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ENERGY INPUTS AND OUTPUTS IN AN AUSTRALIAN COASTAL WHALING OPERATION

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The Cheyne's Beach Whaling Company in Western Australia has kindly made available to the author data on the fuels and power consumption of its catching and factory operations for the 1973, 1974 and 1975 seasons. It has also provided data on the calorific value of its fuel and of the principal products, oil, meal and solubles.

From these data it is possible to calculate approximately the energy input-output balance for these operations, following the advice of Leach (pers. comm.) that a useful first approach can be made by simply looking at direct fuel consumption in comparison with the catch.

The results, averaged over the three years, are summarised in Table 1. The conversion factors supplied by the company for fuel oil have been multiplied by an efficiency factor of 1.134 as suggested by Leach (1975) to allow for production and transportation losses. Similarly an efficiency multiplier of 4.0 has been applied to the conversion for electric power.

The table shows that the total energy content of the products at the factory gate is slightly less than the energy input in fuel and electric power to the catching and processing operations combined. Much the largest part of the energy output (about 80%) is contained in the calorific value of the oil. Since however this oil is largely used for lubrication in which its energy content is not directly utilised, it may be more relevant to consider the energy output ratio for the other products, meal and solubles, which are probably used mainly in feedstuffs. The ratio is then rather under 20%.

The table also shows that approximately two-thirds of the energy input is utilised in catching and towing in the whales and the other third in processing on shore. The amount used in aerial searching for whales is negligible, about 2% of that used in catching.

The total ouput : input ratio for energy appears to be considerably higher than that typical of a number of other sections of the fishing industry. Leach (1975) quotes values for this ratio ranging between 0.0061 and 0.058. The higher ratio for this coastal whaling operation seems to arise from two factors. Firstly the gross weight of the catch per tonne of oil required for its capture is high. Taking the approximate total annual weight of the catch at 20000 tonnes, the catch per tonne of catcher fuel is about 4.6 tonnes, or, for all fuel used, about 3.2 tonnes. By comparison, in the fisheries examined by Leach (1975) the catch per tonne of fuel ranged from 0.14 to 2.1 tonnes, the overall figure for the U.K. fishing industry being 1.5 tonnes per tonne of fuel. Secondly, the energy content of the ultimate products seems for whales

to be unusally high in relation to the gross weight of catch. Again taking the gross catch at 20000 tonnes the energy yield of the products is 14.4 GJ per tonne, compared with a figure for U.K. fisheries on Leach's data of 1.75 GJ per tonne of landed catch.

The high catching efficiency is substantially due to the fact that this operation is usually able to take most of its whales within a fairly small radius (often less than 30 miles) of its base and regularly uses aircraft to keep searching to a minimum.

The high energy yield per gross tonne caught seems however to require further examination. If significant comparisons are to be made between the energy conversion efficiency of whaling and of other fishing or food producing industries, it is essential to be sure that the outputs being compared are actually of the same nature.

Reference

Leach, G., 1975. Energy and Food Production. International Institute for Environment and Development. London. 151 pp.

Table 1. Energy inputs and outputs of the Cheyne's Beach Whaling Station, Western Australia, averaged on 1973, 1974 and 1975 seasons.

ENERGY INPUT				
Aerial Searching				
Fuel Oil	82.5t	@	49.4 GJ/t	0.004 MGJ
Catching				
Fuel Oil	4339t	@	47.7 GJ/t	0.207 MGJ
Processing				
Fuel Oil	1841t	@	48.5 GJ/t	0.089 MGJ
Electric Power	672710kwh	@	14.4 MJ/kwh	0.010 MGJ
Total Processing Input				0.099 MGJ
Total Input				0.310 MGJ
OUTPUT				
Weight of Catch (approx.)				20,000 MGJ
Energy Output				
Oil	5792t	@	39.9 GJ/t	0.231 MGJ
Meal	1573t	@	11.7 GJ/t	0.018 MGJ
Solubles	2673t	@	14.6 GJ/t	0.039 MGJ
Energy content of consumable products				0.057 MGJ
Total energy output				0.288 MGJ
Total Weight of Products				10.038 t
RATIOS				
Energy - total output : total input				0.929
consumable output : total input				0.184
Input per tonne of products				30.9 GJ
Input per tonne caught				15.5 GJ
Weight of products per tonne of fuel (all purposes)				1.60 t