A Guide to the **Tracks and Traces** of Barrow Island

Chevron

Gorgon Project

Operated by **Chevron Australia**
in joint venture with
ExxonMobil Shell
Osaka Gas | Tokyo Gas | Chubu Electric Power

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Barrow Island is the home of the Gorgon Project — one of the world's largest natural gas projects and the largest single resource project in Australia's history. The Gorgon Project is developing the Gorgon and Jansz-Io gas fields located within the Greater Gorgon Area, about 130km off the north-west coast of Western Australia.

The Chevron-operated Gorgon Project is a joint venture between the Australian subsidiaries of Chevron (approximately 47 percent), ExxonMobil (25 percent), Shell (25 percent), Osaka Gas (1.25 percent), Tokyo Gas (1 percent) and Chubu Electric Power (0.417 percent).

Introduction

About Barrow Island

Barrow Island is a nature reserve located approximately 70 kilometres off the north-west coast of Western Australia. It is Western Australia's second largest island. The nature reserve is approximately 25 km long by 10 km wide and totals approximately 23, 400 hectares above the high-tide mark; however, the reserve's area is much greater as it also extends into the intertidal zone.

Over geological time, the land mass that became Barrow Island experienced several sea level changes connecting and separating the flora and fauna from the nearby Australian mainland. More recently, eight to ten thousand years ago, rising sea levels once again separated Barrow Island from the mainland.

Green Turtle tracks and body pits.

Photo – Dorian Moro

Skulls from Loggerhead (adult and immature) and Green (adult) Turtles.

Photo — Dorian Moro

Barrow Island has a special place in Western Australia's history, geography and environmental management. In 1910, Barrow Island was designated as a Class 'A' Nature Reserve reflecting its importance as a refuge for wildlife species, some of which are native to Barrow Island and others which have vulnerable and/or threatened populations on the mainland. Barrow Island nature reserve is vested in the Conservation Commission of Western Australia.

While Barrow Island is an important island from an environmental perspective, it also hosts one of Australia's largest onshore oilfields, and is now home to the Gorgon Project.

Since oil was discovered on Barrow Island in 1964, the island was actively managed by West Australian Petroleum up to 2000, and since then by Chevron Australia. This management ensured the island balanced oil extraction with wildlife and landscape conservation. Features of archaeological and historic interest have also been preserved.

Gull tracks.

Photo — Dorian Moro

Almost 2600 species of plants and animals have been regularly recorded on Barrow Island. These include at least 378 native plants, 13 mammal species (including two species of bats), 119 types of terrestrial and migratory birds, 43 species of terrestrial reptiles, three subterranean vertebrates (an eel, a fish and a snake), 2000 terrestrial invertebrates and 34 species of subterranean invertebrates.

The marine environment is just as diverse, hosting rich communities of coral, seagrass, macroalgae and other benthic invertebrate species. Four species of marine turtle nest on Barrow Island, with Flatback and Green Turtles being the most common. Fish and other mobile species follow the tides.

The continued survival of many of these species on Barrow Island is a direct result of the absence of introduced predators (fox, cat) and competitors (rabbits, goats) that have contributed to their decline on the mainland; the maintenance of environmental processes on

Dugong skull.

Photo — Dorian Moro

the island; and the resilience of species that have evolved in an environment which experiences natural dynamic climatic change over time.

Chevron Australia's key environmental objective is to protect the conservation and biodiversity values of Barrow Island. This means ensuring the maintenance of wildlife habitats upon which they depend. Protection of the island's conservation values focuses on four key areas: quarantine management to ensure non-indigenous species do not enter the island; workforce education on the environmental values of Barrow Island; progressive rehabilitation to reinstate disused production areas; and with careful planning, avoiding critical habitats to maintain the ecosystem functions on the island. Since 1966, a strict environmental management plan has enabled petroleum activities to successfully coexist with Barrow Island's important, and fascinating, flora and fauna.

The Tracks and Traces of Barrow Island

While animals are abundant on Barrow Island, many are seldom seen. Tracks and traces on the beaches or near facilities are useful to identify what animals may live in, or move through, an area. Clues can include skulls, scats (animal waste), tracks and structures such as nests, mounds, webs and warrens.

Note: the images of bones and skulls presented throughout this publication are from animals who died from natural causes.

Tracks of Barrow Island

Animals, particularly larger species, will tend to take the easiest travel route within their home range. This can result in many tracks along roads, sandy beaches or other open areas on Barrow Island. A skill to identify an animal's track is to know where to find the track to begin with.

Tracks are difficult to see or identify when the sun is directly overhead, but are easier to identify early in the morning when the early sun casts a shadow on the track, allowing for the edges of the track to be readily seen. By diagnosing the track, we can also determine the direction of travel of a particular animal species. The length of each footprint is generally measured from the heel to the tip of the longest toe or claw. The width is measured by measuring the widest part of the track.

Tracks left by animals on Barrow Island typically represent mammals, birds or reptiles, though crab and insect tracks are often seen among the beach sands. Mammal tracks vary due to differences in the size and shape of pads on the feet, variation in foot structure, presence/absence of claws, and differences in striding gate. Identifying these differences can help differentiate the tracks of mammal species and provide an indication of the size of the animal that left the track. Reptile tracks will often have a deep tail-drag mark down the centre of the track.

Diagrammatic key to common mammal tracks seen on Barrow Island

Hindfoot (top) and forefoot (bottom) prints of Golden Bandicoot.

Hindfoot (bottom) and forefoot (top) prints of Brushtail Possum.

Hindfoot print of Boodie, Spectacled Hare-wallaby or Euro.

Hindfoot (bottom) and forefoot (top) prints of Water Rat.

Traces of Barrow Island

Traces of animals on Barrow Island include webs, burrows, scats (animal waste), nests, body pits, mounds, feathers and bones such as skulls. Identifying feeding areas of the animal can also be a useful technique to find evidence of their presence. Bones may be difficult to find because they are typically disposed of by predators such as birds of prey, or lizards such as the perentie. Skulls represented in this book are those more commonly found on the island, and the teeth are one distinctive characteristic to understand the likely species the skull belongs to. Other parts of the skeleton, such as the leg bones, will be difficult to identify without consultation with an expert in animal bones.

The location of the traces will depend on the size and species of animal and their habitat on Barrow Island. Notable on Barrow Island are the oilfield platforms developed to encourage Ospreys to establish a nest on, or the marine turtle tracks seen on beaches during the summer months. Included in this book will be a description of the common areas traces will be found on Barrow Island, and distinguishing features of the animal trace to look for.

For a more extensive guide on the tracks and traces of Australian mammals, consult: Triggs, B. (2010). *Tracks, Scats and Other Traces. A Field Guide to Australian Mammals.* Oxford University Press. For information on the animals and habitats on Barrow Island, consult the other books in the Barrow Island nature book series: A Guide to the Mammals of Barrow Island, A Guide to the Reptiles and Amphibians of Barrow Island and A Guide to the Birds of Barrow Island.

Enjoy reading about the tracks and traces of Barrow Island and look out for additional books in the series.

Osprey nest.

Photo – Dorian Moro

Perentie

(Varanus giganteus)

Track Distinguishing Features

The distinguishing characteristic of the Perentie track is the distinct wavy tail-drag mark down the centre of the track, left by its large tail. This is often deep in dry sand as the drag mark swerves down the centre of the track. The Perentie leaves an alternating footprint pattern due to the swagger in its walk – a reflection that its legs are on the side of its body rather than underneath. The hind and front footprints often overlap because of the swagger. The feet have five large claws which leave significant prints in both wet and dry sands. The belly of the Perentie does not typically leave any drag mark as the long legs hold the body off the ground. However, belly drags may be observed for heavily pregnant females or those individuals with a full stomach after feeding.

Perentie track pattern along beach. Note the deep tail drag mark.

Photo – Dorian Moro

Sand-swimming Skink

(Lerista sp.*)*

Track Distinguishing Features

This group of reptiles is also known as legless lizards. Their track is characterised by squiggly lines in the sand, left by the winding movement of individuals as they move or 'swim' across or just beneath the surface of the sand. This species has reduced legs hence the only prints are those of its body. The tracks are often confused with juvenile snake tracks.

Sand-swimming Skink tracks look like a snake has moved though the sand. Also seen in this photo are those tracks of a Gecko (foreground) and a Skink (top, left).

Photo – Dorian Moro

Barrow Island Golden Bandicoot

(Isoodon auratus barrowensis)

Track Distinguishing Features

Due to the hip structure of the Golden Bandicoot they will only leave a bounding track. A bounding track will show paired hind prints whereas the fore prints appear to be staggered. On wet sand the hind foot track shows the long fourth and fifth toes and the front foot of a bandicoot will only show the print of three toes. Though the Golden Bandicoot has a tail, the tail does not typically leave a mark. The type of track will depend on the speed of the gait. If the bound is fast, the front and hind footprints are closer together, with a longer stride between sets of prints. A slower gait results in a greater spread of hind and front prints.

Skull Distinguishing Features

The skull of the Golden Bandicoot has a fused lower jaw (one solid bone) with three pairs of incisor teeth on both upper and lower jaws. The upper and lower jaws also have a pair of small canines, three pairs of premolars and four pairs of triangular molars with sharp cusps to the rear of the jaw, reflecting the omnivorous (and primarily insectivorous) diet of this species. The skull shape is characteristically pointed. The molars are triangular in shape and have several sharp cusps. The length of an adult bandicoot skull is typically around 40 mm.

Bandicoot track pattern in dry sand. The gait is typical of an animal moving slowly. Direction of travel is towards the top of the photo.

Photo — Dorian Moro

Bandicoot track pattern in wet sand. Note the paired hind prints ahead of the staggered front prints, typical of an animal moving slowly. Direction of travel is towards the top of the photo.

Photo — Dorian Moro

Golden Bandicoot skull (right side view) showing dried outer skin.
Shown at 110% of actual size.

Photo — Dorian Moro

Water Rat

(Hydromys chrysogaster)

Track Distinguishing Features

The Water Rat can leave unique tracks depending on whether they are bounding, walking or running. Tracks tend to be seen at the low tide mark around Barrow Island, a sign these native rats are actively moving about searching for food. The hind feet have five toes which are partly webbed and the forefeet have four toes. Depending on whether the terrain is dry or wet, the sole and webbing on the foot may or may not be seen.

The front footprint of the Water Rat will often have marks left by the four clawed toes. A bounding track will show the front and hind prints close together in a non-alternating pattern. This is in comparison to a walking or running track, where the track left by the hind and front prints alternate. Though the Water Rat has a tail, the tail does not typically leave a track.

Skull Distinguishing Features

The Water Rat generally has a long elongated skull. The most distinguishing feature of the skull is the large pair of curved incisors at the front of the upper jaw and lower jaws. The ends of the upper incisor are designed to wear down to a chisel edge, but will continue to grow throughout its lifespan. A long gap occurs before the first set of molars. Two pairs of long molars occur in both upper and lower jaws, a feature distinguishing Water Rats from other rat species (which have three pairs of molars). The molars are highly specialized with depressed ridges for the crushing of shellfish.
The length of an adult Water Rat skull is typically around 55 mm.

Water Rat footprints in wet sand. The webbed hind foot prints are wider than the front foot prints.

Photo – Dorian Moro

Water Rat skull (right side view) showing dried outer skin and noticeably large upper and lower incisor teeth. Shown at 130% of actual size.

Photo – Dorian Moro

Barrow Island Euro

(Macropus robustus isabellinus)

Skull Distinguishing Features

The skull of the Euro has a narrow shape, reflecting its herbivorous diet. All Euros have three incisors on each side of the upper jaw and one pair of large chisel-like incisors on the lower jaw. Both upper and lower jaws have a gap after the incisors (the diastema), a common feature of grazing animals. A large set of rectangular molars occur at the rear of the jaw – the number of pairs varies with age. The molars have high-crowns and deep transverse ridges for grinding plant material. The molars move forward as they become worn and fall out in front. Unlike Hare-wallabies, distinguished by a reduced canine in the upper jaw, the jaw of the Euro has no canines. The length of an adult Euro skull may be up to 140 mm.

Euro skull (left side view). Shown at 50% of actual size.

Photo — Dorian Moro

Underside view of skull showing the well-worn molar teeth, suggesting this was an old animal. Shown at 50% of actual size.

Photo — Dorian Moro

Northern Brushtail Possum

(Trichosurus vulpecula arnhemensis)

Track Distinguishing Features

On Barrow Island where there are no trees, the Brushtail Possum spends the majority of its time walking on the ground. The Brushtail Possum leaves a unique track characterised by hind foot prints which are turned slightly outwards, and which have an opposed clawless first toe (thumb). The second and third toes on the hind foot are joined, and will often only leave one mark, particularly in soft dry sand. In wet sand, these joined toes may be differentiated from each other in the track. In wet sand, five evenly-spread toes may be seen in the print. The Brushtail Possum will either leave a bounding or walking track.

Skull Distinguishing Features

The skull of the Northern Brushtail Possum is bulbous in shape. The upper jaw is generally short with three pairs of chisel-shaped incisors (characteristic of all possums). The lower jaw has one large pair of incisors. While there is one pair of reduced canines on the upper jaw, there are no lower canines. One pair of premolar teeth also occurs on both upper and lower jaws, and characteristically curve outwards. Molars have four sharp cone-shaped crowns. The lower jaw has a small gap, the diastema, between the front teeth and the cheek teeth, a common feature of animals feeding on plant material. The length of an adult Brushtail Possum skull is typically 90 mm.

Northern Brushtail Possum footprints in damp sand. Note the distinctive toe on the hind foot which is turned out at an angle.

Photo – Dorian Moro

Northern Brushtail Possum front prints in sand. Note that only the front feet (and evenly-spread toes) are distinctive in this print due to the soft nature of the sand.

Photo – Harry Butler

Northern Brushtail Possum upper skull (underside view). Shown at 50% of actual size.

Photo – Dorian Moro

Northern Brushtail Possum upper skull (left side view). Shown at 50% of actual size.

Photo – Dorian Moro

Boodie (Burrowing Bettong)

(Bettongia lesueur unnamed subspecies*)*

Track Distinguishing Features

Boodies tend to leave two prints: a long narrow footprint with two distinct toe-marks representing the hind foot and a smaller footprint representing the front foot. It is these long narrow hind feet and distinct toes which give this group their name (Macropod = large foot). Tail drag marks may or may not be seen depending on the soil type (soft sand, wet sand, clayey soil). An individual moving with a slow gait will display two sets of prints: distinctive two-pronged hind feet behind which may be seen the prints or marks of its five toed front feet. Fast bounding animals will only leave prints of their hind feet. Tracks appear similar to those of the Spectacled Hare-wallaby and Euro, but are smaller in size and shorter in length.

Skull Distinguishing Features

The skull is relatively short and broad. Characterising the skull are notably long and robust incisors, a short gap (the diastema) between the incisors and the canine teeth, one pair of canine teeth, and the presence of premolar teeth with more than six vertical grooves. Molars have four low cone-shaped cusps. The lower jaw has a single large incisor with a chisel-shaped end. Boodies are omnivorous and their teeth reflect a varied diet which can include plant seed, tubers, roots, bulbs, underground fungi and arthropods such as termites. The length of an adult Boodie skull is typically up to 60 mm.

Boodie skull top view shown at 50% of actual size.

Photo – Dorian Moro

Boodie skull left hand side view shown at 50% of actual size.

Photo – Dorian Moro

Boodie print showing distinctive hindfoot print. Note the front feet indentation in the sand appear behind the clearer two-pronged hind feet, suggesting this individual is moving slowly.

Photo – Harry Butler

Boodie (Burrowing Bettong) continued

Warrens

Boodie warrens are identifiable on Barrow Island by cavities typically situated in limestone cap-rock caves, scrub or among fig trees growing among limestone outcrops. The Barrow Island Boodie prefers to dig under firm soil to prevent the warren from collapsing. These warrens consist of a complex system of underground burrows and may have multiple entrances. Boodies are a communal species and several different warrens may be used by a group of individuals. Warrens may house from 2-40 Boodies, rarely above 50.

During the night the Boodie will forage widely and will return to the warren for shelter prior to sunrise. Warrens offer a temperate climate for Boodies, offering individuals an enclosed environment with high humidity and low temperature relative to the outside air. Such an environment helps individuals to conserve their water. Within warrens, nests are built most commonly out of vegetation.

Opening to a Boodie warren among limestone outcrop.

Photo – Dorian Moro

Osprey Nests

(Pandion cristatus)

Osprey nests are large structures seen around the coast of Barrow Island. They are built by both sexes by piling sticks on high surfaces and lining the nest with softer materials such as kelp. Ospreys will generally keep the same nest each year, adding to its structure over time. Nests can be up to 1.5 metres thick and 1.2 metres wide. Ospreys prefer to locate their nests at heights and typically near the edge of cliffs. Left over prey such as fish are typically found at the base of the nest.

It is not uncommon for Ospreys to use telegraph poles, power poles, or other high structures to build a nest. Man-made nesting platforms have been constructed on Barrow Island to encourage Ospreys to construct their nests there, rather than on power poles.

Osprey nest with attending male and female birds.

Photo — Russell Lagdon

Early construction of nest on an artificial platform by attending Ospreys.

Photo — Chevron Australia

Welcome Swallow Nest

(Hirundo neoxena)

Welcome Swallows build an open cup-shaped nest that comprises pea like beads of light brown clay that together form the cup. Other materials used to construct the nest include grass and feathers, although mammal hair may also be scavenged to adorn the nest cup.

Nests are about 150 mm in diameter. The nests are attached to a suitable structure such as a vertical rock face, but are typically seen on Barrow Island under the eaves of buildings. Both the male and female birds construct the nest prior to the female laying her eggs.

It is common for the species to breed close to human habitation and manmade structures around Barrow Island such as verandahs, eaves and ledges.

Welcome Swallow nest showing its cup-like shape and its sheltered positioning.

Photo — Russell Lagdon

White-winged Fairy-wren Nest

(Malurus leucopterus edouardi)

The White-winged Fairy-wren (Barrow Island subspecies) constructs a nest in the shape of a dome or oval. Nests are constructed from grasses, leaves and other fine vegetation materials such as flower stalks, as well as seeds, feathers or spider webbing. The nests are generally about 120 mm high and 70 mm wide, with one entrance hole around 45 mm wide. The nest is generally constructed close to the ground, around 0.25 m to 0.8 m above ground level. Fairy-wrens nest amongst a diverse range of vegetation on Barrow Island, including plants such as *Melaleuca cardiophylla, Acacia bivenosa, A. coriacea, Hakea lorea, Grevillea pyramidalis, Triodia angusta* and *T. wiseana*. Crushed *Triodia* sp. leaves and flower stalks are important nest-building materials and shrubs such as *A. coriacea* and *A. bivenosa* offer good perches in an otherwise sparse to open vegetated arid environment. White-winged Fairy-wrens also nest along roadways on Barrow Island in areas without *M. cardiophylla.* The nest is constructed by the female, however, because Fairy-wrens are a social species the nest may be visited by several members of the group to feed the young.

White-winged Fairy-wren nest showing how well it remains camouflaged among vegetation.

Photo — Dorian Moro

Fiddler Crab Burrow

Crab burrows are common on sandy beaches around Barrow Island and can be readily seen on wet sand during low tide. The burrow entrance typically has sandy sediment balls which are the product of their feeding habits: the crab's claw picks up a chunk of sediment from the ground and brings it to the mouth, where its contents are sifted through and dropped as sediment. The presence of these sediment balls is an indication a crab is present in its burrow. Burrows are important for the crabs as a refuge from predators, a source of water during low tides which they need for respiration and feeding, a place to breed, and a place for females to incubate their eggs. The burrow serves as a central hub from where the crabs venture out on their feeding excursions. The crabs repeatedly return to their burrow to defend it against other crabs, to take refuge from predators or to replenish their water supply. Each crab works its burrow to maintain it, and will defend the burrow vigorously against other crabs. Recent research suggests that some males will defend multiple empty burrows as a strategy for attracting mates.

Fiddler Crab burrow (top view).
Photo — Dorian Moro

Fiddler Crab burrow (side view). Note the large number of sediment balls near the entrance suggesting the burrow has a resident crab inside. Also note tracks of a Bandicoot (foreground), turtle hatchling (top left diagonal), and bird (top right diagonal).

Photo — Dorian Moro

Golden Orb-weaver Spider

Webs

A prominent and often large web sighted across Barrow Island, including among building structures, is that of the Golden Orb-weaver Spider. To build the initial connection between two objects, a Golden Orb-weaver Spider will throw itself into the air and the wind will carry it across an open area; in the process it releases a single thread of web. This single strand is then strengthened when the spider crosses the thread and continues the web building process. Golden Orb-weaver Spiders are careful to initially lay down a set of threads that are non-adhesive, and will use these to travel along the web while building it. To avoid detection from predators or its prey, the spider will locate itself to the side of the web and place a single leg on the web. This is to feel vibrations and disturbances of the web when a struggling insect is caught.

Golden Orb-weaver Spider Web outlined in morning dew.

Photo – Dorian Moro

Golden Orb-weaver Spider, one of the largest spiders found in Australia.

Photo – Dorian Moro

Trapdoor Spider

Trapdoor Spiders are found on Barrow Island. There are 13 species known on the Island which dig burrows down into the ground, up to 30 cm deep. As individuals grow in size, they build larger burrows to accommodate their size: the larger the burrow, the larger the individual spider inside. Some burrows have a lid or 'trapdoor' to protect the spider inside. Burrows are difficult to see (and find), especially those sealed with a lid. Some species have a simple soil door while others make a door of litter fragments and some attach a fan of twig lining to the rim of the burrow. The burrows protect the spiders from predators and offer them a stable climate in which to live. Additionally, the burrow is an important means for the trapdoor spider to ambush its prey (typically ground-dwelling insects such as ants or beetles) if they pass near the entrance. The females of the species live their entire lives within their burrows and as a result are rarely seen. The males, however, leave their burrows (especially after rain) to search for mates.

Trapdoor Spider at the entrance to its burrow. Note the sandy-silken lid and circular burrow form.

Photo — Harry Butler

Trapdoor Spider burrow trace, showing stony covering.

Photo — Biota Environmental Sciences

Red Tide

A red tide represents a bloom of red algae on the ocean surface. The rapid reproduction of these organisms can form dense visible patches on the water's surface. The algae that occur in a red tide naturally occur at low concentrations but high concentrations result in the discolouration of the water when sea surface temperatures rise; hence red tides become more visible during the warmer summer months. A red tide is commonly confused with an oil slick.

Aerial views of a red tide off the west coast of Barrow Island.

Termite Mounds

Termite mounds are constructed from clay soils, termite saliva and termite excreta. Mounds are distributed across Barrow Island and may exist for decades. The large mounds seen across Barrow Island are constructed by one species of termite *(Nasutitermes triodiae)*. Over time and particularly following rainfall events, the termites will add to the structure which results in the growth of the mound.

Spinifex plants are the main source of food for the termites and are collected and made into pieces that are carried back to the nest. These are then used in the mound building process.

The nest of the termite mound stretches beneath the ground. The key functions of the termite mound are temperature and humidity regulation. Within the mound is a complex network of channels and vents allowing for the passage of individuals and the intake and release of air. Resident termites can open and close vents to control temperature and humidity and may maintain the mound within ±1 °C.

Due to the temperature control of the mound, it is often used by many species of animals to burrow into and provide shelter. These animals include reptiles such as lizards (including the Perentie), mammals such as the Brushtail Possum and Rock Rat and various species of invertebrates. Perenties will lay their eggs in termite mounds, where the constant activity of the termites acts as a heat source for the eggs. Lizards in particular may be seen basking on top of the mound to capture the early morning heat of the sun.

Termite mound showing recent mound construction following rainfall.

Photo – Dorian Moro

Marine Turtle Tracks and Traces

Marine turtles spend most of their life at sea, but females crawl onto the beach to nest. Male marine turtles rarely come ashore but can be seen close to the waters' edge during the turtle mating and nesting season.

As a female marine turtle crawls up the beach, it pushes sand backwards with each stroke of its flippers, creating an 'up' track. The direction the marine turtle was travelling can be determined by examining where the sand has gathered from the backward push of the flippers. Tracks will differ based on the age (hatchling *versus* adult) and species of marine turtle. Tracks vary with each species and may be asymmetrical/zigzag in appearance, symmetrical and may or may not show tail-drag marks. When nesting is complete, females will return to the water creating a 'down' track back to the waters' edge.

Following emergence from the sand, hatchlings make their way from the nest located above the tide line, to the ocean. Unlike the adults, tracks vary little between species and typically may be traced back to a single conical depression in the sand on the beach where the clutch emerged.

The knowledge of marine turtles on Barrow Island has increased over the past 25 years and this is reflected in the available information on their tracks and traces. All marine turtle tracks, particularly those of hatchlings, need careful assessment to identify them — always consult subject matter experts in this area.

Further information about marine turtle tracks and traces, including biology, can be found in the following international publication, accessible online (May 2011): Eckert, K. L., K. A. Bjorndal, F. A. Abreu-Grobois, and M. Donnelly (Editors). 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Sea Turtle Specialist Group Publication No. 4.

Green Turtle tracks, John Wayne Beach.

Photo — Dorian Moro

Green Turtle tracks, John Wayne Beach.

Photo — Dorian Moro

Flatback Turtle
(Natator depressus)

Track Distinguishing Features – Adult

Adult Flatback Turtle flipper tracks have either a symmetrical or asymmetrical appearance. What distinguishes these tracks from other species is the alternating symmetrical/asymmetrical gait that only this species is capable of. The gait depends upon the speed at which the turtle is moving and the slope of the beach. Flatback Turtle tracks have a larger space between flipper marks than a Green Turtle and a wider plastron than either the Loggerhead or Hawksbill Turtle.

Track Distinguishing Features – Hatchling

Flatback Turtle hatchlings differ from adults as they do not travel with a symmetrical striding gait and therefore hatchling tracks appear similar to Green Turtle hatchling tracks. Tracks resemble two side by side teardrop like markings. The outer marking is made by the front flipper and the inside marking by the rear flipper, with a drag mark that can be seen connecting the next rear flipper mark. The markings will alternate from side to side representing a non-symmetrical striding gait. Flatback Turtle hatchlings have a wide plastron which leaves a visible mark in the sand, if conditions allow.

Adult Flatback Turtle track. Direction of travel is towards the bottom of the photo.

Photo — Kellie Pendoley

Flatback Turtle hatchling track. Direction of travel is from right to left of the photo.

Photo — Dorian Moro

Flatback Turtle hatchling track (flippers not fully unfurled). Direction of travel is from right to left of the photo.

Photo — Dorian Moro

Flatback Turtle hatchling tracks moving towards the sea (top of photo), with bird tracks seen in the foreground.

Photo — Dorian Moro

Green Turtle

(Chelonia mydas)

Track Distinguishing Features – Adult

Green Turtles leave symmetrical paired flipper tracks and a continuous or sometimes broken tail-drag mark down the centre. The front flipper marks of the Green Turtle overlap the back flipper marks and are paired in appearance.

Track Distinguishing Features – Hatchling

Green Turtle hatchlings differ from adults as they do not travel with a symmetrical striding gate. The hatchling will alternate strides with the front and back flippers. The front track flippers will leave a longer track, producing a diamond shape. How well these features can be seen in the sand will depend on how dry or wet the sand is. It is typically not reliable to determine species based on track identification alone.

Adult Green Turtle track. Direction of travel is towards the top of the photo.

Photo — Kellie Pendoley

Green Turtle hatchling track.

Photo — Anna Vitenbergs

Hawksbill Turtle

(Eretmochelys imbricata)

Track Distinguishing Features – Adult

The adult Hawksbill Turtle has an asymmetrical (alternating) or zigzag appearance in its track due to the crawling gait of the flippers alternating between strides. The belly (plastron) and tail also produce this zigzag or wavy pattern. Tail marks in the centre of the track may or may not be present. The front flipper marks are equally sized or slightly larger than the back flipper marks. The back flipper marks are widely spaced and produce a curl pattern in the sand. The Hawksbill Turtle has a similar track to the Loggerhead Turtle with an alternating gait, but the Loggerhead Turtle leaves no tail-drag.

Track Distinguishing Features – Hatchling

Tracks are difficult to distinguish from Green Turtle, Flatback Turtle or Loggerhead Turtle hatchling tracks. How well these features can be seen in the sand will depend on how dry or wet the sand is.

Adult Hawksbill Turtle track. Direction of travel is towards the bottom of the photo.

Photo — Kellie Pendoley

Hatchling Hawksbill Turtle tracks.

Photo — Skye Kelliher

Loggerhead Turtle
(Caretta caretta)

Track Distinguishing Features – Adult

Loggerhead Turtles leave flipper tracks with alternating gait similar to Hawksbill Turtle tracks. The alternating action of the flippers when crawling leaves a zigzag or wavy pattern. Distinguishing the Loggerhead Turtle track from the Hawksbill track is the lack of tail-drag mark and the width of the track, with the Loggerhead Turtle track typically being much wider than the Hawksbill Turtle track. The front flipper marks are equally sized and leave an asymmetrical track. The back flipper marks are more widely spaced and leave a curl in the track.

Track Distinguishing Features – Hatchling

Tracks are difficult to distinguish from Green Turtle, Flatback Turtle or Hawksbill Turtle hatchling tracks. How well these features can be seen in the sand will depend on how dry or wet the sand is.

Loggerhead Turtle adult track. Direction of travel is towards the bottom of the photo.

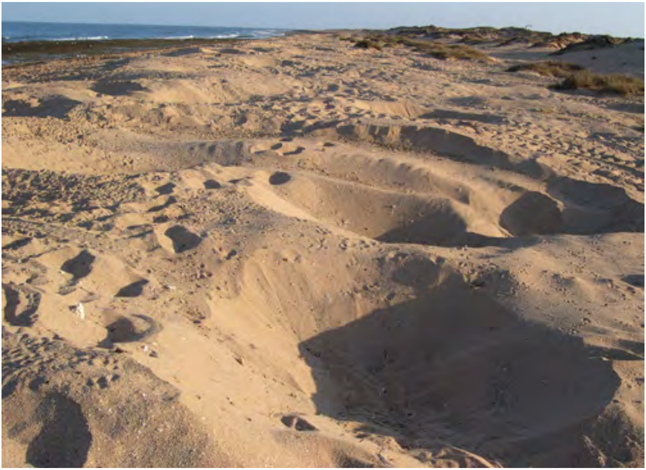
Photo — Department of Environment and Conservation

Marine Turtle Body Pits

Body pits are created by female marine turtles while they are excavating their nests on sandy beaches prior to digging an egg chamber to lay eggs. Body pits are located above the high tide line. The turtle will use her flippers to remove sand in order to lay her eggs in the more suitable damper sand below the surface. The female will use her dexterous back flippers to create an egg chamber if she decides the site is suitable. Often the sand is too dry and the female will abandon the pit, choosing not to lay her eggs on that site.

Digging a body pit can take 40 minutes to an hour depending on the species and she may move to several locations 'testing' the wet or dry texture of the sand before she continues to dig out a pit and commence digging an egg chamber. A body pit can be up to twice as wide as the turtle so the size of the body pit will depend on the species.

Body pits can be commonly viewed on the beaches of Barrow Island and evidence of a pit persists across the year, long after a turtle has laid her clutch of eggs. Tracks of the marine turtle can also be seen going up the beach toward a body pit, and toward the water after the eggs have been laid. Interestingly, the centre of a body pit does not reflect the location of a clutch of eggs, ensuring that predators do not learn where the clutch was laid.



Green Turtle body pits seen on the west coast of Barrow Island.

Photo — Dorian Moro

Marine Turtle False Crawl Track

A female marine turtle may on occasion emerge from the ocean but not commence to dig a body pit. These tracks are referred to as "false crawls" and often occur because the female has been disturbed or did not find a nesting site that was suitable.

There are two types of false crawls: false crawl tracks and false crawl attempts. False crawl tracks resemble a "U" turn in the sand, leaving an up track away from the water and an immediate down track toward the water where the female turtle has returned to the ocean without digging a body pit or a nest chamber.

A false crawl attempt describes the situation where a female turtle crawls up onto the beach and attempts to nest but is unsuccessful; she may leave just a body pit or get as far as the egg chamber before abandoning the attempt and returning to the sea. Where evidence of digging or any attempt to nest is seen along the track this is called a false crawl attempt.

Green Turtle false crawl track as she made her way up the beach and back into the sea.

Photo — David Pescod

Emerged Clutches: The Nest Fan

After hatching, a hatchling may take a number of days to dig its way out of a nest chamber. A nest fan is created when turtle hatchlings emerge from the sand and create tracks heading toward the ocean. Often hatchlings will emerge in large groups which creates the nest fan. A fan may comprise up to 150 individual tracks depending upon the species as hatchlings emerge en masse from their clutch (ie: Green Turtles lay more eggs than Flatback Turtles and so more hatchlings may emerge and leave more tracks). These tracks are often seen to fan out as each hatchling takes a different path to the ocean.

Fan showing mass emergence of turtle hatchling tracks towards the sea.

Photo – Dorian Moro

Other Traces

Hermit Crab tracks.

Photo – Harry Butler

Termite mounds on the Barrow Island landscape.

Photo – Dorian Moro

Spinifex ball rolled up by the surf.

Photo – Dorian Moro

Chevron's Policy on Working in Sensitive Areas

Protecting the safety and health of people and the environment is a Chevron core value. Therefore we:

- Strive to design our facilities and conduct our operations to avoid impacts to human health and to operate in an environmentally sound, reliable and efficient manner.
- Conduct our operations responsibly in all areas, including environments with sensitive biological characteristics

Chevron strives to avoid or reduce significant risks and impacts our projects and operations may pose to sensitive species, habitats and ecosystems. This means that we:

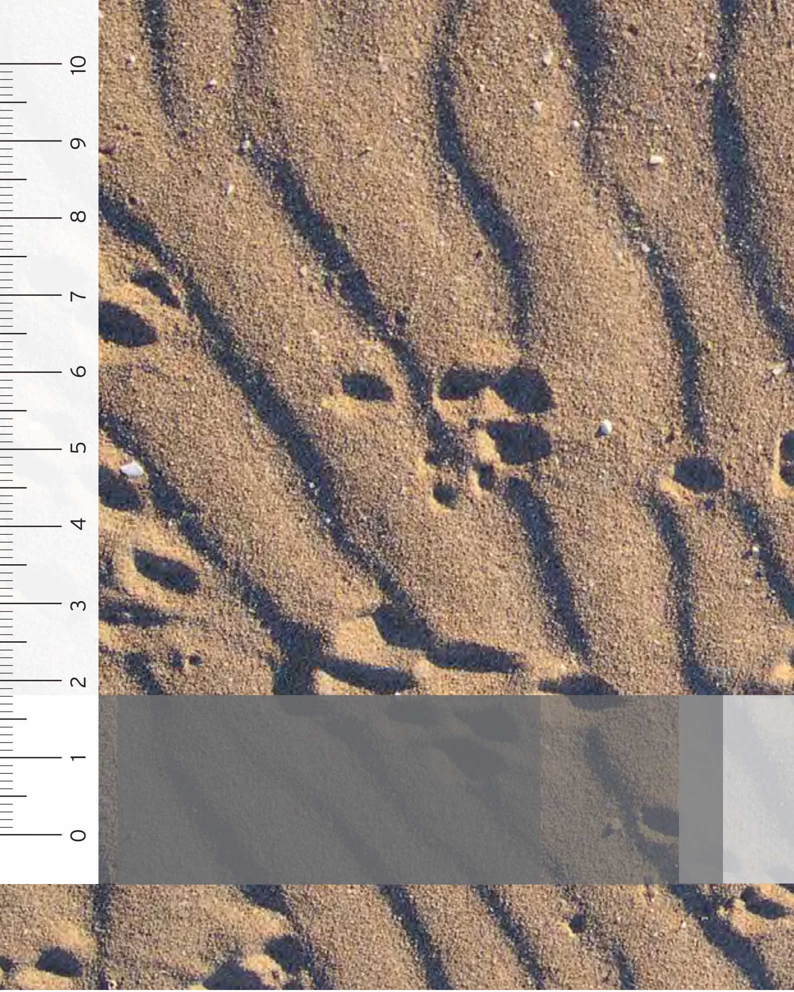
- Integrate biodiversity into our business decision-making and management through our Operational Excellence (OE) management system.
- Drive and assess our performance relating to biodiversity through key OE expectations, such as, Environmental Stewardship, and processes, including HES Due Diligence for Property Transfers; Environmental and Health Impact Assessment; and Risk Management.
- Understand that humans and the natural environment are interdependent and interact with each other in various ways. In managing our impacts we consider those interrelationships and the functions ecosystems perform in supporting sustainable economic development.

Chevron recognises that our activities could affect particularly sensitive or valuable biodiversity inside or outside of legally-designated protected areas. Therefore we:

- Decide whether and how to operate in a protected or sensitive area, based on consideration of the specific circumstances of the area and operation involved.
- Operate in such areas only with government legal authorisation, and where we are confident we can comply with regulatory requirements and use operating practices appropriately protective of the area.
- Use our OE processes to avoid or minimise potential risks of our operations to sensitive biological resources and seek ways to make positive contributions to biodiversity conservation in the area.

Chevron undertakes activities to raise internal and external awareness of the importance of conserving biodiversity and how the company is addressing it. This includes:

- Communicating about our biodiversity-related activities to employees and outside audiences, such as through our Corporate Responsibility report.
- Engaging with government, local communities and others to understand and work to address significant biodiversity issues in areas where we operate.
- Participating in industry associations and other forums to share and promote best practices for biodiversity conservation.
- Seeking to understand and, where appropriate, participating in development of external policy-making activities that affect our operations, such as those adopted under the UN Convention on Biological Diversity and national, regional and local biodiversity policies and plans.
- Working with a variety of external organisations to make positive contributions to biodiversity conservation in areas where we operate and globally.



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