DESCRIPTION OF THE COMMERCIAL SEAWEED SECTOR

The South African seaweed fishery is currently (2013) based on:

- **Beach-cast collection of kelps (Western and Northern Cape).**
- **Harvesting of kelps (Western and Northern Cape).**
- **Harvesting of *Gelidium* species (Eastern Cape).**

Current rights to Seaweed Concession Areas were allocated for ten years (2006-1025).

Research in the Department is focussed mainly on commercial species or those with commercial potential, but we also collaborate with local and overseas scientists in studies of seaweed diversity and climate change and of seaweed aquaculture and beneficiation.

The main commercial species and their biology

- **Processing and markets**
- **Catch history**
- **Socio-economics**
- **Operation of commercial fisheries**
- **Monitoring of seaweed resources**
- **Management strategy, concession areas and permits**
- **Seaweed resource research**
- **EAF considerations**
- **Seaweed Unit publications on current and potential commercial species (separate file)**
- **Research on seaweed diversity and climate change**
- **Seaweed Unit publications on diversity (separate file)**
- **Research on seaweed beneficiation**
- **Seaweed Unit publicationson beneficiation (separate file)**

SEAWEED FREQUENTLY ASKED QUESTIONS

- **How do I get access to a commercial seaweed resource?**
- **Can I eat seaweeds?**
- **Can I collect seaweed for private use?**
- **Are there any poisonous seaweeds?**

THE MAIN COMMERCIAL SPECIES AND THEIR BIOLOGY

The seaweeds that form the basis of the current industry are the kelps (*Ecklonia maxima* and to a lesser extent *Laminariapallida*) and red seaweeds of the genus *Gelidium*.

Fresh fronds of the kelp (*Ecklonia*) are a vital source of feed for many abalone farms. Here a worker removes old fronds and places fresh fronds into tanks of these valuable molluscs.

Ecklonia maxima

Distribution:

Kelp beds of this species occur from Quoin Point, just west of Cape Agulhas (with a small outlier population that developed recently at De Hoop) to just north of Lüderitz, Namibia.

Habitat:

Sporophytes (the large, visible kelp plants) dominate the inshore, rocky regions forming extensive kelp beds in water down to 10 m deep.

Size:

The sporophytes can reach lengths of 13 m, but are usually 4-8m long.

Biomass:

Biomass is variable. Average biomass of E. maxima in a fairly dense kelp bed is 10-15 kg m^{-2} (wet), but biomass can exceed 20 kg m^{-2} (wet).

Reproduction:

The large sporophytes release haploid spores in the water which then settle on any hard surface and germinate giving rise to microscopic male or female gametophytes. Male gametophytes produce sperm which, upon release, swim to the egg produced and housed in the female gametophyte. Fertilization gives rise to a diploid zygote which develops into the new sporophytes.

Population Structure:

Shallow (1-5 m) inshore areas tend to have a high density of short plants. As water depth increases, plants grow longer, but are less dense (fewer per area rock). Like terrestrial forests, kelp beds comprise plants of varying sizes. Usually most of the biomass is in larger plants (5-10m long), with smaller numbers of sub-canopy (younger) plants underneath (0.5-4m long), and small juveniles at the bottom (a few cm to 0.5 m long).

Ecklonia maxima. The spore-producing phase of this large seaweed reaches more than 10 m in length, with a long stipe, topped by a gas-filled bulb that holds the tangle of strap-like fronds near the surface. *Ecklonia maxima* forms extensive beds between Quoin Point (just west of Cape Agulhas) and southern Namibia, and forms the basis of most of the SA seaweed industry.

Laminaria pallida

Distribution:

Occurs from Danger Point to northern Namibia.

Habitat:

From Cape Columbine to around Danger Point sporophytes of *L. pallida* are found under *Ecklonia* and also in deeper water (down to at least 20 m). From Cape Columbine northwards *L. pallida* begins to replace *E. maxima* in shallow kelp beds and develops a hollow stipe.

Size:
Sporophytes are usually 3-4 m long.

Biomass:
Biomass is variable. Average biomass is around 8 kg m^{-2} (wet), but can be double this.

Reproduction:
The large sporophytes release haploid spores in the water which then settle on any hard surface and germinate giving rise to microscopic male or female gametophytes. Male gametophytes produce sperm which, upon release, swim to the egg produced and housed in the female gametophyte. Fertilization gives rise to a diploid zygote which develops into the new sporophytes stage.

Population Structure:
At the southern end of its distribution it dominates below 8-10 m. Northwards *L. pallida* gradually becomes more dominant in the inshore (2-5m), replacing *E. maxima* north of Lüderitz.

Laminaria pallida. Stipes of this kelp reach just over 2 m in length, and bear flat, hand like blades that split into straps. It grows down to at least 20m depth, usually forming a sub-canopy under *Ecklonia* in shallower water. However, up the west coast north of Cape Columbine *Laminaria* develops a hollow stipe and replaces much of the *Ecklonia* in shallow water.

Beds of the kelp *Laminaria pallida* extend to depths of 20 m and more, on reefs off our west coast and north into Namibia.

Gelidium pristoides

A harvester picks *Gelidium* plants from an Eastern Cape shore. Detailed research shows that the harvesting, as currently controlled and practised, has a negligible ecological effect on the *Gelidium* and on intertidal seaweed and animal communities.

Distribution:
Found from Kommetjie to Port Edward, but biomass is highest in the Eastern Cape.

Habitat:
Intertidal, often on shells of the limpet *Scutellastra.*

Size:
Usually a few to about 15 cm tall, but plants hanging on vertical walls may reach 30 cm.

Biomass:
Very variable, but around 100-200 g m^{-2} (wet) in commercial areas.

Reproduction:
Fairly typical red algal life history, with isomorphic sporophytes and gametophytes, but unusual in that bispores are produced rather than tetraspores.

Gelidium pristoides, the intertidal red seaweed that is the mainstay of the SA *Gelidium* industry.

Most recovery after harvesting is by vegetative re-growth rather than new growth from spores.

Population Structure:
Occurs in tufts comprising a few to many individual plants, often of mixed reproductive phases.

Gelidium abbottiorum

Distribution:
Found from Cape Agulhas to northern Kwazulu-Natal, but most abundant in the Eastern Cape and Kwazulu-Natal.

Habitat:
Epilithic, in rock pools and from the sublittoral fringe down to at least several metres depth.

Size:
30 – 40 cm tall.

Biomass:
Very variable, and tufts can be scattered.

Reproduction:
Typical red algal life history with isomorphic generations (sporophytes and gametophytes that look almost identical).

Population Structure:
Found in bushy tufts or as individual plants, scattered.

Gelidium abbottiorum, another important commercial species.

Gelidium pteridifolium

Distribution:
Recorded from False Bay to just north of Durban, but most abundant in the Eastern Cape.

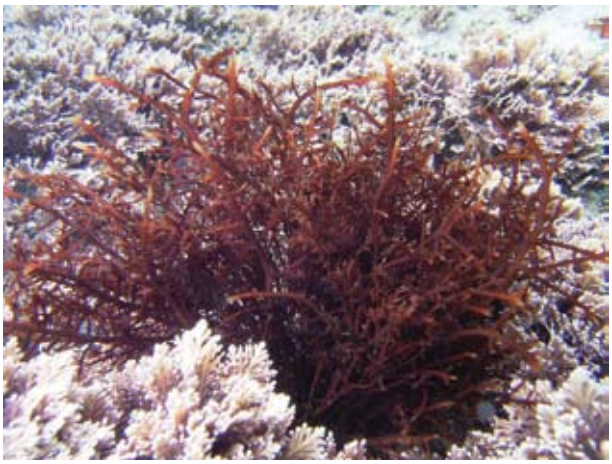
Habitat:
Epilithic, from the sublittoral fringe down to at least 10 m depth.

Size:
About 20 cm long.

Biomass:
Variable, from a few to several hundred g per m^{-2} (wet)

Reproduction:
Typical red algal isomorphic life history.

Population Structure:
Grows as large tufts or isolated individuals.



Gelidium pteridifolium, one of the South African species that is collected and exported for the extraction of agar.

Gracilaria gracilis

Distribution:
In southern Africa it is recorded from Lüderitz (Namibia), St. Helena Bay and Velddrif, Saldanha Bay/Langebaan Lagoon, Table Bay, False Bay, and the Swartkops River.

Habitat:
Plants are usually loose-lying or have their bases buried in the sandy substrate.

Size:
Can grow up to 50 cm or longer.

Biomass:
Highly variable, from a few g to many kg per m^{-2} (wet)

Reproduction:

Mostly vegetative, by pieces breaking off and regrowing. It only rarely becomes reproductive. The life-history is of the isomorphic red algal type: the gametophytes alternate with similar0looking sporophytes.

Population Structure:

Mature populations comprise numerous, dense individual plants anchored in sand
and covering large areas of the bottom of very sheltered bays or estuaries.

Gracilaria gracilis, a stringy red seaweed that contains agar, here growing in shallow water at Saldanha Bay, but often forming extensive beds down to 10 m depth.

Other seaweeds

Species with past or potential commercial uses are also investigated. For example, intertidal populations of the foliose seaweeds *Ulva* and *Porphyra* have been surveyed to determine biomass and potential for harvest. These species are abundant on parts of the west coast.

A researcher surveys a Western Cape shore to determine the biomass of *Ulva* (green blades) and *Porphyra* (purplish-brown blades).

Processing and markets

Much of the seaweed that is harvested (*Gelidium* and most beach-cast kelp) is exported for the extraction of gums (colloidal chemicals that are used in many industries). The international seaweed industry is controlled mainly by large international companies that can manipulate prices, so that marketing of South African raw materials is complicated and requires overseas contacts to obtain a viable return. For instance, at the moment the prices for certain species including our Gracilarioids and some of our *Gelidium* species are too low to justify commercial collection. As a result, returns for South African companies that do not value-add may be marginal, and they are often forced to stockpile material for many months while they are negotiating acceptable prices. The collection and drying of seaweed is a low-tech activity, while transport and secondary processing are expensive. Extraction and manufacture of end-products (plant-growth stimulants, cosmetics, alginate, agar, or carrageenan) is technologically complicated, expensive and subject to international market pressures, with the result that only plant-growth stimulants are produced (from kelp) in South Africa at present.

Large quantities of **fresh kelp** are now used as feed for farmed abalone (more than 6000 tonnes fresh weight of kelp in 2011, with a market value over R 8 million), and in some areas fresh kelp is harvested for local processing into high-value plant-growth stimulants that are marketed locally and internationally to more than 30 countries.

Catch history

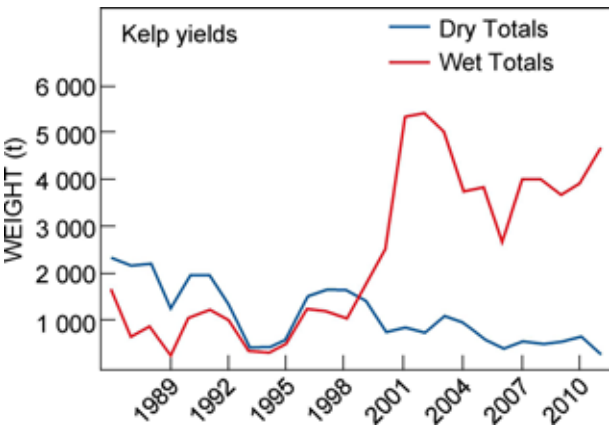


Figure A . Kelp yields since the early 1980's. "Dry Totals" refers to beach-cast material that is almost all exported for alginate extraction. "Wet Totals" refers to material that is harvested fresh for feeding to farmed abalone as well as material used for extraction of plant growth stimulants.

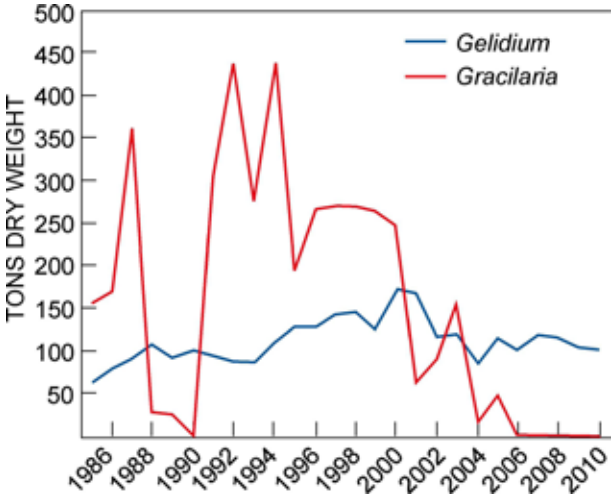


Figure B: Yields (tons dry weight) of the agar-producing red seaweeds *Gelidium and Gracilaria* in South Africa.

Socio-economics

Prices for exported raw material fluctuate with quality and international market trends. The following are estimates (October 2012). Note that Free On Board (FOB) means that the supplier in SA pays all costs until the material is on board ship. The buyer then pays for shipping, insurance, etc.

Dried kelp (chipped):
R 5 600 per ton dry weight FOB

Gelidium pristoides:
R 28 000 per ton dry weight FOB

Gelidium assorted species:
R 20 000 per ton dry weight FOB

Gracilaria (Namibian material):
R 13 500 per ton dry weight FOB

Ecklonia maxima – fresh fronds for abalone feed:
R 1 400 per ton wet weight, delivered to the farm.

Processed seaweed products (liquid plant growth stimulants) vary in price and composition, so that it is impossible to establish an overall value for this sector.

It is estimated that the SA seaweed industry employs about 100 people full time, and another 50-100 part-time.

Operation of commercial fisheries

The coast of South Africa with seaweeds of current or potential commercial value lies between the Orange and the Mtamvuna Rivers and includes the coasts of the Northern Cape, Western Cape and Eastern Cape provinces. It is divided into 23 Concession areas (see Management Strategy). Within each Concession Area, rights are granted for each species or functional group of species (a functional group is 2 or more species that for practical purposes cannot be collected separately, for example beach-cast kelp or *Gelidium* species). Current rights were allocated for a ten-year period (2006-2015).

For various reasons (especially fluctuating demand) not all concession areas contain viable seaweed fisheries. The current commercial fisheries are outlined below.

Beach-cast kelp

This refers to the collection of kelp that is washed ashore by the sea, especially during storms. The kelp is picked up off the beach or rocks by teams of labourers, usually when it is partly or completely dry: only the bigger pieces are removed, and the process is by no means thorough, so a lot of material is left. Material is removed and spread out to dry completely, then milled to various size chips. It is graded, bagged and (mainly) exported for the extraction of alginate, a colloid with many industrial uses. The world alginate industry is very competitive, and we are a minor producer of raw kelp, so returns can be marginal.

Current annual yields (totals for all rights areas) vary around 500 ton dry weight, but they vary with market conditions.

Large quantities of kelp are broken off the rock and washed ashore by heavy seas. Some of this beach-cast material is collected from the shore, dried, milled and exported for the extraction of alginate, a gelling agent with many commercial uses.

Kelp for abalone feed

Fronds of kelp (almost entirely *Ecklonia maxima*) are harvested from the surface, from boats. This is done at low tide, when kelp fronds are accessible from the surface. Workers lean over the side, pull up the kelp head, and either cut the whole head off, or (preferably) cut the fronds off but leave the first 30 cm intact and attached to the head, which allows the plant to re-grow (see “Kelp Harvesting Manual”).

However, in some areas, only the former method is practical. Fresh beach-cast kelp is sometimes also collected for abalone feed.

The fresh kelp fronds are landed and immediately delivered to the abalone farm where they are weighed. At the farm the fronds are cut into smaller sections and supplied to the abalone as food.

Current annual yields, mainly from Concession Areas 5, 6 and 11 (which are close to abalone farms) total more than 6000 t f wt annually, worth about R 8 million.

Operating from a small boat, a harvester cuts fronds of kelp (mainly *Ecklonia maxima*) and rows them ashore where they are loaded onto a trailer and delivered fresh to an abalone farm.

Kelp for liquid growth stimulants

The cell sap of kelps contains plant growth hormones and trace elements, and enjoys a considerable international market in the form of processed extracts that are used in agriculture and horticulture. In SA two companies harvest and process *E. maxima* for these products.

Kelp Products Ltd (Area 9) uses a patented process and are a world leader in the field, exporting to more than 30 countries. Taurus Atlantic Seaweeds Ltd (Area 6) are now also producing and marketing locally and internationally.

Total yields of kelp for these products are around 1000 t fresh weight, but because of the processing and marketing, a value cannot be estimated. Harvesting is similar to that for abalone feed, except that the kelp stipes are often used as well as the fronds.

Gelidium

At present *Gelidium* is only harvested in Concession Area 1 (Kei River to Cape Seal). To the west of this there is less *Gelidium*, and harvesting in the former Transkei has stopped because the bulk of material comprises the less valuable species *G. abbottiorum* and *G. pteridifolium*, which combined with access and security problems makes collection there non-viable at the moment.

Gelidium (mainly *G. pristoides*) is hand-picked by teams of labourers: mostly women from very poor rural communities.The area to be harvest over the spring low tide period (about 5 days) is chosen in advance, based on visual inspection and harvesting history. Workers are transported to the area and accommodated. Each day they are dropped along the chosen shore several hours before LWS and they pick the seaweed tufts by hand (cutting methods were researched in the 1980s but proved impractical). As the tide comes in the workers leave the shore and they and their grain-bags full of damp *Gelidium* are picked up by 4x4. (It is worth noting that in most places this activity depends on 4x4 beach access, but that each area is only visited once in several months at most, and access is strictly controlled).

Workers return to camp where the seaweed is spread out to dry. The seaweed is taken to a central depot where it is sorted, cleaned and baled for export. Some 80-100 t are collected annually, although exports do not always match these amounts because in some years material is stockpiled until prices improve.

The biology and harvesting of *G. pristoides* has been extensively researched (see for example Anderson et al.1991).

A *Gelidium* harvester displays part of his haul on a shore near Fish River in the Eastern Cape. Harvesting removes only a small part of the biomass of this fast-growing seaweed, and has negligible ecological effects.

Gracilaria

Although large amounts of *Gracilaria* used to be collected commercially from the beach in Saldanha Bay (and to a lesser extent in St. Helena Bay), weak international demand has seen this resource unexploited for several years.In the 1990's the Seaweed Unit researched the farming of *Gracilaria* in Saldanha and St. Helena Bays, and showed good potential for commercial farming, particularly in St. Helena Bay. However, since then prices of this seaweed have fallen, and successful commercial farming has not taken place.

The red seaweed *Gracilaria* has been farmed at Lüderitz, Namibia (shown here), and similar methods used to grow it in Saldanha and St Helena Bays in South Africa. However, prices for this seaweed are low at present, and cultivation is probably not worthwhile.

Ulva/Porphyra

In areas 11 and 12 there is commercial demand for these intertidal seaweeds, and surveys have confirmed viable harvestable resources. However, administrative delays have prevented the development of harvesting in these areas.

The sheet-like seaweed *Porphyra* is edible, and some species in the East are grown and processed into nori, which is familiar to lovers of sushi.

Monitoring of seaweed resources

Monitoring –Fisheries dependent

All seaweed commercial returns are required to be submitted monthly to Research and to Management. Research staff check, collate, and monitor catch returns. Every 2 months Research submits a check-sheet of returns to Management, summarising all data and identifying any right-holders who have not submitted returns or broken any other permit conditions.

Commercial data for kelps are subdivided into: beach-cast (dry weight), fresh beach-cast for abalone feed, fresh kelp for abalone feed, kelp for plant-growth stimulant (wet weight). *Gelidium* totals are recorded as dry weight.

Monitoring –Fisheries independent

The massive kelp beds on our west coast shelter numerous seaweeds and animals, and besides being directly commercially useful, they support valuable animals like rock lobster, abalone and fish.

Beach-cast kelp (Northern Cape and Western Cape)

This is managed by TAE (Total Applied Effort). Collections are affected by weather (the main wash-ups follow storms) and market demand, and assessments of the resource are neither practical nor necessary. However, collecting operations are periodically inspected when scientists are in the area.

Harvested kelp (Northern and Western Cape)

Kelp harvests are limited by Maximum Sustainable Yields, as set out in annual permits. The general status of kelp resources is assessed by:

1. Catch returns which are collated and monitored.
2. Annual shore and diving inspections of various kelp beds, including those in 3 below.
3. Annual measurements of kelp densities at certain monitoring sites representing nodes of harvesting activity, namely Area 6 (southern part of coast), Area 11 (west coast) and Port Nolloth/Hondeklip Bay (Namaqualand coast). During 2011/2012 more than 6 additional sites along the coast were surveyed.

At present all estimates of kelp bed areas are based on infrared aerial kelp mapping done in 2005/2006 and described in Anderson *et al*. 2007 (*Afr. J. Mar. Sci*. 29: 369-378). Routine measurements and inspections indicate that the resource is stable and in good condition.

Monitoring of kelp beds is by visual inspection followed by measurements of kelp density (number of plants per area) and biomass by divers. The standard method is to operate only over LWS during calm seas, and to count the number of kelp heads reaching the surface in 80-100 quadrats ($1m^2$) at each of at least two sub-sites. Many of these sites are fixed, and visited annually. In 2011/2012 monitoring was carried out at 6 locations on the west coast.

Although kelp densities (and overall condition) are the main parameters recorded, kelp biomass can be estimated from densities using well established correlations based on hundreds of plants.Density and biomass at a particular site can vary by up to 40% over relatively short periods (a few to 6 months) depending on environmental history (weather, swell, temperature/nutrients). For this reason changes to allowable harvests (Maximum Sustainable Yield) are only considered when changes in density or biomass exceed 40% or there are indications of a substantial change in conditions.

Gelidium

This resource is managed by TAE only. Considerable research and comprehensive assessments were done on this resource in the 1980's. Now the resource is assessed by:

1. Annual monitoring of biomass and cover at two fixed sites: a regularly harvested (Port Alfred) and one that is seldom harvested and also includes a non-harvested control site (Cape St Francis). At each site densities and biomass of G. pristoides are recorded from a series of quadrats laid in transects.
2. Catch returns and reports from the industry.
3. Random, annual inspections of harvested and unharvested sites in the Eastern Cape (in 2011/2012: Kei Mouth, HagaHaga, Cape Recife, Kleinemonde).

Catch returns have remained stable. Monitoring and inspections of various sites indicate normal *Gelidium* populations.

Management Strategy, concession areas and permits

Management objectives

1. Optimal long-term benefit in terms of financial returns and job creation.
2. The encouragement of local processing/beneficiation.
3. Sustainability and ecosystem health.
4. Transformation of the industry.

Management policy

1. The part of the South African coast where seaweeds are currently exploited, between the Orange and Mtamvuna Rivers (Eastern Cape/KZN border) is divided into 23 Seaweed Rights Areas (SRAs) to facilitate management (see map and table of grid references later).
2. Exploitation of seaweed resources is managed by controlling effort (limiting the number of participants) and in the case of kelp harvestingby a Maximum Sustainable Yield (MSY) for the relevant SRA as set out in the annual permit for each area.
3. In each SRA, the rights for each functional group of seaweeds are allocated to only one applicant (the same applicant may be granted the rights to more than one functional group). This is a fundamental principle of the seaweed management system, and prevents competitive over-exploitation of these static resources (in keeping with sections 2a, 2b and 2c of the Marine Living Resources Act). Countries which have not used this system have severely damaged their seaweed resources. The four functional groups on our coast that are of current commercial interest are:
   - A - The kelps *Ecklonia* and *Laminaria*, including both harvested and beach-cast material,
   - B - *Gelidium* (all species),
   - C - *Gracilaria* and
   - D - others as specified, e.g. intertidal *Ulva* and *Porphyra* together. These functional groups are based on practical concerns: ease of man agement, minimisation of conflict between users, etc.
4. Rights are allocated to applicants whose business makes optimal or the fullest possible use of the resource, (to promote optimum utilisation – section 2a of the Marine Living Resources Act).
5. Due consideration is given to restructuring to address historic imbalances (section 2j, Marine Living Resources Act) whilst achieving optimum sus-

tainable utilisation of the resource (section 2a), and utilising the resource to achieve economic growth, capacity building and employment (section 2d).

6. Investment in local processing or value-adding is encouraged by preferential allocation of rights.

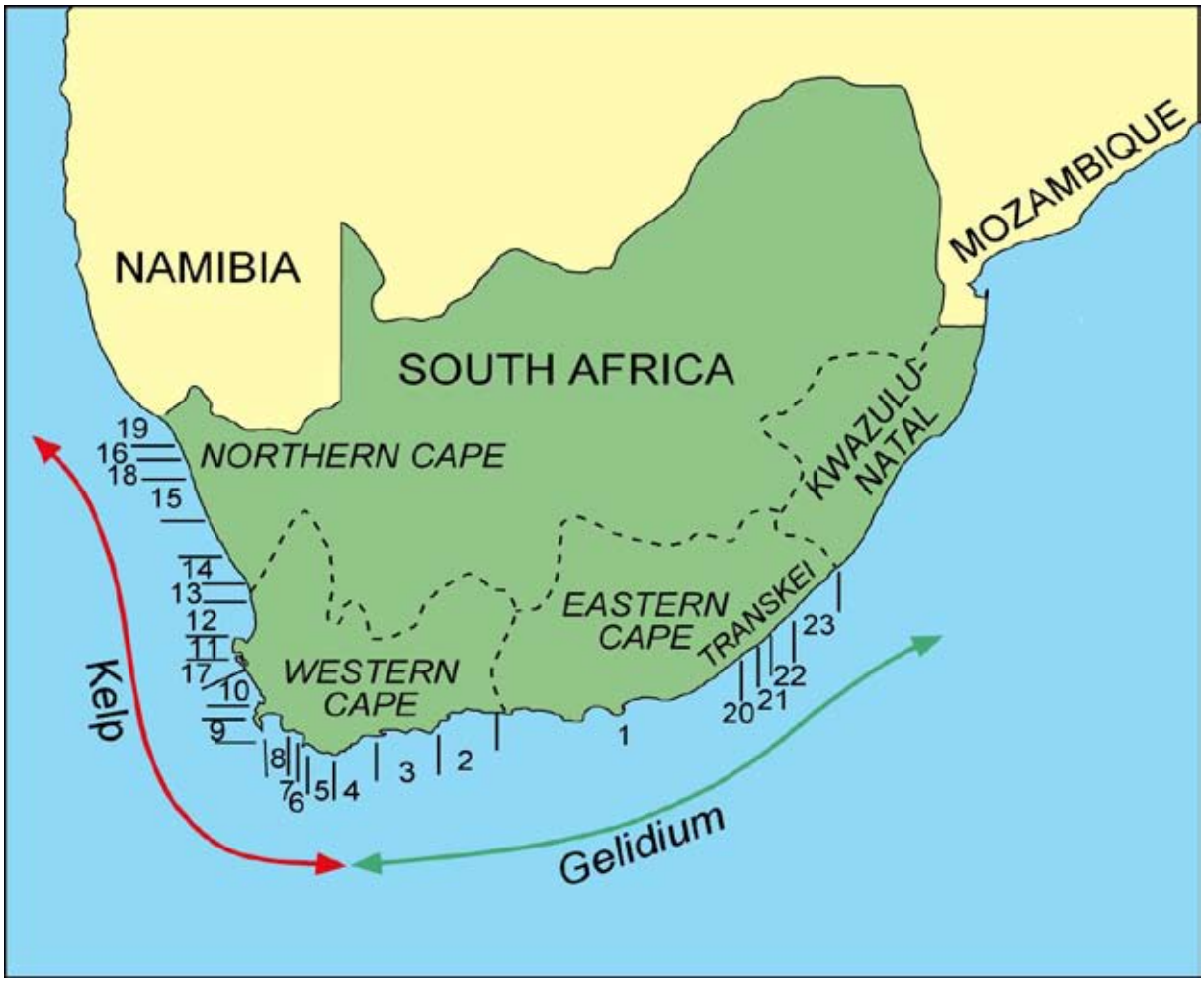
7. The collection/harvesting activities of rights holders are regulated by conditions in the permits for the relevant SRA and seaweed species.

8. Companies or individuals who hold rights must participate directly in the commercial activity, and may not sell the right to use the resource to other parties.

and remains essentially a commercial operation.

Recreational fishery

The term "recreational" means fishing or collecting marine organisms for private use. Seaweeds are sometimes collected as food, sometimes (especially kelp) for use as a garden fertiliser, or for other purpose such as for marine aquaria. Individuals wishing to collect seaweed or remove it from the seashore require an "Annual Recreational Fishing Permit", which can be obtained from any post office. The category that applies to seaweed is "Molluscs,



Map showing positions of the seaweed rights areas in South Africa. For detailed grid references to the concession areas, click here.

Subsistence Fishery

For economic reasons, and because local seaweed is not eaten in South Africa, there is essentially no subsistence fishery. Commercial seaweed activities require investment in vehicles, boats, storage space, and processing facilities. Also, dried products that are to be exported may have to be stored for some time until international prices justify their sale, and they often require international marketing. The result is that the industry is both fairly sophisticated, and in many instances, not highly profitable,

which excludes abalone, but includes Octopus and Squid; worms and other invertebrates, and Aquatic Plants". The permit al lows an individual to collect up to 10kg fresh weight of seaweed per day.

Although few people in South Africa eat seaweed, we have a number of species suitable for consumption, and seaweeds are a useful source of vitamins, trace elements and roughage. None of our seaweeds are known to be poisonous but some taste unpleasant (they contain compounds that discourage animals from eating them) and should be

avoided. There are no guides to cooking and eating South African seaweeds, but overseas guides (e.g. from the US west coast) are often useful if similar local seaweeds are used (closely related species and members of the same genera).

Current Research

The Seaweed Unit has 3 main projects:

1. Seaweed Resource Research,
2. Seaweed Diversity and Climate Change
3. Seaweed Beneficiation.

Research results are communicated to management and where appropriate, published in the scientific literature. Recent and past research publications by current staff members are listed under each of the above categories. For publications on commercial species click here.

1. Seaweed Resource Research

Aim: to carry out the research necessary for sustainable management of seaweed resources and to investigate potential new resources.

Responsible officers:
Dr RJ Anderson and Mr MD Rothman.

Marine Research Assistants:
Mr CJT Boothroyd and Mr FA Kemp.

The Seaweed Unit is responsible for research on species that are commercially exploited or that have potential for exploitation. Results are used to manage our seaweed resources (e.g. for TAE/TAC purposes, in the form of annual and *ad hoc* recommendations) and published in scientific papers.The unit does annual surveys of harvested and non-harvested areas to determine the effect of harvesting and to establish biomass and density of resources through direct *in situ* measurements. Current and recent work is listed below.

Kelp

Present research includes annual monitoring of the resource, basic biological data to better understand growth, distribution and relationships between the various species (including DNA studies),effects of environmental factors on growth of the gametophytes and sporophytes, morphological studies, etc.

Tall kelp plants forming a canopy over varied benthic life, in a kelp bed in False Bay, Cape Peninsula.

Gelidium

Considerable research on our *Gelidium* was done in the 1980s and early 1990s, and at present we annually monitor density and biomass of harvested and non-harvested populations at various locations.

Gracilaria

Natural populations of our gracilarioids (*Gracilaria* and *Gracilariopsis*) in Saldanha and St Helena Bays have been studied over the last two decades, but at present these are not commercially exploited and research efforts are instead concentrated on kelps.

Large amounts of *Gracilaria gracilis* sometimes wash out of Saldanha Bay, but current low prices for this agar-containing seaweed mean that it is no longer collected there – this photo was taken in the 1990s.

Potential resources

A number of our seaweeds have the potential for commercial use. Some are species were used in the past, but harvesting stopped when prices fell (e.g. *Porphyra*, *Gigartina*, *Sarcothalia*, *Mazzaella*), and these and others (e.g. *Ulva*) may have potential for use in future (see Anderson *et al*., 1989). Such potential will depend on market prices or new uses for the chemicals they contain. Meanwhile, we try to anticipate possible candidates for commercial use and we do the research that allows managers to set sustainable limits for harvesting.

Gigartina polycarpa, a local species that produces the colloid "carrageenan", has been collected commercially in the past.

EAF Considerations

These differ according to the resource species. Harvesting of *Gelidium pristoides*, as currently practised, has negligible effects on this seaweed or other intertidal populations (numerous publications are summarised by Anderson *et al*. 1991). Maximum Sustainable Yields of kelp that may be harvested, as set in permits, incorporate past and current research findings in order to minimise any ecological effects that harvesting may have, and ongoing monitoring indicates these to be slight.

2. Research on Seaweed Diversity and Climate Change

Aims: to document the diversity and biogeography of the South African seaweed flora in rela tion to current environmental conditions and to check for introductions of alien species.

For publications on seaweed diversity and climate change click here.

Responsible Officer:
Dr RJ Anderson

For seaweeds, the coast of South Africa includes three distinct biogeographic marine provinces that are determined by sea temperatures: the cool temperate Agulhas Province (south coast) and the tropical Indo-West Pacific Province (northern Kwazulu-Natal). In between these are transition zones, where temperatures are intermediate between those of the adjacent provinces. In total, some 850 seaweed species are recorded from our coast.

One of our many species of green seaweeds, the striking *Caulerpa filiformis* is common on our south and east coasts, especially in sandy gulleys.

Seaweeds are excellent indicators of water temperature in the shallow inshore zone. Like most living organisms, each species tolerates a distinctive range of temperatures and therefore has a particular geographical range that is largely or entirely determined by sea temperature. Also, seaweeds are sessile (they cannot swim away when the temperature becomes unfavourable), relatively long –lived (usually a year or more), often dominant on the shore, and easily collected. Furthermore, the term "seaweeds" includes three phylogenetically distinct phyla (the "greens', "browns" and "reds"). The result is that they are very useful in studies of biogeography and should be particularly useful as biological indicators of medium to long-term changes in sea water temperature ("climate change").

The genus *Laurencia* is common on our south and east coasts, with numerous species that probably contain noxious chemicals to protect them from grazers. *Laurencia complanata* (shown here) is a particularly attractive species.

The Seaweed Unit collaborates with local and overseas scientists to improve our knowledge of the species on our coasts and their distributions, for an essential baseline understanding that will allow us to detect any human or environmental effects on our inshore zone. Staff members have collected new species and contributed to many publications on seaweed diversity, including two books on the SA seaweed flora (the West coast and the coast of Kwazulu-Natal).

Frequent monitoring of the species composition of our coasts also allows us to detect the arrival of any introduced seaweeds, some of which may pose a threat to local ecosystems.

The alien red seaweed *Asparagopsis taxiformis* has reached several parts of our coast. These plants are growing in Knysna estuary.

3. Research on Seaweed beneficiation

Aim: To investigate the potential of South Afri can seaweeds for commercial use including cul tivation.

Responsible Officers:
Dr RJ Anderson and Mr MD Rothman.

For Seaweed Unit publications on beneficiation click here.

This covers research on useful products from seaweeds, as well as on the aquaculture of South African species. The Seaweed Unit also collaborates with, and supplies material to local researchers who are analysing our seaweeds for interesting and potentially useful chemicals.

Cultivation of many seaweeds requires that different life-history phases are grown and studied in the laboratory, such as this very young female kelp gametophyte. (The spore that it is emerging from is on the right).

Our aquaculture research has shifted from investigations of open-water cultivation of the red seaweed *Gracilaria* (see references) to ecophysiological, lab-based studies of several other seaweeds, including *Ulva* and *Porphyra*. Current work includes studies relevant to the production of seaweeds for abalone feed, and collaboration with a Namibian scientist on cultivation of kelp.

This large abalone farm at HagaHaga in the Eastern Cape is one of several that produce much of their abalone feed by growing the seaweeds *Ulva* and *Gracilaria* in massive raceway ponds (on the right). Laboratory research on the ecophysiology of these seaweeds assists abalone farmers to improve their methods of cultivation.

Contact details

Dr Robert James Anderson
Specialist Scientist
Seaweed Unit
Inshore Section
Fisheries Branch, DAFF
Robert.anderson@uct.ac.za
021-689 3032

Dr Anderson obtained a PhD in phycology from the University of Cape Town 1982, when he joined the Seaweed Unit, and since then he has published extensively on southern African seaweeds.

Mark Rothman
Scientist
Seaweed Unit
Inshore Section
Fisheries Branch, DAFF
Mark.Rothman@uct.ac.za
021-689 2971

Mr Rothman joined the Seaweed Unit in 2001, and obtained an MSc in phycology from UCT in 2005. Since then he has concentrated mainly on kelp research, and is currently doing a PhD on Southern African kelp distribution, biology and taxonomy.