

# Dynamic patterns and their effects on *Megaptera novaeangliae* migrations along the world



## Introduction

Humpback Whales (*Megaptera novaeangliae*) have a long-range migrations composed by 2 resting locations: Feeding grounds (Summer/high latitudes) and Breeding grounds (Winter/low latitudes), distributed in each of the Hemispheres around the world (fig.1). The Migration patterns are governed by environmental and selective evolution, and annual shifts of the environment.

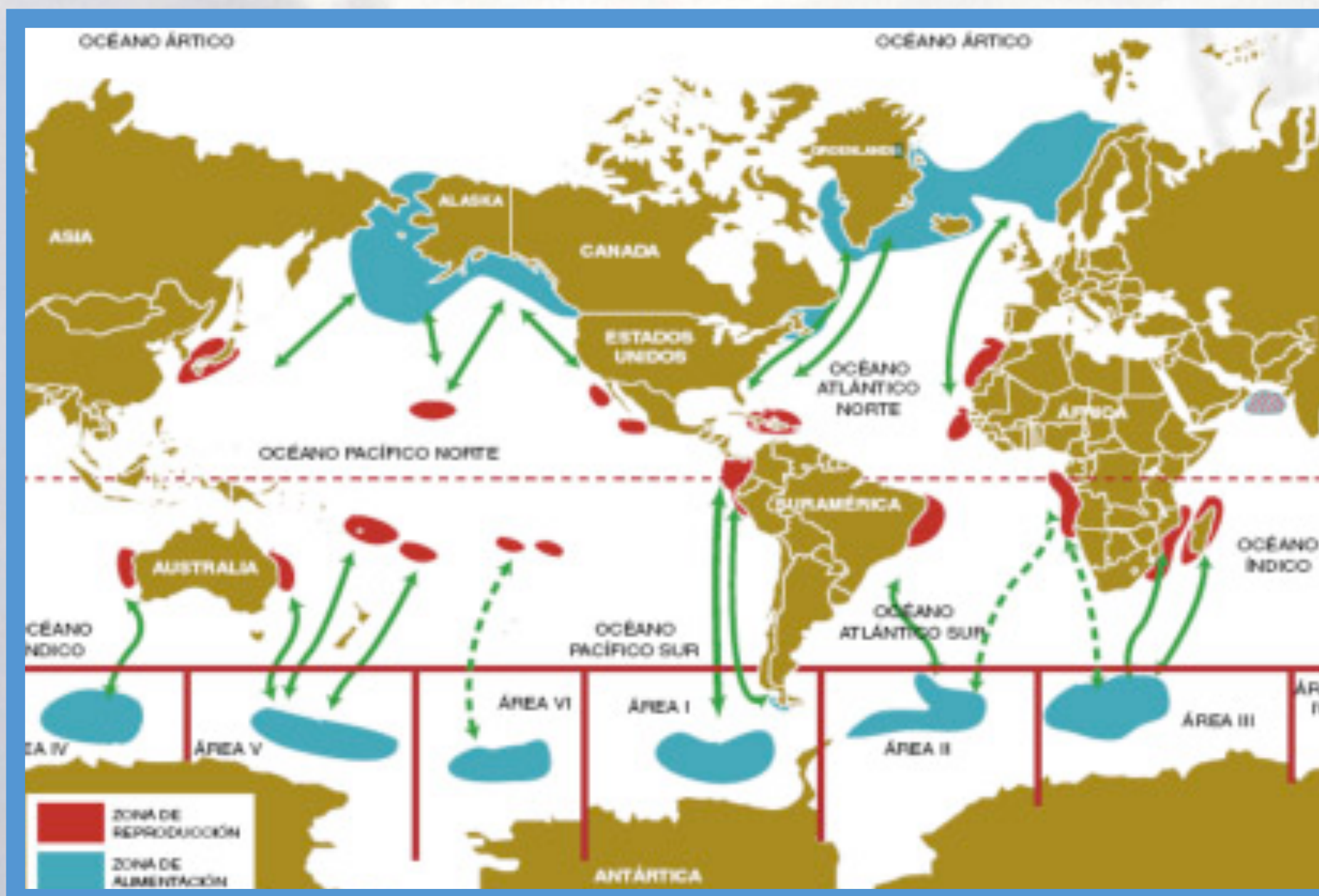
## Objectives

- ◆Clarify the reasons about latitudinal migrations around the two hemispheres.
- ◆Understand the different pattern changes about migration routes.
- ◆Describe the events that causes those pattern shifts.
- ◆Which are the consequences and effects of those pattern variations.

## Reasons of latitudinal migrations

- ◆The resources for feed are located on high latitudes<sup>1</sup>.
- ◆ The Polar ice caps are reduced during summer by an increase of the temperature<sup>2</sup>.
- ◆On high latitudes (Summer) the temperature increases allowing resources peaks<sup>3</sup>, which enables an income of energy. On low latitudes (Winter) the warmer temperature water allows efficiently the calfs breeding . This is called the Energy Conservation Hypothesis<sup>4</sup>.
- ◆Endocrine hormones near winter seasons are synthesized<sup>5</sup>.

Figure 1. Migratory Routes. Currents and Tides. MarineBio Conservation Society.



## Changes and irregularities on migration patterns

- ◆ Some feeding areas are shared by 2 stocks<sup>6</sup> instead the breeding areas that are mainly fragmented.
- ◆ The target areas are not reached regularly. There is an inter-annual variation<sup>7</sup>.
- ◆Some rare individuals do not follow the seasonal annual cycle migration<sup>8</sup>.
- ◆Geographical Overlap events: Isolated stocks separated by hemispheres and sea basins (with different routes) can have contact, called Floating Leks<sup>9</sup>.

## MIGRATION ROUTES

## The events that causes migratory pattern changes

- ◆Migratory routes could be altered by environmental disruptions. Ice caps reduction may affect marine currents<sup>10</sup> (fig.2).
- ◆Environmental disruptions alter Primary Production, taking a direct effect on zooplankton and schoolfish<sup>11</sup>.
- ◆The size groups is directly related by the size of schoolfish, thus the feeding areas slightly moves inter-annually<sup>12</sup>.
- ◆Turism boats pressure may shift breeding areas<sup>13</sup>.

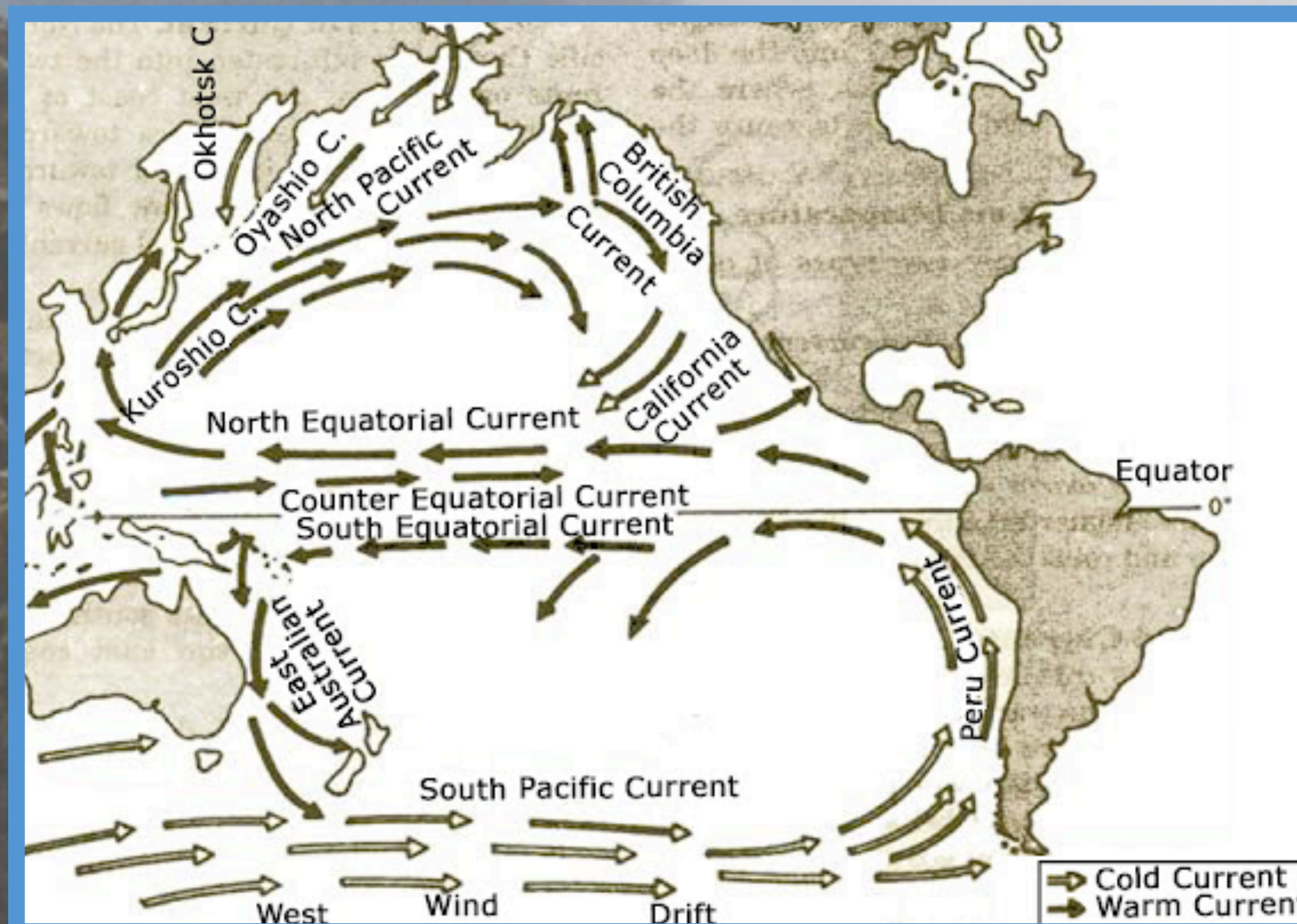


Figure 2. Pacific currents. EEZ Waters of Costa Rica. Maritime Boundaries Geodatabase

## The consequences and effects of those variations

- ◆Singer groups are more separated than non-singer, which leads the in-stock distribution<sup>14</sup>.
- ◆Geographical barriers like Ice Caps could mix isolated stocks if they disappear or are reduced<sup>15</sup>.
- ◆The whaling reduced the world population to 100 individuals in 1960<sup>16</sup>.

## Discussion

- ◆ Habitat selection → Availability of the resources and the time are adding the stocks.
- ◆ Northern Pacific areas are aggregating the feeding grounds.
- ◆Some studies signalized that breeding grounds are a way to avoid the predation<sup>17</sup> towards the calfs apart.
- ◆ The Energy Conservation Hypothesis seems to be the better way to explain the breeding grounds on tropical waters.
- ◆ The fragmentation of those breeding areas may be a derivation of that predation.
- ◆The Whaling stills currently present on the North Pacific such as the Fin whale whaling. Fortunately, the current world stock of humpback whales has increased over 60,000 individuals.
- ◆ The displacement of the feeding areas are strongly related with the Global Climate change, affecting at the same time, the timing arrival at place<sup>18</sup>.
- ◆Those environmental disturbances are causing the Inter-oceanic overlaps and maybe unusual social interactions to survive during migrations (Individuals groups).
- ◆The Humpback Whale have an order of arrival pattern based on the sex and age. Those patterns could be disrupted by the Global Climatic change that are affecting the polar ocean temperatures and in a future the oceanic flow currents. It stills unknown what kind of impact could be on the ecology of the species.

## Conclusion

The diversity of the migration patterns are closely related to resources, abiotic/biotic environmental variables governing occurrence of the individuals, the survival, the reproduction and habitat preference and their conservation. All of it depends on a complex net of interactions for proper operation. Any disturbance of the net can cause a cascade reaction that will alter the ecology of individuals. Monitoring the Humpback whale is such important, not only for ecological factors, but also for its role as umbrella species, as a symbol of conservation of the marine.

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