sailfish (*Istiophorus platypterus*) appear annually off northwestern Australia in large numbers, supporting substantial recreational and charter fisheries in which almost all fish are released. The main centres for this activity are the towns of Broome, Dampier and Exmouth. Examination of historic Japanese longline catch data from northwestern Australia indicated that relatively few sailfish were caught off this area between 1979 and 1998, although little fishing effort occurred during the peak sailfish 'season'. Long term recreational fishery data, consisting of tag and release and charter boat diary data, were used to investigate locations of captures, seasonality of the sailfish aggregations and trends in body size and relative abundance of sailfish through time. No trends in annual catch rates were discernible from the mid 1990s to the present. Sailfish may be caught in most months off Broome, with the average peak period being June through September. Sailfish caught off Broome, as determined from estimated weights at tag-and-release, are slightly, but significantly smaller than those caught off Dampier while fish caught near the Rowley Shoals, and in the Exmouth Gulf, are larger than those caught off Broome and Dampier.

Keywords: Sailfish, *Istiophorus platypterus*, northwestern Australia, recreational fisheries

North-western Australia as a hotspot for endangered elasmobranchs with particular reference to sawfishes and the Northern River Shark

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Abstract

Recent targeted surveys, together with the collection of sawfish (Pristidae) rostra from the general public, have demonstrated that the Kimberley and northern Pilbara are important refuges for sawfish, with four of the world's seven species found here. These comprise all of Australia's known sawfish species, including the three species protected under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999, i.e. Freshwater Sawfish (*Pristis microdon*), Dwarf Sawfish (*Pristis clavata*) and Green Sawfish (*Pristis zijsron*). The Northern River Shark (*Glyphis garricki*), which was only described in 2008, has only recently been discovered in the Kimberley and is listed as Endangered under the EPBC Act. These species are listed as Critically Endangered on the IUCN Red List and collectively represent ~45% of Australia's elasmobranchs that are listed as Vulnerable or higher under the EPBC Act. There is, however, limited information on the spatial extent of these species throughout Western Australia, particularly as most sawfish surveys have targeted only a few specific areas over a vast coastline. We therefore encouraged public participation in providing *Pristis* rostra, taken from the fish as curios, in order to extend the known locations of the species and relate these to life history stages based on their size. Here we report on the published records and our unpublished catches ($n = 376$) across three *Pristis* spp., and collate this with data from donated rostra, 73% ($n = 283$) of which were considered usable, in that catch locations were reliable and they were from Western Australian waters. We provide information on sawfish distributions in Western Australia and identify areas that are important as pupping grounds, nursery areas or harbour mature individuals. We also collate known records of *G. garricki* and provide information on the ecology of this and the EPBC listed sawfish species

Keywords: Pristids; *Pristis*; Kimberley; *Glyphis*; Western Australia

Inter-nesting distribution of green turtles (*Chelonia mydas*) and flatback turtles (*Natator depressus*) at the Lacepede Islands, Western Australia

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Abstract

The inter-nesting distributions of green (*Chelonia mydas*) and flatback (*Natator depressus*) turtles nesting at the Lacepede Islands, off the Kimberley coast of Western Australia, were studied during the 2009–2010 nesting season. Twenty-two satellite transmitters were attached to green and flatback turtles nesting on the West Island rookery; of these, inter-nesting data were received for 10 green and 5 flatback turtles. Turtles were tracked for 20–83 days during inter-nesting. Key findings from this study indicate that flatback turtles generally have a broader inter-nesting distribution than green turtles. All flatback turtles travelled at least 26 km from the nesting beach during inter-nesting, whereas only 2 of the 10 green turtles travelled more than 10 km from the nesting beach. Individuals of both species travelled to within 5 km of the Western Australian mainland coast during inter-nesting. This study has also demonstrated that satellite transmitters can be successfully deployed on green and flatback turtles early in the nesting season without significant data loss due to transmitters being damaged by nesting and inter-nesting behaviours.

Keywords: inter-nesting, green turtles, flatback turtles, satellite telemetry, Lacepede Islands, Kimberley region.

The status of breeding seabirds and herons at Ashmore Reef, off the Kimberley coast, Australia

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Abstract

Ashmore Reef is situated on the edge of Sahul Shelf, off the Kimberley coast, Australia. Surveys in 2010 indicate the three small islands within Ashmore Reef support approximately 100,000 breeding seabirds of 16 species and four heron species on an annual basis. That such a diversity and abundance of tropical seabirds utilize a total land area of just 55 ha for breeding purposes is exceptional in an international context. In this paper we review population sizes of breeding seabirds and herons at Ashmore Reef. Bayesian change-point models applied to count data spanning a 60 year period demonstrate that populations of breeding seabirds have increased at this location. Large ground-nesting seabirds display positive step changes in population size since the late 1980s whilst populations of shrub-nesting congeners display similar step changes since the late 1990s. We discuss the potential reasons for these abrupt population increases.

Keywords: seabirds, herons, Ashmore Reef, Kimberley, population size

Shorebirds of the Kimberley Coast – populations, key sites, trends and threats

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Abstract

The tidal flats of the Kimberley coast support the largest populations of migratory shorebirds in Australia. In this paper we review and discuss population sizes of all 41 shorebird species occurring on the Kimberley coastlines, and summarise the importance of the region in an international context. The Kimberley coastline is used by c. 3.7 million shorebirds, including c. 635,000 migrants from the northern hemisphere and c. 16,000 Australian-bred resident shorebirds which forage on the tidal flats of the Kimberley coast. A further c. 3.06 million migratory shorebirds from near-coastal grasslands (Oriental Plover, Little Curlew and Oriental Pratincoles) use roosts on the Kimberley coast at times. Most coast-dependent shorebirds of the Kimberley are concentrated in a small number of sites. Eighty-mile Beach and Roebuck Bay are the most important two sites; they have the highest numbers of birds, and the greatest diversity of species occurring in internationally significant numbers. Internationally important numbers of several species occur on some offshore islands (Adele Island, Ashmore Reef and the Lacepedes), including several species (e.g. Lesser Sand Plover, Grey Plover, Grey-tailed Tattler and Ruddy Turnstone) which are disproportionately abundant on offshore islands when compared to the mainland. Although most of the key shorebird sites on the Kimberley coast are remote and have not been greatly affected by humans, there are indications that populations of many migratory species on the Kimberley coast are declining, probably because of habitat loss in the east Asian areas where they stage on migration. Continued and enhanced monitoring of shorebirds in the Kimberley that contributes strategically to the conservation management of this group is strongly recommended.

Keywords: shorebirds, Kimberley Coast, tidal flats

Monitoring of humpback whales in the Pender Bay, Kimberley region, Western Australia

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Abstract

Information and learnings from two years of independent and shore-based humpback whale (*Megaptera novaeangliae*) surveys in the remote Kimberley region are presented. Systematic shorebased surveys were undertaken in 2009 and 2010 from the cliff top on the southern part of Pender Bay, Dampier Peninsula, Kimberley region, WA from the Two Moons Whale and Marine Research Base. The humpback whales use Pender Bay for a variety of purposes including calving, breeding, feeding (inferred), resting and staging. The results show the peak of the whale season to be in August with a relatively sharp increase in whale numbers occurring from mid July through to early August with whale numbers slowly decreasing from the end of August through to mid November. The whale numbers were higher in 2009 than 2010 and a range of environmental and meteorological variables have been compared to elucidate any trends. Mothers and calves predominated in the bay in September and October when the relative proportion of calves increased, indicating that Pender Bay was being used as a resting, feeding, calving and staging area. The ongoing challenge of monitoring humpback whales in this isolated part of the Kimberley is to manage the interplay between the availability of whale observers, an isolated location along the Kimberley coast and the amount of logistic support required to keep a field team in operation for the duration of the season which stretches from early June to mid November. We have therefore developed a pragmatic sampling technique, maximising the observer effort based on an average four person team on the cliff top operating five hours per day.

Keywords: humpback whale, seasonal variability, sea surface temperature, meteorological variables, whale behaviours, observer methodology

The Saltwater Crocodile, *Crocodylus porosus* Schneider, 1801, in the Kimberley coastal region

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Abstract

The Australian Saltwater Crocodile, *Crocodylus porosus*, is an iconic species of the Kimberley region of Western Australia. Biogeographically, it is distributed in the Indo-Pacific region and extends to northern Australia, with Australia representing the southernmost range of the species. In Western Australia *C. porosus* now extends to Exmouth Gulf. In the Kimberley region, *C. porosus* is found in most of the major river systems and coastal waterways, with the largest populations in the rivers draining into Cambridge Gulf, and the Prince Regent and Roe River systems. The Kimberly region presents a number of coastlines to the Saltwater Crocodile. In the Cambridge Gulf and King Sound, there are mangrove-fringed or mangrove inhabited tidal flats and tidal creeks, that pass landwards into savannah flats, providing crocodiles with a landscape and seascape for feeding, basking and nesting. The Kimberley Coast is dominantly rocky coasts, rocky ravines/ embayments, sediment-filled valleys with mangroves and tidal creeks, that generally do not pass into savannah flats, and areas for nesting are limited. Since the 1970s when the species was protected, the depleted *C. porosus* populations have recovered across northern Australia. Monitoring shows large geographical variations in current population abundance between and within rivers of the Northern Territory, Queensland and Western Australia, and modelling shows strong support for linkage to the ratio of total area of favourable wetland vegetation (*Melaleuca*, grass and sedge) to total catchment area, rainfall seasonality, and other climate parameters.

Keywords: Saltwater Crocodile, *Crocodylus porosus*, Kimberley

**The Kimberley Coast – Saltwater Country –
monitoring and management of the coastal and marine zone**

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This contribution is an account of how the Traditional Owners of the Kimberley coastal region are involved in land management through biological surveys, data collection, monitoring, and on-ground land management practices.