

Coastal Dunes in Brittany and Their Management

André Guilcher and Bernard Hallégouët

Dynamique et Gestion des Espaces Littoraux

URA D0904 CNRS

Université de Bretagne Occidentale B.P. 814

29285 BREST, France

ABSTRACT



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Coastal dunes are scattered in many places around Brittany, Western France, the largest dune belt being found in the south between Lorient Roadstead and the Quiberon Peninsula. Their primary construction was initiated during a slight regression interrupting the Holocene transgression just after the Bronze Age (± 2400 BP). They continued to be locally fed until the 18th Century, but at present time new dunes are no longer built, except for a case found in the Bay of Audierne, and for the feeding *in situ* of beach ridges by wind, *e.g.* at Goulven, Pays de Léon, which does not lead to edification of real eolian dunes. Following the Second World War, coastal tourism and urbanization have threatened these dune belts. Scientists and activist groups interested in nature conservancy have approached commune councils and civil engineers with information concerning dune degradation and management. With the help of the French Ministry for Environment, the situation has been gradually improved. During the past decades, many areas have been protected by processes of dune preservation without preventing access to beaches. The type of management of the protected or restored dune remains, however, a matter of discussion.

ADDITIONAL INDEX WORDS: *Brittany, coastal dunes, coastal protection, coastal management, dune-beach association, sea-level change, tourism.*

INTRODUCTION

Although the management of the Breton coastal dunes has recently generated considerable interest, only a few geomorphological studies of local sites have been published so far. In spite of their comparatively small size, these dunes are of local importance. Only the area covered by the four "departements" (counties) of Finistère, Morbihan, Ille-et-Vilaine and Côtes-d'Armor, included in Région de Bretagne, is considered here. Loire Atlantique is omitted although it is the site of the former Breton capital, Nantes, and thus belongs also to historical Brittany.

This paper characterizes the distribution of the dunes, and their origin and historical development during the Upper Holocene. The main dune types are defined; the dune belt found between Gâvres and Quiberon, which is by far the largest one in Brittany, is described separately because of its size, although it does not form a special type. In a subsequent part, the

problems of management are exposed and the fate of the dunes in the proximal future is examined.

GEOMORPHOLOGY

Distribution

Breton coastal dunes extend over 297 kilometres, 10.6% of the total length of the Breton coast (Figure 1), and they cover approximately 12,000 hectares. They occur principally on the north coast of Finistère (Pays de Léon) and in Morbihan between Gâvres and Quiberon. Large areas of dunes exist also in South Finistère. Only very small dune belts are found in the eastern part of Côtes-d'Armor and Ille-et-Vilaine, being located in bays and near mouths of small rivers.

Along the English Channel in Pays de Léon (Figure 1), they are situated on a low coastal platform where they often rest upon Pleistocene solifluction deposits, and partly obscure inactive cliffs which occur inland of these forma-

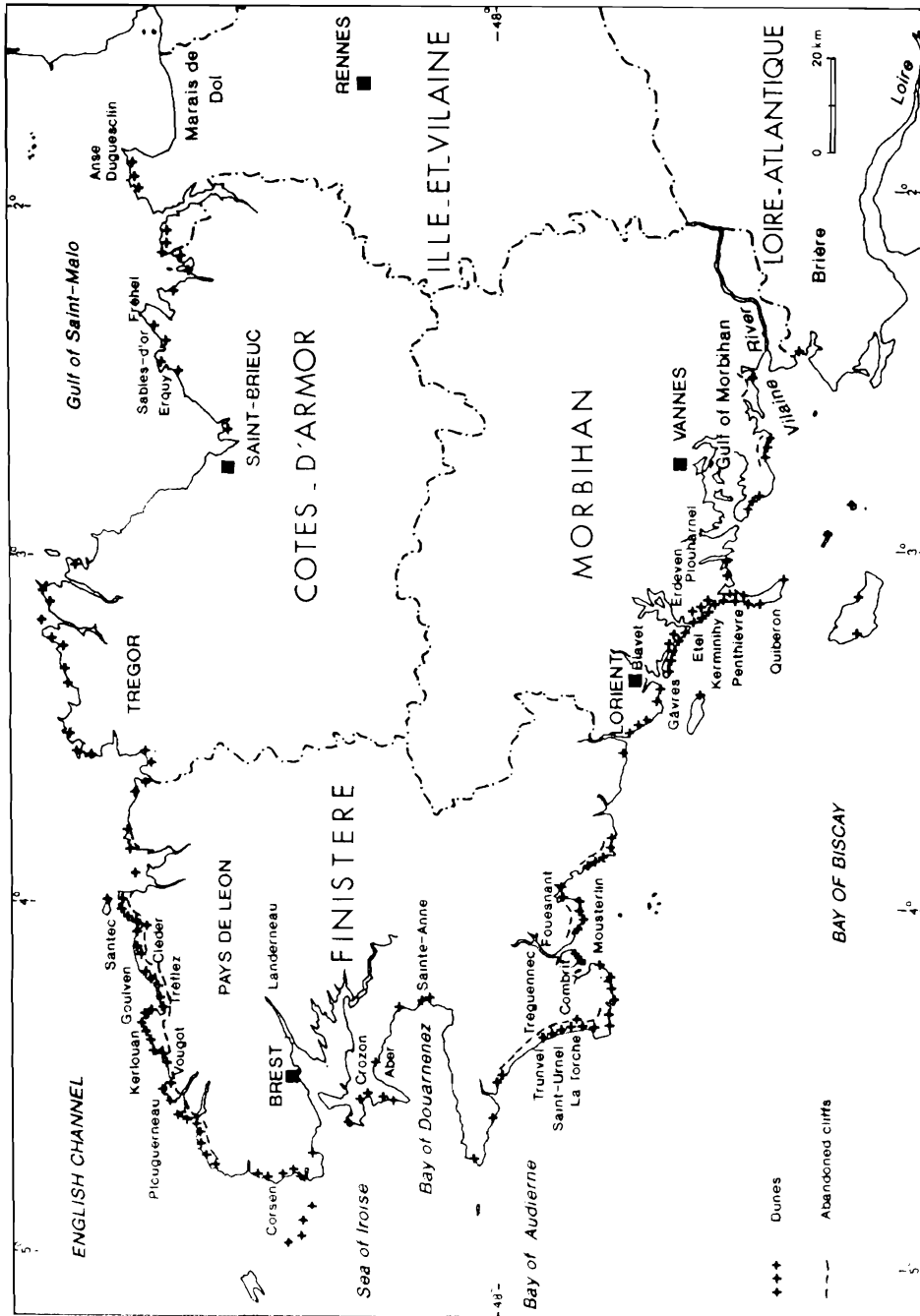


Figure 1. Distribution of coastal dunes in Brittany.

tions. Sometimes, as in the Kerlouan peninsula, they developed several kilometres seaward of these cliffs over a platform, on which they dam swampy depressions. On the west coast of Finistère they were fed by westerly and southwesterly dominant winds. Farther south and southeast in Finistère and Morbihan (GUILCHER, 1948), they are also anchored on rocky platforms, as at Moustierlin, or on higher and larger features, as the Quiberon former island now tied to the continent by a dune-covered tombolo. In these places they dam shallow water bodies, or marshes, or swamps as the so-called "Mer" de Gávres (cf. Figure 7), Plouharnel lakelets, Moustierlin swamp now reclaimed, or they extend inland in undulated plains as in the Bay of Audierne (Figure 1) and at Erdeven (cf. Figure 7).

Origin and Development

The Breton dunes were mainly built during the end of the Holocene sealevel rise after the Weichselian (Wisconsinian) regression. Their sediments derived from the winnowing of periglacial deposits, which had been extensively produced by frost shattering during the glaciation in areas now submerged off Brittany in the English Channel, Sea of Iroise and Bays of Audierne and Biscay (Figure 1). The coarse residual fraction of these deposits has been identified and shown on a series of sedimentological maps at the scale of 1:100,000 of the nearshore continental shelf [GUILCHER (director) 1968 to 1975]; the sandy fraction, blown by wind, formed the dunes. To understand their building, however, it is necessary to consider in which way the Holocene transgression occurred in Brittany.

It is well known from studies carried out throughout the world, compiled by BLOOM (1979) and more recently by Pirazzoli in another atlas still in preparation in Paris, that the curves of sea level rise during the Holocene have been locally quite varied, even outside glaciated areas. In Brittany, especially in Pays de Léon and in Marais de Dol (Figures 1 and 2) and also in Marais de Brière near the Loire estuary, where the investigations have been especially accurate, the rise was a shifting or oscillating type (GIOT, 1968; DELIBRIAS *et al.*, 1971; MORZADEC-KERFOURN, 1974, p. 176 and 185; VISSET, 1979). These conclusions

are based on coastal peat bogs, prehistoric and protohistoric remains. Sea level seems to have reached approximately the present elevation between 3500 and 3000 BP. Evidence for this stage is the existence of brackish peats, in Brière and Marais de Dol, cut off from the sea by coastal ridges which protected them from a later marine transgression. True dune development is, however, not indicated at that time by remains, and it appears from multiple sections that the first aeolian deposits which still exist were related to a later marine regression dated at the Iron Age or La Tène Celtic period (± 2400 BP), during which the sea level was lowered to 4-5 m below the present datum. Large masses of sand then exposed over wide intertidal areas were blown by sea winds and carried inland. There is a general agreement among pre- and proto-historians to consider that the main bulk of the Breton dunes has been related to this episode.

Later periods, however, have brought other contributions. Precise evidence derives from the low sandy area just behind the Bay of Audierne, southwest Brittany, where archaeological excavations in Breton graves (GIOT *et al.*, 1977) have shown the existence of a former sand dune of Iron Age, which, later than a set of graves dated at 1500-1350 BP, was covered by a new dune divided into several stages with intermediate thin soils. The upper part of this new dune is cut by other graves dated at 1000 BP. Later, these dunes in the Bay of Audierne were disturbed by a series of large storms, as indicated at La Torche peninsula (GIOT *et al.*, 1947; GUILCHER, 1948, p. 283) by a layer of shelly gravel and small pebbles rising to 2 metres above present-time sea action, and dated now (GIOT, 1968) at around 600 BP. It may be that this episode of dune disturbance would have resulted in the old shorelines found in the inner part of the large dune belt of Gávres-Quiberon area.

In still more recent times, another progradation of Breton dunes is apparent during the 17th-18th Centuries, at Santec and Plouguerneau in Pays de Léon, in the Crozon peninsula, and in Loire-Atlantique. Churches (*e.g.* Kozilis, Plouguerneau, where investigations are still in progress in 1990) and even villages were buried, and trees were planted to try to stop the sand invasion. This episode seems to be mainly related to the climatic degradation correspond-

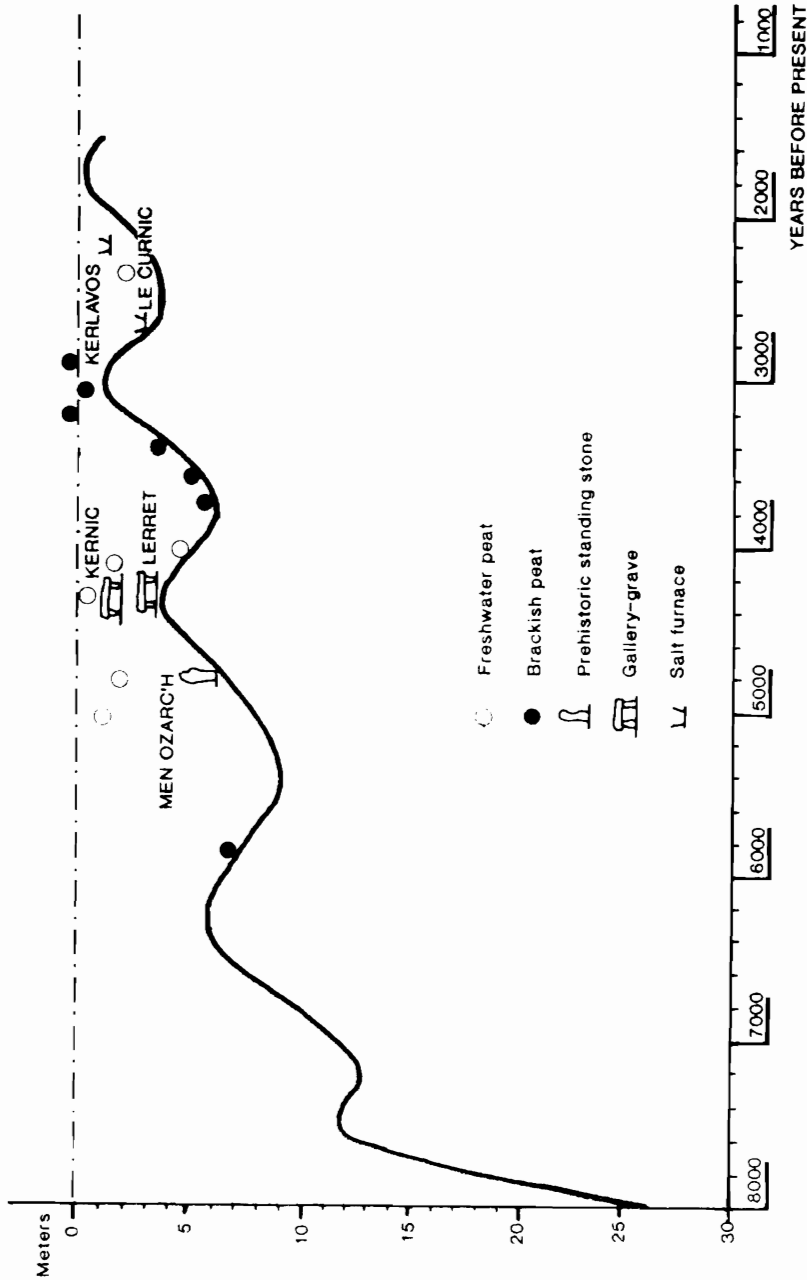


Figure 2. Oscillating rise of sea level during the Holocene in Brittany, as testified by peats and prehistoric remains. (Mainly according to Morzadec-Kerfourn, 1974, p. 176 and 185).

ing with glacial advances in the Alps and other mountains. Even in present time, some small modification by wind is still in progress, in combination with wave action on adjacent beaches.

This history leads to a tentative classification of Breton dunes.

Breton dune types

The dunes can be classified in two general sections: inactive and active dunes. The main group of dunes is found in Morbihan, South Brittany, between Gávres and Quiberon: it does not constitute a real type, but, owing to its size, unusually large in Brittany, it will be characterized and described separately after the types.

Inactive Dunes

This type includes the larger part by far of Breton dunes. Even the dunes which were mobile in the Eighteenth Century have remained stable except in places where they were disturbed by farmers, or, in most recent time, by tourism (see degradation). In larger dune belts, forms are generally irregular or flat, with sometimes crests, more or less parallel to the shoreline, breached by old blowouts now stabilized by vegetation. An example of these former blowouts was found at Blancs Sablons, West Brittany (Figure 3) before this site was disturbed by humans (see degradation). In many sites, a flat foredune extends between the main dune belt and the beach, with a few parabolic structures. Marine pebbles and worn marine shells are found in quarries over these flats, resulting from alternations of sea and wind prevalent action, tied to tiny variations in sea level and occasional storms as in the Bay of Audierne.

Active Dune-Beach Associations

Some sites point to an association still in progress, between waves and wind in building successive ridges which are not true dunes. Such is the case at Penn ar C'Hleuz in the Bay of Gouven, Pays de Léon (Figures 4 and 5, located on Figure 1), a site which has been surveyed in detail (HALLEGOUET *et al.* 1976, 1979; HALLEGOUET, 1978, 1981; GUILCHER, 1978; MENEZ, 1977). Sandy beach ridges are being built by waves during winter storms; subsequently these ridges receive eolian supply in spring and summer, and are quickly stabilized by vegetation (*Ammophila arenaria*, *Agropyron junceum*). As the coast progrades by surplus of sand, provided by a concomitant erosion of the sandy shore updrift, farther east, successive ridges are built, preserving their individuality

instead of being amalgamated into a single large dune by the wind. In other words, the successive ridges are of mixed origin, being initially marine but later enlarged by wind *in situ* and stabilized as such by vegetation.

Similar compound beach ridges have been mentioned by HALLEGOUET (1981) and CASTRO (1981) in four other Breton sites, other ones by HALLEGOUET (1981) in Vendée and the Cotentin Peninsula, south and northeast of the Armorican Massif, and also by RUZ (1989) in Southeast Ireland; Magilligan Foreland in Northern Ireland (CARTER, 1975, 1986) seems equally to Guilcher, after a visit to that site, to be, partly at least, the product of the same process. It has been suggested (MENEZ, 1977; GUILCHER, 1978) to classify these ridges into the Darss type, described in detail by OTTO (1913); it is true that the Darss promontory on the German Baltic coast is, in addition, subject to slight variations of sea level special to the Baltic (KOLP, 1982) but it remains to prove that these events had really an impact on building of the ridges.

It seems difficult to include this compound type into the coastal dune development scenarios proposed recently by PSUTY (1988) for combinations of dune and beach sediment budgets, and, since it seems to be rather widespread, in Europe at least, it is suggested to consider it separately.

Dune Renewal Related to Present-Time Human Action

Recent destructive human action on Breton coast, which will be mentioned for dunes in the second part of the paper, has led in the south of the Bay of Audierne to a formation of new dunes. A long and high pebble ridge has been largely destroyed there since the 1940's, first through exploitation of the pebbles by the German Army, and second during several decades by local contractors. The result (Figure 6) has been a strong (100 metres) retreat of the shoreline, hence a widening of the sandy beach exposed at low tide. This wide beach has presented a source of sand, unusual now in Brittany, which allowed since 1968 the building of small (up to 10 metres) sand hummocks on the low backshore behind. These incipient eolian accumulations are already fixed by vegetation, although subject to deflation with blowouts;



Figure 3. The Blancs Sablons Holocene dunes, located on Figure 10. Situation in 1927, before human degradations in the fifties-sixties. Photograph by the French Hydrographic Office, reproduced with permission. Series of almost inactive blowouts in the outer part, ending in a flat sandy area in the inner part. Sand is almost completely colonized by grass (outer part) and furze (inner part). The military forts were built in the middle of the 19th Century.

during great storms which occurred in December 1989–January 1990, they were invaded by the sea. This event shows that dune building is presently possible in Brittany when a source of sand appears.

Gâvres-Penthièvre (Quiberon) Dune Belt, Morbihan

On this dune belt (Figures 7 and 8), not especially remarkable by the types of dunes which it includes, but principally by its size (25.5 km long and up to 4.5 km wide), there is a general description in GUILCHER (1948), p. 333-336 and some more recent observations, yet unpublished, by one (B. H.) of the present authors. These dunes are located in a reentrant of the coastline between the rocky promontories of Gâvres and Quiberon, to which the dunes are tied at their two ends. It appears that, during

one of the final phases of the Holocene transgression, the outline of the outer beach to which the dunes were related was situated at 2 to 5 kilometres off its present location (symbol 3 on Figure 7). The evidence for this is the occurrence of dead, fossil dunes resting on the top of the cliffs at Kerhostin and Portivy, Quiberon (Figure 8) and no more fed by beaches; similar but smaller dunes are found at Gâvres at the other end of the dune belt. These remnants require a former location of the dune front (and its beach) much more southwesterly than now.

Since the retreat, the dune front and its beach are anchored on several low rocky outcrops (Magouero, La Roche Sèche, Kerhillio: Figures 7 and 8) which make the outline a little irregular. The evolution may be precisely determined since 1737 from successive surveys kept in Archives of the French Hydrographic Office (references and details in GUILCHER, 1948,

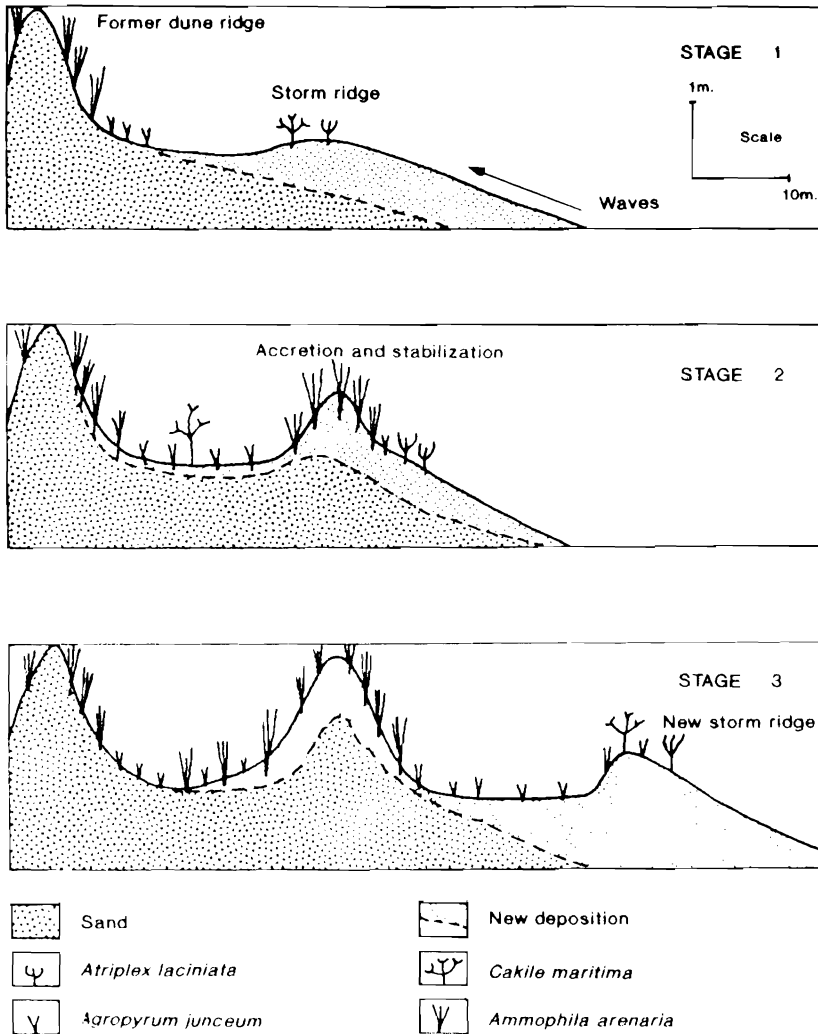


Figure 4. Duneification of beach ridges as at Penn ar A'Heuz, Goulven. Pays de Léon. (Simplified from Hallégouët, 1981).

pp. 333-337), and especially accurate because of the vicinity of the Lorient naval harbour. These surveys show that, since the middle of the 18th Century, the shoreline continues to retreat. At its northern end near the rocky promontory of Gâvres, a cut occurred in 1758 with a passage between the open sea and "Mer" de Gâvres; this passage was closed before 1819. From 1819 to 1918, the shoreline retreated on 50 metres near Gâvres, on 30 to 60 metres between Magouero and the entrance of Rivière d'Etel, on 120 metres just at the south of this entrance. The

former evolution assumed on Figure 7 (symbol 3), is thus confirmed in recent time.

A place of particular interest is the Pen-thièvre isthmus, where the dune belt tends to be cut from the rocky promontory of Quiberon. Such a cut seems to have occurred at some historical stage, being testified, at the east of a sand plain by a long, straight sand ridge (symbol 9 of Figure 8), utilized by the German fortifications of World War II, and still prominent on the shoreline of the Bay of Plouharnel. This old cut was subsequently filled up. During the



Figure 5. General view of the Penn ar C'Hleuz dunified beach ridges. (Photo by B. Hallégouët, 1981).

250 last years, successive surveys (details in GUILCHER, 1948, p. 336) show that the isthmus was 200 m wide in the 18th Century, 110 m wide in 1820, 50 m wide in 1908, and 40 m wide in 1940. So, it tends now again to be cut, but it is artificially maintained by a dam which protects the road and the railroad connecting Quiberon to the continent. In the Bay of Quiberon, a northerly drift feeds in sand the Sables Blancs beach and has built a set of ridges ending at Pen er Lè (Figure 8, symbol 6) which thus continues in direction the old sand ridge (symbol 9) previously referred to.

Such is the general frame of the Gâvres-Penthièvre dune belt. The dune belt itself includes:

- (1) A coastal sand ridge just behind the present-time shoreline (symbol 5, Figure 8) which follows in its outline the general, slow coastal retreat;
- (2) behind this ridge, shapeless sand plains, especially at the north of Penthièvre and behind Kerhillio beach;
- (3) old dune ridges with blowouts at La Falaise (symbol 8 on Figure 8); and
- (4) cliffs in stabilized dunes at the west of Sainte Barbe and Kerivel (symbol 9), which appear to correspond to a former shoreline, because marine shells and pebbles are found in front of them in excavations made by contractors.

Thus a period of progradation seems to have interrupted there the general trend of retreat. Very shallow lakes and swamps occur behind the dunes which dam them. In the north, between "Mer" de Gâvres and the outer coast (Figure 7), another ridge inside the dunes seems also to continue the old shoreline found west of Sainte Barbe and Kerivel. So the dune belt appears to have had a complex history, the general retreat eastwards having probably alternated with episode(s) of progradation, which remain to be determined and dated in further studies, such as those made in the Bay of Audierne (see origin and development).



Figure 6. Incipient (post 1968) dunes in the Bay of Audierne, built after destruction of coastal pebble ridge, retreat of shoreline and widening of foreshore. Retreat is shown by location of German bunkers and an aqueduct previously ending at coastal pebble ridge. (Photo by R. Chatain, 1990).

DEGRADATION AND MANAGEMENT

Natural Degradation

Coastal dunes are dynamic features since the sand mass available for their growth can vary through time by changes in seaside supply and modifications in longshore drift. Such scenarios appear in Psuty's paper (1988) and do not need long general comments here. Moreover, the contemporary general rise of sea-level, which results in Brittany in increased effects of storm surges in estuarine cities as Landerneau, Finistère, could have caused readjustments in sand supply. However, a comparison between an old set of very accurate maps surveyed by the Royal Engineering Cartographers at the scale of 1:14,000, between 1773 and 1776, and the present situation, leads to the conclusion that natural changes in the outline of the coast in Pays

de Léon and Trégor have never exceeded 50 metres in progradation or retreat (GUILCHER, BODERE and HALLEGOUET, 1990). From time to time gales and storms encroach temporarily upon the dunes, as occurred in 1984 and 1989, but, later on, sand is generally supplied again from the beaches and allows the dune fronts to be rebuilt.

Man-Made Degradation

Contractors have heavily degraded some dune belts by sand extraction, as at Goulven and Saint Pabu, Pays de Léon, and even more in the Bay of Audierne and at Erdeven, Morbihan. Farmers have exploited and still exploit calcareous sand on foreshores for field improvement, and the recent development of this old practice with modern machinery has resulted in present retreat of the Penn ar C'Hleuz structure

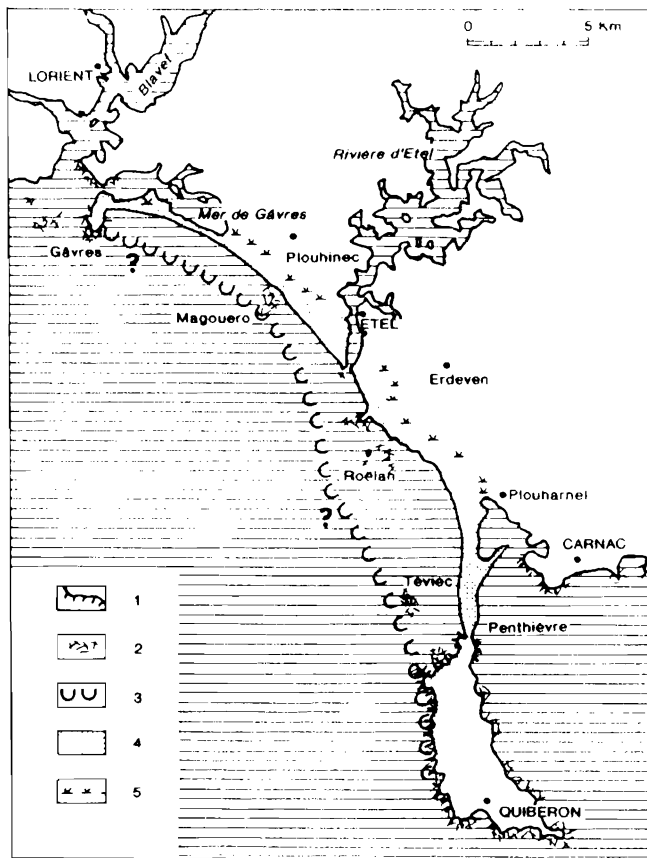


Figure 7. General map of Gávres-Erdeven-Penthièvre-Quiberon coastal area. (1) rocky cliffs, (2) intertidal rocks, (3) old shoreline and foredune location, as evidenced by fossil dunes on cliffs at Quiberon and Gávres (after Guilcher 1948). (4) 1990 dune belt, (5) marshes and swamps behind the dunes.

in the Bay of Goulven, Pays de Léon, described in section 3b, which had been prograded westwards until 1978. Traditional uses as seaweed drying, cut of earth lumps and cattle pasture tend to disappear, but crops favoured by sand as tulips and asparagus are being developed on dunes in the Bay of Audierne. However, the worst damage is caused by the huge expansion of coastal tourism in the post World War II period (Figure 9). Walking, camping, riding, driving, and especially motorcycling have ravaged the dune vegetation and caused remobilization of the sand. The use of the Gávres-Quiberon dunes by the French Army and Navy has been an additional disruptive cause (on the other hand, the military occupation of dunes has prevented them from urbanization). Dune

landscape has been widely modified by the planting of conifer woods around summer houses: *e.g.* at Cléder in Pays de Léon. Some commune (parish) councils, which own the forested dune areas, have attempted to sell the land for house building in order to get money and create jobs for the local people.

Management

Management of the Breton coastal dunes has been progressively improved since 1960, by a series of official regulations instituted by the French government, and thus not unique to Brittany; and by local initiatives and efforts. The French general regulations (GUILCHER *et al.*, 1977) create the general framework for

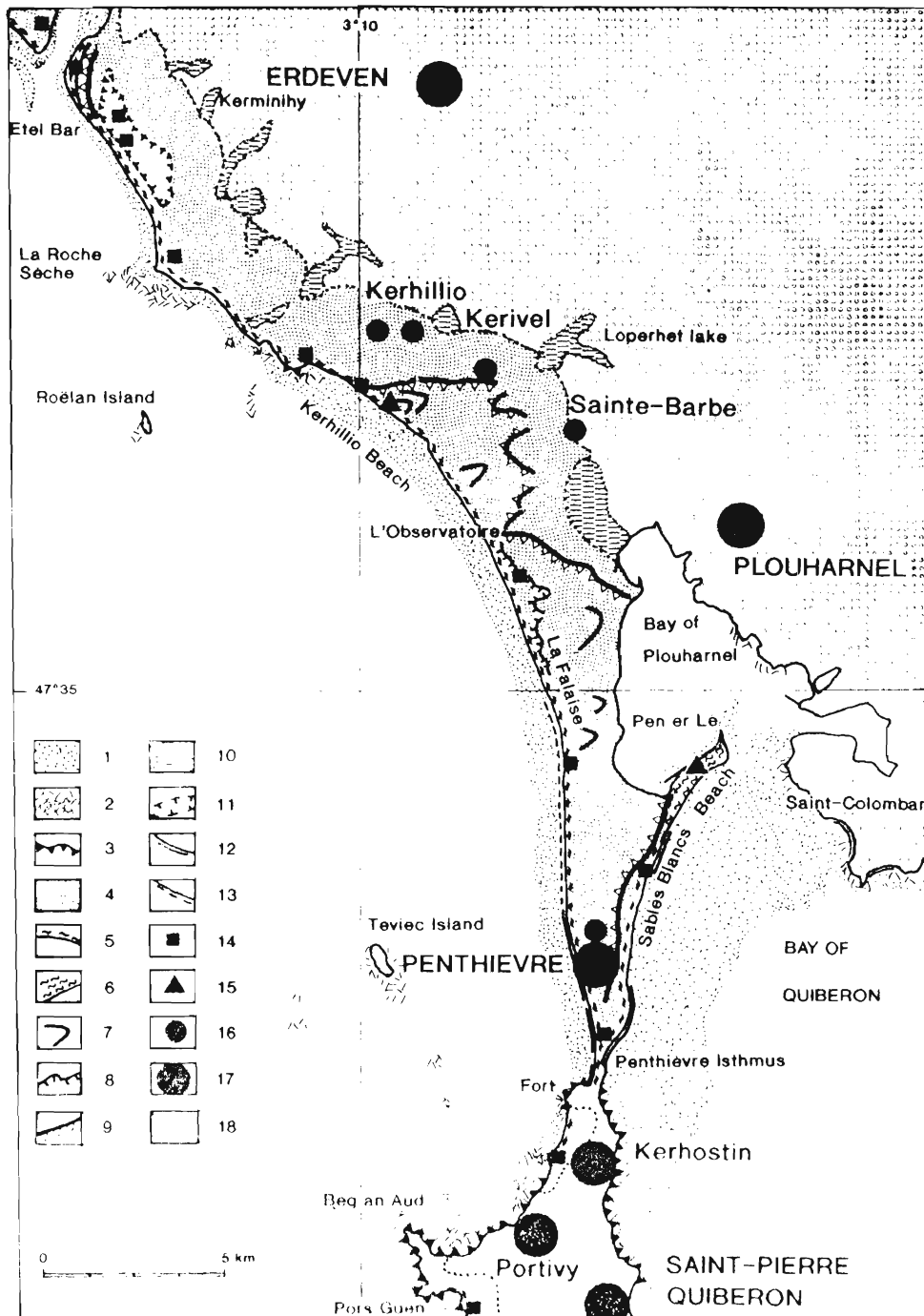


Figure 8. Detailed map of Erdeven-Penthièvre dunes and their surroundings. (1) beach, (2) intertidal rocks, (3) rocky cliff, (4) dunes, (5) foredune, (6) beach ridges, (7) dune crest, (8) old dune ridge with blowouts, (9) former cliff in old dune, (10) lakes and marshes, (11) old quarry now closed, (12) man-made wall, (13) wall made of railway sleepers, (14) parking, (15) camping, (16) hamlet, (17) larger village or township, (18) farming soils and fallow land.



Figure 9. An example of dune degradation and coastal tourism at Vougot, Pays de Léon. (Photo by A. Guilcher 1984). In 1990, the situation has greatly improved there.

management. The 1960 law on “sensible boundaries” was the first step that allowed the department (county) councils to buy private properties for their protection. Laws governing the creation of National and Regional Parks were promulgated in 1960 and 1967. The major development concerning the dunes was the creation, in 1975, of the Coastal Conservancy (Conservatoire de l’Espace Littoral), patterned on the National Trust of Britain. However, unlike the British program, the French Coastal Conservancy is a public entity, and is allowed to buy or receive coastal lands (dunes, headlands, cliffs, marshes and coastal lakes) and to delegate their management to public councils or private societies for nature conservancy. At the beginning of 1988, 1273 hectares of dunes and adjacent marshes had passed on public ownership in Brittany (Figure 10), of which 1098 were located in Finistère. In 1986 a gen-

eral law on coastal management was passed, its main aim being the protection of littoral spaces, but leaving possibilities for economic development when required, and delegating the management authority to a joint participation of local and regional councils.

On the local side, the Society for Study and Protection of Nature in Brittany (Société pour l’Etude et la Protection de la Nature en Bretagne, SEPNEB), created in 1958, has played an outstanding role in its collaboration with the Coastal Conservancy since it manages a large part of the dunes bought by that agency. The Department Councils have also bought some dune areas, for example in the northeast of Cap d’Erquy and Sables-d’Or-les-Pins (cf. Figure 1). The DDE (Directions Départementales de l’Équipement) bring a technical and financial contribution to field works in association with SEPNEB. More and more commune (parish)

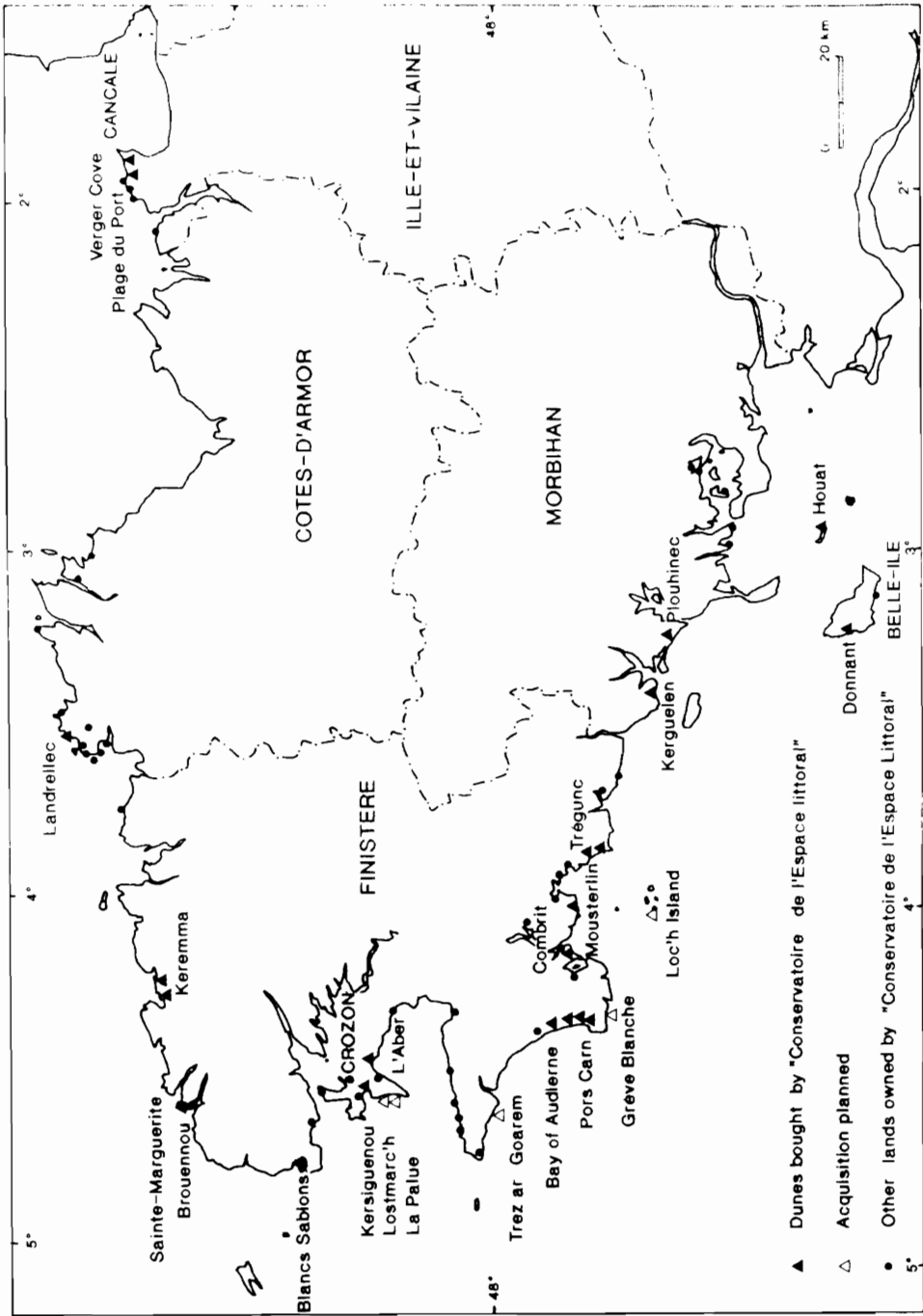


Figure 10. Map of dune acquisitions by Coastal Conservancy.

councils have become interested, and some of them, as at Trégunc, South Finistère, have been quite dynamic in protecting the vegetation of their dune belts and preventing degradations by visitors.

A local exemple of successful management is the Blancs Sablons dunes, in Le Conquet commune, West Finistère, which covers 44 hectares and had been very badly damaged by vacationers from 1952 to 1977. After the Conservancy bought them in 1978, the rehabilitation was undertaken by DDE and SEPNB in collaboration with the commune council (Figure 11). The aim was to restore the vegetation without preventing vacationers from reaching the beach. Marram grass was planted in sections of loose sand closed by "ganivelles," *i.e.* wooden fences; footpaths made of old railway sleepers were directed across the plantings; a camping and trailer site was prepared behind the dunes. The

results may be considered as excellent. The marram grass plantations have proved very efficient in stopping eolian erosion and blow-outs.

In addition to grass planting and creation of footpaths, the techniques of using geotextile nets or geocontainers have been used with some good results to stop the loose sand, *e.g.* at Combrit, Finistère (Figure 12). There are numerous publications on these techniques and the results, more or less successful according to places (summarized in HALLEGOUËT *et al.*, 1986 and 1989). Quarries in dunes have generally been closed, but, unfortunately, farmers continue now in some places to extract sand (80 000 m³ behind the Kernic spit, north Brittany, in 1989). The problem of motorcycling in dunes remains unfortunately to be solved.

On the sandy shorelines themselves, the classic technique of groines has not been often used



Figure 11. Dune management by SEPNB, DDE and Coastal Conservancy at Blancs Sablons, Pays de Léon. Ganivelles, footpath, marram grass growing. (Photo by B. Hallégouët, 1982).

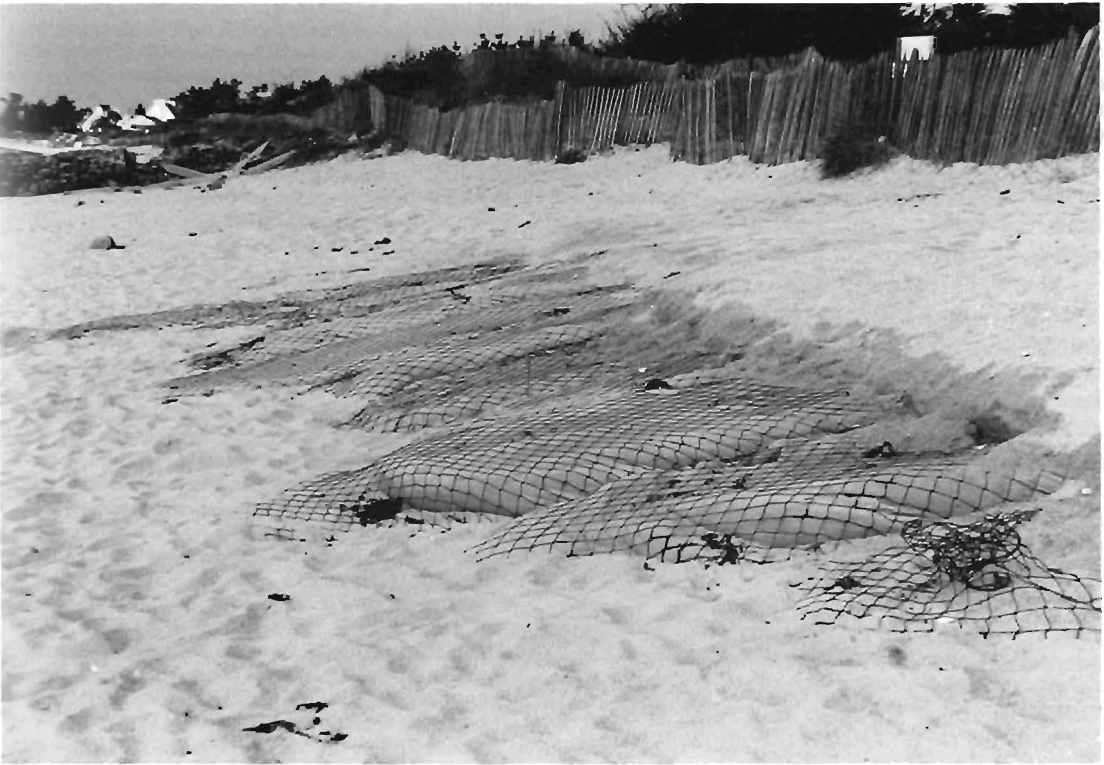


Figure 12. Geotextiles in Combrit dune, south Finistère. Small erosion scarp just behind. Wooden fences in background (Photo by B. Hallégouët, 1988).

in Brittany since it has generally been disappointing where it was tried (CASTRO 1981, and others). An acute problem derives from the fact that, in a large number of places, the commune councils have tried, under the pressure of individual owners of summer houses, to stop completely the natural evolution of the shoreline. Consequently, they have built massive and expensive walls of different types: big blocks of granite, concrete, etc, by which they attempt to stabilize the shore at any price. The commune of Fouesnant, South Finistère, follows this approach, but also others, for example between the Gulf of Morbihan and the Vilaine Estuary. The generalization of such walls doesn't appear reasonable, as suggested by PASKOFF (1989) and GUILCHER (1990) for other areas.

Another problem is that, in some sites bought by the Nature Conservancy, the newly managed landscape has begun to show aspects dif-

ferent from the natural ones. Some communes have periodically the grass cut, and the vegetation turns more or less into meadows, so that, even where they are preserved from destruction or house-building, the Breton dunes tend partly to become half-anthropic features.

CONCLUSION

The origin of the Breton dunes as a whole seems to be now reasonably known. Dune formation in Brittany has been spread over a long lapse of time, although the main events occurred during the Iron Age. The particular site of the Bay of Audierne, where dune growth is still possible (cf. Figure 6), is encouraging, but there is no blinking the fact that such cases remain very exceptional. However, the dune-beach associations, as shown on figures 4 and 5, which do not consist of real eolian dunes, but of hybride edifices, are still in progress of growth,

and it will be interesting to determine their extension outside Brittany. It is unfortunate that the largest Breton dune belt, between Lorient and Quiberon, remains still to be investigated in detail, and a description of its precise shapes and history must be a priority in the foregoing years.

The second part of the 20th Century has been, in Brittany as in many other developed countries, a dreadful period for the coastal dunes with the general rush of holiday makers to the sea shore. Fortunately, the recent efforts for protection and restoration have led to important results, and the local populace seems now, as a whole, sufficiently aware of the need to prevent the disparition of the dunes. But there is a continuing conflict between those who want to restore the dunes to their natural state and traditional activities, and those who wish to change them into gardens for holidays makers: so that the problems of management remain still a matter of discussion.

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□ RÉSUMÉ □

Des dunes littorales se répartissent en de nombreux endroits des côtes de Bretagne. Les plus vastes sont situées dans le sud, entre la rade de Lorient et la presqu'île de Quiberon. Leur édification commença lors d'une légère regression qui interrompit la transgression holocène, durant l'Âge du Fer (± 2400 B.P.). Plus tard, localement, leur formation se poursuivit jusqu'au 18 siècle; mais actuellement les plages n'en nourrissent plus, sauf très exceptionnellement dans la baie d'Audierne. Parmi les types, on doit distinguer particulièrement celui, bien représenté dans la baie de Goulven, dans lequel des crêtes sableuses de plage successives s'engraissent sur place au lieu de former de véritables dunes bordières. Depuis 1950, le tourisme, l'urbanisation et l'extraction de sable ont souvent endommagé les dunes bretonnes. Grâce aux efforts conjugués des administrations et des associations de protection de la nature, la situation s'est maintenant améliorée, et diverses procédures ont été mises en oeuvre pour réhabiliter les paysages dunaires. — *Catherine Bousquet-Bressolier, Géomorphologie EPHE, Montrouge, France.*

□ ZUSAMMENFASSUNG □

In der Bretagne (Westfrankreich) sind Küstendünen an vielen Stellen verbreitet. Der längste Dünengürtel befindet sich im Süden zwischen Lorient Roadstead und der Quiberon-Halbinsel. Ihre Bildung setzte während einer leichten Regression ein, die die holozäne Transgression unmittelbar nach der Bronzezeit unterbrach (± 2400 BP). Örtlich bildeten sie sich bis zum 18. Jahrhundert weiter. Gegenwärtig entstehen keine neuen Dünen. Ausnahmen bilden eine Dünen in der Bucht von Audierne und das Anwachsen von Strandwällen durch äolische Zufuhr von Sand, wie z.B. bei Goulven, Pays de Leon, was aber nicht zum Aufbau ausgeprägter Dünen führt. Nach dem Zweiten Weltkrieg haben Küstentourismus und Urbanisationsprozesse die genannten Dünengürtel bedroht. Wissenschaftler und Naturschutzorganisationen haben sich an Gemeinderäte und Küstenschutzbeauftragte gewandt, um diese über die Zerstörung der Dünen und die notwendigen Maßnahmen zu ihrer Erhaltung zu informieren. Mit der Hilfe des französischen Umweltministeriums konnte die Situation allmählich verbessert werden. Während der vergangenen Jahrzehnte wurden viele Gebiete vom Dünenschutz erfaßt, ohne dabei den Zugang zu den Stränden zu verbieten. Die unterschiedlichen Maßnahmen zum Schutz bzw. zur Wiederherstellung der Dünen bleiben jedoch Gegenstand der Diskussion. — *Helmut Brückner, Geographisches Institut, Universität Düsseldorf, F.R.G.*

□ RESUMEN □

Las dunas costeras se encuentran desmanteladas en muchos lugares de Breña (Oeste de Francia), la mayor franja de dunas se encuentra en el Sur, entre el fondeadero de Lorient y la península de Quiberon. Su formación primaria se inició durante una breve regresión interrumpiendo la transgresión Holocena inmediatamente posterior a la Edad de Bronce (± 2400 BP). Continuaron su proceso de alimentación local hasta el siglo XVIII, pero hasta la actualidad no se han formado nuevas dunas, excepto en el caso encontrado en la Bahía de Audierne y el de la alimentación in situ de las crestas de playa por el viento, como es el caso de Goulven (País de Leon), las cuales no inducen la generación de verdaderas dunas eólicas. Tras la Segunda Guerra Mundial, el turismo costero y el proceso de urbanización han supuesto una continua amenaza para estos cinturones de dunas. Científicos y grupos activistas interesados en la conservación de la naturaleza se han dirigido a organismos e ingenieros civiles con información acerca de la gestión y degradación de las dunas. Con la ayuda del Ministerio de Medio Ambiente francés, la situación ha ido mejorando progresivamente. Durante las pasadas décadas, numerosas áreas han sido protegidas con políticas de preservación de dunas, sin evitar el acceso a las playas. La forma de actuación sobre las dunas protegidas o restauradas es aún materia de discusión. — *Department of Water Sciences, University of Cantabria, Santander, Spain.*