Clarke, P.J. and Myerscough, P.J. (2006). Introduction to the biology and ecology of Gibraltar range National Park and adjacent areas: patterns, processes and prospects. *Proceeding of the Linnean Society of New South Wales* **127**, 1-4.

Papers on the biology and ecology of Gibraltar Range National Park were sought to reflect the increased research focus on the area over the past decade. The 12 papers, published here, come from a variety of natural history disciplines. This collection of papers reflects the start that has been made, and, hopefully, will stimulate further biological and ecological investigation of Gibraltar Range National Park.

Jones, R.H. and Bruhl, J. J. (2006). *Acacia beadleana* (Fabaceae: Mimosoideae), a new, rare, localised species from Gibraltar Range National Park, New South Wales. *Proceedings of the Linnean Society of New South Wales* **127**, 5-10.

A new, rare species of phyllodinous *Acacia* from granitic areas of the Gibraltar Range in northern New South Wales is described on the basis of phenetic analysis. Comparison of *A. beadleana* with other morphologically similar species and notes on its biology and ecology are presented. Conservation status for *A. beadleana* is proposed.

Caddy, H.A.R. and Gross, C.L. (2006). Population structure and fecundity in the putative sterile shrub, *Grevillea rhizomatosa* Olde & Marriott (Proteaceae). *Proceedings of the Linnean Society of New South Wales* **127**, 11-18.

Grevillea rhizomatosa Olde & Marriott (Proteaceae) is a threatened species of shrub known only from 12 populations within a 7 x 8 km area within Gibraltar Range and Washpool National Parks, northern New South Wales, Australia. Prior to this study it was believed that the species only reproduced from rhizomatous suckers as seed and fruit were never detected in the wild. A concern for the reproductive and evolutionary potential of the species in the event of a catastrophic disturbance was the basis for an investigation into the reproductive ecology of *G. rhizomatosa*. Such an event occurred in October 2002 with an intense wildfire affecting most of the populations. Five populations were studied in detail for demography and fecundity prior to this fire and two populations were resurveyed in August 2005. In 2000, 916 individual stems were recorded across these populations and only small to large shrubs were found; no seedlings were recorded. Post-fire response was documented in two populations where plants were found to be resprouting and suckering from underground stems. In the pre-fire surveys of 2000 and 2001 flowering occurred in all populations, but since the fire of October 2002 flowering has only occurred in unburnt habitats. Flowers on shrubs in two of the five populations failed to produce fruit, but low fruit-set (7-13% of flowers) occurred in three populations. Seeds collected from two populations (n = 14) were tested for viability using tetrazolium chloride and were 100% viable. Ramets were detected in all populations and resprouting from underground stems was observed after wildfire. This is the first record of viable seed in this species and fertile populations require specific management to prevent loss of fertile plants. This could occur if repeated burning selects for vegetative reproduction and sterile plants.

Vaughton, G. and Ramsey, M. (2006). Selfed seed set and inbreeding depression in obligate seeding populations of *Banksia marginata*. *Proceedings of the Linnean Society of New South Wales* **127**, 19-26.

Self-compatible species can often produce seeds when pollinators are scarce or unreliable, but any advantage may be lessened if selfed progeny are less fit than outcrossed progeny due to inbreeding depression. We use hand self-pollinations to determine whether *Banksia marginata* is self-compatible and examine the relative fitness of seeds derived from self- and open-pollination at several early life-cycle stages to gauge the likely impact of inbreeding depression. Substantial numbers of fruits and seeds were produced following selfing, indicating that plants are self-compatible. However, differences between self- and open-pollinated inflorescences indicated that relative self-fertility was less than one. Compared with open-pollinated seeds, selfed seeds were smaller and produced smaller seedlings that were less likely to survive. Percent germination of self- and open-pollinated seeds was similar. Cumulative fitness estimated over several life-cycle stages, including seed production, indicated that selfed progeny were on average only 62% as fit as open-pollinated progeny. These differences in relative fitness indicate that despite self-compatibility, populations have experienced a history of outcrossing. *Banksia marginata* plants at Gibraltar Range National Park are killed by fire, and self-compatibility may be associated with this trait.

Williams, P. and Clarke P.J. (2006). Fire history and soil gradients generate floristic patterns in montane sedgelands and wet heaths of Gibraltar Range National Park. *Proceedings of the Linnean Society of New South Wales* **127**, 27-38.

High rainfall escarpment areas along the Great Dividing Range provide habitats for sedgeland and wet heath vegetation in areas with impeded drainage. There are few studies of the processes that influence the floristic composition of montane sedgelands and heaths in relation to fires that sweep these landscapes. Gibraltar Range National Park contains extensive areas of sedge-heaths that remain mostly free from anthropogenic disturbance. These areas have a well-known fire history which provides an opportunity to test whether: 1) plant resources are related to time-since-fire; 2) floristic composition is more strongly related to physiographic factors than time-since-fire, and 3) floristic composition of vegetation is related to fire frequency. Physiographic position strongly influenced the vegetation's structure and floristic composition, with taller heaths confined to better-drained edges whereas sedgelands were more common in poorly drained slopes regardless of fire regime. In turn, these patterns were related to soil conductivity reflecting the fertility status of the soils. Upper slope heaths were more species

rich than those lower in the landscape where soil conductivity was higher. Time-since-fire strongly influenced heath structure and species richness declined in the heaths with canopy closure at some sites. Floristic composition across the physiographic gradient was more divergent soon after fire and became more similar 15 years after fire. Fire frequency had no significant effect on shrub species richness, but frequent fires decreased the abundance of some woody species. Inter-fire intervals of less than seven years may reduce the abundance of some shrub species. Both the history of fire and ease of access make the sedgelands and wet heaths of Gibraltar Range an ideal location to assess the long-term effects of fire regimes in montane sedge-heaths.

Virgona, S., Vaughton, G. and Ramsey, M. (1996). Habitat segregation of *Banksia* shrubs at Gibraltar Range National Park. *Proceedings of the Linnean Society of New South Wales* **127**, 39-47.

Events during seedling recruitment affect species' distributions, causing habitat segregation of congeneric species within the same area. We documented the segregation of *Banksia marginata* and *B. spinulosa* var. *neoanglica* in adjacent swamp and woodland habitats at two sites by surveying adult and seedling distributions. We also examined seed banks and seed characters as factors contributing to segregation. Habitat segregation was pronounced, with 92% of *B. marginata* adults located in swamps and 98% of *B. spinulosa* adults located in woodlands. After fire, 84% of *B. marginata* seedlings were in swamps, but 10 months later this increased to 93%, indicating that although seeds dispersed to and germinated in adjacent woodlands, most seedlings failed to establish. Seedlings of *B. spinulosa* were confined to woodlands, indicating that seeds did not disperse into swamps or that, if they did, seeds failed to germinate or seedlings suffered early mortality. Canopy seed banks of both species were large (> 280 seeds/plant) and seeds of both species possess membranous wings, allowing dispersal between habitats. Overall, neither limited numbers of seeds nor limited seed dispersal are likely to cause habitat segregation. Instead, processes occurring during early seedling growth are probably more influential.

Knox, K.J.E. and Clarke, P.J. (2006). Response of resprouting shrubs to repeated fires in the dry sclerophyll forest of Gibraltar Range National Park. *Proceedings of the Linnean Society of New South Wales* **127**, 49-56.

Fire regimes affect survival and reproduction of shrub species in fire-prone vegetation such as occurs in Gibraltar Range National Park. The influence of fire regimes on resprouting shrubs is known for a range of species in coastal regions of Australia but is poorly known in montane sclerophyll communities. The fire responses of three Proteaceae shrubs (*Banksia spinulosa*, *Hakea laevipes*, *Petrophile canescens*) and a grasstree (*Xanthorrhoea johnsonii*) were measured after the wildfire of 2002 to determine whether: 1) storage organ size was related to post-fire growth and flowering response, 2) fire frequency influences post-fire mortality and if survival was related to the size of plant; 3) fire frequency influences the resprouting ability of plants, and 4) fire frequency affects pyrogenic flowering in the post-fire environment. We found the size of storage organs was positively related to post-fire sprouting in the three shrubs and to flowering in the grasstree. However, high fire frequency only affected the survival of *Banksia spinulosa* and decreased flowering in *Xanthorrhoea johnsonii*. Survival in all species ranged between 83 and 99% and it appears that the intervals between fires (7-22 years) had been sufficient for most adult plants to regain the ability to resprout. The ability of juvenile plants to develop the ability to resprout needs to be tested on seedlings that established after recent fires.

Croft, P., Hofmeyer, D. and Hunter, J.T. (2006). Fire response of four rare plant species at Gibraltar Range National Park, Northern Tablelands, NSW. *Proceedings of the Linnean Society of New South Wales* **127**, 57-62.

Fire responses are reported in four rare species at Gibraltar Range National Park following hazard-reduction burning. *Acacia barringtonensis* Tindale, *Grevillea rhizomatosa* P.M.Olde & N.R.Marriot, *Persoonia rufa* L.A.S.Johnson & P.H.Weston and *Telopea aspera* M.D. Crisp & P. H. Weston were the species investigated. In each species, individuals were tagged prior to a hazard reduction fire and their fates followed for 34 months. In *Acacia barringtonensis*, individuals survived fire and resprouted from buds at the base of stems and from rhizomes but the resprouts were heavily browsed by insects and Swamp Wallabies (*Wallabia bicolor* Desmarest). In *Grevillea rhizomatosa*, individuals survived and resprouted from underground rhizomes and no seedlings were found after fire~~s~~. After fire in *Persoonia rufa*, all scorched plants died but seedling recruitment occurred from a soil-stored seed. In *Telopea aspera*, most burnt individuals resprouted from basal shoots and survived despite heavy post-fire grazing pressure. Increasing fire frequencies by hazard-reduction burning may threaten the survival of all four species, and it is suggested that other methods of reducing fuel be used to manage fire in this area of Gibraltar Range National Park.

Campbell, M.L. and Clarke, P.J. (2006). Response of montane wet sclerophyll forest understorey species to fire: evidence from high and low intensity fires. *Proceedings of the Linnean Society of New South Wales* **127**, 63-73.

On the New England Tablelands wet sclerophyll forests typically form the ecotone between rainforest and dry sclerophyll forest. Currently there are few data on the response of wet sclerophyll plant species to fire. We compared the fire-response traits of woody understorey and sub-canopy species in wet sclerophyll forest after high and low intensity fires. The majority of species (>80%) resprouted after fire and the prevalence of resprouting did not differ with fire intensity. Obligate seeders were rare in these communities (<10% of species), and similar numbers of rainforest and sclerophyllous species were killed by fire. Resprouting from basal stems and root suckering were the most common mechanisms of vegetative regeneration; however, these traits may have arisen more in response to canopy disturbance than fire regime. We found that most rainforest taxa resprouted but lacked

post-fire seedling recruitment, whereas most resprouting sclerophyllous taxa recruited from seed after fire. This dichotomy in seedling recruitment could reflect the productivity and disturbance gradients across the ecotone. We propose that gap-phase recruitment is favoured towards the rainforest margin and fire-related recruitment is more prevalent at the eucalypt forest edge.

Goldingay, R.L. and Newell, D.A. (2006). A preliminary assessment of disturbance to rock outcrops in Gibraltar Range National Park. *Proceedings of the Linnean Society of New South Wales* **127**, 75-81.

The significance of habitat disturbance within protected areas remains poorly understood. This study assessed habitat disturbance to granite rock outcrops within a protected area in north-east New South Wales. Survey sites were classed as near (<350 m) or far (>500 m) from roads and walking tracks. Habitat disturbance was dependent on site category, occurring at 8 of 10 near sites compared to 1 of 12 far sites. Disturbance mostly consisted of the construction of rock cairns that may deplete the availability of loose rocks at a site. Reptiles were frequently found sheltering under loose rocks, attesting to the valuable role that this type of substrate provides. Further research is required to understand the significance of this disturbance and the extent of dependence by the local reptile fauna on this substrate. Our data provide a baseline against which future surveys can be compared.

Mahony, M. (2006). Amphibians of Gibraltar Range. *Proceedings of the Linnean Society of New South Wales*. **127,** 83-91.

The Gibraltar Range supports a relatively high diversity of amphibians and thirty frog species, with equal numbers of tree frogs (Hylidae) and ground frogs (Myobarachidae) having been recorded there. It is postulated that the geological history of the Great Dividing Range and the rugged landforms on its eastern edge, known as the Great Escarpment, provides the underlying explanation for the amphibian diversity present. Among the amphibians four major biogeography groups are recognized based on distribution and association with major vegetation communities. The largest group consists of 15 species that have wide distributions within and beyond the range and occur in several vegetation communities, and only one member is categorized as threatened. The second group consists of 12 species and is associated with wet forest habitats of the escarpment and coastal belt, with four threatened species. The third group is restricted to rainforest habitats and consists of three species of ground frog, two of which are threatened. The final group is associated with the drier open forests and grasslands of the tablelands and western slopes and consists of four species, three of which are threatened. No frog is endemic to the range, although one ground frog, *Philoria pughi*, is found only in the range and the nearby New England Range and Timbarra Plateau. This species and *Assa darlingtoni*, another ground frog, are closely associated with the warm temperate rainforest that is restricted to the higher altitudes on the Gibraltar Range, and their distribution is considered to be relictual. Their broader distribution is within isolated montane rainforest that occurs on the higher peaks of the Great Escarpment and coastal ranges. Among the frogs of the Gibraltar Range, 11 of the 30 species are categorized as threatened, eight of which are associated with stream habitats. This is despite the large areas of undisturbed natural habitat present on the range. In contrast species associated with pond habitats are less represented in this group.

Vernes, K., Green, S., Howes, A. and Dunn, L. (2006). Species richness and habitat associations on non-flying mammals in Gibraltar Range National Park. *Proceedings of the Linnean Society of New South Wales* **127**, 93-105.

We surveyed mammals in Gibraltar Range National Park using a range of census methods between May 2003 and September 2005. Our primary survey techniques included 5780 trap nights and more than 40 km of walked spotlighting transects, and our observations, coupled with previously collected datasets, revealed the occurrence of 28 native species and six introduced species of non-flying mammal. To examine the importance of habitat heterogeneity in influencing this high mammal species richness, we surveyed mammals across a steep vegetation gradient from swamp, through two eucalypt forest types, to rainforest. The mammal community responded strongly to this gradient, with different suites of species favouring different parts of the gradient. We also attempted to describe the entire mammal community in one of these forest types, wet eucalypt forest, because we suspected it to be one of the more species-rich habitats in the park. The mammal community in this forest type was assessed on two 2.6-ha grids using Elliot and cage trapping (plus incidental observations), and comprised at least 12 species of non-flying native mammal. Brown antechinus (*Antechinus stuartii*), bush rats (*Rattus fuscipes*), and fawn-footed melomys (*Melomys cervinipes*) were the most abundant ground-dwelling mammals in this community.

Harris, J.M. (2006). The discovery and early natural history of the eastern pygmy-possum, *Cercartetus nanus*. *Proceedings of the Linnean Society of New South Wales* **127**, 107-124.

Early accounts of the eastern pygmy-possum, *Cercartetus nanus* (Marsupialia: Burramyidae), are reviewed and the history of its discovery is reported. François Péron discovered the species when on a short stay on Maria Island in 1802. Various names have been conferred upon it, but *C. nanus* is now accepted. The early natural history literature on *C. nanus* has some very interesting and highly relevant accounts of morphology, distribution, behaviour, habitat and diet. Some discrepancies and misinterpretations in the early literature are identified, and several interesting 19th Century illustrations of *C. nanus* are reproduced. This study documents the significance of the primary source material pertaining to this small elusive marsupial.

Piper, K.J. and Herrmann, N. (2006). Additions to Knowledge of the Early Pleistocene Wallaby, *Baringa nelsonensis* Flannery and Hann 1984 (Marsupialia: Macropodinae). *Proceedings of the Linnean Society of New South Wales* **127**, 125-131.

Following the recovery of more specimens of the extinct wallaby, *Baringa nelsonensis*, from early Pleistocene deposits at Nelson Bay, near Portland, Victoria, dental elements that were previously unknown, or only tentatively associated with *Baringa* at the time of its establishment, are described here. Specimens from the early Pliocene Curramulka Local Fauna, Yorke Peninsula, South Australia, previously allied with *Baringa*, are re-examined, and it is concluded that they do not belong to this genus. *Baringa* is an intermediate browser-grazer, but the relatively enlarged I^1 and characteristic vertical wear facet on I_1 suggest an unusual feeding specialisation.

Williamson, P.L. and Rickards, R.B. (2006). Eastonian (Upper Ordovician) Graptolites from Michelago, near Canberra. *Proceedings of the Linnean Society of New South Wales* **127**, 133-156.

A diverse Upper Ordovician (Eastonian) graptoloid fauna of some 20 taxa has been obtained from 'black shales' of the uppermost Foxlow Beds near Ryrie Hill south of Michelago. Eighteen of these are figured and described. The age indication is Eastonian 2 and 3, possibly about the *caudatus/morrisi* Biozone boundary in global graptolite terms. Some specimens exhibit a peculiar preservation, possibly of associated soft parts, though not necessarily graptolite soft parts.

Timms, B.V. (2006). The geomorphology and hydrology of saline lakes of the middle Paroo, arid-zone Australia. *Proceedings of the Linnean Society of New South Wales* **127**: 157-174.

Sixteen subsaline (0.5 – 3 gL^{-1}) and saline lakes (> 3 gL^{-1}) of the Paroo have been studied for periods of up to 18 years. Many were formed by drainage routes being blocked by dunes, some lie in dune swales, some lie at the edge of the Paroo floodplain where alluvial sediments are thinner, and Lake Wyara lies in a depression on a fault line. All developed further by deflation and owe their form to wind-induced currents and wave action shaping shorelines. Most saline lakes have lunette dunes on the eastern shore, and many larger ones have migrated westwards. Lakes of low salinity have sandy beaches and no, or poorly developed, lunettes. Lakes with N-S axes have the southeastern corner cut off by spits generated by currents induced by northwesterley winds. A few lakes are filling with sediment derived from the overgrazing of catchments associated with European settlement.

Larger lakes with inflowing streams fill in El Niño years, then dry over the next few years. Smaller lakes without surface inflows may fill a few times in wet years but dry quickly. Most lakes remain dry in La Nina years. Salinity regimes fluctuate widely and, while instantaneous faunal lists may be depauperate, cumulative species lists can be long. However, lakes which normally are fresh, but become saline in their final stage of drying, develop only a limited saline lake fauna.

Földvary, G.Z. (2006). *Pseudoplasmopora* (Cnidaria, Tabulata) in the Siluro-Devonian of eastern Australia with comments on its global biogeography. *Proceedings of the Linnean Society of New South Wales* **127**, 175-189.

The tabulate coral *Pseudoplasmopora* is widely distributed in Eastern Australia, China, central and southeastern Asia, the Rhenish-Alpine region of central Europe, Gotland and eastern U.S.A. Occurrences of the genus in Australia are reviewed: *Pseudoplasmopora follis, P. heliolitoides* and *P. gippslandica* are reassessed, and *Pseudoplasmopora* sp. A and B are discussed in open nomenclature. During Late Silurian times *Pseudoplasmopora* was confined to Eurasia (predominantly Kazakhstan), eastern Gondwana (Tasman Fold Belt of eastern Australia), South China, Gotland and eastern Laurentia. Though disappearing from the latter two regions before the end of the Silurian, elsewhere during the Early Devonian *Pseudoplasmopora* underwent considerable biogeographic expansion, particularly within China and central Europe, whilst persisting in eastern Gondwana. The youngest species are of Eifelian age. This widespread record suggests that it may have potential in palaeobiogeographic analysis of the mid-Palaeozoic continental distribution.

Baker, A.C., Hose, G.C. and Murray, B.R. (2006). Vegetation responses to *Pinus radiata* (D. Don) invasion: a multivariate analysis using principal response curves. *Proceedings of the Linnean Society of New South Wales* **127**, 191-197.

Radiata pine (*Pinus radiata* D. Don) has been introduced to many new regions outside its native range as a plantation species. Plantations are frequently located adjacent to native vegetation. This proximity allows not only pine wildings, but also large amounts of non-native leaf litter, to enter the surrounding natural vegetation. Our aim in the present study was to assess the composition of plant communities in vegetation surrounding plantations in relation to proximity to pine plantations. Using multivariate Principal Response Curves (PRC) analysis, we show significant differences in the composition of native vegetation between transects adjacent to and not adjacent to pine plantations. Species-level analysis identified a suite of native species that were frequently found in transects adjacent to pine plantations, and a second suite of native species that were reduced in abundance in transects next to pine plantations. This second group of species should be the focus of future conservation work, since they appear to be sensitive to disturbance wrought by pine plantations. We show that the ability of PRC analysis to reveal both community-level and species-level responses to disturbance brought about by exotic species can lead to the generation of testable hypotheses bridging species and community ecology.

Valentine, J.L., Cole, D.J. and Simpson, A.J. (2006). Silurian linguliformean brachiopods and conodonts from the Cobra Formation, southeastern New South Wales, Australia. *Proceedings of the Linnean Society of New South Wales* **127**, 199-234.

Silurian linguliformean brachiopods and conodonts are documented and described from the type section through the Cobra Formation (Taralga Group) in Murruin Creek, near Taralga. The linguliformean brachiopod fauna includes linguloids (six taxa), discinoids (three taxa), acrotretoids (four taxa) and a siphonotretoid. These are the first Late Silurian linguliformean brachiopods to be documented from eastern Australia. New taxa include *Acrotretella dizeugosa* sp. nov., upon which is based the first detailed description of the ontogeny of *Acrotretella* Ireland, 1961. Eleven multi-element conodont taxa are recognised, including the temporally significant taxon, *Kockelella maenniki* Serpagli and Corradini, 1998. Based on these conodont data, and other faunal elements, the Cobra Formation in Murruin Creek appears to range from mid-Wenlock? to mid-Ludlow (early to mid-*siluricus* Zone) in age.

Percival, I.G., Zhen, Y.Y. and Pickett, J.W. (2006). Late Ordovician faunas from the Quandialla-Marsden district, south-central New South Wales. *Proceedings of the Linnean Society of New South Wales* **127**, 235-255.

Two Late Ordovician faunas, one from shallow water limestones and the other from deep water spiculitic siltstones, are documented from the southern Macquarie Arc in south-central New South Wales. Limestone encountered in the subsurface during exploration drilling in the Barmedman Creek area (midway between Marsden and West Wyalong) yields Eastonian conodonts including *Aphelognathus* cf. *webbyi*, *Belodina compressa*, *Phragmodus undatus*, *Tasmanognathus* cf. *borealis* and *Yaoxianognathus*? *tunguskaensis*. Associated macrofauna includes the corals *Tetradium tenue*, *Bajgolia*? cf. *grandis*, *Propora bowanensis*, *Paleofavosites*?, *Cystihalysites*, *Halysites* and *Palaeophyllum*, stromatoporoids *Labechiella variabilis*, *Stratodictyon ozakii*, *Clathrodictyon* cf. *microundulatum* and *Ecclimadictyon*, and sponge *Cliefdenella* cf. *perdentata*. The Jingerangle Formation, exposed between Caragabal and Quandialla, may be as young as Bolindian 2 on the basis of some poorly preserved graptolites. Associated nektic nautiloids and sponges (*Hindia*) represent components of Benthic Assemblage 4-5, suggesting a deep water environment. The limestones at Barmedman Creek, and the spiculitic clastic rocks of the Jingerangle Formation, are associated (although exact relationships are unclear) with two separate volcanic complexes in the Macquarie Arc. Late Ordovician successions exposed further north in the area west of Parkes and Forbes, where early to late Eastonian limestones are overlain by early Bolindian deep water sediments, provide the closest regional analogues to the fossiliferous strata documented in the paper.